Volume 37
Number 1
January 2012

ISSN 2230-9705

Journal of Agriculture Research and Technology

Publication of the
Mahatma Phule Krishi Vidyapeeth, Rahuri,
Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola,
Marathwada Agricultural University, Parbhani and
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, M.S. (India)

SUBSCRIPTION RATES

(1)	Student subscriber	Rs. 100/– per annum
(2)	Member subscriber	Rs. 150/– per annum
(3)	Institution	Rs. 800/– per annum
(4)	*Single Copy :*	
	(a) Individual	Rs. 60/–
	(b) Institution	Rs. 250/–
(5)	*Life Member :*	
	(a) Individual	Rs. 1,500/–*
	(b) Institution	Rs. 3,000/–
(6)	Patron	Rs. 8,000/–
(7)	Sustaining Associate	Rs. 15,000/–
(8)	*Foreign Countries :*	
	(a) Individual	$ 60/–
	(b) Institution	$ 120/–
(9)	*Foreign Countries (Single copy) :*	
	(a) Individual	$ 30/–
	(b) Institution	$ 50/–

(*can also be paid in 3 instalments in a year)

Journal of Agriculture Research and Technology

Volume 37 **Number 1** **January 2012**

CONTENTS

Effect of Phosphatic Fertilizers, Gypsum and Sulphur on Yield, Quality and Economics of Groundnut (*Arachis hypogaea* L.) - S. R. Salke, A. A. Shaikh and N. D. Dalavi 5

Effect of Integrated Nutrient Management on Growth, Yield and Economics of Soybean Genotypes - C. R. Patel, M. K. Patel, S. N. Khajanji and J. R. Patel 8

Effect of Planting Methods and Fertilizers Levels on Growth, Yield and Economics of Maize (*Zea mays* L.) Hybrids - V. T. Jadhav and D. K. Shelke 11

Studies on Residual Effect of Maize-Lucerne Intercropping on Succeeding Bengalgram - L. Venkatesh and Y. B. Palled 15

Correlation and Path Analysis Studies in Cucumber (*Cucumis sativus* Linn.) - M. R. Bhande, P. C. Haldavanekar, P. M. Haldankar, S. S. Sawant and V. V. Dalvi 18

Kripa : An Extra Bold Kabuli Chickpea for Central and South Zone of India - P. N. Harer, L. B. Mhase and D. V. Deshmukh 25

Effect of Different Containers and Media on Horticultural Performance of Gerbera (*Gerbera jamesonii*) Under Protected Cultivation - R. D. Kale, K. B. Jagtap and C. D. Badgujar 29

Stability Performance of Chickpea Genotypes Under Rainfed, Irrigated and Late Sown Conditions - V. M. Kulkarni, Y. R. Pawar, V. B. Shinde, L. B. Mhase and P. N. Harer 33

Genetic Analysis of Single Cross Hybrids of Maize - S. N. Jadhav, B. H. Chavan, D. V. Dahat, N. D. Bangar and A. N. Kshirsagar 37

Combining Ability for Yield and Component Characters in Rice (*Oryza sativa* L.) - P. P. Patil, R. D. Vashi, V. A. Lodam, S. R. Patil and S. S. Patil 41

Nutritional Quality of High Yielding *Rabi* Sorghum Genotypes - U. D. Chavan, J. V. Patil and M. S. Shinde 46

Seasonal Variation in Physiological Behaviour of Alphonso Mango Under Konkan Conditions - M. M. Burondkar, K. H. Pujari, K. A. Shinde and S. G. Bhave 51

Genetic Variability and Character Association in French bean (*Phaseolus vulgaris* L.) - A. N. Kshirsagar, N. D. Bangar, P. B. Kanade and B. H. Chavan 55

Genetic Divergence in French bean (*Phaseolus vulgaris* L.) - A. N. Kshirsagar, N. D. Bangar, B. H. Chavan and P. B. Kanade 59

Residue Study of Emamectin Benzoate on Brinjal - Aparna Kalawate and M. D. Dethe 62

Bioefficacy Study of Proclaim on Brinjal - Aparna Kalawate and M. D. Dethe 66

Evaluation and Identification of Potential Bivoltine Silkworm Breeds for Non-Traditional Sericulture Region of Tropics - S. G. Rayar 70

Diversity of Fluorescent Pseudomonads from Western Ghats of Uttara Kannada District of Karnataka for *in-vitro* Phosphate Solubilization - D. V. Indi and A. R. Alagawadi 77

Seasonal Incidence of Two Spotted Spider Mite (*Tetranchus urticae* Koch.) on Gerbera under Polyhouse Condition - V. D. Dhage, M. M. Suryawanshi, A. S. Dhane and S. S. Shelke 82

Content Analysis of Marathi Newspaper Agrowon with Special Reference to Sources of Farm Information - M. C. Jadhav and S. B. Shinde 86

Knowledge and Adoption of Food Grains Storage Practices by the Farm Women - P. J. Uplap, S. S. Khandave and D. R. Thorat 90

Training Needs of Farm Women Regarding Food Grain Storage Practices - P. J. Uplap, S. S. Khandave and D. R. Thorat 93

Attainable Productivity of Major Crops in Western Maharashtra - C. A. Nimbalkar, B. H. Khan, V.S. Wani and S. D. Shinde 96

Impact of Participation in SHG with Reference to Technological Change in Agriculture - M. S. Bhairamkar, V. G. Patil, and A. J. Nirban 102

A Study on Diversification of Cotton Area Under Other Crops - P. P. Wankhade, R. T. Katole, S. K. Godase and D. M. Mankar 107

A Study of Self Help Groups Engaged in Agrobased Enterprises - D. M. Mankar, R. S. Raut and P. P. Bhople 111

Development of Thermo-Chemical Pretreatment for Dehulling of Pigeonpea - V. A. Salve, P. S. Phirke, V. P. Kad and P. A. Turbathmath 117

Hydraulic Studies of Microsprinkers - R. D. Bansod 122

Effect of Feeding Detoxified Blank Sorghum on Growth Performance, Feed Conservation Efficiency and Carcass Traits of Broiler Chicks - S. V. Daphale, S. A. Dhage, Y. G. Fulpagare and B. D. Patil 125

Draftability of Crossbreds, Dangi, Khillar and Local Non-Descript Bullocks under Konkan Region of Maharashtra - D. J.Bhagat, N. N. Prasade and R. G. Burte 130

RESEARCH NOTES

Economics of Integrated Nutrient Management in Ginger - K. K. Dhasade, A. A. Shaikh and A. D. Tambe 135

Intra-specific and Inter-specific Hybridization Studies in Seeded x Seedless Grapes (*Vitis* sps.) - S. G. Patil, S. P. Karkamkar and R. V. Kadu 136

Response to Edible Oils, Chemicals and Packaging Materials on Chemical Parameters of Guava (*Psidium guajava* L.) During Storage cv. Allahabad Safeda - R. K. Jat, C. B. Patel, B. V. Padhiar, D. A. Mhetre and M. K. Yadav 140

Training Needs of Cotton Growers About Plant Protection Measures - A. D. Khandare 142

Economic Feasibility of Different Training Systems in Bitter Gourd (*Momordica charantia* L.) cv. Konkan Tara under Konkan Conditions of Maharashtra - S. A. Ranpise and S. S. Bhokare 144

Genetic Association and Path Coefficient Analysis in Indian Mustard - Ngashepam Paikhomba and N. R. Rangare 146

Impact of Different Ecological Situations on Major Diseases and Efficacy of Fungicides Against Blast of Rice - Ajit Kumar Singh, J. R. Patel, Rakesh Banwasi, Anjeet Jangre and C. R. Patel 149

Role Performance of Gram Panchayat Members - S. R. Bhagwat, G. S. Ankush, J. V. Mande and D. D. Suradkar 151

Rainfall and Dry Spell Analysis for Beed - M. D. Abuj, A. P. Magar, V. T. Bombale, P. G. Popale and S. A. Birajdar 153

Development and Performance Testing of Mechanical Rotary Filter for Sugarcane Juice in Jaggery Processing - G. S. Nevkar, D. S. Patil, S. M. More and V. N. Nale 156

Studies on Biology and Biometrics of Cucumber Leaf Miner (*Liriomyza trifolii* Burgess) - Mendi Hanumappa and V. M. Chavan 159

Assessment of Nature and Weight of Callus in Diverse Genotypes of Pigeonpea (*Cajanus cajan* (L.) Millsp) - S. N. Sarode, S. V. Sawardekar, S. S. Sawant, S. G. Bhave and N. B. Gokhale 161

Stability for Grain Yield in Pigeonpea - Y. R. Pawar, V. B. Shinde, M. R. Bedis, L. B. Mhase and P. N. Harer 163

New Record of *Acerophagus papayae* (N & S) on Papaya Mealybug (*Paracoccus marginatus* (W & G)) in India - R. V. Nakat, D. S. Pokharkar, A. S. Dhane and N. D. Tamboli 165

Effect of Organic Amendments on Yield and Nutrients Uptake by Rice in Alkali Soils under Cauvery Command Area - M. L. Shivalingaiah, H. C. Prakasha, B. R. Jagadeesh, B. G. Shekara and Ayeesha Munawery 167

Response of Single Cut Oat (*Avena sativa* L.) Genotypes to Nitrogen Levels Under Irrigated Condition - S. H. Pathan and S. R. Chavan 170

Storability of Groundnut Pods as Influenced by Different Packaging Materials - A. K. Shinde and B. B. Jadhav 172

Effect of Nutrient Management on Green Forage Yield and Quality of Berseem (*Trifolium alexandrium* L.) - S. S. Gaikwad, S. H. Pathan and A. B. Kamble 175

Effect of Different Levels and Sources of Sulphur on Grain Yield and Sulphur Uptake of Rice on Lateritic Soil of Konkan - N. G. Bhope, K. D. Patil and S. A. Chavan 177

Response of Brinjal (*Solanum melongena* L.) to Fertilizer Levels and Plant Spacing under Drip Irrigation - T. M. Nayakawadi, P. P. Shinde, S. M. Salunkhe and P. D. Khambal 180

J. Agric. Res. Technol., 37 (1) : 005-007 (2012)

Effect of Phosphatic Fertilizers, Gypsum and Sulphur on Yield, Quality and Economics of Groundnut (*Arachis hypogaea* L.)

S. R. Salke[1], A. A. Shaikh[2] and N. D. Dalavi[3]
College of Agriculture, Pune - 411 005 (India)
(Received : 20-12-2010)

Abstract

The results revealed that the yield and economics of groundnut were favourably influenced due to RDF + gypsum @ 500 kg ha^{-1} (250 kg gypsum ha^{-1} at the time of sowing and 250 kg gypsum ha^{-1} at the time of peg formation) + 5 t FYM ha^{-1}.

Key words : Phosphatic fertilizers, gypsum, sulphur.

The groundnut crop plays an important role in rural economy and has got immense importance in the national economy of our country. With increase in population in geometric progression, the demand for vegetable oil in India has been steadily increasing more than 4 per cent per annum, whereas, the rate of increase in production is only 2 per cent per annum. Every year the gap between demand and supply of edible oil is going on increasing.

Very meager information is available on calcium and sulphur requirement in groundnut hence, emphasis is given on nutrient management in groundnut.

Materials and Methods

The experiments were conducted during *kharif* 2006 and 2007 at Agronomy farm, College of Agriculture Pune 411 005 (M.S.) The soil of experimental area was Inceptisol and medium black with 60-90cm depth.

The experiments were conducted in a randomised block design with four replications. Phule Pragati (JL-24) variety was used. There were six treatments consisting of T_1 - absolute control, T_2 - single super phosphate + 5 t FYM ha^{-1}, T_3 - diammonium phosphate + 5 t FYM ha^{-1}, T4 - rock phosphate + 5 t FYM ha^{-1}, T_5 - RDF + gypsum @ 500 kg ha^{-1} (250 kg^{-1} at the time of sowing and 250 kg ha^{-1} at the time of peg formation) + 5 t FYM ha^{-1} and T_6 - RDF + elemental sulphur @ 30 kg ha^{-1} + 5 t FYM ha^{-1}. The gross and net plot sizes were 4.00 x 3.00 and 3.60 x 2.40 m^2, respectively. The groundnut was dibbled at 30 x 10 cm.

Results and Discussion

The mean dry pod and dry haulm yields (Table 1) were 18.50 q ha^{-1} and 26.36 q ha^{-1}, respectively. The addition of RDF + gypsum @ 500 kg ha^{-1} (250 kg at the time of sowing and 250 kg at the time of peg formation) + 5 t FYM ha^{-1} to groundnut was significantly superior in respect of dry pod and dry haulm yields (23.58 and 33.91 q ha^{-1}). It was at par with RDF + elemental sulphur @ 30 kg ha^{-1} + 5 t FYM ha^{-1} for dry pod yield (21.06 q ha^{-1}). The dry pod yield was found at par with each other by an application of single superphosphate, diammonium phosphate and rock phosphate + 5 t FYM ha^{-1} (19.38, 17.44 and 16.69 q ha^{-1}, respectively). The control treatment recorded

1. Jr. Res. Asstt., 2. and 3. Associate Professors of Agronomy.

significantly lower dry pod and haulm yields of groundnut (12.87 and 18.77 q ha^{-1}, respectively). This might be due to the effect of calcium and sulphur present in single super phosphate and gypsum required for pod development and filling up of groundnut kernels and finally increased yields. These results are similar to those obtained by Devkumar and Giri (1998).

Thus, an application of calcium, phosphorus and sulphur are essential for higher dry pod yield of groundnut. These results are similar to those obtained by Singh *et al*. (1990) and Tripathi and Hazra (2003).

The oil per cent, oil yield, protein per cent and protein yield (49.68%, 8.51 q ha^{-1}, 30.74%, 5.26 q ha^{-1}, respectively) were significantly influenced by application of RDF + gypsum @ 500 kg ha^{-1} (250 kg at the time of sowing and 250 kg at the time of peg formation) + 5 t of FYM ha^{-1}. This treatment was statistically at par with the treatment RDF + elemental sulphur @ 30 kg ha^{-1} + 5 t of FYM ha^{-1} (49.00%, 7.03 q ha^{-1}, 29.39%, and 4.21

Table 1. Mean dry pod and dry haulm yields, oil content in kernels, oil yield, protein content in kernels and protein yield as influenced by different treatments (pooled over seasons).

Treatment	Dry pod yield (q ha^{-1})	Dry haulm yield (q ha^{-1})	Oil % in kernels	Oil yield (q ha^{-1})	Protein % in kernels	Protein yield (q ha^{-1})
Control	12.87	18.77	45.72	3.73	26.05	2.13
Single super phosphate + 5 t ha^{-1} FYM	19.38	28.15	48.23	6.21	28.91	3.73
Diammonium phosphate + 5 t ha^{-1} FYM	17.44	23.49	47.84	5.44	27.52	3.13
Rock phosphate + 5 t ha^{-1} FYM	16.69	23.15	46.27	5.02	27.47	2.83
RDF (25:50 N:P kg ha^{-1} + gypsum (500 kg ha^{-1}, 1/2 at sowing and 1/2 at peg formation) + 5 t ha^{-1} FYM	23.58	33.91	49.68	8.51	30.74	5.26
RDF + elemental sulphur 30 kg ha^{-1} + 5 t ha^{-1} FYM	21.06	28.99	49.00	7.03	29.39	4.21
SEm±	1.14	1.45	0.30	0.17	0.34	0.10
C.D. at 5 %	3.44	4.37	0.93	0.53	1.03	0.30
Mean	18.50	26.36	47.49	6.36	28.13	3.78

Table 2. Mean cost of cultivation, gross monetary returns, net profit and benefit cost ratio as influenced by different treatments (pooled over two seasons).

Treatment	Cost of cultivation (Rs. ha^{-1})	Gross monetary returns (Rs. ha^{-1})	Net monetary returns (Rs. ha^{-1})	Benefit cost ratio
Control	11655	20592	8937	1.76
Single super phosphate + 5 t ha^{-1} FYM	18101	31002	12901	1.71
Diammonium phosphate + 5 t ha^{-1} FYM	17712	27904	10192	1.57
Rock phosphate + 5 t ha^{-1} FYM	17587	26704	9117	1.51
RDF (25:50 N:P kg ha^{-1} + gypsum (500 kg ha^{-1}, 1/2 at sowing and 1/2 at peg formation) + 5 t ha^{-1} FYM	18401	37728	19327	2.05
RDF + elemental sulphur 30 kg ha^{-1} + 5 t ha^{-1} FYM	18239	33696	15457	1.84
Mean	16949	24549	7600	1.44

q ha^{-1}, respectively). Single superphosphate (48.23%, 6.21 q ha-1 and 28.91%,3.73 q ha^{-1}), diammonium phosphate (47.84%, 5.44 q ha^{-1} and 27.52%, 3.13 q ha^{-1} and rock phosphate (46.27%, 5.02 q ha^{-1} and 27.47%, 2.83 q ha^{-1} respectively) alongwith 5 t FYM ha^{-1} were at par with each other. The control treatment recorded significantly lower oil per cent, oil yield, protein per cent and protein yield (45.72 %, 3.73 q ha^{-1} and 26.50%, 2.13 q ha^{-1}). The increased oil and protein content in groundnut might be associated with sulphur and calcium nutrition through fertilizers to groundnut. Sulphur is a constituent of protein and plays a major important role in oil synthesis in oilseed crops. These results are similar to those obtained by Patil *et al*. (2003).

Economics : For working out the benefit cost ratio and net monetary returns per hectare these studies have been made by taking into consideration the cost of cultivation and gross monetary returns.

It is observed from the data (Table 2) that the gross and net monetary returns and B:C ratio were considerably higher (Rs. 37,728/- ha^{-1}, Rs. 19,327/- ha^{-1} and 2.05, respectively) in treatment RDF + gypsum @ 500 kg ha^{-1} (250 kg at the time of sowing and 250 kg at the time of peg formation) + 5 t of FYM ha^{-1} than rest of the treatments. It was followed by the treatment RDF + elemental sulphur @30 kg ha^{-1} + 5 t of FYM ha^{-1} (Rs. 33,696/- ha^{-1}, Rs. 15,457/- ha^{-1} and 1.84, respectively) and single super phosphate (Rs. 31,002/- ha^{-1}, Rs. 12,901/- ha^{-1} and 1.71, respectively).

References

Devkumar, M. and Giri, Gajendra. l998. Influence of weed control doses and time of gypsum application on yield attributes, pod and oil yield of groundnut (*Arachis hypogaea* L.). Indian J. Agron. 43(3): 453-458.

Patil, S. S., Raut, P. D., Ingle, G. L. and Dongare, S. T. 2003. Effect of sulphur and magnesium on yield, nutrient uptake and quality of groundnut. New Agriculturist. 14(1/2): 49-52.

Singh, A. L., Joshi, Y. C., Chaudhari, V. and Zala, P. V. 1990. Effect of different sources of iron and sulphur on leaf chlorosis, nutrient uptake and yield of groundnut. Fert. Res. 24(2): 85-96.

Tripathi, S. B. and Hazra, C. R. 2003. Sulphur requqirment of groundnut (*Arachis hypogaea* L.) under wheat (*Triticum aestivum*) based cropping system. Indian J. agric. Sci. 73(7): 368-372.

J. Agric. Res. Technol., 37 (1) : 008-010 (2012)

Effect of Integrated Nutrient Management on Growth, Yield and Economics of Soybean Genotypes

C. R. Patel[1], M. K. Patel[2], S. N. Khajanji[3] and J. R. Patel[4]
College of Agriculture, Raipur - 492 001 (India)
(Received : 20-12-2010)

Abstract

Application of 125 per cent of recommended dose of fertilizer along with 5 t ha^{-1} FYM produced significantly higher growth and yield attributes, grain (20.08 q ha^{-1}) and straw (26.24 q ha^{-1}) yields as well as net return (Rs. 25148.00 ha^{-1}) compared to other treatments. Soybean genotype JS-97-52 yielded significantly higher growth and yield parameters, grain (17.39 q ha^{-1}) and straw (24.42 q ha^{-1}) yields and net return (Rs. 23644.00 ha^{-1}) as compared to variety JS-93-05.

Key words : INM, growth, yield, economics, soybean, genotypes.

A number of factors contributing to the productivity of soybean, nutrient management have been pivotal since the nutrient turnover in soil-plant system is considerably high under intensive cropping. Neither the chemical fertilizers nor the organic/biological sources alone can achieve production sustainability. Thus, for sustainable soil fertility and productivity of soybean, it becomes imperative to adopt the strategies which are of low cost, eco-friendly, highly viable and efficient in managing the crop production with no adverse effect on the environment. Therefore , the integrated nutrient management (INM) now-a-days is the only concept which needs to be adopted in agriculture. Similarly, crop genotypes may vary in their ability to produce economic yield in a given set of agro-climatic condition. Considering the above facts the present study was under taken.

Materials and Methods

A field experiment on soybean was conducted at Instructional cum research farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) under rainfed condition during *kharif* 2009 in clay soil having low in available nitrogen (217 kg ha^{-1}), medium in available phosphorus (13 kg ha^{-1}) and high in available potassium (371 kg ha^{-1}) contents. The reaction of the soil was neutral (7.1 pH). The trial was laid out in a factorial randomized block design with three replications under a gross plot size of 6.0 x 3.6 m. Crop was sown on 5th July, 2009 adopting 30 x 10 cm spacing and harvested on 14th October, 2009. All recommended cultural practices were followed. The treatments comprised of 12 nutritional schedules (Table 1) and two varieties of soybean (JS-93-05 and JS-97-52). The basal dose of fertilizer and manure was given as per the treatments at the time of sowing in furrows. However, *Rhizobium* (*Bradyrhizobium japonicum*) and phosphate solubilising bacteria (PSB) were seed dressed before sowing of soybean.

Results and Discussion

Seed yield : Significatly higher seed yield (20.08 q ha^{-1}) was recorded with the application of 125 per cent of RDF + farm yard

1. M.Sc. (Agronomy) student, 2. Bank Officer, 3. and 4. Professor of Agronomy.

manure (5 t ha^{-1}) as compared to other nutrient combinations. The application of 125 per cent of RDF + *Rhizobium* + PSB (18.86 q) and 125 per cent of RDF (18.60 q) were at par and stood second in position. These three nutrient schedules were produced 121, 107 and 104 per cent higher seed yield over absolute control (9.09 q ha^{-1}). The absolute control and combination of *Rhizobium* + PSB produced similar yield under study. Maximum seed yield was recorded by the application of 125 per cent of RDF + FYM was due to nutrient supply by inorganic and organic fertilizer combination which resulted in better development of growth and yield attributes of soybean. Similar results were also obtained by Gajbhiye and Mali (2009). Soybenn variety JS-97-52 produced significantly more (44.32%) seed yield (17.39 q ha^{-1}) than JS-93-05 (12.05 q ha^{-1}). The possible explanation of higher seed yield with JS-97-52 was the production of taller plant, more number of leaves, root nodules and pods plant^{-1} as well as test weight compared to variety JS-93-05. Yield variation among varieties were also observed by Mehasen and Saeed (2005).

Stover yield : The application of 125 per cent of RDF + farm yard manure produced significantly more stover yield (26.24 q ha^{-1}) over other treatments. However, it was on par with 125 per cent of RDF (25 39 q), 125 per

Table 1. Effect of integrated nutrient management on growth, yield and economics of soybean genotypes.

Treatments	Plant height (cm)	Leaves plant-1 (60 DAS)	Branches plant^{-1}	Dry matter plant^{-1} (g)	Nodules plant^{-1}	Pods plant^{-1}	Seeds pod^{-1}	1000 seed weight (g)	Seed yield (q ha^{-1})	Stover yield (q ha^{-1})	Net return (Rs. ha^{-1})
Nutritional schedule :											
75% of RDF	54.8	35.9	9.5	15.0	52.3	50.4	2.57	81.2	12.68	18.19	14256
75% of RDF + *Rhizobium* + PSB	55.0	35.7	9.8	14.0	58.2	53.5	2.62	80.9	13.48	17.69	15791
75% of RDF + FYM	56.0	34.8	10.2	14.7	58.2	54.7	2.68	81.9	14.67	19.41	17297
100% of RDF	57.4	36.8	10.9	15.4	62.2	55.9	2.70	85.9	15.98	21.22	19357
100% of RDF + *Rhizobium* + PSB	58.5	37.9	11.1	15.7	70.1	56.3	2.71	86.8	16.27	22.29	19941
100% of RDF + FYM	59.2	41.4	11.3	16.2	69.6	58.5	2.72	86.8	17.02	24.45	20588
125% of RDF	59.2	39.8	11.9	16.5	72.1	55.0	2.74	87.0	18.60	25.39	23146
125% of RDF + *Rhizobium* + PSB	59.5	38.5	12.2	17.3	77.3	58.4	2.74	87.4	18.86	25.38	23635
125% of RDF + FYM	60.0	39.2	12.6	18.1	77.3	60.4	2.79	89.0	20.08	26.24	25148
Rhizobium + PSB	59.9	38.0	8.5	12.0	55.1	43.7	2.51	78.0	09.40	16.64	12529
FYM	55.0	34.2	9.1	12.4	54.1	46.8	2.57	83.3	10.52	16.94	13814
Absolute control	54.1	32.7	8.0	11.0	48.3	41.4	2.41	80.0	09.09	16.21	11927
SE±	0.47	0.66	0.23	1.23	2.03	1.41	0.07	0.18	0.37	0.67	736
CD (5%)	1.33	1.89	0.72	3.51	5.78	4.45	0.24	0.57	1.15	2.05	2117
Genotype :											
JS-93-05	49.7	35.2	10.1	14.0	66.7	43.6	3.09	89.8	12.05	17.26	22611
JS-97-52	65.1	38.9	10.8	15.7	59.1	62.2	2.20	78.2	17.39	24.42	23644
SE±	0.19	0.27	0.12	0.50	0.83	1.36	0.03	0.08	0.17	0.46	347
CD (5%)	0.57	0.77	0.33	1.43	2.36	3.89	0.11	0.24	0.54	1.67	950

Note : RDF = 30:60:40:20 kg ha^{-1} N, P_2O_5, K_2O and S, respectively and FYM dose = 5 t ha^{-1}

cent of RDF + *Rhizobium* + PSB (25.38 q) and 100 per cent of RDF + FYM (24.15 q ha^{-1}) nutrient management system. Similarly, the stover yield was significantly less under lower level of chemical fertilizers and with bio-fertilizers (75 % of RDF alone and in combination of *Rhizobium* + PSB), combination of *Rhizobium* + PSB, FYM alone and absolute control treatments and were at par with each other. These results corroborate the findings of Sarawagi et al. (2007). Soybean variety JS-97-52 produced statistically higher stover yield (24.42 q ha^{-1}) than JS-93-05 (17.26 q ha^{-1}) under study due to higher growth parameters . The results are in agreement with the observations of Gupta *et al*. (2003).

Net return : The net return realized was significantly more (Rs. 25148 ha^{-1}) with 125 per cent of RDF + FYM as compared to other treatments and was at par with 125 per cent of RDF + *Rhizobium* + PSB and 125 per cent of RDF. The minimum net return (Rs. 11927 ha^{-1}) was noted under absolute control. However, it was on par with *Rhizobium* + PSB and FYM alone treatments. Data (Table 1) also indicated that FYM 5 t ha^{-1} was similar to 75 per cent of RDF and its combination with *Rhizobium* + PSB in respect of net returns. Similar findings were also reported by Deshmukh *et al*. (2005). The variety JS-97-52 recorded significantly higher net return (Rs. 23644 ha^{-1}) than JS-93-05 (Rs. 22611 ha^{-1}). The higher net return might be due to more seed and stover yield. The results of the study are consistent with the findings of Paikra *et al.* (1988).

References

Deshmukh, K. K., Khatik, S. K. and Dubey, D. P. 2005. Effect of integrated use of organic, inorganic and biofertilizers on production, nutrient availability and economic feasibility of soybean grown on soil oi Kaymore Plateau and Satpara Hills. J. of Soil and Crops. 15(1): 21-25.

Gajbhiye, B. R. and Mali, C. V. 2009. Soil moisture, nodulation, yield attributes and quality of soybean under integrated nutrient management. J. Maharashtra agric. Univ. 34 (3): 266-268.

Gupta, V., Sharma, G. L., Sonakiya, V. K. and Tiwari, G. 2003. Impact of different levels of FYM and sulphur on morphophysiological indices and productivity of soybean genotypes, JNKVV Res. J. 37(2): 76-78.

Mehasen, S. A. S. and Saeed, N. A. 2005. Effect of mineral nitrogen, farm yard manure and bacterial inoculation on two soybean cultivars. Annals of Agric. Sci. 43(4): 1391-1399.

Paikdra, A., Mishra, M. and Mishra, S. N. 1988. Response of soybean varieties to nitrogen and phosphorus. Indian J. Agron. 33(3): 320-322.

Sarawagi, S. K., Sharma, G. K. and Rajput, R. S. 2007. Yield, economics, energy and phosphorus use efficiency of soybean as influenced by nutrients and organic matter in Vertisols. Annals of Plant and Soil Res. 9(2): 194-196.

J. Agric. Res. Technol., 37 (1) : 011-014 (2012)

Effect of Planting Methods and Fertilizer Levels on Growth, Yield and Economics of Maize (*Zea mays* L.) Hybrids

V. T. Jadhav[1] and D. K. Shelke[2]
Department of Agronomy, Marathwada Agricultural University, Parbhani - 431 402 (India)
(Received : 25-08-2008)

Abstract

Opening of furrows in every row at 30 days after sowing (DAS) recorded significantly better growth, yield attributes, higher nutrient uptake, B:C ratio and grain yield compared to other planting methods in maize, which also recorded 13.76 per cent higher grain yield than flat bed method. Maize hybrid Kargil recorded significantly higher grain yield than Parbhani Shakti. Further, plant growth, yield attributes, nutrient uptake and B:C ratio was significantly higher in Kargil than Parbhani Shakti. Application of 125 per cent RDF recorded significantly more grain yield (6.91 t ha^{-1}), B:C ratio (2.19), better growth, yield and nutrient uptake. Sowing of hybrid Kargil with opening of furrow in every row using 125 per cent RDF showed superiority in respect of growth, yield attributes, nutrients uptake and economic returns.

Key words : Economic returns, fertilizer levels, hybrids, nutrient uptake, planting methods.

Wider inter row space of maize during its initial growth stage causes runoff and leaching of nutrients due to erratic rainfall. On the other hand it is very successptible to water logging condition. Opening of furrows in between rows helps to conserve moisture and reduces the leaching and runoff. Thus, the type of land layouts assumes special importance in rainfed maize cultivation. In rainy season, *in-situ* moisture conservation measures increases grain yield mainly due to reduction of runoff, soil losses and increases availability of moisture and nutrients (Patil and Sheelvantar, 2001). Information on such aspect on newly released high yielding hybrids under rainfed conditions in vertisol is meagre. Hence, the present study was undertaken to study the response of maize hybrids to land layouts and fertilizer levels.

Materials and Methods

The field investigation was carried out during *kharif* season of 2003 and 2004 at the Experimental Farm of Department of Agronomy, Marathwada Agricultural University, Parbhani. The soil was clayey with low in available N (111.5 kg ha^{-1}) medium in available P (13.5 kg ha^{-1}) and high in available K (432.8 kg ha^{-1}). The reaction of the soil was slightly alkaline (pH 7.9). The estimated value of different parameters *viz*. bulk density (1.30 g cm^2) water holding capacity (14.25%) and organic C (0.51%). The experiment consisted of 18 treatment combinations involving three planting methods *viz*., flat bed, opening of furrows in every row at 30 DAS and paired row furrow opening at 30 DAS and two hybrids *viz*. Kargil and Parbhani Shakti as main treatment and three fertilizer levels *viz*. 75, 100 and 125 per cent RDF ha^{-1} as sub plot treatments. The recommended dose of 120 kg N, 60 kg P and 40 kg K ha^{-1} was considered while formulating the experiment. Half dose of N and full dose of P and K was applied at the time of sowing and remaining half dose of N at time of furrow opening as per treatment. The split plot design was used with three replications. Sowing was done by dibbling method on 4th and 3rd July

1. Asstt. Professor and 2. Head, Dept. of Agronomy.

and harvested on 20th and 25th October during 2003 and 2004, respectively. Total rainfall of 530 mm, spread over 36 rainy days, was received during 2003 year and 322 mm received in 24 rainy days during 2004. However, during 2003. maximum rainfall was occurred at early crop growth stage(460 mm) and less at reproductive stage(40.3 mm), while during 2004, optimum rainfall was occurred at early stage (164.2 mm)and reproductive stages of crop (136.4 mm).

Results and Discussion

Grain yield : Planting of maize by opening of furrow in every row at 30 DAS was found to be significantly superior over flat bed followed by the opening of furrow in between paired row in respect of plant height, yield attributes, *viz*. length of cob, number of grains cob^{-1}, 1000 grain weight and grain yield (Table 1). The mean total consumptive use and water use efficiency in opening of furrows in every row planting method were 303 mm and 22.67 kg ha^{-1} mm, respectively. The corresponding values in flat bed method were 278 mm and 21.30 kg ha^{-1} mm, respectively. This might be due to better availability of soil moisture and nutrients to the crop due to better aeration and drainage. This might have improved the physical and hydrological condition of configurated land treatments than flat bed due to increased surface area. The per cent increase in surface area in every row furrow opening and paired row furrow opening over flat bed was 12.27 and 6.13 per cent, respectively. Increase in infiltration rate after tillage by plough has also been reported by Freese *et al*. (1993).

Maize hybrid Kargil had significantly taller plant type, better yield attributes and higher grain yield during second year (Table 1). The pooled data of grain yield showed that maize hybrid Kargil recorded 68.5 q ha^{-1} grain yield which was 13.42 per cent higher than

Table 1. Effect of planting methods and fertilizer levels on growth, yield attributes and grain yield of maize hybrids.

Treatments	Plant height (cm)		Length of cob (cm)		Grains cob^{-1}		1000 grain weight (g)		Grain yield (q ha^{-1})
	2003	2004	2003	2004	2003	2004	2003	2004	
Planting methods :									
Flat bed	182.28	179.28	15.71	15.88	442	465	284.85	321.56	59.47
Ridges and furrow	190.02	193.36	17.75	18.78	483	501	295.84	336.50	68.96
Paired row furrow	185.27	186.13	16.86	17.30	452	481	290.24	329.31	63.29
SEm±	1.45	2.52	0.15	0.22	5.94	5.28	1.43	2.38	0.73
CD at 5%	4.56	7.93	0.49	0.71	18.70	15.77	4.51	7.14	2.68
Hybrids :									
Parbhani Shakti	188.17	187.19	16.34	16.49	438	465	284.58	313.48	59.31
Kargil	184.02	185.33	17.88	18.15	479	499	297.37	332.96	68.50
SEm±	1.18	2.05	0.12	0.18	4.85	4.98	1.17	2.34	0.60
CD at 5%	3.72	N.S.	0.40	0.58	15.57	15.14	3.68	7.21	2.19
Fertilizer levels :									
75% RDF	182.63	182.50	16.24	16.47	133	441	279.81	317.28	59.16
100% RDF	186.22	186.38	17.04	17.29	454	481	292.45	330.06	63.48
125% RDF	189.43	189.89	18.04	18.19	487	525	300.67	340.33	69.08
SEm±	0.99	1.65	0.20	0.11	5.90	5.05	1.09	2.86	0.61
CD at 5%	2.88	4.85	0.60	0.31	17.20	15.02	3.18	8.36	1.82

Parbhani Shakti (59.3 q ha^{-1}). It might be due to varietal differences in photosynthetic activities and accumulation in yield components and ultimately grain yield. Similar results of varietal differences were also reported by Geetha (2000).

Growth, yield attributes and grain yield were significantly higher with every increase in level of fertilizer (Table 1). The highest grain yield was recorded with 125 than 100 and 75 per cent RDF. The per cent increase in grain yield in 125 per cent RDF level over 100 and 75 per cent RDF levels were 8.11 and 14.35 per cent respectively. It might be due to increase in availability of nutrients to the crop plant which helped the plant to attain its maximum yield potential by improving plant growth, which resulted in synthesis of more photosynthates sufficient to meet the need of plant. Similar findings were also reported by Singh and Sarkar (2001). The interaction effects were found to be non-significant.

Nutrient uptake : The uptake of nutrients by maize was significantly influenced by planting methods (Table 2). Ridges and furrow opening in every row recorded significantly more uptake of N,P and K by maize (180,46 and 81 kg NPK ha^{-1}). Singh *et al.* (2002) reported that increasing *in situ* soil moisture conservation improved the availability of nutrients to crop leading to higher nutrient turn over in sandy loam soils.

Maize hybrid Kargil recorded significantly more uptake of N, P and K (170, 44 and 79 kg NPK ha^{-1}) than Parbhani Shakti (160, 41 and

Table 2. Effect of planting methods and fertilizer levels on nutrient uptake, net returns, B:C ratio, water use and WUE of maize hybrids.

Treatments	Total N uptake (kg ha^{-1})		Total P uptake (kg ha^{-1})		Total K uptake (kg ha^{-1})		Net returns	Cost of cultivation	Benefit cost ratio	Water use (mm)	WUE (kg ha^{-1} -mm)
	2003	2004	2003	2004	2003	2004	(000 ha^{-1})				
Planting methods :											
Flat bed	127.98	152.16	30.50	35.09	55.25	70.97	18.6	18.5	2.00	278	21.30
Ridges and furrow	148.88	180.28	37.90	46.23	65.20	81.93	23.9	19.6	2.26	303	22.67
Paired row furrow	140.44	169.37	34.22	41.90	61.83	77.44	20.6	18.7	2.10	292	21.58
SEm±	2.30	2.50	1.00	1.04	1.70	1.95	1.1	-	-	-	-
CD at 5%	7.25	7.61	3.16	3.29	5.37	6.05	3.4	-	-	-	-
Hybrids :											
Parbhani Shakti	134.96	160.01	34.93	41.43	65.33	76.40	18.4	19.0	1.94	290	20.36
Kargil	145.22	170.70	37.48	44.72	69.85	79.83	23.6	18.9	2.25	292	23.34
SEm±	1.88	1.74	0.82	0.85	1.39	1.12	0.9	-	-	-	-
CD at 5%	5.92	5.48	2.50	2.69	4.32	3.32	2.8	-	-	-	-
Fertilizer levels :											
75% RDF	122.37	156.99	31.87	36.79	60.15	73.58	18.3	18.2	2.00	290	20.32
100% RDF	135.70	167.28	34.96	40.22	65.16	78.37	20.6	18.9	2.08	291	21.72
125% RDF	151.87	178.34	37.79	43.21	69.96	83.39	23.3	19.6	2.19	293	23.51
SEm±	1.79	2.07	0.78	0.81	1.35	1.48	0.9	-	-	-	-
CD at 5%	5.25	6.23	2.28	2.37	3.96	4.45	2.7	-	-	-	-

76 kg NPK ha^{-1}),respectively. This was ascribed to more N, P and K content in stover and higher yield in Kargil hybrid. It might be due to more uptake of nutrient from soil.

Nutrient uptake was significantly influenced by fertilizer levels. The increase in uptake of N, P and K with higher level of fertilizers may be due to fact that balanced and optimum application of NPK resulted in increased concentration of NPK in soil solution which ultimately increased the uptake. Similar findings were reported by Hazara and Tripathi (1999).

Economics : Planting methods, hybrids and fertilizer levels reflected significantly with each other in respect of net returns and benefit:cost ratio (Table 2). Opening of furrow in every row at 30 DAS planting method recorded highest net returns and benefit cost ratio Rs. 24000 ha^{-1} and 2.26 respectively. Hybrid Kargil recorded Rs. 23000 ha^{-1} net returns and 2.25 B:C ratio. 125 per cent RDF recorded higher net returns and benefit:cost ratio Rs. 23000 ha^{-1} and 2.19, respectively, than other treatments. It may be because of more grain and stover yields obtained under these treatments.

Based on two years study it was concluded that maize hybrid Kargil grown with opening of furrow in every row at 30 DAS and fertilized with 125 per cent RDF level was found most advantageous.

References

Freese, R. C., Cassel, D. K. and Denton, H. P. 1993.Information in a piedanont soil under three tillage systems. J. of Soil and Water Conserv. 48(3): 214-218.

Geetha, K. 2000. Per se performance of parents and hybrids in maize for grain yield characters, Madras Agric. J. 87(1-3): 57-60.

Hazara, C. R. and Tripathi, S. B. 1999. Effect of nitrogen application and preceeded cowpea on forage yield of winter maize and soil fertility. J. of Indian Soc. of Soil Sci. 47(3): 561-563.

Patil, S. L. and Sheelvantar, M. N. 2001. Effect of in-situ moisture conservation practices and grain yield of *rabi* sorghum in the vertisols of semi arid tropics of south India. Indian J. Agric. Sci. 74(4): 229-233.

Singh, Kalyan, Singh, U. N., Singh, Y., Singh, S. R., Chandal, R. S. and Singh, K. K. 2002. Effect of tillage, inter-terrace and mulching on yield and nutrient uptake by maize -chickpea cropping system. Indian J. of Agric. Sci. 72(12): 728-730.

Singh, S. S. and Sarkar, A. K. 2001. Balanced use of major nutrients for sustaining higher productivity of maize-wheat cropping system in acidic soils of Jharkhand. Indian J. of Agron. 46(4): 606-609.

J. Agric. Res. Technol., 37 (1) : 015-017 (2012)

Studies on Residual Effect of Maize-Lucerne Intercropping on Succeeding Bengalgram

L. Venkatesh[1] and Y. B. Palled[2]
Department of Agronomy, University of Agricultural Sciences, Dharwad - 580 005 (India)
(Received : 07-12-2008)

Abstract

Significantly higher grain and stover yield of succeeding bengalgram crop was recorded after maize (90 x 20 cm) lucerne (green manuring) at 1:2 row proportion (12.51 and 14.76 q h^{-1}, respectively) compared to rest of the treatments except lucerne green manuring treatments with which it was on par. Higher amount of available soil nitrogen (249.17 kg ha^{-1}) was found after harvest of bengalgram in proceeding treatment of maize + lucerne (green manuring) at 1:2 row proportion over initial status of soil. Whereas, marked depletion with regard to available soil phosphorus and potassium after harvest of bengalgram were noticed over initial status of soil due to intercropping system. Significantly higher net returns (Rs. 21133 ha^{-1}) and benefit:cost ratio (4.29) of bengalgram were realized after maize (90 x 20 cm) + lecerne (green manuring) at 1:2 row proportion compared to rest of the treatments except lucerne green manuring treatments.

Key words : Residual effect, intercropping, maize - lucerne.

Legumes intercropping is known to improve soil fertility and supply part of nutrient requirement of associated intercrops or sequence crops. Leguminous plants produce large quantity of biomass which after *in-situ* incorporation slowly release the nutrients depending on the C:N ratio of incorporated green manure. Hence, crops grown in sequence are going to be benefited due to cereal + legume intercropping systems. Bengalgram is a dominant *rabi* crop in vertisols of northern transitional zone of Karnataka. Hence, present field study was conducted to know the residual effect of maize + lucerne intercropping on succeeding crop of bengalgram.

Materials and Methods

A field experiment was conducted during *rabi* season of 2006-07 after different maize + lucerne intercropping systems to study the residual effect on succeeding bengalgram at Main Agricultural Research Station, University of Agricultural Sciences, Dharwad under rainfed condition. The soil of the experimental site was medium deep Vertisol having pH of 7.6. Soil before initiation of experiment was found to contain 228, 34.20 and 339.30 kg ha^{-1} of available N, P_2O_5 and K_2O, respectively. The rainfall during the year of experimentation (2006-07) was 870.2 mm, which was 14.58 per cent more than the average of the past 56 years.

The *kharif* maize + lucerne intercropping treatments included eight treatment combinations consisting of two plant geometries of maize (90 x 20 cm and 90 / 30 x 30 cm) and two maize + lucerne row proportions (1:1 and 1:2) with lucerne either for green manuring or for forage. In addition, there were three sole maize treatments with different plant geometries. The experiment was laid out in randomized complete block design replicated thrice with a plot size of 7.29 x 3.6 m. In same experimental site after harvest of

1. M.Sc. (Agri.) student and 2. Head of Dept.

maize and lucerne the bengalgram variety Annigeri-1 was sown during *rabi* season without application of any fertilizers to know the residual effect of maize-lucerne intercropping on succeeding bengalgram.

Results and Discussion

The experimental data (Table 1) indicated that significantly higher total dry matter (21.96 g plant^{-1}), number of pods (53 plant^{-1}), grain weight (12.50 g plant-1) and hundred grain weight (24.23 g) of bengalgram were recorded after maize (90 x 20 cm) + lucerne (green manuring) at 1:2 row proportion compared to rest of the treatments except after maize (90 x 20 cm) + lucerne (green manuring) at 1:1 row proportion. This can be attributed to incorporation of higher biomass of lucerne in 1:2 row proportion over 1:1 row proportion. The results agree with the findings of

Table 1. Growth and yield parameters of bengalgram as influenced by residual effect of maize-lucerne intercropping.

Treatments	Dry matter plant^{-1} (g)	Pods plant^{-1}	Grain weight plant^{-1} (g)	100 grain weight (g)
T_1 : Paired row sole maize (90/30 x 30 cm)	15.18	34.00	6.12	20.20
T_2 : Sole maize (90 x 20 cm)	15.62	35.00	6.53	20.61
T_3 : Sole maize (60 x 30 cm)	16.32	37.00	7.09	21.15
T_4 : T_1 + Lucerne (2:1), Lucerne for fodder	17.11	40.00	8.11	21.79
T_5 : T_1 + Lucerne (2:2), Lucerne for fodder	17.34	41.00	8.23	21.75
T_6 : T_2 + Lucerne (1:1), Lucerne for fodder	17.95	42.00	8.84	22.28
T_7 : T_2 + Lucerne (1 :2), Lucerne for fodder	18.23	43.00	9.11	22.33
T_8 : T_1 + Lucerne (2:1), Lucerne for green manuring	19.72	45.00	10.24	23.46
T_9 : T_1 + Lucerne (2:2), Lucerne for green manuring	20.02	47.00	10.45	22.78
T_{10} : T_2 + Lucerne(1:1), Lucerne for green manuring	20.72	49.00	11.08	23.31
T_{11} : T_2 + Lucerne (1:2), Lucerne for green manuring	21.96	53.00	12.50	24.23
SEm±	0.50	2.59	0.64	0.37
CD (0.05)	1.48	7.64	1.89	1.11

Table 2. Yield, economics and available nutrients (kg ha^{-1}) at harvest of bengalgram as influenced by residual effect of maize-lucerne intercropping.

Treat-ments	Grain yield (q ha^{-1})	Stover (q ha^{-1})	Harvest index	Net returns (Rs. ha^{-1})	B:C ratio	Nitrogen	Phosp-horus	Pota-ssium
T_1	7.73	9.88	43.88	11225	2.28	223.01	26.96	327.78
T_2	7.97	10.12	44.06	11728	2.38	225.70	27.15	329.35
T_3	8.57	10.72	44.43	12971	2.63	226.16	28.06	328.49
T_4	8.80	10.95	44.55	13233	2.69	236.54	25.05	322.88
T_5	8.84	11.02	44.51	13538	2.75	237.62	23.99	321.34
T_6	9.26	11.44	44.73	14401	2.93	236.14	26.37	323.32
T_7	9.39	11.57	44.79	14663	2.98	238.15	25.97	322.34
T_8	11.18	13.38	45.17	18370	3.73	243.17	29.03	324.05
T_9	11.51	13.71	45.63	19053	3.87	246.72	29.59	324.92
T_{10}	12.05	14.27	45.78	20186	4.10	247.12	29.98	325.09
T_{11}	12.51	14.76	45.87	21133	4.29	249.17	31.11	325.66
SEm±	0.49	0.55	0.28	780	0.18	4.68	1.42	1.47
CD (0.05)	1.46	1.64	0.84	2301	0.55	13.80	4.21	4.35

Dasaraddy (1998) and Tiwari *et al*. (2004).

Significantly higher grain yield (12.51 q ha^{-1}), stover yield (14.76 q ha^{-1}) and harvest index (45.87%) of succeeding bengalgram crop were recorded after maize (90 x 20 cm) + lucerne (green manuring) at 1:2 row proportion compared to rest of the treatments except lucerne green manuring treatments with which it was on par (Table 2). Significantly higher seed yield of bengalgram in lucerne green manured plots could be attributed to better expression of yield components. The findings are in conformity with the results reported by Balyan and Seth (1989), who observed higher grain yield of wheat grown after maize + cowpea (green manuring). Similar results have been reported by Dasaraddy (1998), Tiwari *et al*. (2004). Jamwal (2005) and Yadav *et al*. (2005).

The higher grain and stover yield of bengalgram in lucerne green manured treatments could also be attributed to higher soil moisture content. The lucerne green manuring might have helped to conserve soil moisture by acting as surface mulch after incorporation and increased infiltration rate of soil considerably. The results agree with the findings of Balyan (1997).

Significantly higher net returns (Rs. 2113 ha^{-1}) and benefit:cost ratio (4.29) of bengalgram were realized after maize (90 x 20 cm) + lucerne (green manuring) at 1:2 row proportion compared to rest of the treatments except lucerne green manured treatments (Table 2). This can be attributed to higher gross income as a result of higher yield of bengalgram. Similar results were also reported by Jamwal (2005).

Higher amount of available soil nitrogen (249.17 kg ha^{-1}) was found after harvest of bengalgram after maize + lucerne (green manuring) at 1:2 row proportion over initial status of soil. Whereas, marked depletion with regard to available soil phosphorus and potassium after harvest of bengalgram were noticed over initial status of soil. The higher amount of available soil nitrogen is attributed to symbiotic fixation of atmospheric nitrogen by root nodules of both lucerne and bengalgram in addition to incorporation of organic matter by lucerne. The results agree with the findings of Dasaraddy (1998) and Tiwari *et al*. (2004). It is because of legume crops required more amount of P and K for their growth and development. Similar results were also reported by Padhi and Panigrahi (2006), who observed intercropping of legumes with maize resulted in significantly increased available soil nitrogen content and decreased available soil P and K content compared to initial status of soil.

References

Balyan, J. S. 1997. Performance of maize (*Zea mays*) based intercropping systems and their after effect on wheat (*Triticum aestivum*), Indian J. Agron., 42(1): 26-28.

Balyan, J. S. and Seth. 1989. Effect of cropping systems on maize production and their residual effect on succeeding wheat. Indian J. Agron., 34(1): 57-60.

Dasaraddy, S. V. 1998. Studies on residual effect of *in situ* green manuring on the safflower crop in maize + legume-safflower sequence. M.Sc.(Agri.) thesis, Uni. Agric. Sci., Dharwad (India).

Jamwal, J. S. 2005. Productivity and economics of maize-wheat cropping systems under integrated nutrient supply system in rainfed areas of Jammu. Indian J. Agron. 50(2): 110-1 12.

Padhi, A. K. and Panigrahi, R. K. 2006. Effect of intercrop and crop geometry on productivity, economics, energetics and soil-fertility status of maize based intercropping systems. Indian J. Agron., 51(3): 174-177.

Tiwari, R. C., Sharma, P. K. and Khandelwal, S. K. 2004. Effect of green manuring through *Sesbania cannabina* and *Sesbania rostrata* and nitrogen application through urea to maize (*Zea mays*) in maize-wheat cropping system. Indian J. Agron., 49(1): 15-17.

Yadav, M. P., Rai, J., Kushwaha, S. P. and Singh, G. K. 2005. Production potential and economic analysis of various cropping systems for central plains zone of Uttar Pradesh, Indian J. Agron., 50(2): 83-85.

J. Agric. Res. Technol., 37 (1) : 018-024 (2012)

Correlation and Path Analysis Studies in Cucumber (*Cucumis sativus* Linn.)

M. R. Bhande[1], P. C. Haldavanekar[2], P. M. Haldankar[3], S. S. Sawant[4] and V. V. Dalvi[5]
Department of Horticulture, College of Agriculture, Dapoli - 415 712 (India)
(Received : 28-03-2010)

Abstract

Correlation studies in cucumber revealed strong positive association of number of fruits vine^{-1}, volume of fruit, length of fruit, weight of fruit and girth of fruit with fruit yield vine^{-1}. The path analysis studies indicated that the characters volume of fruit, girth of fruit, their number vine^{-1}, node at first staminate flower and sex ratio had direct positive effect on fruit yield vine^{-1} which could be the selection criteria for genetic improvement of fruit yield vine^{-1} in cucumber. The genotype Sheetal and PCUC-8 had maximum moisture percentage. Maximum total soluble solids were reported in genotype DC-2 and highest vitamin-C content in PCUC-28. Among the minerals phosphorus content was maximum in PCUC-28 while, minimum in CHC-1. Calcium content of fruit was highest in the genotype AAUC-2. The genotypes Sheetal and PCUC-28 would be desirable among the population for further use in breeding programme.

Key words : Correlation, path analysis, cucumber.

In India, cucumber is grown on an area of 18,720 ha. with annual production of 1,20,000 MT (Anon. 2006a). In Maharashtra, it is cultivated on an area of 1187 ha. with annual production of 5163 MT during 2006 (Anon. 2006b). Cucumber is also grown commercially during rainy and summer season.

The phenotypic correlation does not give an accurate idea about inherent association between different variables because they are susceptible to environmental fluctuations.

Hence, it is necessary to estimate genotypic correlation coefficient for designing a reliable and efficient breeding programme when a number of variables are included in study of correlation, indirect associations become complex and important. In such cases, more refine technique as path coefficient analysis helps to find direct and indirect causes of association.

1. M.Sc. (Agri.) student, 2. Asso. Professor, 3. Professor, 4. Jr. Res. Asstt. and 5. Asstt. Professor.

Materials and Methods

The present investigation was conducted at All India Coordinated Research Project on Vegetable crops, Central Experiment Station, Wakawali, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli (MS) during *kharif* 2007.

The experiment was laid out in a randomized block design with three replications. Fifteen genotypes of cucumber collected from central experiment sation, Wakawali. Recommended cultural practices were followed raise crop successfully. The genotypes were studied for thirteen characters (Table 1). Observations were recorded from randomly selected five plants from each genotype in each replication. The data was subjected to analysis by using the method suggested by Panse and Sukhatme (1967). Genotypic and phenotypic correlation was worked out as per method suggested by Johnson *et al.* (1955). It was partitioned into

direct and indirect effects by path analysis as suggested by Dewey and Lu (1959).

Results and Discussion

Phenotypic and genotypic correlation coefficient : The correlation coefficients were worked out for all the possible combinations among the characters under study at phenotypic and genotypic levels and presented in Table 1, revealed that the fruit yield vine^{-1} showed highly significant positive association with number of fruits vine^{-1}, volume of fruit, length of fruit, weight of fruit and girth of fruit. The length of vine had positive but non-significant correlation with fruit yield vine^{-1}. The characters, had positive but non-significant correlation with fruit yield vine^{-1}. The characters, days to first harvest and node at first pistillate flower exhibited significant negative correlation with fruit yield vine^{-1}. The characters, node at first staminate flower, sex ratio, seed weight fruit^{-1} and number of branches vine^{-1} was negatively and non-significantly associated with fruit yield vine^{-1}.

In general, genotypic correlation coefficients were higher in magnitude over the respective phenotypic correlation coefficients except the association in few pair of characters. Association of fruit yield vine^{-1} with number of fruits vine^{-1}, volume of fruit, length of fruit and weight of fruit were found to be positive and highly significant. Days to first harvest and node at first pistillate flower showed negative and highly significant correlation with fruit yield vine^{-1}. Girth of fruit had positive and significant correlation with fruit yield vine^{-1}. The characters, node at first staminate flower, sex ratio, seed weight fruit^{-1} and number of branches vine^{-1} exhibited negative and non-significant association with fruit yield vine^{-1}. Length of fruit had weak positive and non-significant correlation with fruit yield vine^{-1}.

Phenotypic and genotypic correlation within the yield contributing characters : The node at first staminate flower had positive and highly significant correlation with days to first harvest. It had positive significant association with number of branches vine^{-1}. The node at first pistillate flower, number of fruits vine^{-1}, sex ratio, length of fruit, length of vine and volume of fruit were non-significantly but positively associated with node at first staminate flower. The characters seed weight fruit^{-1}, girth of fruit and weight of fruit had negative and non-significant correlation with node at first staminate flower at phenotypic level. While at genotypic level it had positive and highly significant correlation with days to first harvest and number of branches vine^{-1}. Node at first pistillate flower was positively and significantly correlated with node at first staminate flower. The characters, number of fruits vine^{-1}, sex ratio, length of fruit, length of vine and volume of fruit showed positive and non-significant correlation with node at first staminate flower. It had negative nonsignificant association with seed weight fruit^{-1}, girth of fruit and weight of fruit.

Node at first pistillate flower had positive and highly significant correlation with sex ratio and days to first harvest. The characters, length of vine, girth of fruit and number of branches vine^{-1} exhibited positive nonsignificant association with node at first pistillate flower while, volume of fruit, number of fruits vine^{-1}, length of fruit and seed weight fruit^{-1}, showed negative and nonsignificant association with node at first pistillate flower. It had negative and significant correlation with weight of fruit at phenotypic level. At genotypic level node at first pistillate flower showed positive and highly significant correlation with days to first harvest and sex ratio. Weight of fruit had negative and significant correlation with node at first pistillate flower. The characters, length of vine, girth of

Table 1. Phenotypic and genotypic correlation coefficient among thirteen quantitative characters in cucumber.

Characters		**Node at first staminate flower**	**Node at first pistillate flower**	**Branches vine^{-1}**	**Length of vine (m)**	**Length of fruit (cm)**	**Weight of fruit (g)**	**Volume of fruit (ml)**	**Girth of fruit (cm)**	**Fruit vine^{-1}**	**Sex ratio (M:F)**	**Seed weight fruit^{-1} (g)**	**Days to first harvest**	**Fruit yield vine^{-1} (kg)**
Node at first	P	-	0.270	0.352*	0.052	0.067	-0.030	0.016	-0.166	0.172	0.096	-0.224	0.599**	-0.162
staminate flower	G	-	0.340*	0.390**	0.046	0.080	-0.032	0.017	-0.188	0.219	0.124	-0.256	0.673**	-0.198
Node at first	P		-	0.012	0.135	-0.203	-0.326 *	-0.266	0.068	-0.204	0.457**	-0.044	0.419**	-0.370*
pistillate flower	G		-	0.024	0.173	-0.210	-0.353*	-0.286	0.067	-0.202	0.505**	-0.072	0.560**	-0.415**
Branches vine^{-1}	P			-	-0.120	0.154	0.197	0.247	0.106	0.056	-0.125	0.501**	0.093	-0.049
	G			-	-0.129	0.160	0.206	0.257	0.133	0.056	-0.121	0.52**	0.098	-0.043
Length of vine (m)	P				-	-0.308 *	-0.196	-0.149	0.197	-0.086	-0.152	-0.002	-0.019	0.032
	G				-	-0.324*	-0.200	-0.154	0.194	-0.092	-0.158	-0.014	-0.006	0.003
Length of fruit (cm)	P					-	0.739**	0.760**	0.687**	0.428**	-0.171	0.057	-0.358*	0.619**
	G					-	0.752**	0.772**	0.743**	0.441**	-0.172	0.060	-0.425**	0.655**
Weight of fruit (g)	P						-	0.990**	0.489**	0.330*	-0.231	0.162	-0.646**	0.602**
	G						-	0.992**	0.524**	0.347*	-0.234	0.163	-0.725**	0.634
Volume of fruit (ml)	P							-	0.521**	0.376*	-0.219	0.180	-0.614**	0.637**
	G							-	0.559**	0.395**	-0.220	0.182	-0.687**	0.670**
Girth of fruit (cm)	P								-	0.033	-0.060	0.324*	-0.415**	0.351*
	G								-	0.047	-0.070	0.340*	-0.461**	0.344*
Fruits vine^{-1}	P									-	-0.123	-0.371*	-0.294*	0.829**
	G									-	-0.131	-0.383**	-0.332	0.885**
Sex ratio (M:F)	P										-	0.124	0.126	-0.115
	G										-	0.126	0.144	-0.114
Seed weight fruit $^{-1}$ (g)	P											-	-0.205	-0.091
	G											-	-0.205	-0.097
Days to first harvest	P												-	-0.634**
	G												-	-0.702**

*, ** Significant at 5 and 1 per cent level respectively.

fruit and number of branches vine^{-1} were positive nonsignificant correlation with node at first pistillate flower. The association between node at first pistillate flower with volume of fruit, length of fruit, number of fruits vine^{-1} and seed weight fruit^{-1} were negative and non significant. Node at first pistillate flower positive and highly significant association with sex ratio and days to first harvest genotypic and phenotypic levels. These results were in close association with Solanki and Seth (1980b) in cucumber.

Number of branches vine^{-1} had positive and significant correlation with seed weight fruit^{-1}. The characters, volume of fruit, weight of fruit, length of fruit and girth of fruit had positive and non-significant correlation with number of branches vine^{-1}. It had weak positive association with days to first harvest and number of fruits vine^{-1}. While, sex ratio and length of vine showed negative and non-significant association with number of branches vine^{-1} at phenotypic level. Number of branches vine^{-1} had positive and highly significant correlation with seed weight fruit^{-1}. The characters, volume of fruit, weight of fruit, length of fruit and girth of fruit had positive and non-significant correlation with number of branches vine^{-1} while, number of fruits vine^{-1} and days to first harvest had weak positive correlation with number of branches vine^{-1}. It had negative and non-significant association was observed with length of vine and sex ratio at genotypic level.

The length of vine had positive but non-significant correlation with girth of fruit. Length of fruit had negative and significant association with length of vine. The characters, weight of fruit, sex ratio, volume of fruit, number of fruits vine^{-1}, days to first harvest and seed weight fruit^{-1} were negative and non significant correlation with length of vine at phenotypic level. This character exhibited positive and

Table 2. Path analysis of different yield contributing characters at genotypic level in cucumber.

Characters	Node at first staminate flower	Node at first pistillate flower	Branches vine^{-1}	Length of vine (m)	Length of fruit (cm)	Weight of fruit (g)	Volume of fruit (ml)	Girth of fruit (cm)	Fruit vine^{-1}	Sex ratio (M:F)	Seed weight fruit^{-1} (g)	Days to first harvest	Fruit yield vine^{-1} (kg
Node at first staminate flower	0.290	-0.313	-0.219	-0.038	-0.122	0.212	0.124	-0.233	0.117	0.012	0.052	-0.082	-0.198
Node at first pistillate flower	0.099	-0.920	-0.014	-0.141	0.320	2.370	-2.100	0.083	-0.108	0.050	0.015	-0.068	-0.415
Branches vine^{-1}	0.113	-0.022	-0.562	0.105	-0.244	-1.383	1.885	0.164	0.030	-0.012	-0.106	-0.012	-0.043
Length of vine (m)	0.013	-0.159	0.073	-0.813	0.493	1.345	-1.127	0.239	-0.049	-0.016	0.003	0.001	0.003
Length of fruit (cm)	0.023	0.193	-0.090	0.263	-1.521	-5.055	5.664	0.918	0.236	-0.017	-0.012	0.052	0.655**
Weight of fruit (g)	-0.009	0.324	-0.116	0.163	-1.144	-6.721	7.273	0.647	0.185	-0.023	-0.033	0.088	0.634**
Volume of fruit (ml)	0.005	0.263	-0.145	0.125	-1.174	-6.665	7.334	0.691	0.211	-0.022	-0.037	0.083	0.670**
Girth of fruit (cm)	-0.055	-0.061	-0.075	-0.157	-1.130	-3.521	4.103	1.236	0.025	-0.007	-0.069	0.056	0.344*
Fruits vine^{-1}	0.064	0.186	-0.032	0.074	-0.671	-2.330	2.896	0.058	0.534	-0.013	0.078	0.040	0.885**
Sex ratio (M:F)	0.036	-0.465	0.068	0.128	0.261	1.575	-1.616	-0.086	-0.070	0.098	-0.026	-0.018	-0.114
Seed weight fruit^{-1} (g)	-0.074	0.066	-0.292	0.012	-0.091	-1.097	1.331	0.420	-0.205	0.012	-0.204	0.025	-0.097
Days to first harvest	0.195	-0.515	-0.055	0.005	0.646	4.871	-5.037	-0.569	-0.178	0.014	0.042	-0.121	-0.702

Underlined figures indicate direct effect. R^2 = 0.9919 Residual effect = 0.090

nonsignificant correlation with girth of fruit. Length of fruit had negative and nonsignificant association with length of vine. The length of vine negatively and non significantly correlated with weight of fruit, sex ratio, volume of fruit, number of fruits vine^{-1}, seed weight fruit^{-1} and days to first harvest at genotypic level.

Length of fruit exhibited strong positive and highly significant correlation with volume of fruit, weight of fruit, girth of fruit and number of fruits vine^{-1}. Seed weight fruit^{-1} had weak positive and non-significant correlation with length of fruit. It had negative significant correlation with days to first harvest and negative non-significant association with sex ratio at phenotypic level. While, positive and highly significant correlation with volume of fruit, weight of fruit, girth of fruit and number of fruits vine^{-1}. It had negative and highly significant correlation observed with days to first harvest. Seed weight fruit^{-1} had positive non-significant correlation and sex ratio had negative and non-significant correlation with length of fruit at genotypic level.

Weight of fruit possessed positive and highly significant correlation with volume of fruit, girth of fruit and number of fruits vine^{-1} had positive and significant association with weight of fruit. While, days to first harvest had negative and highly significant correlation with weight of fruit. Weight of fruit had positive but non-significant correlation with seed weight fruit^{-1} and negative and nonsignificant correlation with sex ratio at phenotypic level. This character also had positive and highly significant correlation with volume of fruit and girth of fruit. While, number of fruits vine^{-1} had significant positive correlation with weight of fruit. Negative and highly significant correlation found for days to first harvest with weight of fruit. It exhibited positive association with seed weight fruit^{-1} while, sex ratio showed negative non-significant correlation with weight of fruit at genotypic level. The character weight of fruit had positive and highly significant correlation with fruit yield vine^{-1}, both at genotypic and phenotypic levels. It had low positive direct effect on fruit yield vine^{-1} at phenotypic levels.

Volume of fruit had highly significant and positive correlation with girth of fruit. Number of fruits vine^{-1} had positive significant correlation and days to first harvest had negative and highly significant correlation with volume of fruit. It had positive but non-significant correlation with seed weight fruit^{-1}. The sex ratio exhibited negative and non-significant association with volume of. fruit at phenotypic level. While, it had positive and highly significant correlation with fruit yield vine^{-1}, girth of fruit and number of fruits vine^{-1}. It exhibited strong negative correlation with days to first harvest. It had positive and non-significant correlation with seed weight fruit^{-1} and negative and non-significant correlation with sex ratio at genotypic level.

Girth of fruit exhibited positive and significant correlation with seed weight per fruit. Days to first harvest had negative and highly significant association with girth of fruit. Number of fruits vine-1 had weak positive association and sex ratio had weak negative and non-significant association with girth of fruit at phenotypic level. The positive association of girth of fruit was significant with seed weight fruit^{-1}. Girth of fruit had negative and highly significant correlation with days to first harvest. It had positive but non-significant correlation with number of fruits vine^{-1} and negative non-significant correlation with sex ratio at genotypic level.

The number of fruits vine^{-1} had negative and significant correlation with seed weight fruit^{-1} and days to first harvest. The character, sex ratio had negative and nonsignificant

correlation with number of fruits vine^{-1} at phenotypic level. This character had negative and highly significant correlation with seed weight fruit^{-1}. Days to first harvest and sex ratio exhibited negative non-significant association with number of fruits vine^{-1} at genotypic level.

The fruit related components like weight of fruit, length of fruit, girth of fruit, volume of fruit and number of fruits vine^{-1} positive and highly significant association among each other at both genotypic and phenotypic levels. The similar observations noticed by Prasad and Singh (1994).

Sex ratio exhibited positive but non-significant correlation with days to first harvest and seed weight fruit^{-1} at phenotypic level. At genotypic level it showed positive but non-significant correlation with days to first harvest and seed weight fruit^{-1}.

Seed weight fruit^{-1} had negative and non-significant correlation with days to first harvest at phenotypic level while, at genotypic level, it was found to be negatively and non-significantly correlated with days to first harvest.

The fruit yield vine^{-1} showed highly significant and positive association with number of fruits vine^{-1} at genotypic and phenotypic levels. The similar results were obtained earlier by Rajput *et al*. (1991), Chen *et al*. (1994), Ma *et al*. (1995) and Neikov and Alexander (1995) in cucumber. The fruit yield vine^{-1} had positive and highly significant association with weight of fruit, length of fruit, volume of fruit and girth of fruit at genotypic and phenotypic levels.

Genotypic correlation coefficients were greater than the respective phenotypic correlation coefficients for all the pairs of characters except few pairs of characters. The results are in accordance with Solanki and Seth (1980b), Dhaliwal and Randhawa (1998) in cucumber. Estimates of genotypic correlation coefficients give an idea about the inherent association, while phenotypic correlation coefficient includes environmental fluctuation.

Phenotypic and genotypic correlation coefficients partitioned into path coefficients : The correlation coefficients were further partitioned in order to assess the direct and indirect effects of various characters on fruit yield vine^{-1}. The fruit yield vine^{-1} was the dependent variable while, other characters were taken as independent variables. The phenotypic correlation coefficients were partitioned into direct and indirect effects and presented in Table 2. Phenotypic path coefficient analysis revealed that number of fruits vine^{-1}, length of fruit, length of vine, sex ratio, volume of fruit, seed weight fruit^{-1}, days to first harvest and weight of fruit showed positive direct effect on fruit yield vine^{-1}. While node at first staminate flower girth of fruit node at first pistillate flower and number of branches vine^{-1} showed negative direct effect on fruit yield vine^{-1}.

At genotypic level volume of fruit, girth of fruit, number of fruits vine^{-1}, node at first staminate flower and sex ratio had considerable positive direct effect on fruit yield vine^{-1}. While weight of fruit, length of fruit, node at first pistillate flower, length of vine, number of branches, seed weight fruit^{-1} and days to first harvest had appreciable negative direct effect on fruit yield vine^{-1}.

Weight of fruit had negative direct effect on fruit yield vine^{-1} at genotypic level. It showed considerable positive indirect effect via. length of fruit, number of fruits vine^{-1} and volume of fruit and fruit yield vine^{-1} at phenotypic level and high positive indirect effect via. volume of fruit, girth of fruit, node at first pistillate flower, number of fruits vine^{-1} and length of fruit on fruit yield vine^{-1} at genotypic level. These results were in line with Nagaprasuna and

Ramarao (1989) for fruit weight on fruit yield vine^{-1} in cucumber.

Number of branches vine^{-1} showed negative correlation with fruit yield vine^{-1}. The direct effect of this character was negative on fruit yield vine^{-1} at both genotypic and phenotypic levels. Besides, the positive indirect effect of number of branches vine^{-1} via. volume of fruit, girth of fruit, node at first staminate flower, length of vine and number of fruits vine^{-1} on fruit yield vine^{-1}. This result was in agreement with the findings of Shaha *et al*. (1999) in ridge gourd.

Sex ratio showed positive direct effect on fruit yield vine^{-1} at both genotypic and phenotypic levels. It had positive indirect effect via. weight of fruit, length of fruit, length of vine, number of branches vine^{-1} and node at first staminate flower on fruit yield vine^{-1}. This result was in close association with Saikia *et al*. (1995). They observed considerable direct positive direct effect of sex ratio.

Node at first pistillate flower had negative direct effect on fruit yield vine^{-1} both at genotypic and phenotypic levels. It had positive indirect effect via. weight of fruit, length of fruit, node at first staminate flower, girth of fruit, sex ratio and seed weight fruit^{-1} on fruit yield vine^{-1} at genotypic level. These results are in confirmation with earlier findings of Prasad and Singh (1994) and Saikia *et al*. (1995) in cucumber.

The residual coefficients of path analysis were negligible at genotypic and phenotypic level, indicating the minimum role of other components on fruit yield vine^{-1}.

References

Anonymous, 2006a. Area and production of various crops statistics. Food and Agric. Org. Publ. on its web site www.fao.org.

Anonymous, 2006b. Agricultural Statistics. Depart. of Agric., Maharashtra, Publ. on its web site www.agrimah.nic.in

Chen, X. H., Cho, P. S. and Xu, Q. E. 1994. Genetic correlation and path coefficient analysis of parthenocarpic yield components in Cucumber. Advances in Horticulture. Depar. of Hort., Jaingsu Agri. College, China, pp. 249-251.

Dhaliwal, M. S. and Randhwa, B. S. 1998. Mutual association and causation in Cucumber. J. Res. Punjab agric. Univ. 35(3 and 4): 161-165.

Dewey, D. R. and Lu, H. K. 1959. A correlation and path coefficient analysis of components of creasted wheat grass seed production. Agron. J. 51(6): 515-518.

Johnson, H. W., Robinson, H. P. and Comstock, R. W. 1955. Estimation of genetic and environmental variability in soybean. Agron. J. 47: 314-318.

Ma, D. H., Lu, S. Z., Shen, W. Y., Huo, Z. R., Li, S. J. and Zhang, Q. D. 1995. Phenotypic correlation and path coefficient analysis on some characters in cucumber. Acta Agric. Borealisinia. 10(2): 34-37.

Neikov, S. and Alexander, M. l995. Correlation between some quantitative characters of salad cucumber cultivars. Bulgarian J. Agric. Sci. 1(3): 275-278.

Panse, V. G. and Sukhatme, P. V. 1967. Statistical Mthods for Agricultural Workers, 4th Edn. ICAR, New Delhi, pp. 228-232.

Prasad, V. S. R. K. and Singh, D. P. 1994. Genetic association and interrelationship between yield components in cucumber. J. Maharashtra agric. Univ. 19(1): 147-148.

Rajput, J. C., Palve, S. B. and Jamadagni, B. M. 1991. Correlation and path analysis studies in cucumber (*Cucumis sativus* Linn.). Maharashtra J. Hort. 1(5): 52-55.

Saikia, J., Shadeque, A. and Bora, G. C. 1995. Genetic studies in cucumber. Haryana J. Hort. Sci. 24(2): 126-130.

Solanki, S. S. And Seth, J. N. 1980b. Correlation studies in cucumber (*Cucumis sativus* L.) Veg. Sci. 7(2): 94-101.

J. Agric. Res. Technol., 37 (1) : 025-029 (2012)

Kripa : An Extra Bold *Kabuli* Chickpea for Central and South Zone of India

P. N. Harer[1], L. B. Mhase[2] and D. V. Deshmukh[3]
Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 11-07-2010)

Abstract

Kripa (Phule G 0517) is a *kabuli* chickpea variety derived through the local selection from the farmer's field. It has semi spreading growth habit, broad leaflets with extra bold seed size. Based on performance in Co-ordinated trials Phule G 0517 consistently maintained higher yields of 2005 kg ha^{-1}. In South Zone of India it produced 1594 kg ha^{-1}. It fulfills the need of extra bold seed size (56-58 g 100^{-1} seed) and fetches more market price over check variety KAK 2. It is superior in respect of milling, cooking, protein content and other qualities of grain. This genotype performed better under higher dcses of fertilizers at recommended spacing. This genotype was less susceptible for *Helicoverpa armigera* and found to be resistant to *Fusarium* wilt in wilt sick plot. Therefore, released the variety under the name "Kripa" for commercial cultivation in Central and South Zone of India.

Key words : Phule G 0517, *kabuli*, extra bold seed size, resistant, quality.

Chickpea is an important and popular nutritive pulse crop in India. Because of the special feature and great demand, there was an urgent need to develop an extra bold *kabuli* chickpea with higher yields. Hence, there was need to develop such genotype to fulfill immediate need of the farmers. The extra large seeded genotype Phule G 0517 is (59.4 g 100^{-1} seeds) developed to fulfill such need. This genotype has been developed at Pulses Improvement Project, MPKV, Rahuri through selection from local germplasm.

Materials and Methods

An effective collection of local gennplasm from farmer's field was done by the scientists of Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri during 2004-05 under an ad-hoc project 'ISOPOM'. From these collections, the extra bold seed size *kabuli* genotype having seed weight more than 50 g 100^{-1} seeds were tested in Regional Varietal Trial (*kabuli*) at Rahuri, Gadhinglaj and Digraj under rainfed and at Rahuri, Savalivihir and Pandharpur under irrigated conditions. Amongst them, the promising genotypes *viz*., Phule G 0515, 0516, 0517 and 0519 were found to be superior under irrigated condition. Therefore, it was tested under irrigated condition in state multilocaticn varietal trial at various locations of Maharashtra as well as under Co-ordinated trials at different locations of Central and South Zone of India. Accordingly, it was tested for the wider spacing as well as higher doses of fertilizers. It was screened for major pest *Helicoverpa armigera* and major disease *Fusarium* wilt in wilt sick plot at MPKV, Rahuri. It was released for commercial cultivation in Central and South Zone of India in the year 2009 under the name "Kripa" by CVRC. The statistical analysis was carried out according to Panse and Sukhatme (1985).

Results and Discussion

Performance of Phule G 0517 in different trials : In regional varietal trial

1. Principal Scientist, 2. Scientist (Plant Breeding) and 3. Sr. Res. Asstt.

during 2006-07 conducted at Rahuri, Savalivihir and Pandharpur under irrigated condition the average yield of this genotype was 1686 kg ha^{-1} (Table 1), whereas, in state multilocation varietal trial conducted at five locations of Maharashtra, its average yield was 1502 kg ha^{-1} which recorded 15.18 per cent increase over extra bold *kabuli* check PKV 4-1 (1304 kg ha^{-1}). It was also tested in extra large seeded *kabuli* > 50 g 100^{-1} seed weight (ISOPOM trial) at one location each of Central and South Zone of India and yielded 1796 and 1546 kg ha^{-1}, respectively. In 2007-08, the genotype was tested in state multilocation varietal trials at six locations of Maharashtra and on an average it yielded 1696 kg ha^{-1} which was 30.36 per cent higher over the extra bold *kabuli* check PKV 4-1 (1296 kg ha^{-1}). On the basis of performance during 2006-07 in extra large seeded *kabuli* > 50 g 100^{-1} seed weight (ISOPOM trial) it was promoted for second year testing and tested over two locations each in Central and South Zone of India during 2007-08. On an average, it yielded 2791 and 2117 kg ha^{-1}, respectively. The genotype re-tested in 2008-09 in state multilocation varietal trial conducted at seven locations of Maharashtra and on an average it

Table 1. Performance of Phule G 0517 in multilocation varietal trials.

Year	Trial	Trial locations	Yield (kg ha^{-1})				% increase of Phule G 0515 over		
			Phule 0515	Virat (cm)	KAK 2 (ch)	PKV 4-1 (ch)	Virat (cm)	KAK 2 (ch)	PKV 4-1 (ch)
2006-07	Regional varietal trial	3	1686	1830	-	-	-7.81	-	-
2006-07	State multilocation varietal trial	5	1502	1527	1559	1304	-1.63	-3.66	15.18
2007-08	State multilocation varietal trial	6	1696	2091	1874	1296	-18.9	-9.50	30.86
2007-09	State multilocation varietal trial	7	1328	1620	1471	1203	-18.02	-9.72	10.39
Mean		21	1526	1762	1630	1262	-13.39	-6.38	20.92

Table 2. Performance of Phule G 0517 in co-ordinated trials.

Year	Trial	Trial locations	Yield (kg ha^{-1})			% increase of Phule G 0515 over	
			Phule 0515	IPCK 02	KAK 2 (ch)	IPCK 02	KAK 2 (ch)
Central Zone of India :							
2006-07	Extra large seeded *kabuli* > 50 g 100^{-1} seed weight (ISOPOM)	1	1796	1736	1861	3.46	-3.49
2007-08	Extra large seeded *kabuli* > 50 g 100^{-1} seed weight (ISOPOM)	2	2791	2792	3098	-0.03	-9.91
2007-09	AVT-2 (Extra large seeded *kabuli* > 50 g 100^{-1} seed weight)	2	1323	1318	1126	0.38	17.50
Mean		5	2005	1992	2062	0.65	-2.76
South Zone of India :							
2006-07	Extra large seeded *kabuli* > 50 g 100^{-1} seed weight (ISOPOM)	1	1546	1275	1614	21.25	-4.21
2007-08	Extra large seeded *kabuli* > 50 g 100^{-1} seed weight (ISOPOM)	2	2117	1884	2099	12.37	0.86
2007-09	AVT-2 (Extra large seeded *kabuli* > 50 g 100^{-1} seed weight)	2	1095	1047	1321	4.58	-17.11
Mean		5	1594	1427	1691	11.70	-5.74
General Mean		10	1800	1710	1877	5.26	-4.10

yielded 1328 kg ha^{-1}, which was 10.39 per cent higher over the extra bold *kabuli* check PKV 4-1 (1203 kg ha^{-1}). On the basis of performance during 2007-08 in extra large seeded *kabuli* > 50 g 100^{-1} seed, weight (ISOPOM trial), it was promoted for AVT-2 (extra large seeded *kabuli* > 50 g 100^{-1} seed weight) and tested over two locations each in Central and South Zone of India. On an average, it recorded 1323 and 1095 kg ha^{-1} seed yield in Central and South Zone of India, respectively (Anon, 2009). In Central Zone yield increased by 17.50 per cent while in South Zone it was reduced by 17.11 per cent than KAK 2 (Table 2).

On the basis of average of three years data of 21 trials in multilocation varietal trials, the genotype Phule G 0517 (1526 kg ha^{-1}) recorded 20.92 per cent higher yield over extra bold *kabuli* check PKV 4-1 (1262 kg ha^{-1}). In five trials of Central Zone of India, it yielded 2005 kg ha^{-1} and the reduction was only 2.76 per cent than KAK 2 (2062 kg ha^{-1}). Whereas, in five trials of South Zone of India it maintained seed yield of 1594 kg ha^{-1} and reduction was only 5.74 per cent than KAK 2 (1691 kg ha^{-1}).

In agronomic experiment, the genotype Phule G 0517 was tested for various spacing and fertilizer doses (Table 3). The culture performed better under spacing of 30 x 10 (1800 kg ha^{-1}) against 45 x 10 cm (1654 kg ha^{-1}) and fertilizer doses of 30:60:00 (1773 kg ha^{-1} as against 25:50:00 (1681 kg ha^{-1}). It indicated that the genotype was responsive for higher doses of fertilizers under recommended spacing (Anon, 2009).

Pest and diseases : The genotype Phule G 0517 recorded 20.40, 16.72 and 6.48 per cent pod borer (*Helicoverpa armigera*) attack in the year 2006-07, 2007-08 and 2008-09, respectively having average PSR rating 6.67.

Table 3. Seed yield of *kabuli* chickpea varieties by spacing and fertilizer doses.

Varieties x spacing	45 x 10 cm	30 x 10 cm	Mean
Varieties :			
Phule G 0517	1654	1800	1727
Virat	1860	2056	1958
KAK 2	1725	1887	1806
Phule G 0516	1539	1666	1602
Mean	1694	1852	1773
	SE± = 87.90	CD at 5% = NS	
Varieties x fertilizer doses :			
Fertilizer dose	25:50:00	30:60:00	Mean
Varieties			
Phule G 0517	1681	1773	1727
Virat	1925	1990	1958
KAK 2	1740	1873	1806
Phule G 0516	1575	1630	1602
Mean	1730	1846	1773
	SE± = 87.00	CD at 5% = NS	
Spacing x fertilizer doses :			
Spacing	45 x 10 cm	30 x 10 cm	Mean
Fertilizer dose			
25:50:00	1649	1740	1695
30:60:00	1812	1893	1852
Mean	1730	1817	1773
	SE± = 62.15	CD at 5% = NS	

Table 4. Reaction to major pest *Helicoverpa armigera* (2006-07 to 2008-09).

Varieties	% PD	PSR
Phule G 0517	14.53	6.67
Virat	13.92	-
KAK 2	17.10	6.33
Vihar	13.74	5.67
PKV 4-1	21.56	7.00

Table 5. Reaction to *Fusarium* wilt in wilt sick plot (2006-07 to 2008-09).

Varieties	Per cent wilt
Phule G 0517	7.36
Virat	6.86
Vihar	6.36
KAK 2	45.79
PKV 4-1	42.63
JG 62 (Susc. Ch)	100.00

The average per cent pod damage was 16.53 which was less than extra bold seeded check varieties KAK 2 (17.10% and PKV 4-1 (21.56%). Therefore, it was found to be less susceptible for *Helicoverpa armigera* (Table 4).

The screening in wilt sick plot during 2006-07 to 2008-09 revealed that the genotype Phule G 0517 was resistant to *Fusarium* wilt (7.36%), whereas the checks KAK 2 (45.79%) and PKV 4-1 (42.63%) were found to be susceptible (Table 5).

Quality characters : In quality studies in the (Table 7), Phule G 0517 recorded highest percentage of clean dhal recovery (85.00%) and broken dhal (8.96%) than Virat (81.20 and 5.80%) and less amount of churi + gota (2.72%) and husk + whole seed (3.32%). The grains had 23.2 per cent protein which are equivalent to Virat (23.7%).

It had medium maturity duration (105-110 days), semi-spreading growth habit, broad leaflets, extra large seed size (56.0 to 58.00 100^{-1} seeds), whitish flowers, multipinate leaflets with pubescent hairiness, wrinkled bold seeds with owl's head shape (Table 8), responsive to fertilizers possessing high yield potential.

The large seeded *kabuli* chickpea receives better prices in market because of special demand of standard caterers for the preparation of attractive and delicious dishes like *chana-masala* and *chana-bhatora*. Because of it's special feature and great demand, there was an urgent need to develop an extra bold *kabuli* chickpea with higher yields. Being high yield potential and less susceptibility for *Helicoverpa armigera* and resistance to *Fusarium* wilt, the variety Phule G 0517 has been recommended for release under the name 'Kripa' as an extra bold seeded *kabuli* chickpea for commercial cultivation under irrigated condition in heavy to medium soils of chickpea growing tracts of Central Zone (Maharashtra and Madhya Pradesh) and South Zone (Karnataka) of India (Anon, 2009).

Table 6. Pooled zonewise mean 100 seed weight of *kabuli* chickpea Phule G 0517 during 2006-07 to 2008-09.

Varieties	100 seed weight (g)			Mean
	CZ	SZ	NWPZ	
Phule G 0517	61.8	56.9	59.5	59.4
KAK 2	40.8	43.4	37.9	40.7
IPCK 02	64.3	55.4	57.3	59.0

Table 7. Quality parameters of chickpea Phule G 0517.

Varities	Milling quality				Protein (%)
	Clean dhal (%)	Broken dhal (%)	Churi+ gota (%)	Husk+ whole seeds (%)	
Phule G 0517	85.00	8.96	2.72	3.32	23.2
Virat (ch)	81.20	5.80	2.70	10.30	23.7

Table 8. Morphological characters of *kabuli* chickpea variety Phule G 0517.

Name of characters	Particulars
Plant pigmentation	No anthocyanin on stem
Plant hairiness	Pubescent
Leaf type	Maltipinate
Leaflets $leaf^{-1}$	8-9
Days to flowering	41-42
Days to maturity	107-108
Number of seeds pod^{-1}	Single
Flower colour	White
Flowers and pods $peduncle^{-1}$	One
Pods per $plant^{-1}$	38-40
Seed shape	Owl's head
Testa texture	Rough
Seed colour	Ivory while
100 seed weight	59.4 kg
Growth habit	Semi-spreading

Acknowledgement

The authors are thankful to ICAR, providing funds under ISOPOM and all concerned scientists and the technical staff who helped in screening and evaluation in various trials at different locations.

References

Anonymous. 2009. Report of research review subcommittee on pulses (2005-07 to 2008-09). Mahattm Phule Krishi Vidyapeeth, Rahuri.

Anonymous. 2009. Annual Report. All India Co-ordinated Research Project on Chickpea, IIPR, Kanpur (U. P.)

Anonymous. 2009. Proposal for release of *kabuli* chickpea variety Phule G 0517 submitted to Rabi Pulses Group Meet of AICRP on Chickpea and MULLaRP at Marathwada Agricultural University, Parbhani (M. S.) on 30th Aug to 1st Sept.

Panse, V. G. and P. V. Sukhatme. 1985. Statistical Methods for Agricultural Workers. ICAR, New Delhi, Fourth Ed.

J. Agric. Res. Technol., 37 (1) : 029-033 (2012)

Effect of Different Containers and Media on Horticultural Performance of Gerbera (*Gerbera jamesonii*) Under Protected Cultivation*

R. D. Kale[1], K. B. Jagtap[2] and C. D. Badgujar[3]
Department of Horticulture, College of Agriculture, Pune - 411 005 (India)
(Received : 21-07-2010)

Abstract

In naturally ventillated polyhouse at first harvest, plastic pots with soil mixture produced better vegetative growth in terms of number of leaves per plant (12.58), leaf area (113.57 cm^2), leaf area index (5.04) and plant spread (49.00 cm). However, at last harvest the earthen pots with enriched cocopeat performed significantly better vegetative growth parameter such as per cent plant survival (96.67%) number of leaves $plant^{-1}$ (14.17), leaf area (145.18 cm^2) and leaf area index (8.09). Significantly least number of days required for appearance of first flower bud (79.11 days) and days required for first harvest (91.61 days) was recorded when gerbera was grown in plastic pot with soil mixture while significantly highest number of flowers $plant^{-1}$ (15.53) and per square meter (139.80) was recorded in gerbera grown in earthen pots with enriched cocopeat. Thus gerbera grown in earthen pots with enriched cocopeat exhibited better horticultural performance in terms of growth and yield parameters.

Key words : Gerbera, containers, media.

Gerbera (*Gerbera jamesonii*) is an important flower crop grown commercially under protected cultivation throughout the world for its cut flowers and also as an ornamental potted plant. The container system of gerbera cultivation with various media is becoming popular now a days. Cocopeat is quite often used in horticulture, especially in rose and other potted plant production (Blom, 1997). Its chemical and physical properties are favourable for gerbera production. Hence, the present investigation was carried out to study the effect of different containers and media on horticultural performance of gerbera under

*Part of M.Sc.(Agri.) thesis submitted by Sr. author to MPKV, Rahuri.

1. M.Sc.(Agri.) student, 2. Asso. Professor and 3. Asstt. Professor.

protected cultivation.

Materials and Methods

A pot culture experiment was conducted at Hi-Tech Floriculture and Vegtable Project, College of Agriculture, Pune during July 2009 to March 2010 under naturally ventilated polyhouse. Experiment designed in FCRD consisted of two pot types i.e. earthen pots (P_1) and plastic pots (P_2) of three litres capacity and four media i.e. cocopeat (M_1), buffered cocopeat (M_2), enriched cocopeat (M_3) and soil mixture (Red laterite soil +FYM+ paddy straw @3:1:1) (M_4); having eight treatment combinations replicated thrice. The raw cocopeat after washing with calcium nitrate is called as buffered cocopeat, whereas the buffered cocopeat after enrichment with nutrients becomes enriched cocopeat, both are available in the market. Five weeks old gerbera tissue cultured plants of cv Cocuy with four to five leaves were used for the experiment. All the cultural practices were followed as per the

Table 1. Growth parameters of gerbera as influenced by different containers, media and their interactions.

Treatment	At first harvest (120 DAP)				At last harvest (270 DAP)				
	Leaves plant^{-1}	Leaf area (cm^2)	LAI	Plant spread (cm)	Leaves plant^{-1}	Leaf area (cm^2)	LAI	Plant spread (cm)	Per cent survival
Containers :									
Earthen pot (P_1)	11.10	90.85	3.97	44.49	12.61	129.73	6.50	55.52	88.34
Plastic pot (P_2)	10.67	100.87	3.82	38.25	12.39	128.48	5.64	55.74	82.50
Mean	10.89	95.86	3.90	41.37	12.50	129.11	6.07	55.63	85.42
SEm±	0.23	4.16	0.19	0.95	0.11	0.83	0.07	0.23	2.22
CD (at 5%)	NS	NS	NS	2.88	NS	NS	0.21	NS	NS
Media :									
Raw cocopeat (M_1)	9.71	38.23	3.20	38.15	12.63	129.82	6.10	57.04	83.34
Buffered cocopeat (M_2)	10.46	104.47	4.06	40.33	13.29	136.74	6.78	59.32	81.67
Enriched cocopeat (M_3)	11.17	90.42	3.78	38.39	13.38	137.65	6.93	57.59	85.00
Soil mixture (M_4)	12.21	100.33	4.55	48.63	10.71	112.21	4.47	48.59	91.67
Mean	10.89	95.86	3.89	41.37	12.49	129.10	6.07	55.63	85.42
SEm±	0.33	5.88	0.27	1.34	0.16	1.17	0.09	0.32	3.14
CD (at 5%)	0.99	NS	0.82	4.07	0.46	3.54	0.29	0.97	NS
Interaction :									
P_1M_1	10.08	79.82	3.19	40.46	12.50	126.91	6.24	55.72	80.00
P_1M_2	10.92	105.93	4.53	45.33	13.33	138.15	7.24	57.98	83.34
P_1M_3	11.58	90.59	4.12	43.94	14.17	145.18	8.09	60.02	96.64
P_1M_4	11.83	87.08	4.05	48.25	10.42	108.67	4.45	48.37	93.34
P_2M_1	9.33	96.63	3.21	35.83	12.75	132.74	5.97	58.36	86.67
P_2M_2	10.00	103.02	3.59	35.33	13.25	135.34	6.33	60.65	80.00
P_2M_3	10.75	90.26	3.44	32.83	12.58	130.11	5.78	55.16	73.34
P_2M_4	12.58	113.57	5.04	49.00	11.00	115.75	4.49	48.80	90.00
Mean	10.89	95.86	3.89	41.37	12.50	129.11	6.07	55.63	85.42
SEm±	0.46	8.31	0.38	1.89	0.21	1.65	0.14	0.45	4.44
CD (at 5%)	NS	NS	NS	5.76	0.65	5.01	0.41	1.37	13.45

DAP = Days after planting, NS = Non significant.

recommendations for growing healthy gerbera crops. The observations on growth parameters were recorded after 120 to 270 days after planting whereas flower yield was taken regularly upto 270 days.

Results and Discussion

From the data presented in Table 1, the individual effect of containers revealed that the earthen pots (P_1) produced better vegetative growth of gerbera at first harvesting in terms of number of leaves plant^{-1} (11.10) leaf area index (3.97) and plant spread (44.49 cm). However, leaf area was found higher (100.87 cm^2) in plastic pots (P_2). Similarly at last harvesting, earthen pots (P_1) proved to be better for number of leaves per plant (12.61), leaf area (129.73 cm^2), leaf area index (6.50) and per cent survival (88.34%) except plant spread which was found better (55.74 cm) in plastic pots (P_2). This might be due to earthen pots provided better aeration and drainage which is necessary for better root growth and vegetative parameters. Pawar *et al*. (2005) reported better vegetative growth in chrysanthemum with earthen pots.

The effect of different media at first flower harvesting showed that the media, soil mixture

Table 2. Yield attributes of Gerbera as influenced by different containers, media and their interactions.

Treatment	Days required for appearance of first flower bud	Days required for first harvest	Flowers plant^{-1}	Flowers square^{-1} meter
Containers :				
Earthen pot (P_1)	86.07	100.09	13.38	120.45
Plastic pot (P_2)	97.86	110.68	12.62	113.85
Mean	91.96	105.38	13.02	117.15
SEm±	0.59	0.61	0.12	1.05
CD (at 5%)	1.78	1.86	0.35	3.19
Media :				
Raw cocopeat (M_1)	94.27	108.88	12.20	109.80
Buffered cocopeat (M_2)	95.64	109.14	13.77	123.90
Enriched cocopeat (M_3)	98.14	110.86	13.17	118.50
Soil mixture (M_4)	79.81	92.67	12.93	116.40
Mean	91.96	105.39	13.02	117.15
SEm±	0.83	0.87	0.17	1.49
CD (at 5%)	2.51	2.63	0.50	4.51
Interaction :				
P_1M_1	91.61	107.33	12.00	108.00
P_1M_2	86.99	101.27	14.33	129.00
P_1M_3	85.16	98.05	15.53	139.80
P_1M_4	80.49	93.72	11.67	105.00
P_2M_1	96.94	110.44	12.40	111.60
P_2M_2	104.27	116.99	13.20	118.80
P_2M_3	111.11	123.66	10.80	97.20
P_2M_4	79.11	91.61	14.20	127.80
Mean	91.96	105.39	13.02	117.15
SEm±	1.17	1.23	0.23	2.10
CD (at 5%)	3.56	3.72	0.71	6.38

(M_4) was significantly superior for most of the growth parameters such as number of leaves plant^{-1} (12.21), leaf area index (4.55) and plant spread (48.63 cm) except leaf area which was found highest (104.47 cm^2) in buffered cocopeat (M_2). At last harvest enriched cocopeat (M_3) was significantly superior for number of leaves plant^{-1} (13.38), leaf area (137.65 cm^2) and leaf area index (6.93). However, the plant spread was found significantly highest (59.32 cm) with buffered cocopeat and per cent survival (91.67%) with soil mixture (M_4). Initially, the soil mixture media produced better vegetative growth, might be due to more availability of nutrients but later on enriched cocopeat and buffered cocopeat showed better results might be due to their better chemical and physical properties. The above results are on the same line as reported by Gupta *et al*. (2004), Barreto and Jagtap (2006) and Sindhu *et al.* (2008), in gerbera. Even though at first havest most of the growth parameters nonsignificantly varied, the plastic pots having soil mixture was found superior for all the growth parameters at first harvest i.e. number of leaves plant^{-1} (12.58), leaf area (113.57 cm^2), leaf area index (5.04) and plant spread (49.00). However, at last harvest earthen pots with enriched cocopeat proved to be significantly superior for most of the growth parameters such as number of leaves plant^{-1} (14.17), leaf area (145.18 cm^2), leaf area index (8.00) and survival (96.64%) except plant spread which was found highest in plastic pots witt buffered cocopeat (60.65 cm).

The better growth of gerbera initially in plastic pots with soil mixture might be due to more nutrient availability and congenial condition for growth to the plants but later on earthen pots with enriched cocopeat performed better to produce better vegetative growth on account of optimum growing conditions. Pawar *et al.* (2005) reported better growth of chrysanthemum in earthen pots.

The data presented in Table 2 revealed that the earliest flower bud initiation (86.07 days) and earliest flower harvesting (100.07 days) was observed in earthen pots while among the media, lowest number of days required for appearance of first flower bud (79.80 days) and lowest number of days required for first harvest (92.67 days) were due to soil mixture (M_4) which were recorded significantly least number of days for appearance of first flower bud (79.11 days) and number of days required for first harvesting (91.61 days). These results were in agreement with those reported by Leffering (1975) in gerbera. Better vegetative growth initially in respective treatments resulted in better establishment and early flowering of gerbera.

However, the highest number of flowers plant^{-1} and meter^{-2} were observed in earthen pots (13.38 and 120.45), buffered cocopeat (13.77 and 123.90) and earthen pots with enriched cocopeat (15.53 and 139.80) respectively among the containers, media and their interaction effects. The similar results were also obtained by Gupta *et al*. (2004) in gerbera crop. These results might be due to the fact that cocopeat especially enriched cocopeat and buffered cocopeat possess better physical and chemical properties which resulted in maximum uptake of nutrients and thus more flower yields.

Acknowledgement

Authors greatfully acknowledge the financial support received from ICAR through Niche area of excellence protected floriculture and vegetable production scheme for this research work.

References

Barreto, M. S. and Jagtap, K. B., 2006. Assessment of substrates for economical production of gerbera (*Gerbera jamesoni*) flowers under protected cultivation. J. Ornamental Hort.9(2): 136-138.

Blom, T. J. 1997. Coco-coir versus granulated rockwool and arching versus traditional harvesting of roses in a recalculating system. ISHS Symp. Growing media and Hydroponics, Windsor, Canada, Book of Abst. Poster 10.

Gupta, Y. C, Le, Quec Dein, Dhiman, S. R. and Jain, R. 2004. Standardization of growing media under protected enviroment for gerbera in mid hill of Himachal Pradesh. J. of Ornamental Hort., 7(1): 99-102.

Leffering, L. 1975. Effect of day length and temperature on shoot and flower production of gerbera. Acta. Hort. 51: 263-265.

Pawar, A. V, Jagtap, K. B., Shrinath, B. M. and Jadhav, S.B. 2005. Comparative studies on pot mum chrysanthemum (*Dendranthema grandiflora*) with respect to varieties, pots and substrates. J. Maharashtra Agric. Univ. 30(3): 269-271.

Sindhu, S. S. Gholap. D. B, and Singh, M. R. 2008. Effect of media amendment on physico-chemical properties and leaf nutrient concentration on gerbera cv. Tesrina. In: "Book abstract" Nat. Symp. recent advances in floriculture, 4-6 March 2008 at NAU, Navasari, Gujrat pp. 53.

J. Agric. Res. Technol., 37 (1) : 033-036 (2012)

Stability Performance of Chickpea Genotypes Under Rainfed, Irrigated and Late Sown Conditions

V. M. Kulkarni[1], Y. R. Pawar[2], V. B. Shinde[3], L. B. Mhase[4] and P. N. Harer[5]
Pulses Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 31-08-2010)

Abstract

Both linear and non-linear components of variation in G x E played important role for the expression of yield trait. The genotype Phule G 0105-10-1, Phule G 0105-10-5 and Phule G 0105-15-5 were found most stable for seed yield and widely adapted under rainfed, irrigated and late sown conditions. However, Phule G 0105-10-4 is better for irrigated and late sown conditions and Phule G 0105-12-7 is better for rainfed condition.

Key words : Stability, G x E interaction, chickpea.

The ultimate aim of any plant breeding programme is to develop cultivars with high yield potential and consistent performance over the diverse environments. Under such circumstances, it is desirable to have a stable genotype for commercial exploitation over a wide range of environments. Stability indicates the constant mean efficiency in different environments (Atta *et al.*, 2009).

Chickpea (*Cicer arietinum* L.) is an important nutrition source, its dry grains containing around 20 per cent raw protein and 6 per cent leucine. Variability of ecological conditions, in appropriate production methods and insufficient numbers of stable types may cause fluctuations in the production of chickpea. Production efficiency, suitable place and conditions for the production of developed types should be determined by the plant breeders. Considerable increase in production and productivity of chickpea has been achieved in central India during last decade. However, its production and productivity shows lot of

1., 2., 3. Jr. Res. Asstt., 4. Scientist (Plant Breeding) and 5. Principal Scientist.

fluctuations from season to season. To stabilize the production and productivity of this important pulse crop, it was considered imperative to evaluate genotypes endowed with high degree of adaptability, combined with superior productivity levels over a range of eco-geographical conditions for successfully exploiting its inherent potential. The present investigation were undertaken to identify stable genotype under different growing situation (rainfed, irrigated and late sown). With this view, fourteen promising genotypes developed at Pulses Improvement Project, MPKV, Rahuri were evaluated for their stability for yield potential under six different environments of Maharashtra.

Materials and Methods

The regional varietal trial comprising of fourteen chickpea genotypes along with 2 checks *viz*., Vijay and Digvijay developed at Mahatma Phule Krishi Vidyapeeth, Rahuri were grown in a randomized block design with three replications during *rabi* 2008-09 at six locations under different conditions *viz*., Mohol and Rahuri (Early sown rainfed condition), Rahuri and Savalivihir (Optimum sown irrigated condition) and Rahuri and Pune (Late sown condition).

Three irrigations at the time of sowing, flowering and pod filling stages were given to irrigated and late sown trials. All recommended package of practices for chickpea were followed. Data were recorded on grain and other ancillary characters. The statistical analysis was carried out according to Eberhart and Russell (1966).

Results and Discussion

A pooled analysis of variance showed that, the differences between genotypes and environments were significant (Table 1) suggesting the presence of genetic difference among the chickpea genotypes for grain yield. Significance of genotype x environments interaction for grain yield indicated that the genotypes interacted with the environments. The mean square due to environments (linear) was highly significant indicating the real difference in genotypes for regression over environmental means. The variance due to G x E (linear) and non-linear component (pooled deviation) were significant for seed yield. G x E (linear) is attributable to regression and hence predictable. Mean squares for pooled deviations were significant, indicating that the G x E interaction of genotypes was also unpredictable. These results are in agreement with results of Deshmukh *et al.* (1998) and Mhase *et al.* (1998).

Phenotypic stability was assessed by considering the mean performance of genotypes over environment ($\bar{X}$), the linear regression of the genotypes over environmental

Table 1. Analysis of variance (mean squares) for stability with six environments.

Source of variation	df	Sum of squares	Mean sum of squares
Genotypes	15	161.01498	10.73433*
Environments + (G x E)	80	1565.19870	19.56498***
Environments	5	1132.63669	226.52734***
Genotypes x environments	75	432.56200	5.76749**
Environments (Linear)	1	1132.63669	1132.63669**
Genotypes x Environments (Linear)	15	70.155	4.677**
Pooled deviation	54	369.90372	5.779**
Pooled error	180	367.346	2.0408

indexes (bi) and the deviation from the regression (S^2di). An ideal genotype should have high mean performance, regression coefficient (bi) equal to unity and deviation from regression (S^2di) as small as possible or approaching zero.

Based on all three stability parameters, it is suggested that, the responsiveness of the genotypes and their performance could be partly predictable over environments with adequate precision. The genotypes Phulc G 0105-10-1, Phule G 0105-10-5 and Phule G 0105-15-5 had regression coefficient equal to unity (bi=1.083, 1.058, 1.115 respectively) and non-significant S^2di (-0.536, 2.816, -2.368 respectively) associated with high mean grain yield (1973, 1836, 1747 kg ha^{-1} respectively) could be considered as stable genotypes and appeared widely adapted over rainfed, irrigated and late sown conditions. Similar results were reported by Deshmukh *et al.* (1990], Atta *et al*. (2009), Kan *et al*. (2010), and Kareppa and Mhase (2010). However, genotype Phule G 0105-10-4 had high mean seed yield (1892 kg ha^{-1}) with bi value greater than unity (bi=1.550) with non-significant S^2di (1.272) suggesting that, this was below average in stability. This would perform better in superior environmental conditions. The genotyps Phule G 0105-12-7, exhibited higher grain yield (1759 kg ha^{-1}) with 'bi' value less than the unity (0.600) and non-significant S^2di (-0.0537) showed its average stability and it does better under poor environmental condition (Table 2).

Table 2. Stability parameters of different chickpea genotypes over rainfed, irrigated and late sown conditions.

Genotypes	Mean yield kg ha-1 ($\bar{X}$)	Regression coefficient (bi)	Deviation from regression (s^2di)
Phule G 07102	1935	0.70	7.926**
Phule G 07104	1878	0.896	4.268*
Phule G 07109	1666	0.896	4.952*
Phule G 01 05-10-1	1973	1.083	-0.536
FhuleG 0105-10-4	1892	1.550	1.272
Phule G 01 05-10-5	1836	1.058	2.816
Phule G 0105-12-1	1725	0.942	4.593*
Phule G 01 02-14-1	1703	0.914	0.821
Phule G 01 05-12-7	1759	0.600	-0.0537
Phule G 01 05-14-1	1719	1.181	13.341***
Phule G 01 05-15-5	1747	1.115	-2.368
Phule G 01 05-17-2	1758	1.333	-1.338
Phule G 014-6-3	1535	0.947	14.246***
Phule G 06104	1739	0.859	3.441
Vijay (Ch)	1472	0.853	1.718
Digvijay (Cn)	1676	0.871	0.019

The mean performance of stable genotypes is presented in Table 3. These genotypes having higher seed yield coupled with earliness in flowering and maturity, having more fruiting branches, pods $plant^{-1}$, yield $plant^{-1}$, with higher 100 seed weight, which are the yield

Table 3. Mean performance of stable chickpea genotypes for the yield contributing characters.

Genotype	Stability performance	Days to 50% flowering	Days to maturity	Plant spread (cm)	Fruiting branches plant-1	Pods $plant^{-1}$	Yield $plant^{-1}$ (g)	100 seed weight (g)
Phule G 0105-10-1	Stable	46	92	19.10	15.00	56.10	9.96	23.46
Phulc G 0105-10-5	Stable	46	94	18.80	13.10	52.60	11.63	20.40
Phule G 0105-15-5	Stable	46	92	14.90	17.33	52.60	9.79	18.60
Phule G 0105-10-4	Below average	47	93	20.66	12.20	45.00	9.90	23.26
Phule G 0105-12-7	Above average	47	91	18.46	12.0	47.20	9.73	25.85

contributing characters. The genotype Phule G 0105-10-1 recorded more fruiting branches (15.0), highest pods plant^{-1} (56.10) with more 100 seed weight (23.46 g) indicating that this genotype is performing better over the locations. These genotypes will be rigorously tested in coordinated chickpea evaluation trials and utlilzed in chickpea breeding programme.

The present study indicated that, the genotypes, Phule G 0105-10-1, Phule G 0105-10-5 and Phule G 0105-15-5 were found as most desirable for rainfed, irrigated and late sown conditions, however, Phule G 0105-10-4 is better for irrigated and late sown conditions and Phule G 0105-12-7 is better for rainfed condition.

References

Atta, B. M., Shah T. M., Abbas G., Haq, M. A. 2009. Genotype x evironment interaction for seed yield in kabuli chickpea (*Cicer arietinum* L.) genotypes developed through mutation breeding. Pak. J., Bot., 41(4): 1883-1890.

Deshmukh, R. B., Kute, N. S., Aher R. P. and Mhase, L. B. 1998. Stability for grain yield in chickpea. Indian J. Pulses Res. 11(1): 79-81.

Eberhart, S. A. and Russel W. L. 1966. Stability parameters for comparing varieties. Crop Sci. 6(1): 36-40.

Kan Asuman, Kaya Muharrem, Gurbuz Aysegul, Sanil Arif, Ozcan Kamil and Ciftci Cemalettin Yasar. 2010. A study on genotype x environment interaction in chickpea cultivars (*Citter arietinum* L.) grown in arid and semi-arid conditions. Scientific Res. and Essays. 5(10): 1164-1171.

Kareppa, S. M. and Mhase, L. B. 2010. Genotype x environment analysis for yieid of irrigated chickpea. J. Maharashtra agric. Univ. 35(2): 299-300.

Mhase, L. B., Manjare M. R., Aher R. P. and Kolte T. B. 1998. Stability for grain yield in chickpea under rainfed condition. Indian J. Pulses Res. 11(2): 120-122.

J. Agric. Res. Technol., 37 (1) : 037-040 (2012)

Genetic Analysis of Single Cross Hybrids of Maize*

S. N. Jadhav[1], B. H. Chavan[2], D. V. Dahat[3], N. D. Bangar[4] and A. N. Kshirsagar[5]
College of Agriculture, Pune - 411 005 (India)
(Received : 10-11-2010)

Abstract

The heterosis and combining ability analysis using modified line x tester design was conducted in maize crosses and inbred lines for yield and twelve yield contributing traits. Crosses showed significant heterosis over better parent for most of the traits studied except starch content and number of grain rows ear^{-1}, while few of the crosses showed significant standard heterosis for grain yield, starch content and earliness. The crosses KMI-H43 x KMI-H39 and KMI-H23 x KMI-H152 showed high percentage of heterobeltiosis for grain yield and its contributing traits. The SCA variance was higher than GCA variance for all the traits. The ratio of GCA : SCA indicated predominance of non additive gene action for all the traits studied . Among the females KMI-H42 and KMI-H43 and KMI-H152 among males were found to be best general combiners for grain yield and also for most of the yield contributing traits. Likwise among hybrids KMI-H23 x KMI-H152 and KMI-H43 x KMI-H39 for grain yield and KMI-H31 x KMI-H152 for earliness were the best specific combinations.

Key words : Heterosis, combining ability, gene action, variance, inbred, maize.

The grain yield and its contributing traits are primary traits targeted for maize improvement. The study of heterosis helps in selecting crosses with high yielding potential for commercial exploitation of F_1 and to advance desirable segregants in subsequent generations. The exploitation of heterosis in maize can be accomplished through the development and identification of high *per se* performing vigourous parental lines. Their subsequent evaluation for combining ability in cross combinations helps to identify hybrids with high heterotic effects. The present investigation was carried out to study the extent of heterosis to identify the best combiners and high yielding parental lines.

Materials and Methods

Seven diverse lines of maize *viz*., KMI-H23, KMI-H31, KMI-H42, KMI-H43. KMI-H63, KMI-H88 and KMI-H138 and three testers *viz*., KMI-H39, KMI-H152 and KMI-H158 were intermated in modified line x tester fashion during summer 2008. All 21 hybrids along with 10 parents and 2 standards checks (Maharaja and Super 900M) were sown in a randomized block design with 3 replications at the Botany section farm, College of Agriculture, Pune-5, during *kharif* 2008. Each entry was represented by single row of 4 m length spaced 75 cm with 20 cm distance between two plants. The data were recorded on yield and yield contributing traits on five randomly selected competitive plants. The heterosis (%) over better parent and standard check was carried out by following Rai (1979) and the combining ability analysis, was carried out as per Arunachalam (1974).

Results and Discussion

Analysis of variance revealed that the variances due to treatments (genotypes) were

*Part of M.Sc.(Agri.) thesis submitted to M.P.K.V. Rahuri.

1. M.Sc.(Agri.) student, 2. Asstt. Professor, 3., 4., Asso. Professor and 5. Agril. Asstt.

significant and there exist a good amount of genetic variability among them and their interactions. The parents vs. crosses mean sum of squares were significant for all the traits studied except for starch content indicating the good amount of heterotic effects for the characters.

It was observed that most of the characters had significant heterosis over better parent in desirable direction. The crosses KMI-H43 x KMI-H39 and KMI-H23 x KMI-HI52 with high percentage of better parent helerosis for grain yield also exhibited the heterosis for other traits like plant and ear height, length and girth of

Table 1. Component of variation for 13 characters in 7 x 3 MLT of maize.

Components	Days to 50% tasseling	Days to 50% silking	Days to 75% dry husk	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear girth (cm)	No. of grain rows ear-1	No. of grains ear^{-1}	100 grain weight	Grain yield plant-1	Starch content (%)	Biomass plant^{-1} at harvetst
σ^2 GCA	2.04	2.68	2.39	217.28	61.19	2.12	0.27	0.03	57.86	2.72	87.14	0.37	192.70
σ^2 SCA	4.67	6.75	7.56	758.42	180.24	4.61	0.62	0.47	23.49	6.81	386.25	3.14	17.47
σ^2 A	4.08	5.37	4.79	434.56	122.38	424	054	0.05	1143	5.43	174.28	0.74	385.41
σ^2 D	4.67	6.75	756	758.12	180.24	4.61	0.62	0.47	2349	6.81	386.25	3.14	17.47
A:D ratio	0.87	0.80	0.63	0.57	0.67	0.92	0.86	0.11	049	0.80	045	0.23	0.22

Table 2. Estimates of general combining ability effects for 13 characters in 7 x 3 MLT of maize.

Parents	Days to 50% tasseling	Days to 50% silking	Days to 75% dry husk	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear girth (cm)	Grain rows ear^{-1}	Grains ear^{-1}	100 grain weight	Grain yield plant^{-1}	Starch content (%)	Biomass plant^{-1} at harvetst
Lines :													
KMI-H23	2.40**	2.30**	1.62*	11.57**	-0.53	-2.25**	-1.69**	-0.13	-31.8**	-3.3**	-15.63**	-1.25	-88.54**
KMI-H3I	2.71**	-2.48**	-1.60*	-4.21	8.81**	0.81**	-0.02	0.42	-4.79	-0.06	2.69	0.35	13.46*
KMI-H42	0.62	1.08*	0 S4	28.68**	15.70**	2.31**	0.97**	-0.01	50.43**	3.00**	23.70**	4.43**	81.68**
KMI-H43	1.73*	1.75**	1.73**	21.13**	8.03**	3.03**	1.12**	0.21	55.32**	2.01**	21.59**	0.32	68.13**
KMI-H63	0.18	-0.14	0.62	-8.76*	-2.41**	-0.91**	0.18	-0.02	-38 79**	-0.23	-13.30**	-3.81**	-24.65**
KMI-H88	-2.60**	-3.25**	-3.60**	-4.42"	-25.7**	-2.52**	-0.37	-0.001	-3.24"	0.78	-9.52**	0.61	-32.87**
KMI-H138	0.40	0.75	0.40	-4.21	-3.86**	-0.47	-0.20	-0.47	6.87	-2.2**	-9.52**	-0.64	-17.21**
S.Em.±	0.70	0.50	0.63	3.92	0.70	0.30	0.28	0.25	10.29	0.59	2.18	0.69	5.60
C.D. 5%	1.41	1.01	1.27	7.92	1.42	0.60	0.56	0.51	20.80	1.19	4.41	1.34	11.32
C.D. 1%	1.89	1.35	1.71	10.59	1.90	0.81	0.75	0.68	27.84	1.59	5.90	1.85	15.15
Testers :													
KMI-H39	0.47*	0.94**	1.03*	9.13**	-0.62	1.13**	-0.31	0.06	16.27*	-0.31	2.69	-1.31**	1.35
KMI-H52	-1.46**	-1.68"	-1.68**	-0.92	3.62**	-0.14	0.14	-0.26	-13.16	1.57**	0.70	0.21	1.83
KMI-H158	0.49	0.75*	0.65	-8.21**	-3.00**	-0.99**	0.18	0.21	-3.11	-1.26**	-3.40*	1.10*	-3.18
S.Em.±	0.46	0.33	0.41	2.56	0.46	0.20	0.18	0.17	6.74	0.38	1.43	0.45	3.67
C.D. 5%	0.93	0.66	0.66	5.18	0.93	0.39	0.37	0.33	13.62	0.78	2.89	0.41	7.41
C.D. 1%	1.24	1.24	1.12	6.93	1.25	0.53	0.49	0.45	16.22	1.04	3.87	1.21	9.92

Where, *,** = Significant a 5 and 1 per cent level of probability, respectively.

ear. number of grains ear^{-1}, 100 grain weight and biomass plant^{-1} at harvest. The other crosses like KMI-H43 x KMI-H39. KMI-H42 x KMI-H39 and KMI-H43 x KMI-HI52 for plant height. KMI-H63 x KMI-H39 and KMI-H31 x KMI-H39 for ear height. KMI-H43 x KMI-H39, KMI-H43 x KMI-HI52, KMI-H23 x KMI-H152 and KMI-H31 x KMI-H39 for ear length. KMI-H63 x KMI-H39and KMI-H63 x KMI-HI52 for ear girth. KMI-H63 x KMI-H152, KMI-H63 x KMI-H39 and KMI-H43 x KMI-H39 for number of grain rows ear^{-1} KMI-H42 x KMI-H158, KMI-H42 x KMI-HI52 and KMI-H43 x KMI-H39 for number of grains ear^{-1} KM1-H23 x KMI-HI52. KMI-H43 x KMI-H39 and KMI-H31 x KMI-H152 for 100 grain weight were found to be best combinations for respective traits. The cross KMI-H43 x KMI-H39 only recorded standard helerosis for grain yield to the tune of 15.78 per cent. Similar findings have been reported earlier by Ashish and Singh (2003) and Devi *et al*. (2007).

From the analysis of variance (Table 1), it was observed that the GCA variance was less than SCA variance for all the characters under study. Estimate of dominance variance (σ^2D) was higher for all the characters than additive variance (σ^2A). It was observed that A:D ratio was less than unity for all the traits under study indicating preponderance of dominant gene action. Similar findings were reported earlier by Subramaniyan and Subbrainan (2006), Amit Dadheech and Joshi (2007).

A perusal of GCA effects (Table 2) revealed that KMT-H42 among the lines and KMI-H 152 among the testers were best general combiners fibr yield and most of yield contributing traits, respectively. The estimates also showed that the parent *viz*., KMI-H31,

Table 3. Estimates of specific combining ability effects for 13 characters in 7 x 3 MLT of maize.

Parents	Days to 50% tasseling	Days to 50% silking	Days to 75% dry husk	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear girth (cm)	Grain rows ear^{-1}	Grains ear^{-1}	100 grain weight	Grain yield plant^{-1}	Starch content (%)	Biomass plant^{-1} at harvetst
KMI-H23 x KMI-H39	-2.64*	-2.83**	-3.14**	15.43*	1.29	-2.35**	-1.60"	-0.33	-62.16"	-2.28*	-22.37**	-0.36	-43.79**
KMI-H23 x KMI-H152	1.74	2.80**	3.41**	35.14**	22.05**	2.91**	1.85**	0.91	10.83**	5.01**	43.64**	2.36	87.40**
KMI-H31 x KMI-H152	-3.10*	-3.76**	-3.87**	-19.10**	-2.62*	-0.14	-0.77	-0.90*	-35.39	0.78	-13.70**	-1.04	12.75
KMI-H43 x KMI39	2.70*	3.06**	4.10**	24.87**	4.06**	2.04**	0.96	0.65	14.73	3.71**	18.75**	1.95	4.21
KMI-H63 x KMI-H39	0.25	-0.05	-0.51	-13.24	2.51*	0.65	0.36	-0.44	17.51	-1.18	0.30	2.85*	45.32**
KMI-H88 X KMI-H158	0.02	-0.51	-1.17	24.21**	12.22**	0.21	0.43	-0.91	50.00**	0.63	12.62**	00.00	29.409**
KMI-H138 x KMI-H158	-1.16	-1.41	-1.54	7.87	7.00**	0.83	0.42	0.60	19.89	1.42	8.95*	0.18	-22.94*
S.E.(sij)±	1.21	0.87	1.09	6.78	1.22	0.52	0.48	0.44	17.82	1.18	3.78	1.19	9.70
S.E.(sij-ski)±	1.71	1.22	1.55	9.59	1.72	0.73	0.68	0.62	25.21	1.44	5.35	1.69	13.72
C.D. 5%	2.45	1.75	2.21	13.71	2.46	1.04	0.98	0.88	36.03	2.06	7.64	2.40	14.60
C.D. 1%	3.28	2.34	2.95	18.35	330	1.40	1.31	1.18	48.22	2.75	10.23	3.2.1	26.24

Where, *,** = Significant a 5 and 1 per cent level of probability, respectively.

KMI-H88, and KMI-H 152 for earliness, KMI-H23, KMI-H43 and KMI-H39 for plant height. KMI-H31, and KMI-H43 for ear height, KMI-H31. KMM-H43 and KMI-H39 for ear length. KMI-H43 for ear girth. KMI-H43 and KMI-H39 for number of grains ear^{-1}, KMI-H43 and KMI-H152 for 100 grain weight, KMI-H42 and KMI-H43 for grain yield, KMI-H42 for starch content were identified as good general combiners for respective traits. The above results were in agreement with the results of Katna *et al*. (2005), Gissa *et al*. (2007) and Alam *et al*. (2008).

A perusal of best hybrid on the basis of SCA effects for grain yield plant^{-1} (Table-3) revealed that the crosses KMI-H23 x KMI-H39 and KMI-H43 x KMI-H39 exhibited highest magnitude of positively significant SCA effects for grain yield plant^{-1} along with positively significant SCA effects for other directly contributing characters. The *per se* performance of parental lines of these crosses were also good. Likewise the combinations, KMI-H3I x KMI-H152 and KMI-H23 x KMI-H39 for earliness. KMM 123 x KMI-H152 and KMI-H43 x KMI-H39 for plant height, ear height, ear length 100 grain weight and grain yield plant^{-1}. KMI-H23 x KMI-H152 for ear girth, number of grains ear^{-1} and biomass plant^{-1} at harvest and KMI-H63 x KMI-H39 for starch content exhibited significant SCA effects for respective characters indicating the fact that these combinations can be exploited for the characters mentioned. Similar results were reported by Suhramaniyan and Subbraman (2006), Gissa *et al.* (2007) and Sridic *et al.* (2007).

Based on the present investigation it is concluded that the hybrids KMI-H43 x KMI-H39, KMI-H23 x KMI-H152, KMI-H42 x KMI-H152 and KMI-H43 x KMI-H152 could be used to exploit heterosis. The female parents KMI-H42 and KMI-H43 and male parent KMI-H152 were identified as the best combiners and could be used in various breeding programme for improvement in maize.

References

Alam, A. K. M., Ahmed, S., Begum, M. and Sultan, M. K. 2008, Heterosis and combining ability for grain yield and its contributing. characters in maize. Bangladesh J. Agril. Res., 33(3): 375-379.

Amit Dadheech and Joshi, V. N. 2007. Heterosis and combining ability for quality and yield in early maturing single cross hybrids of maize. Indian J. Agric. Res., 41(3): 210-214.

Arunachalam, V. 1974. The fallacy behind the use of modified L x T design. Indian J. Genet., 24(2): 280-287.

Ashish Srivastava and Singh, I. S. 2003. Heterosis and combining ability for yield and maturily involving exotic and indigenous inbred lines of maize (*Zea mays* L.). Indian J. Genet. 63(4): 345-346.

Devi, B., Sarma, N., Barua, S. and Talukdar, P. 2007. Analysis of mid parent heterosis in a variety diallel in rain fed maize. Indian J. Genet., 67(6): 200-202.

Gissa, D. W., Zelleke, Labuschangne, M. T., Hussien, T. and Singh, H. 2007. Helerosis and combining ability for grain yield and its components in selected maize inbred lines. South African J. of Pl. and Soil, 24(3): 133-137.

Katna, G., Sinh, H. B., Sharma, J. K. And Guteria S. K. 2005. Heterosis and combining ability studies for yield and its related traits in maize (*Zea mays* L). Crop Res. 30(2): 221-226.

Rai, B. 1979. Heterosis breeding. Agrobiological Publ. Delhi. pp. 1-183.

Sridic, J., Pajic Z. and Drinic-Mladenovic, S. 2007. Inheritance of maize grain yield components. Maydica. 52(3): 261-264.

Subramaniyan, A. and Subbraman, N. 2006. Combining ability analysis for yield and its contributing traits in maize. Indian J. Agric. Res., 40(2): 131-134.

J. Agric. Res. Technol., 37 (1) : 041-045 (2012)

Combining Ability for Yield and Component Characters in Rice (*Oryza sativa* L.)*

P. P. Patil[1], R. D. Vashi[2], V. A. Lodam[3], S. R. Patil[4] and S. S. Patil[5]
Department of Plant Breeding and Genetics, Navsari Agricultural University, Navsari - 396 450 (India)
(Received : 10-11-2010)

Abstract

The analysis for combining ability was significant for all the characters which indicated the presence of both additive and non-additive gene actions. The magnitude of mean square due to SCA were smaller than the GCA for the most of the traits indicating the preponderance of additive gene effects for all the character under study, whereas the ratio of the estimates of variances due to GCA to that of SCA indicated the preponderance of non-additive type of gene effects for most of the characters except for kernel length/breadth ratio and protein content. The best general combiners for grain yield plant^{-1} were GR-12, IET-20548 and IET-20536, whereas for other yield attributing characters the best general combiners were NVSR-20 and IET-20528. The best specific cross combinations GR-12 x Safedkada, NVSR-20 x IET-20528, Safedkada x Lalkada, IET-20528 x IET-20533 and IET-20548 x IET-20536 showed the highest SCA effect for grain yield plant^{-1}. These cross combinations could be utilized in future breeding programme for improvement in yield and quality of rice.

Key words : Rice, combining ability, diallel analysis, yield, yield components.

In designing an efficient breeding programme, the breeder is confronted with the problem of choosing parents. A knowledge of the genetic system, controlling yield and its components, is thus useful in understanding the prepotency of the parents and thus help to select parents possessing a built in genetic potential. Many workers have made use of such studies in other cereal crops, but information on this aspect in rice is rather limited. The present study was thus attempt to assess the relative importance of general and specific combining ability for yield and its components in a diallel set of ten lines of diverse origin excluding reciprocals.

Materials and Methods

The material consisted of ten rice genotypes *viz*., GR-12, NVSR-20, IET-20I52, IET-20528, IET-20529, IET-20533, IET-20548, IET-20536, Safedkada and Lalkada crossed in all possible combinations, excluding the reciprocals. The 10 parents and their F_{1s} were grown in a randomized block design with 3 replications during *kharif* 2008 at N.A.R.P. Farm, N.A.U., Navsari. Each plot consisted of a single row of 10 plants with a spacing of 20 x 15 cm. Observations were recorded on days to 50 per cent flowering, productive tillers plant^{-1}, plant height, panicle length, grains panicle^{-1}, test weight, grain yield plant^{-1}, kernel L/B ratio, protein content and amylose content for 5 plants selected at random. Analysis of combining ability was carried out according to Method II, Model I of Griffing (1956).

Results and Discussion

Analysis of variance : The analysis of variance revealed highly significant differences among parents and hybrids for all the characters studied except for plant height in

*Part of M.Sc.(Agri.) thesis submitted to N.A.U., Navsari.

1., 3., 4., 5. M.Sc.(Agri.) student and 2. Professor.

case of parents, indicating presence of considerable amount of genetic variability in the material tested (Table 1). The mean square due to general and specific combining ability were highly significant for all the characters indicating importance of both additive as well as non-additive gene effects involved in the expression of all the characters. However, the variances due to specific combining ability were higher than general combining ability for all the traits except kernel length/breadth ratio and protein content pointed out to be the preponderance of non-additive gene effects in the expression of these characters. The present findings are in congruent with the reports of Kumar *et al*. (2007), Pradhan and Singh (2008), Sharma and Mani (2008). Kumar *et al*. (2008) and Salgotra (2009) in rice.

Effect of GCA : Among parents GR-12, JET-20548 and IET-20536 were the best general combiner for grain yield plant^{-1} (Table 2). The parent GR-12 was also found to be good general combiner for productive tillers plant^{-1}, grains panicle^{-1} and amylose content, parent IET-20548 was also found to be good general combiner for days to 50 per cent flowering, productive tillers plant^{-1}, panicle length, grains panicle^{-1}, protein content and amylose content, whereas parent IET-20536 was also found to be good general combiner for plant height, panicle length, test weight, kernel length/breadth ratio, protein content and amylose content. NVSR-20 was best general combiner for productive tillers plant^{-1}, panicle length, grains panicle^{-1}, test weight and amylose content, while IET-20528 was best general combiner for panicle length, grains panicle^{-1}, test weight, L/B ratio and amylose content. The present findings indicated that parent IET-20533 may be exploited for earliness and dwarfhess in plant height, whereas parents IET-20548 and Lalkada had significant general combining ability effects for earliness. Among parents GR-12, NVSR-20, IET-20528, IET-20536 and IET-20548 had significant general combining ability effects for most of the yield attributing traits. This could be considered as the best combining parents of the present study in yield attributes and hence could be utilized in the future breeding programme. It was observed that none of the parents was

Table 1. Analysis of variance (mean squares) for combining ability in rice.

Source of variation	d.f.	DFF	PP	PH (cm)	PL (cm)	GP	TW (g)	GYP (g)	L/B ratio	PC (%)	AC (%)
Replications	2	17.188	0.451	4.597	1.272	3.062	1.206	9.428	0.006	0.140	0.410
Genotypes	54	185.327**	6.526**	199.811**	21.859**	1532.055**	17.116**	50.019**	0.954**	2.735**	18.178**
Parents	9	115.011**	4.583**	75.840	41.699**	850.715**	16.083**	22.109**	1.567**	4.352**	17.523**
Hybrids	44	196.521**	6.903**	214.717**	15.477**	1693.617**	17.192**	50.225**	0.793**	2.460**	18.162**
Parents vs Hybrids	1	325.647**	7.628**	659.706**	124.081**	555.379**	23.082**	292.145**	2.511**	0.278*	24.800**
Error	108	20.887	0.703	64.441	2.807	68.464	1.21	7.070	0.012	0.050	0.551
GCA	9	125.48**	6.19**	78.89**	26.30**	1480.81**	11.70**	41.38**	1.35**	4.00**	22.03**
SCA	45	49.03**	1.37**	64.14**	3.48**	316.65**	4.50**	11.73**	0.11**	0.29**	2.86**
Error	108	6.96	0.23	21.48	0.93	22.82	0.40	2.35	0.00	0.01	0.18
σ^2 GCA		6.37	0.40	1.22	1.90	97.01	0.59	2.47	0.10	0.30	1.59
σ^2SCA		42.07	1.13	42.66	2.54	293.83	4.09	9.37	0.10	0.27	2.68

DFF = Days to 50% flowering, PP = Productive tillers plant^{-1}, PH = Plant height (cm), PL= Panicle length(cm), GP = Grains panicle^{-1}, TW = Test weight, GYP = Grain yield plant^{-1}, L/B ratio = Length/breadth ratio, PC = Protein content (%) and AC = Amylose content (%). *, **Significance at 5 and 1 per cent respectively.

good general combiner for all the traits. These results are getting support from the findings of Parihar and Pathak (2008), Sharma and Mani (2008) and Tyagi *et al.* (2008).

The *per se* performance of the parents and their GCA effects were almost in close correspondence which indicated that *per se* performance of the parents could possibly be taken as a criterion for selection of parents.

Effects of SCA : In case of specific combining ability effects, none of the hybrid exhibited favourable SCA effect for all the characters. Significant specific combining ability in favourable direction was observed in many crosses for days to 50 per cent flowering (14), productive tillers plant^{-1} (11), plant height (8), panicle length (8), grains panicle^{-1} (14), test weight (15), grain yield plant^{-1} (11), L/B ratio (17), protein content (16) and amylose content (18). These results are getting support from the findings of Kumar *et al*. (2006), Sinha *et al.* (2006), Sharma (2006), Sarial *et al.* (2007), Singh *et al*. (2007), Parihar and Pathak (2008) and Pradhan and Singh (2008).

The majority of the crosses showed significant specific combining ability (SCA) effect which involved at least one parent having high GCA estimates. It can be seen from Table 3 that all the crosses having best specific combination for grain yield plant^{-1} were obtained either through good x average, average x average or average xpoor and good x good parental combination. Among all the 45 hybrids, first five best specific combinations were GR-12 x Safedkada, NVSR-20 x IET-20528, Safedkada x Lalkada, IET-20528 x IET-20533 and IET-20548 x IET-20536. The best specific combination i.e. GR-12 x Safedkada also recorded the desirable SCA effects for days to 50 per cent flowering, productive tillers plant^{-1}, plant height, panicle length, grains panicle^{-1}, test weight, protein content and amylose content. The second best cross i.e. NVSR-20 x IET-20528 had desirable SCA effects for days to 50 per cent flowering, productive tillers plant^{-1}, plant height, grains panicle^{-1}, test weight, L/B ratio and amylose content, whereas the third best cross Safedkada x Lalkada had desirable SCA effects for days to 50 per cent flowering, productive tillers plant^{-1}, plant height, grains per panicle, protein content and amylose content. The forth best specific

Table 2. Estimation of general combining ability (GCA) effects of parents for various characters in rice.

Parent	DDF	PP	PH (cm)	PL (cm)	GP	TW (g)	GYP (g)	L/B ratio	PC (%)	AC (%)
GR-12	-0.72	0.96**	2.55*	-0.06	5.85**	-1.04**	1.55**	-0.14**	-0.42**	0.25*
NVSR-20	1.79*	1.05**	-0.04	1.68**	9.30**	0.68**	0.50	-0.05**	0.04	0.97**
IET-20152	4.58**	-0.70**	2.87*	-0.08	-2.43	-0.62**	-2.11**	-0.13**	-0.99**	-1.45**
IET-20528	2.85**	0.25	-0.13	0.68*	8.03**	0.52**	0.59	0.51**	0.03	0.47**
IET-20529	2.78**	0.07	0.97	-0.70**	-5.23**	0.11	-0.47	0.20**	-0.43**	0.49**
IET-20533	-2.07**	-0.57**	-5.18**	-0.15	0.20	-1.21**	-1.29**	0.04*	-0.33**	-1.81**
IET-20548	-5.79**	0.76**	-1.82	2.14**	19.58**	-1.37**	3.71**	-0.18**	0.20**	1.88**
IET-20536	0.13	-0.63**	-2.64*	0.98**	-4.13**	1.42**	0.86*	0.55**	0.37**	1.55**
Safed kada	0.60	-0.56**	1.36	-1.95**	-14.04**	0.76**	-0.81	-0.40**	1.06**	-1.85**
La kada	-3.89**	-0.63**	2.07	-2.54**	-17.14**	0.74**	-2.53**	-0.39**	0.46**	-0.50**
S.E. (gi)±	0.72	0.13	1.26	0.26	1.30	0.17	0.42	0.01	0.03	0.11
S.E. (gi-gi)±	1.07	0.19	1.89	0.39	1.95	0.26	0.62	0.02	0.05	0.17

DFF = Days to 50% flowering, PP = Productive tillers plant^{-1}, PH = Plant height (cm), PL= Panicle length(cm), GP = Grains panicle^{-1}, TW = Test weight, GYP = Grain yield plant^{-1}, L/B ratio = Length/breadth ratio, PC = Protein content (%) and AC = Amylose content (%). *, **Significance at 5 and 1 per cent respectively.

combination IET-20528 x IET-20533 had desirable SCA effects for days to 50 per cent flowering, panicle length, grains per panicle, test weight, L/B ratio, protein content and amylose content. The fifth best specific combination IET-20548 x IET-20536 had recorded desirable SCA effects for days to 50 per cent flowering, productive tillers plant^{-1}, grains panicle^{-1}, test weight, L/B ratio and amylose content.

Five out of forty five crosses were having superior SCA effect for grain yield plant^{-1} (Table 3). The best SCA effect and the highest *per se* performance was noted in the cross GR-12 x Safedkada, NVSR-20 x IET-20528 and IET-20548 x IET-20536, it is interesting to note that the best crosses in SCA effects were also having higher *per se* performance. Out of five crosses only one cross IET-20548 x IET-20536 both parent did good x good GCA effects. Other crosses either involved good x average, average x average and average x poor combining parents. Good x good GCA combinations could be due to additive type gene actions which are fixable in nature. This type good x good general combiners may be exploited further using pedigree method of breeding for the development of pure lines. Crosses such as GR-12 x Safedkada, NVSR-20 x IET-2052S, Safedkada x Lalkada and IET-20528 x JET-20533 had high SCA effect for grain yield plant^{-1} and resulted from good x average, average x average, average x poor and average x poor combiners, respectively. This might be due to additive x dominance type of interaction with epistasis gene action and non fixable genetic components for grain yield plant^{-1}. This indicated possibility to obtained desirable transgressive segregants and hybrid vigour from such crosses by adopting cyclic selection or biparental breeding programme. It appeared that crosses with one good and one average or one average and one poor general combiners and even average general combining parents would produce hybrids with good specific combinations. Parents with highest GCA effect will not necessarily generate top specific cross combinations as also reported by Peng and Virmani (1991).

On the basis of combining ability the most promising parents for yield attributing traits were GR-12, NVSR-20, IET-20528, IET-20536 and IET-20548 and most promising hybrids were GR-12 x Safedkada, NVSR-20 x IET-20528, Safedkada x Lalkada, IET-20528 x IET-20533 and IET-20548 x IET-20536.These crosses could be exploited for getting desirable recombinants from the segregating population. It was further observed that SCA of crosses for yield was largely depend on their SCA effects for componential characters particularly for productive tillers plant^{-1}, panicle length, grains panicle^{-1} and test weight.

Table 3. Five best combiners for grain yield plant^{-1} and their performance for other traits.

Cross	*Per se* performance	SCA effect	GCA effect	Other traits showing desirable SCA effect
GR-12 x Safed kada	29.68	6.48**	G x A	DFF, PP, PH, PL, GP, TW, PC, AC
NVSR-20 x IET-20528	29.78	6.22**	A x A	DFF, PP, PH, GP, TW, L/B ratio, AC
Safed kada x Lal kada	24.69	5.59**	A x P	DFF,PP,PH, GP.PC.AC
IET-20528 x IET-20533	27.30	5.55**	A x P	DFF, PL, GP, TW, L/B ratio, PC, AC
IET-20548 x IET-20536	32.40	5.37**	G x G	DFF, PP, GP, TW, L/B ratio, AC

**Significance at 1 per cent level, DFF = Days to 50% flowering, PP = Productive tillers plant^{-1}, PH = Plant height (cm), PL= Panicle length(cm), GP = Grains panicle^{-1}, TW = Test weight, GYP = Grain yield plant^{-1}, L/B ratio = Length/breadth ratio, PC = Protein content (%) and AC = Amylose content (%). *, **Significance at 5 and 1 per cent respectively.

The present investigation has revealed the importance of both additive and non additive gene effects in the inheritance of some polygenic traits in rice. Under such situations maximum yield can be achieved with a system that can exploit both additive and non additive gene effects simultaneously. In such populations, biparental mating as well as mating of selected plants in early segregating generations could help in developing potential population having optimum levels of homozygosity and heterozygosity (Debnath and Sarkar, 1990). Further exploitation of such populations will result in high yielding lines.

References

Debnath, S. C. and Sarkar, K. R. l990. Combining ability analysis in grain yield and some of its attributes in maize.Indian J. Genet., 50: 57-61.

Griffing, B. 1956. Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biol. Sci., 9: 463-493.

Kumar, S. T., Narasimman, R., Thangavelu, P., Eswaran, R. and Kumar, C. P. S. 2007. Combining ability analysis for yield and its component characters in rice (*Oryza sativa* L.). Internat. J. Plant Sci., 2(1): 151-155.

Kumar, S., Singh, H. B. and Sharma, J. K. 2008. Mode of gene action for grain yield, its components and grain quality traits in non-segregating generation (F_1) of rice. Oryza, 45(2): 152-155.

Kumar, S., Singh, H. B., Sharma, J. K. and Sood, S. 2006. Combining ability for grain yield and associated traits in segregating generation of rice (*Oryza sativa* L.). Indian J. Agric. Sci. 76(9): 566-569.

Parihar, A. and Pathak, A. R. 2008. Combining ability and heterosis for yield and component traits in rice. Indian J. Crop Sci., 3(1): 169-171.

Peng, J. Y. and Virmani, S. S. l99l. Heterosis in some intervarietal crosses of rice. Oryza, 28: 31-36.

Pradhan, S. K. and Singh, S. 2008. Combining ability and gene action analysis for morphological and quality traits in Basmati rice. Oryza, 45(3): 193-197.

Salgotra, R. K., Gupta, B. B. and Singh, P. 2009. Combining ability studies foi yield and yield components in Basmati rice. Oryza, 46(1): 12-16.

Sarial, A. K., Sarial, S. S. and Singh, V. P. 2007. Combining ability of new Basmati fertility restorers for grain yield and its components in rice (*Oryza sativa* L.).IndianJ. Genet., 67(2): 156-160.

Sharma, R. K. 2006. Studies on gene action and combining ability for yield and its component traits in rice (*Oryza sativa* L.). Indian J. Genet., 66(3): 227-228.

Sharma, R. K. and Mani, S. C. 2008. Analysis of gene action and combining ability for yield and its component characters in rice. Oryza, 45(2): 94-97.

Singh, N. K., Kumar, A. and Kumar, R. 2007. Combining ability for yield and yield components in rice.Oryza, 44(2): 156-159.

Sinha, P. K., Mandal, N. P, Prasad, C. and Prasad, K. 2006. Genetic analysis for grain yield and its components in upland rice. Oryza, 43(1): 5-9.

Tyagi, J. P., Singh, T. and Singh, V. P. 2008. Combining ability analysis in rice. Oryza, 45(3): 235-238.

J. Agric. Res. Technol., 37 (1) : 046-050 (2012)

Nutritional Quality of High Yielding *Rabi* Sorghum Genotypes

U. D. Chavan[1], J. V. Patil[2] and M. S. Shinde[3]
Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 09-01-2011)

Abstract

Seven *rabi* sorghum genotypes, consisting of released and newly developed varieties were evaluated against Maldandi (M 35-1) for various quality traits, such as *roti* making, grain quality and for fodder palatability. Overall *roti* making quality was the best for the variety M-35-1 (9.35) on a rating scale of 1-10, followed by RSV 423 (9.10) and SPY 1546 (8.95). Among the new genotypes, the grain quality of RSV 423 and SPY 1546 were superior to others. Highest grain yield was recorded in RSV 423 (26.8, q ha^{-1}) followed by SPV 1546 (25.3, q ha^{-1}). The new genotype RSV 423 recorded highest total sugars (2.78%), crude fiber (1.47%), and water uptake (191 ml 100^{-1} g). Overall high acceptability of the sorghum genotypes was correlated with high fiber and high crude protein content in the grain. However, the fodder quality of M 35-1 was superior than the newly developed genotypes with highest crude protein (6.63%) and *in vitro* dry matter digestibility (IVDMD) (63.82%). SPV 1546 was most palatable (86.8%). On the basis of all quality parameters studied, the new genotype SPV 1546 was found to be most promising followed by RSV 423.

Key words : Sorghum, grain and fodder quality, M 35-1, RSV 423.

Rabi sorghum [*Sorghum bicolor* (L.) Moench] is an important food and fodder crop particularly in arid and semi-arid tropics. It is a dual purpose crop providing staple food for human consumption and fodder for livestock. Being a drought resistant crop, it can give dependable and stable yields in both *kharif* and *rabi* seasons (Salunkhe, 1984 and Audilakshmi *et al.* 2007). In India, sorghum is mainly consumed in the form of unleavened pancake (bhakri) and several indigenous processed food products. In recent years, sorghum production in India has increased as a result of the introduction of high yielding hybrids and varieties (Audilakshmi *et al.* 2007). In view of the relevance of sorghum crop as food and feed, evaluation of nutritional quality of new genotypes of sorghum is important.

1. Asso. Prof., 2. Ex. Sorghum Breeder and 3. Asstt. Prof.

Materials and Methods

Samples of sorghum grain and stover of new and popular sorghum genotypes (Table 1) were obtained from the Sorghum Improvement Project, Mahatma Phule Krishi Vidyapeeth Rahuri. Samples were collected from each replication for analysis during *rabi* season of 2004-2005. The grain samples were first studied for physico-chemical parameters such as hectoliter weight in kg (AACC 1975) and then ground to 60 mesh using A-1 stainless steel grinding mill (M/s. Kamda Machines and Tools, Ahmednagar) and used for chemical analysis. Sorghum *roti* (bhakari) was prepared with traditional method on a hot concave iron pan, locally called as "tava". The sorghum straw samples were cut into small pieces and ground into fine powder (60 mesh) and used for chemical analysis. Protein, fiber content and water uptake were analyzed using standard procedures of AOAC (1990). Total sugars were determined from grain flour samples by using

Table 1. Organoleptic properties of sorghum roti prepared from selected genotypes.

Genotypes	Colour and appearance	Flavour	Texture	Taste	Overall acceptability
M35-1	9.5	9.2	9.2	9.5	9.35
RSLG-262	8.2	8.5	8.0	8.2	8.23
CSV-216	8.8	8.0	8.2	8.6	8.40
RSV-423	9.2	9.0	9.0	9.2	9.10
RSV-458	8.6	8.8	9.0	8.8	8.80
RSV-672	8.0	8.2	8.6	8.5	8.32
SPV-1546	8.8	8.8	9.0	9.2	8.95
CSV-18	8.2	8.0	8.4	8.5	8.27
Mean	8.7	8.6	8.7	8.8	8.68
S.E. ±	0.48	0.42	0.41	0.42	0.40
C.D. at 5%	1.46	1.29	1.23	1.25	1.21
Correlation with acceptability (r, n=8)	0.90	0.90	0.90	0.97	1.0

Scoring done on 1-10 point scale. 1=Not acceptable, 2=Dislike extremely, 3=Dislike very much, 4=Dislike moderately, 5=Dislike slightly, 6=Neither like or dislike, 7=Like slightly, 8=Like moderately, 9=Like very much, 10=Like extremely.

standard procedure of Dubois *et al*. (1956). Tannins and phytic acid were determined using standard methods of Price *et al.* (1978) and Tangkongchitr *et al*. (1981) with some modification by Naczk *et al*. (1986) respectively. The neutral detergent fiber (NDF), acid detergent fiber (ADF) and *in vitro* dry matter digestibility (IVDMD) were estimated by using standard method of Van Soest *et al*. (1967). Sorghum *roti* quality was judged from semi-trained judges using 10 points scale (Amerine *et al.* 1980) as a Duncan multiple range test (DMRT). Palatability of sorghum stover was judged at Cattle Improvement Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India. All determinations were carried out in triplicate as per the replications drawn from the field and mean for the genotypes, range (maximum and minimum), standard error of means (S.E.±) and critical difference (C.D. at 5%) were computed for identifying genotypic differences, using standard methods given by Panse and Sukhatme (1967).

Results and Discussion

Grain quality : The sorghum grains having pearly white colour, bold in size, high hectoliter weight, and attractiveness are prefered by the

Table 2. Grain yield and chemical composition of selected sorghum genotypes.

Genotype	Grain yield (q ha^{-1})	Crude protein (%)	Total sugars (%)	Crude fiber (%)	Hectoliter weight (kg ha^{-1})	Water absorption (%)	Tannin (%)	Phytic acid (mg 100^{-1} g)
M35-1	20.0	10.43	2.68	1.36	81.76	186	0.53	173
RSLG-262	18.7	9.51	2.40	1.17	82.02	189	0.58	182
CSV-216	23.2	9.63	2.56	1.28	80.59	191	0.58	171
RSV-423	26.8	9.74	2.78	1.47	82.30	191	0.48	168
RSV-458	17.7	9.27	2.20	1.22	84.29	177	0.59	170
RSV-672	21.5	9.04	2.48	1.19	80.22	151	0.63	176
SPV- 1546	25.3	9.70	2.57	1.31	82.29	168	0.50	165
CSV-18	17.3	8.80	2.41	1.25	81.33	153	0.55	172
Range	17.3-26.8	8.80-10.43	2.20-2.78	1.17-1.47	80.22-84.29	151-191	0.48-0.63	165-182
Mean	21.3	9.52	2.51	1.28	81.85	176	0.56	172
S.E.±	1.40	0.46	0.16	0.09	1.16	15	0.056	4.83
C.D. at 5%	4.10	1.40	0.50	0.28	3.50	47	0.17	14.50
Correlation with taste n=8	-	0.74	0.62	0.80	0.28	0.26	0.63	0.31

Table 3. Fodder yield and biochemical constituents of sorghum fodder.

Genotype	Straw yield (q ha^{-1})	Crude protein (%)	Crude fiber (%)	NDF (%)	ADF (%)	IVDMD (%)	Palatability (Voluntary intake) (%)
M35-1	58.2	6.63	37.23	68.22	42.11	63.82	80.6
RSLG-262	52.0	6.03	32.55	63.47	39.36	59.48	81.0
CSV-216	66.9	6.23	27.69	62.92	37.31	54.39	73.3
RSV-423	61.8	6.08	28.33	63.79	43.32	61.20	85.2
RSV-458	56.2	5.92	39.87	69.13	42.42	58.03	85.1
RSV-672	56.0	6.07	37.50	66.93	46.59	53.63	84.2
SPV- 1546	64.2	6.03	33.53	68.46	40.53	62.93	86.8
CSV-18	62.5	5.98	28.87	53.78	36.58	61.03	81.9
Range	52.0-66.9	5.92-6.63	27.69-39.87	53.78-69.13	36.58-46.59	53.63-63.82	73.3-86.8
Mean	59.7	6.12	33.20	64.58	41.03	59.31	82.3
S.E. ±	4.6	0.21	4.36	4.68	3.08	3.50	3.96
C.D. at 5%	13.9	0.63	13.10	14.06	9.25	10.51	11.90
Correlation with palatability (n=8)		-0.43	0.43	0.32	0.56	0.39	1.00
Correlation with IVDMD (n=8)		0.28	-0.03	-0.01	-0.18	1.00	0.39

consumers. The flour of sorghum genotypes having above grain quality parameters along with high water holding capacity, crude protein content, soluble proteins and total sugars gives good quality *roti* (bhakari). Therefore, selected sorghum genotypes having above characters were used for the *roti* quality evaluation.

***Roti* quality :** Maldandi (M 35-1) is well known for its excellent *roti* (Bhakari) making quality (Raghavendra Rao *et al.* 1979 and Vimala *et al*. 1996). For *roti* quality evaluation, the colour and appearance, texture, smoothness, taste and overall acceptability parameters were considered. Maldandi (M 35-1) genotype scored highest for all parameters as well as overall acceptability of *roti* followed by new genotypes RSV 423, SPV 1546, RSV 458 and CSV 216 (Table 1). The overall acceptability score of *roti* for RSV 423 (9.10) and SPV 1546 (8.95) were highest than the released popular genotypes CSV 216 (8.40) and RSLG 262 (8.23) but slightly lower than the Maldandi (9.35). The hectoliter weight of grains was highest for RSV 458 (84.3) followed by RSV 423 (82.30) and SPV 1546 (82.29). These genotypes gave very heavy weight grains and higher yield of flour. The crude protein content was higher in M 35-1 (10.43%) followed by RSV 423 (9.74%) and SPV 1546 (9.70%) (Kadam *et al*. 1977). The crude fiber, total sugars were also higher in RSV 423 followed by M 35-1 and SPV 1546. The water absorption capacity was highest in RSV 423 and CSV 216 followed by RSLG 262 and M 35-1. Higher content of fiber, sugar as well as

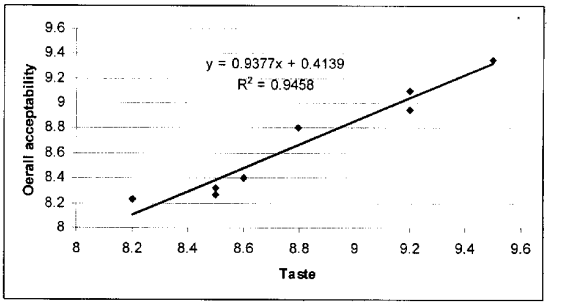

Fig. 1. Correlation between taste and overall acceptability.

water absorption capacity may be responsible to keep *roti* smooth for longer period and gives good taste (Chandrashekar and Desikachar, 1982). Among the new genotypes RSV 423 and SPV 1546 were found to be promising genotypes for *roti* quality.

Although the number of genotypes were limited (n=8) the trend suggests that among different organoleptic and physico-chemical characteristics of the grain, the overall acceptability of a genotype for *roti* quality was most closely correlated with taste (Table 1) and the taste in turn was correlated in decreasing order of magnitude as: crude fiber (%) > crude protein (%) > total sugars (%) (Table 2). Water absorption capacity was least related to taste. Most of the variation in taste seems to be associated with fiber and crude protein. A stepywise regression between taste as dependent variable and the three other parameters as independent variable should help in computing the relative contributions of these parameters in determining taste (Fig. 1).

Antinutritional factors : The tannin content ranged from 0.48 to 0.63 per cent. The phytic acid content also ranged from 165 to 182 mg 100^{-1} g. Similar results were shown by Kadam *et al*. (1977). Those genotypes having lower tannins and phytic acid showed higher organoleptic score for *roti* quality (RSV 423 and SPV 1546). The new genotypes showed lower level of tannins and phytic acid levels as compared to the earlier released cultivars, RSLG 262 and M 35-1.

Stover quality : The crude protein content (Table 3), in sorghum stover ranged from 5.92 to 6.63 per cent. The highest protein content was observed in M 35-1 (6.63%) followed by CSV 216 (6.23%) (Anonymous 2006 a,b). The crude fiber content was high in RSV 458 (39.87%) followed by RSV 672 (37.20%) and M 35-1 (37.23%), (Table 3). The NDF content was in higher level in RSV 458 (69.13%) while ADF in RSV 672 (46.59%). The most prominent parameter for nutritional quality of fodder/straw is the *in-vitro* dry matter digestibility (IVDMD) (Raymond 1969). It was highest in M 35-1 (63.82%) followed by SPV 1546 (62.93%), RSV 423 (61.20%) and CSV 18 (61.03%). The new genotype RSV 423 had higher IVDMD than the CSV 216 and RSLG 262. Payability as a voluntary intake of straw ranged from 73.3 to 86.8 per cent. The voluntary intake of straw was highest in SPV 1546 followed by RSV 423 (85.2%) and RSV 458 (85.1%).

Considering various quality parameters as well as yield, it could be concluded that SPV 1546 and RSV 423, the two new high yielding genotypes, are promising for grain as well as stover quality. These genotypes were comparable to the most popular and acceptable genotype M 35-1. Large scale demonstration and extension of these high yielding genotypes for superior grain and stover quality would contribute to greater profitability to sorghum farmers.

Acknowledgement

Authors are thankful to Dr. N. Seetharama, Project Director, NRCS, Rajendranagar, Hyderabad for valuable suggestions and inputs given for this work.

References

AACC. 1975. American Association of Cereal Chemists, Approved A.A.C.C., Methods. 10-50, pp. 1-4.

Amerine, M. A., Pangborn, R. M. and Rossler, E. B. 1980. Principles of Sensory Evaluation of Food. Acad. Press, New York. pp. 35-376.

Anonymous. 2006a. Research Review Committee Meeting Report on Sorghum. Mahatma Phule Krishi Vidyapeeth Rahuri, pp. 1-182.

Anonymous. 2006b. Report on trials and nurseries *kharif*, *rabi* and forage sorghum. 36th Annual Group Meeting held at Marathwada Agricultural University Parbhani.

11-13 May. NRCS, Hyderabad, Rajendranagar, Vol. 2: pp. 209.

AOAC. 1990. Official Methods of Analysis. 15th Edn. Association of Official Analytical Chemists, Washington, DC, pp. 113-127.

Audilakashmi, S., Aruna, C., Solunke, R. B., Kamatar, M. Y., Kandalkar, H. G., Gaikwad, P., Ganesh Murthy, K., Jayaraj, K., Ratnavathi, C. V., Kannababu, N., Indria, S. and Seetharama, N. 2007. Approaches to grain quality improvement in rainy season sorghum in India. Crop Protection. 26: 630-641.

Dubois, M., Gilles, K. A., Hamilton, J. K., Robers, P. A. and Smith, F. 1956. Determination of sugars by phenol-sulphuric acid method. Anal. Chem. 15: 229-233.

Chandrashekar, A. and Desikachar, H. S. R. 1982. Processing and culinary properties of grain sorghum. Symp. Nutritional and Processing Quality of Sorghum, All-India Co-ordinated Sorghum Improvement Project Workshop, May 17-19, Pune, Maharashtra. India.

Kadam, S. S., Kachhve, K. G. and Chavan, J. K. 1977. Seasonal variation in protein content of grain sorghum. Res. Bull. MAU. Parbhani. Maharashtra. 1: 11-12.

Naczk, M., Diosady, L. L. and Rubin, L. J. 1986. The phytate and complex phenol content of meals produced by alkanol-ammonia/hexane extraction of canola. Lebensm-Wiss. Technol. 19: 13-16.

Panse, V. G. and Sukhatme, P. V. 1967. Statistical Methods for Agricultural Workers 2nd Edn. I.C.A.R., New Delhi.

Price, M. L., Van Scoyoc, S. and Butler, L. G. 1978. A critical evaluation of the vanillin reaction as an assay for tannin in sorghum grain. J. of Agric. and Food Chem. 26: 1214-1218.

Raghavendra Rao, S. N., Malleshi, N. G., Sreedharamurthy, S., Viraktamath, C. S. and Desikachar, H. S. R. 1979. Characteristics of *roti*, dosa, and vermicelli from maize, sorghum and bajara. J. of Food Sci. and Technol. 16: 21-24.

Raymond, W. F. 1969. In: Advances in Agronomy. 21,1. Academic Press, New York.

Salunkhe, D. K. 1984. Sorghum grain quality: Problems and prospects. In: Nutritional and processing quality of sorghum. Eds. Salunkhe, D. K., Chavan, J. K. and Jadhav, S. J. Oxford and IBH, New Delhi. pp. 275.

Tangkongchitr, U., Seib, P. A. and Hoseney, R. C. 1981. Phytic acid 1. Determination of three forms of phytic acid in flour, dough and bread. Cereal Chemi. 58: 226-228.

Van Soest, P. J., Vane, R. N. and Moore, L. A. 1967. Estimation of true digestibility of forages by *in-vitro* digestion of cell wall. X^{th} Internat. Cong. pp. 438.

Vimala, V., Geervani, P. and Uma Pradeep, R. 1996. Effect of dehulling and genotypes of sorghum (Sorghum vulgare) on *roti* quality. J. of Food Sci. and Technology. 33: 234-236.

J. Agric. Res. Technol., 37 (1) : 051-054 (2012)

Seasonal Variation in Physiological Behaviour of Alphonso Mango Under Konkan Conditions

M. M. Burondkar[1], K. H. Pujari[2], K. A. Shinde[3] and S. G. Bhave[4]
Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli - 415 712 (India)
(Received : 27-02-2011)

Abstract

All the three seasons significantly influenced the physiological behavior of Alphonso mango irrespective of locations. The net photosynthesis (7.246 µ mol CO_2 m^{-2} sec^{-1}) and stomatal conductance (0.171 µ mol H_2O m^{-2} sec^{-1}) was significantly higher during winter season as compared to summer (4.961 µ mol CO_2 m^{-2} sec^{-1}, 0.1225 µ mol H_2O m^{-2} sec^{-1}) and monsoon (2.2942 µ mol CO_2 m^{-2} sec^{-1}, 0.110 µ mol H_2O m^{-2} sec^{-1}) season. The rate of transpiration (3.945 µ mol H_2O m^{-2} sec^{-1}) and respiration (3.510 µ mol CO_2 m^{-2} sec^{-1}) was significantly higher during summer season, and lowest during monsoon (3.343 µ mol H_2O m^{-2} sec^{-1}, 2.940 µ mol CO_2 m^{-2} sec^{-1}) and winter (2.980 µ mol H_2O m^{-2} sec^{-1}, 2.506 µ mol CO_2 m^{-2} sec^{-1}) season. The difference in air and leaf temperature was negative during winter (0.659°C) season and positive during summer (0.305°C) and monsoon (0.497°C) season.

Key words : Mango, photosynthesis, respiration, season, stomatal conductance.

Konkan region in the west cost of India is known world wide for commercial cultivation of prime Indian export mango variety "Alphonso". Red lateritic, slightly acidic soil with annual rainfall ranging from 3000-3500 mm during June to September, followed by bright sunny days period of over 7 month from October to May, render this region as one of the best regions in the world for commercial cultivation of mango. In this region Alphonso is cultivated on an area of 1.65 lakh ha. which is about 10 per cent of the total area under mango in the country. However, the productivity of Alphonso mango in konkan is very low and stagnated around 2.5 to 3.0 tonnes per ha (Anon., 1996). Among the several biotic and abiotic factors poor carbon assimilation owing to poor sunlight, after harvest of the crop almost for the period of 4 months from June to September during monsoon appears to be a major attributing factors towards poor yield efficiency. The altitude and topographical variation can bring about changes, which significantly affect plant growth, thus there is very considerable climatic variability in both macro and micro-scale. The prevailing weather parameters highly influence these physiological traits (Maroco *et al.* 1997). The present investigation was therefore proposed to study the trend in physiological behavior of Alphonso mango as influenced by season and location in konkan conditions.

1., 2. Professor, 3. Sr. Res. Asstt. and 4. Head Dept. of Botany.

Materials and Methods

The experiment was conducted during 2009-2010, with an objective to study physiological behavior of Alphonso mango at different locations. The experiment was conducted in 3 seasons *viz*., winter (S_1), summer (S_2) and monsoon (S_3) as a main treatment and 3 locations *viz*., 10 km. away from sea in rocky lands (L_1), 10 km away from sea in deep soil (L_2) and near sea coast (L_3) as a sub treatments, adopting factorial randomized block design. Important physiological traits *viz*.,

rate of photosynthesis (µ mol CO_2 m^{-2} sec^{-1}), rate of stomatal conductance (µ mol H_2O m^{-2} sec^{-1}), rate of transpiration (µ mol H_2O m-2 sec-1), rate of respiration (µ mol CO_2 m^{-2} sec^{-1}) and temperature difference (°C), were recorded of fully expanded leaves using Portable Photosynthesis System (LICOR model 6400) during three seasons at three location in Ratnagiri district along the west cost of Konkan.

Results and Discussion

Climate change affects plants in many different ways; change in climatic condition can change the photosynthetic rate. In the present investigation photosynthesis of Alphonso mango was found to be highly influenced by both season and location (Table 1). A net photosynthetic rate was significantly higher during winter season (7.246 µ mol CO_2 m^{-2} sec^{-1}) as compared to summer (4.9606 µ mol CO_2 m^{-2} sec^{-1}) and monsoon (2.2942 µ mol CO_2 m^{-2} sec^{-1}) season. This trend may be because of abundant sunlight with sufficient post monsoon soil water level. Where as, during monsoon season very low quantity of sunlight (Table 6) was available. Similar trend was reported in soybean by Harley *et al*., (1985) and grape by Nabi *et al.* (2000). They observed that shaded leaf has lower rate of photosynthesis compared to exposed leaf. Among three different locations, maximum rate of photosynthesis was observed at L_1 (10 km from sea in rock i.e. 5.685 µ mol CO_2 m^{-2} sec^{-1}) compared to L_2 (4.356 µ mol CO_2 m^{-2} sec^{-1}) location. Over all, higher rate of photosynthesis was observed during winter season at L_1 (8.886 µ mol CO_2 m^{-2} sec^{-1}), where as the lowest rate was observed in same location during monsoon season (2.161 µ mol CO_2 m^{-2} sec^{-1}). Carbon assimilation efficiency determines plant growth and productivity. This efficiency is a compound effect of net photosynthesis and related physiological parameters in any crops. The seasonal

Table 1. Effect of season and locations on rate of photosynthesis (µ mol CO_2 m^{-2} sec^{-1}) in Alphonso mango under Konkan conditions.

Season/ Locations	10 km. from sea in rock (L_1)	10 km. from sea in soil (L_2)	Near to sea (L_3)	Mean
Winter (S_1)	8.88	6.35	6.50	7.25
Summer (S_2)	6.00	4.48	4.39	4.96
Monsoon (S_3)	2.16	2.23	2.48	2.29
Mean	5.68	4.35	4.46	4.83
	S.Em.±	C.D. at 5%		
Location	0.05	0.14		
Season	0.05	0.14		
L x S	0.14	0.41		

Table 2. Effect of season and locations on rate of stomatal conductance (µ mol H_2O m^{-2} sec^{-1}) in Alphonso mango under Konkan conditions.

Season/ Locations	L_1	L_2	L_3	Mean
Winter (S_1)	0.177	0.164	0.169	0.122
Summer (S_2)	0.121	0.125	0.120	0.110
Monsoon (S_3)	0.112	0.102	0.116	0.134
Mean	0.137	0.130	0.135	
	S.Em.±	C.D. at 5%		
Location	0.001	0.003		
Season	0.001	0.003		
L x S	0.003	0.003		

Table 3. Effect of season and locations on rate of transpiration (µ mol H_2O m^{-2} sec^{-1}) in Alphonso mango urraer Konkan conditions.

Season/ Locations	L_1	L_2	L_3	Mean
Winter (S_1)	3.304	2.612	3.024	2.980
Summer (S_2)	4.793	3.613	3.427	3.944
Monsoon (S_3)	3.578	2.995	3.455	3.343
Mean	3.892	3.073	3.302	3.422
	S.Em.±	C.D. at 5%		
Location	0.023	0.064		
Season	0.023	0.064		
L x S	0.068	0.192		

variation in photosynthetic efficiency of crop due to prevailing weather condition widely has been reported (Kalty-Torres *et al*., 1988; Singh *et al*., 1988; Dufrene and-Saugier, 1993).

Similar trend in respect of stomatal conductance was observed as the rate of stomatal conductance was significantly higher during winter season (0.171 µ mol H_2O m^{-2} sec^{-1}) as compared to summer (0.1225 µ mol H_2O m^{-2} sec^{-1} and monsoon (0.1103 µ mol H_2O m^{-2} sec^{-1}) season (Table 2). This could be attributed to prevailing bright sunlight (981.912 µ mol m^{-2} sec^{-1}), coupled with availability of soil water, as residual effect of monsoon season. Similar trend was observed by Pandey and Tyagi (1999) and Nabi *et al*., (2000). They found that during September and December higher rate of stomatal conductance was observed. At L_1 location significantly higher rate (0.137 µ mol H_2O m^{-2} sec^{-1}) of stomatal conductance was observed as compared to L_2 and L_3 locations. Overall numerically higher rate of stomatal conductance was observed during winter season at L_1 location (0.177 µ mol H_2O m^{-2} sec^{-1}), where as the lowest observed during monsoon season at L_2 location (0.102 µ mol H_2O m^{-2} sec^{-1}). Direct effect of leaf to air vapour pressure deficit (VPD) on stomatal regulation was reported in many woody crops Wong *et al*., (1985), Flore and Lakso (1989) and Luvaha *et al*., (2007).

The rate of transpiration was significantly higher during summer (3.9448 µ mol H_2O m^{-2} sec^{-1}) season, where as lower observed during monsoon (3.3432 µ mol H_2O m^{-2} sec^{-1}) and lowest in winter (2.9802 µ mol H_2O m^{-2} sec^{-1}) season (Table 3). At L_1 location significantly higher (3.8924 µ mol H_2O m^{-2} sec^{-1}) rate of transpiration was observed compared to L_3 (3.3022 µ mol H_2O m^{-2} sec^{-1}) and L_2 (3.0736 µ mol H_2O m^{-2} sec^{-1}) locations. Overall significantly higher rate of transpiration was observed during summer season at L_1 location (4.793879 µ mol H_2O m^{-2} sec^{-1}) where as the lowest observed during winter season at L_2 location (2.612 µ mol H_2O m^{-2} sec^{-1}). The day time variations in photosynthetic rates, transpiration rates, etc. were studied by

Table 4. Effect of season and locations on rate of respiration (µ mol CO_2 m^{-2} sec^{-1}) in Alphonso mango under Konkan conditions.

Season/ Locations	L_1	L_2	L_3	Mean
Winter (S_1)	2.827	1.557	3.132	2.505
Summer (S_2)	3.910	3.374	3.245	3.509
Monsoon (S_3)	2.851	3.016	2.951	2.937
Mean	3.196	2.649	3.109	2.985
	S.Em.±	C.D. at 5%		
Location	0.030	0.086		
Season	0.030	0.086		
L x S	0.091	0.259		

Table 5. Effect of season and locations on rate of temperature difference (°C) in Alphonso mango under Konkan conditions.

Season/ Locations	L_1	L_2	L_3	Mean
Winter (S_1)	-0.6737	-1.1280	-0.1759	-0.6592
Summer (S_2)	0.2741	0.2400	0.4001	0.3047
Monsoon (S_3)	0.2359	0.9535	0.3022	0.4972
Mean	-0.0546	0.0218	0.1755	0.0476

Table 6. Seasonal variation in available sunlight under Konkan conditions.

Season/ Locations	L_1	L_2	L_3	Mean
Winter (S_1)	985.48	979.76	980.48	981.91
Summer (S_2)	1613.23	1628.37	1625.23	1622.28
Monsoon (S_3)	398.88	402.88	400.45	400.73
Mean	999.19	1003.67	1002.05	1001.64
	S.Em.±	C.D. at 5%		
Location	3.44	9.78		
Season	3.44	9.78		
L x S	10.32	29.33		

Jayasekara *et al*., (1996) in coconut during summer and monsoon seasons. They found that net photosynthetic rate, transpiration rate and stomatal conductance were higher during wet season. Similar trend was observed by Ball *et al*., (1987) and Luvaha *et al*., (2007).

Net respiration rate were significantly higher in summer season (3.5098 µ mol CO_2 m^{-2} sec^{-1}) as compared to monsoon (2.9397 µ mol CO_2 m^{-2} sec^{-1}) and winter (2.5057 µ mol CO_2 m^{-2} sec^{-1}) season (Table 4). At L_1 location significantly higher rate of respiration (3.1966 µ mol CO_2 m^{-2} sec^{-1}) was observed compared to L_3 (3.1094 µ mol CO_2 m^{-2} sec^{-1}) and L_2 (2.6493 µ mol CO_2 m^{-2} sec^{-1}) location. Overall significantly higher rate of respiration was observed during summer season at L_1 location (3.91047 µ mol CO_2 m^{-2} sec^{-1}), where as the lowest rate observed during winter season at L_2 (1.557 µ mol CO_2 m^{-2} sec^{-1}) location.

It was observed that higher leaf temperature than air temperature shows negative temperature difference. Where as lower leaf temperature than air temperature shows positive temperature differenced (Table 5). The rate of temperature difference was negative during winter (-0.65922°C) season and positive during summer (0.30474°C) and monsoon (0.49721°C) season.

References

Anonymous, 1996. Report of Research Council of Horticulture, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli.

Ball, J. T., Woodrow, I. E. and Berry, J. A. 1987. A model predicting stomatal conductance and its contribution to the control of photosynthesis under different environmental conditions. In progress in photosynthesis research. Ed. J. Biggins. Martinus Nihjoff, Dordrecht, The Nethrelands, 4: 221 -224.

Dufrerje, E. and Saugierl, B. 1993. Gas exchange of oil palm in relation to light, vapour pressure deficit, temperature and leaf age. Oleagineux 48: 347-356.

Flore, J. A.and Lakso, A. N.1989. Environmental and physiological regulation of photosynthesis in fruit crops. Hortic. Rev. 11: 111-157.

Harley, P. C., Weber, J. A. and Gates, D. M. l985. Interactive effects of light, leaf temperature, carbon dioxide and oxygen on photosynthesis in soybean. Planta. 165: 249-263.

Jayasekhara, C., Nainanayake, N. P. A. D. and Jayasekhara, K. S. 1996. Photosynthestic characteristics and productivity of the coconut palm. J. Plantation Crop 24: 538-547.

Kalty-Torres, W., Kerr, P. S., Usuda, H. and Huber, S. C. 1988. Diurnal change in maize leaf photosynthesis carbon exchange rate enzyme activities. Plant Physiol 31: 320-323.

Luvaha, E., Netondo, G. W. and Ouma, G. 2007. Physiological responses of mango (*Mangifera indica*) rootstock seedlings to water stress. J. Agril. and Biol. Sci.

Maroco, J. P., Pereira, J. S. and Chaves, M. M. 1997. Stomatal response to leaf to air vapour pressure deficit in Sahelian species. Aist J. Plant Physiol. 27: 318-387.

Nabi, G., Trought, M, Whitehead, D. and Rahman, N. 2000. The influence of short-term shading on photosynthesis and stomatal conductance in different leaf position of grapevines (*Vitis vinifera* L.). Pakistan J. Biol. 3(1): 136-141.

Pandey, S. and Tyagi, D. N. 1999. Change in chlorophyll content and photosynthetic rate of four cultivars of mango during reproductive phase. Biologia Plantarum 42(3): 457-461.

Singh, V. P., Dey, S. K. and Murthy, K. S. 1988. Diurnal change in photosynthesis and related characters in rice varieties. Indian J. Plant. Physiol. 37: 247-274.

Wopg, S. C., Cowan, R. and Farquhar, G. D. 1985. Stomatal conductance relates with photosynthetic capacity. Nature. 282: 424-426.

J. Agric. Res. Technol., 37 (1) : 055-058 (2012)

Genetic Variability and Character Association in French bean (*Phaseolus vulgaris* L.)*

A. N. Kshirsagar[1], N. D. Bangar[2], P. B. Kanade[3] and B. H. Chavan[4]
Department of Botany, College of Agriculture, Pune - 411 005 (India)
(Received : 27-03-2011)

Abstract

The genotypic and phenotypic variances were highest for plant height followed by days to maturity and 100-seed weight. High heritability estimates were observed for protein content, plant height and pods plant^{-1}. Genotypic correlation coefficients were found to be of higher magnitude than the corresponding phenotypic values. Path coefficient analysis revealed that pod length had the highest positive direct effect on seed yield followed by pods plant^{-1} and days to 50 per cent flowering while plant height, 100-seed weight and branches plant^{-1} showed negative direct effect on seed yield.

Key words: Correlation, path analysis, variability, french bean.

French bean (*Phaseolus vulgaris* L.) is extensively cultivated as green vegetable and dry pulse in wide geographical range all over the globe and is a rich source of protein, minerals and vitamins. A thorough knowledge of existing genetic variation and degree of association between yield contributing characters is essential for developing high yielding genotypes in french bean. The observed variability is a combined measure of genetic and environmental causes. However, only the genetic variability is heritable from generation to generation. Heritability and genetic advance serve as useful tools to the breeder in determining the direction and magnitude of selection. Correlation studies provide an opportunity to study the magnitude and direction of association of yield with its components and also among various components. To accumulate optimum combination of yield contributing characters in a single genotype, it is essential to know the implication of the inter-relationships of various characters along with path coefficients. Considering these points, the present study was undertaken to evaluate the genotypes for yield and its components and to understand inter-relationships among economic traits in french bean.

Materials and Methods

The present investigation was conducted at the Botany Department, College of Agriculture, Pune with forty genotypes of french bean during *kharif* 2006. The experiment was laid out in a randomized block design with three replications. Each genotype was grown in a single row of 4 m length each with inter row spacing of 30 cm. Intra row spacing of plants was kept at 10 cm. All the crop management and plant protection operations were carried out as per recommended package of practices. The observations were recorded on five randomly selected plants for each genotype in each replication for yield and yield contributing characters.

The phenotypic and genotypic coefficients of variation were estimated as per standard

*Part of M. Sc.(Agri) thesis submitted by the senior author to MPKV, Rahuri.

1. and 3. M.Sc.(Agri.) students. 2. Associate Professor, and 4. Asstt. Professor.

procedure of Burton (1952), heritability in broad sense and expected genetic advance by using the methodology suggested by Allard (1960). Correlation coefficients were calculated following the procedure described by Panse and Sukhatme (1978) and path analysis was done following method suggested by Dewey and Lu (1959).

Results and Discussion

The estimates of genetic parameters for yield and its components are presented in Table 1. A wide range of phenotypic variability was observed and the genotypes showed significant differences in respect of all the ten characters indicating presence of genetic variability among the genotypes. The magnitude of genotypic and phenotypic variances was highest for plant height (210.92, 241.79) followed by days to maturity (10.26, 56.65) and 100-seed weight (10.15, 57.03). The estimates of phenotypic coefficients of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all the characters under study, indicating that

Table 1. Estimates of variability parameters for yield and its components in french bean.

Characters	Range	Mean	σ^2g	σ^2p	GCV	PCV	h^2 broad	GA	GA as % of mean
Days to 50% flowering	27.33-37.33	33.192	6.465	12.452	7.661	10.631	51.92	3.774	11.371
Days to maturity	68.67-83.67	74.36	10.261	56.655	4.307	10.121	18.11	2.808	3.776
Plant height (cm.)	27.27-75.33	36.95	210.921	241.787	39.295	42.072	87.23	27.943	75.605
Branches plant^{-1}	2.33-3.67	3.05	0.101	0.251	10.390	16.392	40.18	0.415	13.567
Pods plant^{-1}	3.20-7.13	4.72	0.606	1.040	16.488	21.605	58.24	1.224	25.920
Pod length (cm.)	8.60-12.10	10.01	0.358	0.776	5.973	8.796	46.12	0.837	8.356
Seeds pod^{-1}	2.87-5.07	3.94	0.107	0.384	8.310	15.709	27.29	0.357	9.055
100-seed weight (g)	22.33-45.33	36.15	10.153	57.026	8.812	20.885	17.80	2.770	7.660
Protein content (%)	16.45-24.02	21.28	3.585	3.957	8.897	9.347	90.61	3.713	17.446
Seed yield plant^{-1} (g)	6.48-10.17	7.90	0.473	1.152	8.703	13.576	41.09	0.909	11.492

Table 2. Genotypic (above diagonal) and Phenotypic (below diagonal) correlations among yield and yield components in french bean.

Characters	Days to 50% flowering	Days to maturity	Plant height (cm)	Branches plant^{-1}	Pods plant^{-1}	Pod length (cm)	Seeds pod^{-1}	100 seed weight (g)	Protein content (%)	Seed yield plant^{-1} (g)
Days to 50 % flowering	1.000	-0.493**	0.143	-0.011	-0.035	-0.016	-0.180	0.135	-0.343*	0.058
Days to maturity	-0.166	1.000	0.283	-0.048	-0.024	0.029	0.207	-0.301*	0.367*	0.076
Plant height (cm.)	0.106	0.099	1.000	-0.309	0.419**	0.191	0.684**	-0.560**	-0.096	0.162
Branches plant^{-1}	-0.013	-0.034	-0.179	1.000	0.370*	0.514**	0.171	0.802**	0.017	0.543**
Pods plant^{-1}	-0.010	-0.064	0.330*	0.150	1.000	0.017	0.494**	-0.632**	0.134	0.720**
Pod length (cm)	0.005	0.051	0.147	0.228	0.012	1.000	0.670**	0.749**	-0.080	0.487**
Seeds pod^{-1}	-0.049	-0.009	0.442**	0.095	0.212	0.419**	1.000	-0.452**	0.121	0.374*
100-Seed weight (g)	0.061	0.037	-0.298	0.031	-0.258	0.356*	-0.189	1.000	-0.450**	0.407**
Protein content (%)	-0.221	0.131	-0.072	0.032	0.125	-0.059	0.039	-0.203	1.000	-0.074
Seed yield plant^{-1} (g)	-0.003	-0.003	0.121	0.281	0.347*	0.156	0.141	-0.010	-0.049	1.000

*,** Significant at 5 and 1 per cent, respectively.

variability existing in these characters was influenced by genetic factors as well as environmental factors in their expression. Plant height showed highest GCV and PCV whereas pod length showed lowest. Similar results were reported by Shete and Kale (1988), Shinde and Dumbre (2001) and Raffi and Nath (2004). The differences between estimates of PCV and GCV were low for characters like protein content, plant height and pods plant^{-1}, indicating limited role played by genotype x environment (GE) in expression of these characters. These results supported the earlier finding for test weight and plant height (Raffi and Nath 2004).

The heritability (broad sense) was highest for protein content (90.61 %) and it was followed by plant height (87.23 %) and pods plant^{-1} (58.24 %). The genetic advance as per cent of mean followed the same pattern. The high heritability along with high genetic advance as per cent of mean for characters suggests that phenotypic selection is likely to be more efficient. In the present study, high genetic advance as per cent of mean together with high heritability were noticed for protein content, plant height and pods plant^{-1} indicating simple directional selection could be effective for improving these characters. Similar finding were reported by Chand (1999) and Raffi and Nath (2004).

In the present study, it was observed that the genotypic correlation coefficients were higher in magnitude than the phenotypic correlation coefficients between most of the characters (Table 2). Seed yield significantly positively correlated with branches plant^{-1}, pods plant^{-1}, seeds pod^{-1}, pod length and 100-seed weight at genotypic level. Number of pods plant^{-1} was significantly positively correlated with plant height and branches plant^{-1}. Whereas days to 50 per cent flowering were significantly negatively associated with days to maturity and protein content, 100-seed weight were significantly negatively associated with seeds pod^{-1}, pods plant^{-1}, plant height, days to maturity and positively with pod length and branches plant^{-1}. Among the yield components, branches plant^{-1}, pods plant^{-1} and pod length significantly positively correlated with each other at genotypic level, indicating that simultaneous selection for these characters would bring an improvement in seed yield plant^{-1}. Similar conclusions were drawn by Dursun (2007) and Salehi *et al*. (2008).

Table 3. Direct (diagonal) and indirect effects of yield and its components in french bean.

Characters	Days to 50% flowering	Days to maturity	Plant height (cm.)	Branches plant^{-1}	Pods plant^{-1}	Pod length (cm.)	Seeds pod^{-1}	100 seed weight (g)	Protein content (%)	Seed yield plant^{-1} (g)
Days to 50 % flowering	0.685	0.119	-0.217	0.007	-0.036	-0.022	-0.006	-0.085	-0.043	0.058
Days to maturity	-0.338	-0.242	-0.431	0.028	-0.025	0.386	0.006	0.189	0.047	0.076
Plant height (cm.)	0.098	-0.068	-1.521	0.180	0.440	0.253	0.021	0.353	-0.012	0.162
Branches plant^{-1}	-0.008	0.012	0.471	-0.583	0.389	0.685	0.005	-0.505	0.002	0.543**
Pods plant^{-1}	76.024	0.006	-0.637	-0.216	1.051	0.023	0.015	0.398	0.018	0.720**
Pod length (cm.)	-0.011	-0.070	-0.290	-0.300	0.018	1.330	0.021	-0.472	-0.010	0.487**
Seeds pod^{-1}	-0.124	-0.050	-1.041	-0.100	0.519	0.891	0.031	0.284	0.015	0.374*
100-Seed weight (g)	0.092	0.073	0.852	-0.467	-0.664	0.996	-0.014	-0.630	-0.057*	0.407**
Protein content (%)	-0.235	-0.089	0.145	-0.010	0.141	-0.107	0.004	0.283	0.123	-0.074

*,** Significant at 5 and 1 per cent, respectively.

Path coefficient analysis (Table 3) revealed that pod length had the highest positive direct effect on seed yield plant^{-1} followed by pods plant^{-1}, indicating that these were the principal components of seed yield. Similar results were also obtained by Chand (1998 and 1999). The protein content and seeds pod^{-1} showed low positive direct effects on seed yield. Plant height exhibited highest negative direct effects on yield followed by 100-seed weight and branches plant^{-1}. As the components are either positively or negatively correlated with seed yield, a better understanding of direct and indirect influence of various characters on seed yield would emerge from path analysis. Thus, it provides a base to the breeder for designing the most effective selection programme.

References

Allard, R. W. 1960. Principles of Plant Breeding. John Willey and Sons, Inc. New York, pp. 92-94.

Burton, G. W. 1952. Quantitative inheritance in grasses. Proc. 6th Internat. Grassland Cong. 1: 227-283.

Chand, P. 1998. Character association and path analysis in rajmash (*Phaseolus valgaris* L.). Madras Agril. J. 85: 188-190.

Chand, P. 1999. Genetic variability in rajmash (*Phaseolus valgaris* L.). Madras Agril. J. 86: 675-676.

Dewey, D. R. and Lu, K. H. 1959. A correlation and path analysis of components of crested wheat grass seed production. Agronomy J. 51: 515-518.

Dursun, A. 2007. Variability, heritability and correlation studies in bean (*Phaseolus valgaris* L.) genotypes. World J. of Agric. Sci. 3(1): 12-16.

Panse, V. G. and Sukhatme, P. V. 1978. Statistical Methods for Agricultural Workers. ICAR. New Delhi.

Raffi, S. A. and Nath, U. K. 2004. Variability, heritability, genetic advance and relationships of yield and yield contributing characters in dry bean (*Phaseolus valgaris* L.). J. of Biol. Sci. 4(2): 157-159.

Salehi, M., Tajik, M. and Ebadi, A. G. 2008. The study of relationship between different traits in common bean (*Phaseolus valgaris* L.) with multivariate statistical methods. American-Eurasian J. Agric. and Environ. Sic. 3(6): 806-809.

Shete, B. J. and Kale, P. N. 1988. Genetic variability and correlation studies in french bean. J. of Maharashtra Agri. Ufiiv. l3.(1): 031-034.

Shinde, S. S. and Dumbre, A. D. 2001. Correlation and path analysis in french bean. J. Maharashtra agric. Univ. 26(1): 048-049.

J. Agric. Res. Technol., 37 (1) : 059-062 (2012)

Genetic Divergence in French bean (*Phaseolus vulgaris* L.)

A. N. Kshirsagar[1], N. D. Bangar[2], B. H. Chavan[3] and P. B. Kanade[4]
Department of Botony, College of Agriculture, Pune - 411 005 (India)
(Received : 27-03-2011)

Abstract

Genetic divergence was estimated in 40 genotypes of french bean for thirteen characters by using Mahalanobis's D^2 statistics. The genotypes were grouped into five clusters. Cluster I was the largest with 31 genotypes. The highest inter cluster distance was observed between cluster III and cluster IV followed by cluster II and III suggesting more variability in genetic makeup of the genotypes included in these clusters. Cluster IV had highest mean values for seed yield plant^{-1} , protein content, 100-seed weight, pod length, branches plant^{-1} and height of lowest fruiting node. Seeds pod^{-1} and protein content (%) contributed maximum towards genetic divergence. Based on inter cluster distances, genotypes present in cluster II, III and IV could be used as parents for hybridization programme to develop desirable types of french bean.

Key words : French bean, genetic divergence, D^2 analysis, quantitative traits.

In any crop improvement programme, assessment of genetic diversity is an essential pre-requisite for identifying potential parents for hybridization. Diverse parents are expected to yield higher frequency of heterotic hybrids in addition to generating a broad spectrum of variability in segregating generations. D^2 statistics is useful multi-variate statistical tool for effective discrimination among various genotypes on the basis of genetic diversity (Murthy and Arunachalam, 1966). An attempt was made in this study to assess the major components in french bean germplasm obtained from NBPGR, New Delhi and NARP (PZ), Pune and also to identify divergent parents from distantly related clusters for future hybridization.

Materials and Methods

Forty french bean genotypes were grown in a randomized block design with three replications at field experimental area of Department of Botany, College of Agriculture, Pune (M.S.) during *kharif* 2006. Each genotype was grown in a single row plot of 4 meter long with inter row spacing of 30 cm. Intra row spacing of plants was kept at 10 cm. One plant was kept per hill after thinning. All the crop management and plant protection operations were carried out as per the recommended package of practices. The observations were recorded on five randomly selected plants for each genotype in each replications. The mean of five plants were subjected to statistical analysis. Wilk's criterion was used to test the significance of difference in the mean values for all the thirteen characters. Genetic diversity was estimated as per Mahalanobi's D^2 statistics (1936) and clustering of genotypes was done according to Tocher's method as described by Rao (1952).

Results and Discussion

The analysis of variance revealed highly significant differences among the genotypes for all the thirteen characters indicating the

1., 4. M.Sc.(Agri.) students, 2. Asso. Professor and 3. Asstt. Professor.

existence of genetic variability among the experimental material. The forty genotypes of french bean were grouped into five clusters, (Table 1). Cluster I was the largest having 31 genotypes indicating overall genetic similarity among them, whereas cluster II consisted 4 genotypes and cluster III consisted 3 genotypes. Clusters IV (PLB-176) and V (DPR- 8750) had one genotype each suggesting that these genotypes were the most diverse as compared

Table 1. Grouping of 40 genotypes of french bean into clusters.

Clusters	Genotypes no.	Genotypes
I	31	1C 416677, EC400425, No 3109, IIPR 07-34, DPR 23, HUR 556, RDAR-2, HURG-596, HURG-136, LIE-106, HURG-375, D-l, UI-63, DPR-8753, EC 400394, No- 675, No-3122, HURG-14, PDR-14, IPR-98-5, IIPR- 86-4, EC 278133, PLB- 446, DOT-334, R- 606, HPR-35, Varun, Phule Suyash, HUR-1213, HURG- 40, DPR- 8753A
II	4	EC 400396, RAD-33, DJ 334, HURG- 64A
III	3	DPR 8753-B, HURG-61, Vaghya
IV	1	PLB- 176
V	1	DPR- 8750

Table 2. Average intra and inter cluster distance ($D = \sqrt{D^2}$) values.

Cluster	I	II	III	IV	V
I	85.613 (9.252)	197.347 (14.048)	186.484 (13.656)	513.175 (22.653)	254.543 (15.954)
II		64.861 (8.054)	533.040 (23.088)	158.174 (12.570)	253.872 (15.933)
III			82.541 (9.085)	1061.033 (32.573)	470.042 (21.680)
IV				0 (0)	526.172 (22.938)
V					0 (0)

Note : (i) Figures in parenthesis indicate D values (ii) Diagonal values indicate intra-cluster distance.

Table 3. Cluster means for 13 characters in 40 genotypes in french bean.

Characters	Clusters					Contribution towards divergence (%)
	I	II	III	IV	V	
Days to 50% flowering	33.26	32.25	33.33	33.00	37.00	11.03
Days to maturity	74.26	75.75	72.00	85.00	80.00	0.26
Plant height (cm)	34.58	36.30	29.03	35.20	77.40	5.64
Height of lowest fruiting node	20.11	25.20	15.80	29.00	23.60	0.38
Branches plant^{-1}	3.00	3.20	3.17	3.20	2.40	3.46
Pods plant^{-1}	4.53	5.55	3.90	5.00	7.20	4.10
Pod length (cm)	9.92	10.03	10.40	12.80	10.20	5.26
Seeds pod^{-1}	3.99	4.10	3.80	4.60	5.10	34.36
100-seed weight (g)	36.55	34.00	37.67	46.00	30.00	2.44
Harvest index (%)	51.13	55.84	46.65	55.26	44.25	6.03
Nodules plant^{-1}	10.19	6.30	6.40	7.00	8.00	6.67
Protein content (%)	21.40	21.79	19.45	24.50	20.12	18.72
Seed yield plant^{-1} (g)	7.80	7.55	7.47	8.12	7.78	1.67

to other.

The inter and intra cluster distance ($D = \sqrt{D^2}$) values were worked out from divergence analysis and are presented in Table-2. The intra cluster distances were lower than the inter-cluster distances. Thus, the genotypes included within a cluster had less diversity among themselves. The maximum intra cluster distance (D = 9.25) was observed in cluster I followed by cluster III (D = 9.08) and cluster II (D = 8.05). The clusters IV and V had one genotype each and hence, their intra cluster distance was zero.

The highest inter cluster distance (D = 32.57) was observed between cluster III and IV followed by cluster II and III (D = 23.09), cluster IV and V (D = 22.94) and cluster I and IV (D = 22.65), suggesting more variability in genetic makeup of the genotypes included in these clusters. The genotypes belonging to the clusters separated by high statistical distance could be used in hybridization programme for obtaining a wide spectrum of variation among the segregates. In this context, genotypes from cluster II, III and IV should be selected as parents in hybridization programme for yield improvement in the genotypes of french bean. Large inter-cluster distances have been reported earlier by Chauhan *et al.* (2005) and Nehvi *et al.* (2007).

The results on the contribution of individual traits towards the total divergence (Table-3) suggested that the per cent contribution was the highest from seeds pod^{-1} (34.36%) followed by protein content (18.72%) and days to 50 per cent flowering (11.03%). The magnitude of contribution by nodules plant^{-1} (6.67%), harvest index (6.03%), plant height (5.64%) and pod length (5.26%) was medium. Other characters *viz*., pods plant^{-1}, branches plant^{-1}, seeds pod^{-1}, seed yield plant^{-1}, height of lowest fruiting node and days to maturity contributed less than 5 per cent towards genetic divergence. The present results are in agreement with those of Dikshit *et al*. (1999) who also identified above said traits as the principle components contributing maximum to the total variation in french bean. Greater range of mean values among the cluster was recorded for different traits. The genotype PLB-176 forming a separate cluster IV recorded highest mean values for seed yield plant^{-1} (8.12), protein content (24.50%), 100-seed weight (46.00), pod length (12.80), branches plant^{-1} (3.20) and height of lowest fruiting node (29.00). Cluster I was the second highest for seed yield plant^{-1} (7.80) with high nodules plant^{-1} (10.19), while cluster V had high mean values for seeds pod^{-1} (5.10), pods plant^{-1} (7.20) and plant height (77.40). Cluster II had minimum days to 50 per cent flowering (32.25) with maximum harvest index (55.84%). Thus, this cluster contained early genotypes. Based on cluster means, Nehvi *et al.* (2007) also reported wide range of variation for seed yield and its components in french bean. Therefore, it is suggested that the genotypes from most diverse clusters may be used as parents in hybridization programme to develop high yielding varieties.

It has been well established fact that more the genetically diverse parents used in hybridization programme, greater will be the chances of obtaining high heterotic hybrids and broad spectrum variability in segregating generations (Arunachalam, 1981). It has also been observed that the most productive hybrids may come from high yielding parents with a high genetic diversity. Therefore, based upon high seed yield and large inter-cluster distances, it is advisable to attempt crossing among the genotypes from cluster II, III and IV, which may lead to broad spectrum of favorable genetic variability for yield improvement in french bean.

References

Arunachalam, V. 1981. Genetic distance in plant. Indian J. of Gent. and Plant Breed. 41: 226-236.

Chauhan, R. M., Haibatpure, S. H. and Kurup, N. S. 2005. Genetic divergence in french bean. Ind. J. Pulses Res. 18(1): 21-22.

Dikshit, H. K., Gupta, S. R., Asthana, A. N. and Devraj. 1999. Genetic parameters and diversity in french bean. Legume Res. 22(3): 198-200.

Mahalanobis, P. C. 1936. On the generalized distance in statistics. Proc. Nat. Inst. Sci. India. 2: 49-55.

Murthy, B. R. and Arunachalam, V. 1966. The nature of divergence in relation to breeding system in some crop plants. Indian J. of Genet. and Plant Breed. 26A: 188-198.

Nehvi, F. A., Singh Gynendra, Abu manzar and Allai B. A. 2007. Evaluation of local landraces of french bean under temperate conditions of Kashmir valley. J. food legumes. 20(l):41-42.

Rao, C. R. 1952. Advanced Statistical Methods in Biometrical Research. John Wiley and Sons, Inc. New York.

J. Agric. Res. Technol., 37 (1) : 062-065 (2012)

Residue Study of Emamectin Benzoate on Brinjal

Aparna Kalawate[1] and M. D. Dethe[2]
Department of Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 16-08-2009)

Abstract

Based on the dissipation of residues on fruit after last spray of emamectin benzoate (12.5 and 25.0 g a.i: ha^{-1}), initial residues reached below detection limit (TBDL) in about 2 to 6 days. Considering all safety parameters to consumers the waiting period (PHI) of about 2 to 6 days is proposed for emamectin benzoate. Extent of reduction in residues from fruit due to washing followed by cooking process was found to be 100 per cent at both doses.

Key words : Emamectin benzoate, residue, brinjal.

Brinjal or egg plant (*Solanum melangena* Linnaeus) is an important vegetable crop cultivated throughout the warmer region of the world. Among the several pests, jassid (*Amrasca bigutulla biguiulla* Ishida), whitefly (*Bemisia tabaci* Gennadius), aphid (*Aphis gossypii* Glover), mite (*Tetranychus* spp.) and shoot and fruit borer (*Leucinodes orbonali* Guenee) are the prominent pests responsible for minimizing the yield of marketable quality brinjal fruits.

Chemical pesticides are used as the frontline defence sources against pests in India, inspite of their drawbacks. Recommended use of pesticides at the right time helps in reducing the pest damage. But farmers often use the same chemical repeatedly or increase the dose and frequency of pesticide to ensure minimum crop damage. In the recent past, synthetic pyrethroids have been. extensively used for the control of insect pests of brinjal. However, their, indiscriminate use has created a number of problems such as development of resistance, pest resurgence and pesticide residues.

1. Ph.D. student and 2. Head of Dept.

In order to overcome above problems, systematic evaluation of new molecule with better insecticidal properties is essential. Therefore, in the present investigation the residues of emamectin benzoate has been studied.

Materials and Methods

Residue studies were carried out in both the experiments in respect of fruits harvested after third spray of treatments with emamectin benzoate 5 per cent SG (12.5 and 25.0 g a.i. ha^{-1} $spray^{-1}$). At the same time fruits from untreated control plots were also subjected to residue analysis. Pesticide residues were analysed in edible quality fruits collected periodically to decide the safety of treatments to consumers. Fruit samples from each plot were collected at an interval of 0 (2 hr), 3 and 5, 7, 10 and 15 days after last spray and subjected to analysis by following the steps of extraction, cleanup and estimation as described under.

Samplings : Brinjal fruits from the plots sprayed (treated) with emamectm benzoate at the dose of 12.5 and 25 g a,i. ha^{-1} $spray^{-1}$ were sampled for residue studies. Control samples were collected similarly from the untreated plots in the polythene bags. The samples collected from three replications of each treatment were pooled together and they were, made into two replicates for residue analysis. From each treatment 500 g of brinjal fruits were taken. The fruits were finely sliced and from that 25 g of laboratory sample in duplicate was drawn for analysis.

Extraction, cleanup and estimation : The 25 g sliced fruit sample was soaked in 100 ml acetonitrite for 30 minutes. Then the whole material, was transferred, in a conical flask and shaken for 30 minutes on a mechanical shaker. The samples were filtered using Buchner funnel and the sample cake was rinsed with 2 x 50 ml of acetonitrile. The filtrate was combined and dried in a rotary vacuum evaporator. The sample.extract was reconstituted in 100 per cent acetonitrile (HPLC grade) for final HPLC analysis.

Operating parameters

Mobile phase	:	Acetonitrile (42%): Methanol (42%): 2% Ammonium acetate (16 %)
Wavelength (λ max)	:	245 nm
Flow	:	0.4 ml min^{-1}
Retention time (RT)	:	4.94 ± 0.09 minutes for B1a and 4.19 ± 0.08 minutes for B1b

Results and Discussion

Estimated residues on individual sample at zero time interval indicated that the higher application rate (25 g a.i. ha^{-1}) resulted in higher initial residue (Table. 1.). The initial residues were 0.112 (±0.0001) and 0.092 (±0.002) ppm at 12.5 g a.i ha^{-1} and 0.198 (±0.002) and 0.203 (±0.009) ppm at 25 g a.i. ha^{-1} (Table 3) in *kharif* and summer season, respectively, in emamectin benzoate treated fruits. Emaniectia benzoate levels at higher rate fell with time from 0.198 to 0.091 and 0.203 to 0.095 ppm within 3 days with an estimated half life of 2.8 days. No detectable residues were found in the samples brought after 5 days post-application. The retention time for emamectin benzoate on UV-HPLC detection was 4.94±0.09 for B1a and 4.19±0.08 minutes for B1b.

The dissipation rate of emamectin benzoate was much similar to that reported by Maynard *et al.* (1989). They reported the biphasic degradation (first rapid phase followed by second slower phase) of avermectin B1a. Sunlight enhanced, the-degradiation and degradates appeared to be more volatile than the parent compound. It is also reported that

Table 1. Residues of emamectin benzoate on brinjal fruits (mg kg^{-1}).

Days after treatment	Mean residue (±SD)			
	12.5 g a.i. ha^{-1}		25 g a.i. ha^{-1}	
	Kharif	Summer	*Kharif*	Summer
0	0.112 (0.0001)	0.092 (0.002)	0.198 (0.002)	0.203 (0.009)
1	0.081 (0.017)	0.07 (0.001)	0.130 (0.004)	0.148 (0.002)
3	0.068 (0.007)	BDL	0.091 (0.002)	0.095 (0.002)
5	BDL	BDL	BDL	BDL
7	BDL	BDL	BDL	BDL
10	BDL	BDL	BDL	BDL
RL50 (days)	4.47	2.54	2.80	2.79
TMRL (days)	4.76	2.23	5.28	5.53
TBDL (days)	4.76	2.23	5.28	5.53

BDL = Below detectable limit of 0.05 ppm, MRL = Maximum residue limit of 0.05 ppm

photolytic degradation is only the explanation for rapid initial loss. The researchers concluded that avermectin B1a degrades very rapidly under normal environmental conditions (T ½ = < 1 day for 1st phase). A biphasic dissipation of the total abamectin residues was also reported by Bull *et al*. (1984), Iwata *et al*. (1985) and Ku *et al*. (1985). Residue behaviour studies in fruits and vegetables are important in assessing the health risks and pollution of environment. The climatic conditions after treatment are important factors in residue dissipation. Many conventional pesticides commonly used on vegetables are now under review for safety to consumers. Commercial production of brinjal requires repeated pesticide applications during fruiting stage. There are several reports on contamination of fruits and vegetables with residues however, few data related to residue on brinjal are available. Hence, the present studies were considered most important. Based on the dissipation of residues of emamectin benzoate on brinjal, fruits after third spray and keeping in view the safety parameters (toxicological) to consumers the waiting period (PHI) of about 2 to 6 days for emamectin benzoate can be proposed while using them at appropriate doses against pests.

Home processes on residue decline : In this study, the brinjal fruit samples harvested one day after the third spray were subjected to thorough washing of fruits with tap water and washing followed by cooking. Pre-washing emamectin benzoate residue level (Table 2) was 0.15 and 0.07 in the higher (25 g a.i. ha^{-1}) and lower dose (12.5 g a.i. ha^{-1}) respectively. The residues level after washing reduced by 100 per cent in both doses. Due to washing and cooking processes, the decline in residues of emamectin

Table 2. Residue levels of emamectin benzoate before and after processing of brinjal fruits.

Particulars	Dose of emamectin benzoate (g a.i. ha^{-1})	
	12.5	25
Residues in PPM (1 DAS)	BDL	0.15
Residues in PPM found in samples after washing	BDL	BDL
Reduction of residues after washing (%)	100	100
Residues in PPM found in samples after washing and cooking	BDL	BDL
Reduction in residues after washing and cooking (%)	100	100

DAS : Days after third spray

benzoate was also 100 per cent in both doses. The simple process such as washing and cooking are very helpful in removing, the residues from fruits and vegetables. The effect of home processes on decline of residues on fruits was .assessed in experiment of summer season. The residue remained 100 per cent in emamectin benzoate at lower and higher doses. Thus, it is clear that routine process of washing as well as cooking, before the consumption certainly helps in minimizing load of pesticide residues on the vegetable fruits. Earlier studies on other pesticides also exhibited similar results in respect of various other vegetables (Agnihotri, 1999).

Data on levels of residues in brinjal fruits revealed that application of emamectin benzoate (12.5 g a.i. ha^{-1}) according to good agricultural practice is risk free from residue point of view. On the background of better bioefficacy obtained at lower dose 6.25 g a.i. ha^{-1} of emamectin benzoate, its use would be relatively most safe to consumers. Relatively shorter pre-harvest intervals will be needed for emamectin benzoate applications in comparison with conventional insecticides.

References

Agnihotri, N. P. 1999. Pesticide safety evaluation and monitoring. AICRP .on Pesticide Residues. Div. of Agric. Chem., IARI, New Delhi.

Bull, D. L., Gruber, V. F., Ivie, G. W., Ku, C. C., McConnell, J. G., Stevenson, J. M. and Vandenfleuval, W. J. A. 1984. Fate of avermectin $B_1{}^a$ in soil and plants. J. Agric. Food Chem. 32 : 94-100.

Iwata, I., McConnell, J. G., Flor, J. E., Putter, I. and Dinoff, T. M. 1985. Residues of avermectin B1a on and in citrus fruits and foliage. J. Agric. Food Cherrt. 33: 467-471.

Ku, C. C., Hwang, S. C., Kaplan, L., Nallin, M. K. and Jacob, T. A. 1.985. The preparation of Carbon - 14 labelled avermectin B1a J. label Compound Radiopharm, 22:451-458.

Maynard, M. S., Iwata, L., Wislocki, P. O., Ku, C. C. and Jocob, T. A. 1989. Fate of avermectin $B_1{}^a$ on citrus fruits. 1. Distribution and magnitude of the avermectin B1a and ^{14}C residues on citrus fruits from a field study. J. Agric. Food cAem. 37: 178-183.

J. Agric. Res. Technol., 37 (1) : 066-070 (2012)

Bioefficacy Study of Proclaim on Brinjal

Aparna Kalawate[1] and M. D. Dethe[2]
Department of Entomology, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 16-08-209)

Abstract

In *kharif* and *rabi* seasons performance of proclaim (< 6.25 g a.i. ha^{-1} $spray^{-1}$) was quite better in minimizing the infestation of jassids, whiteflies and aphids and it was also effective in keeping down the shoot damage. However, level of damage was minimum in cypermethrin but on par with the test pesticide. Although the fruit damage recorded in cypermethrin sprayed crop was minimum, it wax not significantly superior to test compounds. Marketable quality brinjal fruit yield based on the total of six pickings in treated crop of proclaim (6.25 g a.i. ha^{-1}) was 15.14 to 19.95 t ha^{-1}, in comparison to 16.30 to 21.01 t ha^{-1} in spray treatment of cypermethrin 50 g a.i. ha^{-1}.

Key words : Proclaim, bioefficacy, brinjal, emamectin benzoate.

Chemical pesticides are used as the frontline defence sources against pests in India, inspitc of their drawbacks. Recommended use of pesticides at the right time helps in reducing the pest damage. But farmers often use the same, chemical repeatedly or increase the dose and frequency of pesticide to ensure minimum crop damage. In the recent past, synthetic pyrethroids have been extensively used for the control of insect pests of brinjal. However, their indiscriminate use has created a number of problems such as development of resistance, pest resurgence and pesticide residues. In order to overcome above problems, systematic, evaluation of new molecule with better insecticidal properties is essential. Therefore, the present investigation the in bioefficacy of proclaim (emamectin benzoate) has been studied.

Materials and Methods

Sucking pests : The observations on counts of sucking pests *viz*., aphid (nymph and wingless adult), jassid (nymph) and whitefly (nymph) were recorded on five randomly selected plants per treatment plot. On each plant, three leaves (one each, from bottom, middle and top portion of the plant) were observed from lower side to note the pest count. First count was taken one day before first spray and post treatment counts were made 1,3 and 7 days after spray. The data on surviving population were reported on per plant basis (Mean of population/three leaves).

Shoot and fruit/borer : Crop damage caused by BSFB was measured on the basis of damaged shoots and fruits separately. In order to assess the per cent shoot damage, the damage shoots on five randomly selected tagged plants were, counted as against total available shoots on the observed plants. Shoot damage was recorded only in respect of first spray. Fruit damage was recorded after second and third spray. Healthy and infested fruits were measured on the basis of number and weight so as to work out per cent damage. So far as yield of net plot is concerned weight of healthy, fruits obtained in first six pickings was collectively considered for judging the treatment

1. Ph.D. student and 2. Head of Dept.

effect. The transformed data were analysed statistically as a randomized block design (Gomez and Gomez, 1976).

Results and Discussion

Pests and yield : During *kharif* performance of individual test pesticide at different rates against pests of brinjal and cumulative average fruit yield of six pickings is summarized in Table 1. Of the test pesticides proclaim, 6.25 g a.i. ha^{-1} proved most effective against jassid, whitefly and aphid with low levels of infestation (11.70, 2.20 and 3.45, respectively).

Spinosad afforded moderate control of jassid, whitefly and aphid. However, it was found to be the most effective against BSFB. The lowest, per cent fruit infestation (13.34 and 13.69 per cent on number and weight basis respectively) was found in spinosad 72 g a.i. ha^{-1} treated plots. Spinosad at 72 g a. i. ha^{-1} resulted in notable yield of healthy brinjal fruits (15.68 t ha^{-1}). However, the fruit yield of 15.14 t ha^{-1} was recorded in proclaim 6.25 g a.i. ha^{-1} treatment plot.

NSE (5 per cent) crude extract gave poor control of jassid, whitefly and aphid. The per cent fruit infestation in NSE treated plot was 20.36 and 22.52 on number and weight basis as against 27.62 and 29.77 in untreated control. Comparatively low yield was recorded in NSE treated plots (13.57 t ha^{-1}) than other pesticide treatments.

Control of jassid, whitefly and aphid obtained in cypermethrin treated plots was relatively more than that noticed in test pesticides. Gypermethrin resulted as the most effective treatment against BSFB recording 13.10 (number basis) and 13.40 (weight basis) per cent fruit damage. Obviously, high yield was obtained (16.30 t ha^{-1}) in cypermethrin treated plots when compared with spinosad and proclaim treatments.

In summer season, although the magnitude of jassid population was low, proclaim at all three rates recorded significantly lower number of jassids (6.97 to 7.51) in contrast to 20.28 jassids per plant in untreated control. Again proclaim treatments resulted as the best treatments in controlling whiteflies and aphids (1.97 to 2.43 and 2.95 to 3.55, respectively). Shoot and fruit borer infestation was comparatively less in proclaim treatments and averaged 8.31 to 8.60 and 8.56 to 8.92 per cent fruit damage on number and weight basis, respectively. Proclaim treatments provided yield to the tune of 19.22 to 19.95 t ha^{-1}.

Foliar applications of spinosad provided moderate control of jassid, whitefly and aphid populations. Spinosad was the most effective to counter the fruit borer damage averaged 7.89 to 8.13 and. 8.21 to 8.34 per cent fruit damage on number and weight basis, respectively. The marked increase in healthy fruit yield resulting due to lowest fruit damage was observed in spinosad 72 g a.i. ha^{-1} treatment where the maximum marketable brinjal fruit yield of 20.41 t ha^{-1} was recorded.

NSE (5 per cent) applications failed to lower the jassid, whitefly and aphid population significantly. However, 15.51 and 17.09 per cent fruit damage was found in NSE. treated plots as against 19.67 and 20.82 per cent fruit damage in unsprayed crop on number and weight basis, respectively. Lower yield of 16.64 t ha^{-1} was observed in NSE treatment.

Cypermethrin had an excellent efficacy against jassid, whitefly and aphid throughout the span of three sprays. Moreover, it afforded best control of fruit borer and showed less fruit damage on number (7.70 per cent) and weight (7.97 per cent) basis. The yield of healthy fruits in cypermethrin plots was 21.01 t ha^{-1} and this

was the highest yield recorded among the other pesticide treatment plots. Effective jassid control in spray of cypermethrin 50 g a.i. ha^{-1} obtained in the present research is consistent with the earlier results obtained by Borad *et al*. (2002). Keeping in view development of resistance is jassids to several conventional insecticides, proclaim at the rate of < 6.25 g a.i. ha^{-1} can be considered appropriate in suppressing the jassid infestation on brinjal crop. In the present investigation a test pesticide proclaims used at < 6.25 g a.i. ha^{-1} provided satisfactory control of brinjal jassids. Although, the reports on efficacy of this pesticide are not found on brinjal jassids, most related compound abamectin provided moderate control of jassids on okra crop by Kale (2003). However use rate of abamectin was different i.e. 12.5 to 30 g a.i. ha^{-1} than the proclaim, evaluated in present study on brinjal.

Excessive use of synthetic pyrethroids on cotton resulting resurgence of whiteflies has been well experienced by the cultivator (Jayaraj, 1987). On this background, proclaim spray treatment would be considered as a better alternative. Ghosh *et al*. (2004) reported effective performance of avermectin against whiteflies on brinjal in West Bengal. Inferior performance of neem based product noticed in the present study was also reported by Mote and Shivu Bhavikatti (2003) in field experiment on brinjal for comparing the efficacy of

Table 1. Overall performance of pesticides on pests and fruit yield of brinjal : *kharif* 2005 and Summer 2006.

Treatment	Mean number plant^{-1}						Fruit borer infestation (%)				Mean yield (t ha^{-1})	
	Jassid		Whitefiles		Aphids		Number basis		Weight basis			
	A	B	A	B	A	B	A	B	A	B	A	B
Spinosad 56.25 g a.i. ha^{-1}	26.77 (5.06)	14.41 (3.86)	2.94 (1.87)	5.32 (2.41)	16.26 (4.10)	16.01 (4.01)	13.58 (21.41)	8.01 (16.38)	13.94 (21.73)	8.24 (16.58)	15.31	19.71
Spinosad 72 g a.i. ha^{-1}	25.68 (4.94)	13.97 (3.77)	2.78 (1.81)	5.19 (2.38)	16.05 (4.07)	15.17 (3.91)	13.34 (21.20)	7.89 (16.23)	13.69 (21.50)	8.21 (16.54)	15.68	20.41
Spinosad 90 g a.i. ha^{-1}	28.80 (5.25)	14.97 (3.93)	3.02 (1.87)	5.53 (2.46)	16.42 (4.11)	16.38 (3.72)	13.69 (21.50)	8.13 (16.49)	14.15 (21.92)	8.34 (16.68)	15.19	19.09
Emamectin benzoate 5 g a.i. ha^{-1}	12.11 (3.49)	7.20 (2.66)	2.28 (1.67)	2.26 (1.65)	3.61 (2.03)	3.11 (1.89)	13.89 (21.68)	8.41 (16.75)	14.41 (22.15)	8.70 (17.05)	14.95	19.48
Emamectin benzoate 6.25 g a.i. ha^{-1}	11.70 (3.44)	6.97 (2.62)	2.20 (1.65)	1.97 (1.57)	3.45 (1.99)	2.95 (1.82)	13.74 (21.60)	8.31 (16.65)	14.31 (22.04)	8.56 (16.89)	15.14	19.95
Emamectin benzoate 12.5 g a.i. ha^{-1}	13.24 (3.63)	7.51 (2.72)	2.41 (1.70)	2.43 (1.70)	3.84 (2.17)	3.55 (2.02)	13.98 (21.98)	8.60 (16.94)	14.66 (22.26)	8.92 (17.28)	14.46	19.22
Cypermethrin 50 g a.i. ha^{-1}	9.60 (3.11)	6.74 (2.57)	2.15 (1.62)	1.84 (1.52)	2.95 (1.85)	2.57 (1.76)	13.10 (21.01)	7.70 (15.96)	13.40 (21.29)	7.97 (16.28)	16.30	21.01
NSE 5 % crude extract 500 L ha^{-1}	40.76 (6.32)	17.01 (4.17)	4.94 (2.33)	16.10 (4.05)	20.65 (4.53)	18.73 (4.33)	20.36 (26.61)	15.51 (23.06)	22.52 (28.27)	17.09 (24.17)	13.57	16.64
Untreated control	44.00 (6.57)	20.28 (4.57)	5.73 (2.50)	21.00 (4.62)	26.57 (5.11)	25.61 (5.04)	27.62 (31.56)	19.67 (26.21)	29.77 (32.92)	20.82 (26.94)	12.96	14.92
S.E.±	0.310	0.254	0.040	0.068	0.040	0.317	0.395	0.390	0.259	0.742	0.163	0.388
CD at 5 %	0.912	0.762	0.121	0.203	0.121	0.950	1.287	1.271	0.845	2.421	0.489	1.162

Figures in parentheses are the arcsine transformed values. * Fruit yield of only six pickings. A = *Kharif* 2005, B = Summer 2006.

chemical and non-chemical pesticides against pests of brinjal.

Although several workers reported effective performance of cypermethrin on brinjal aphids (Borad *et al.* 2002; Mote and, Shivu Bhavikatti, 2003 and Muthukumar and Kalyanasundaram; 2003), its repeatated use is discouraged due to risk of resurgence and development of resistance. Nevertheless such precaution formed an important aspect in Integrated Pest Management. On this background, the use of proclaim (< 6.25 g a.i. ha^{-1}) can be considered as better option for keeping down the infestation level below threshold level of 8-10 aphids per leaf indicated by Mote and Puri (2003) for IPM on brinjal.

The results obtained in this study indicated that proclaim provided next level control of fruit borers. Fruit injury in proclaim treatment (6.25 g a.i. ha^{-1}) averaged from 13.74 to 14.31. and 8.31 to 8.56 per cent during *kharif* and summer season respectively. Such results were obtained by Prasad and Devappa (2006b), wherein proclaim at 10 g a.i. ha^{-1} was found to be effective in reducing the dead hearts and fruit damage in brinjal. Nevertheless, the dose of proclaim used by these workers was higher than 6.25 g a.i. ha^{-1} which showed better control in this study. Proclaim reported to be effective in minimizing the damage caused to fruiting bodies of cotton by *H. armigera* (Suganyakanna *et al*., 2005; Meena *et al*., 2006 and Murugraj *et al*., 2006). Moreover it was reported to be effective against diamondback moth (Prasad and Devappa, 2006a).

Marketable fruit yield after following the schedule of three sprays was collectively taken for six pickings because fruit damage level in absence of control measures would rose to very high levels in all plots. The yields also would have been influenced by the total damage done to the crop by all pests together and infested vegetative growth phase of the crop also might have an influence on the yield. Proclaim can be incorporated in resistance management strategy involving rotational sprays on brinjal.

The result of this study can be concluded that proclaim at < 6.25 g a.i. ha^{-1} rate provided excellent control of jassid, whitefly and aphid. Foliar sprays with 5 per cent SG formulation would be highly effective against sucking pests and BSFB infesting vegetative growth phase of brinjal. A strong dose independent efficacy pattern is observed. Low dose rate may increase the time of protection and can fit in the sustainable pest management, strategy and poses no residue risks. On the background of better bioefficacy obtained at lower dose 6.25 g a.i. ha^{-1} of proclaim, its use would be relatively most safe to consumers. Seasons long use of a single pesticide is discouraged in most resistance management tactics. Instead, alternating compounds with different modes of action is advocated to delay the resistance in target species. The test compounds have novel, different modes of action. It fit very well in the IPM strategy of brinjal crop due to their low toxicity to mammals and natural enemies of pests. Proclaim alternated with spinosad would be the best IPM tool for managing major pests (jassid, aphid, whitefly and BSFB). The test pesticide can be considered as an alternative to synthetic, pyrethroids on brinjal crop more particularly in the situation where development of resistance to pyrethorids and resurgence of sucking pests was experienced.

References

Borad, P. K., Patel, H. M., Chavda, A. J. and Patel, J. R. 2002. Bioefficacy of endosulfan and cypermethrin mixture against insect pests of brinjal (*Solanum molongena*). Indian J. Agril. Sci. 72(11): 685.-6S8.

Gomez, K. A. and Gomez, A. A. 1984. Statistical procedures for Agricultural Research (2nd edn.). Book of an Rice Res. Inst. Philippines. A Wiely Iriterscience Pub. John Wiley and Sons, New York, Chickester,

Brisbane, Toronto, Singapur. p. 680.

Ghosh, S. K., Laskar, N., Basak, S. N. and Senapati, S. K. 2004. Seaspnal fluctuation of Bemisia tabaci Genn. on brinjal and field evaluation of some pesticides against *Bemisia tabaci* under terai region of West Bengal. Environ. Ecol. 22(4): 758-762.

Jayaraj, S. 1987. Resurgence of sucking pests. Tamil ,Nadu Agricultural University, Coimbatore, India.

Kale, V. D. 2003. Studies on thiamethoxam, fipronil, abamectin and spinosad against pests of okra. PhD (Agri.) thesis, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar, Maharashtra, India.

Mote, U. N. and Shivu Bhavikatti. 2003. Efficacy of chemical and non-chemical insecticides against major pests of brinjal in kharif season. J. Appl. Zool. Res. 14(1): 54-56.

Muthukumar, M. and Kalyanasundaram, M. 2003. Efficacy of certain insecticides against major sucking insects of brinjal (*Solanum melongena* L.). South Indian Hort. 51(1/6): 207-213.

Mote, U. N. and Puri, S. N. 2003. Integrated Pest Management Modules. MPKV, Exten. Publ. 406: 37.

Murugaraj, P., Nachiapan, R. M. and Selvanarayanan, V. 2006. Efficacy of emamectin benzoate (Proclaim 05 SG) against tomato fruit borer, *Helicoverpa armigera* (Hubner). Pestology. 30(1): 11-16.

Meena, R. S., Srivastava, C. P. and Joshi, N. 2006. Bioefficacy of some newer insecticides against the major insect pests of short duration pigeonpea. Pestology. 30(9): 13-16.

Suganyakanna, S., Chandra Sekaran, S., Regupathy, A. and Stanly, J. 2005. Field efficacy of emamectin 5 SG against tomato fruit borer, *Helicoverpa armigera* (Hubner). Pestology. 29(4): 17-20.

Prasad Kumar and Devappa, V. 2006a. Bioefficacy of emamectin benzoate 5 % SG (Proclaim) against diamondback moth in cabbage. Pestology. 30(2): 23-25.

Prasad Kumar and Devappa, V. 2006b. Bioefficacy of emamectin benzoate 5% SG (Proclaim) against brinjal shoot and Iruit borer. Pestology. 30(3): 17-19.

J. Agric. Res. Technol., 37 (1) : 070-076 (2012)

Evaluation and Identification of Potential Bivoltine Silkworm Breeds for Non-Traditional Sericulture Region of Tropics

S. G. Rayar[1]
Department of Entomology, University of Agricultural Science, Dharwad - 580 005 (India)
(Received : 28-02-2010)

Abstract

The study revealed that the better performance of KSO-1, CSR-2, NP-2, KPGA, CC-1, CSR-4 and CSR-26 for majority of the traits studied. Based on the multiple traits evaluation index value SH-6, KPGA, CC-1, CSR-27, KSO-1, APS-5, NB4D2, CSR-4, CSR-26, APS-8 and NP-2 breeds scored above 50 average value for the traits contributing to the silk yield. Hence, these breeds could be used as potential parents for evolving the hybrids suitable to the agro-climatic conditions of tropic region.

Key words : *Bombyx mori* L., bivoltine breeds, non traditional sericulture region, tropics.

In India, a concentrated effort in tropical bivoltine research has lead to the evolution of new breeds/hybrids and contributed for the substantial increase in bivoltine silk production. However, the dream of producing large quantity of bivoltine silk could not be realized and the reasons attributed are adverse climatic conditions prevailing in different agro-climatic conditions (Datta, 2000). Dandin *et al*. (2005)

1. Asso. Professor.

emphasized the necessity of identifying location specific silkworm breeds/hybrids suitable to the varied agro-climatic conditions by mobilizing the genetic resources across the institutes. Perusal of the literature revealed that very little work has been done in identifying the location specific bivoltine breeds/hybrids suitable to different agro-climatic conditions of northern transitional zone of Karnataka, though this zone has been classified as potential non traditional zone-II for bivoltine rearing (Bongale and Raghuraman, 1999). Presently many bivoltine breeds suitable for favourable, adverse and moderate input situation have been evolved across the institutes, no systematic work has been done to identity suitable bivoltine breeds for this region.

Materials and Methods

Seventeen bivoltine pure breeds evolved at various institutes were procured for the study and their characteristics are presented in Table 1. The breeds *viz*., SH-6, NB7, KPGA, KPGB, CC-1, NB_4D_2, NB_{18} were procured from Director, Central Sericultural Germplasm Resource Centre, Hosur (Tamil Nadu), CSR-2, CSR-27, CSR-4, CSR-6 and CSR-26 were obtained from the Director, Central Sericultural Research and Training Institute, Mysore (Karnataka) and KSO-1 and NP-2 breeds were procured from the Director, Karnataka State Sericultural Research and Development Institute, Thalaghattapura (Bangalore). All the breeds were reared twice during August to November, 2008 in three replications with a disease free laying per replication (400 silkworms) by following a standard bivoltine silkworm rearing technology (Dandin *et al*. 2000). Silkworms hatched from one laying were reared in rectangular wooden trays (2.5' x 2.5') and were fed daily thrice with V-l mulberry leaves. Till the end of three instars silkworms were reared by providing the chopped leaves of

Table 1. Characteristics of the bivoltine silkworm breeds used in the study.

Breeds	Parentage	Evolved at	Larval marking	Cocoon shape	Cocoon colour	Cocoon grains
SH-6	Shungetsu x Hosho	RSRS, Dehradun	Marked, bluish white	Oval	Bright white	Medium
CC-1	(NB7 x NB-1) x (KA x SPC-1)	CSR & TI, Mysore	Plain, bluish white	Oval	Bright white	Medium
KPGA	(N122 x C110) x (N124 x C124)	RSRS, Kalimpong	Plain, bluish	Oval	Bright white	Medium
KPGB	N501 x C502	RSRS, Kalimpong	Plain, bluish	Oval	Bright white	Medium
NB7	Kinshu x Showa	CSR & TI, Mysore	Plain, bluish white	Oval	Bright white	Medium
CSR-2	Shunrei x Shogetsu	CSR & TI, Mysore	Plain, bluish white	Oval	Bright white	Fine to medium
CSR-27	Thaihei x Choan	CSR & TI, Mysore	Plain	Oval	Bright white	Fine to medium
KSO-1	NB4D2 x NP1	KSSR & DI, Bangalore	Plain	Oval	White	Medium
APS-5	Hemavathy (line separation)	APSSR & DI, Hindupur	Plain, bluish white	Oval	White	Medium
NB4D2	(Koko x Seihaku) x (N124 x C124)	CSR & TI, Mysore	Plain, bluish white	Dumbbell	Bright white	Medium
NB18	(Koko x Seihaku) x (N124 x C124)	CSR & TI, Mysore	Plain, bluish white	Dumbbell	Bright white	Medium
CSR-4	(BN18xBCS25)xNB4D2	CSR & TI, Mysore	Plain, bluish white	Dumbbell	Bright white	Fine to medium
CSR-6	Shunrei x Shogetsu	CSR & TI, Mysore	Marked, reddish tinge	Dumbbell	Dull white	Fine to medium
CSR-26	C135 xNB4	CSR & TI, Mysore	Marked, dull white	Dumbbell	White	Fine to medium
NP-2	PM x N.P.	KSSR & DI, Bangalore	Plain	Dumbbell	White	Medium
APS-4	TR (line separation)	APSSR & DI, Hindupur	Plain, bluish white	Medium dumbbell	White	Medium
APS-8	Swarna (line separation)	APSSR & DI, Hindupur	Plain, bluish white	Medium dumbbell	White	Medium

0.50 cm^2 size for I instar, 2 cm^2 sizes for II instar and 4 cm^2 size for III instar. While, the fourth and fifth instar silkworms were reared with shoot feeding method by using V-l mulberry shoots thrice a day on a shoot rearing stand. The bed cleaning was done with cleaning net once during I instar, twice during II instar and thrice during III instar. For the prevention of diseases lime powder was dusted on the rearing bed and on silkworms during each moulting and after the moulting a bed disinfectant, Vijetha powder was dusted on the silkworms and feeding was resumed 30 minutes after the dusting. Observations were made on fifteen economic traits. The mean values were used for analysis of variance (Snedecor and Cockhran, 1979) and to estimate the multiple traits evaluation index values (Mano *et al.* 1993).

Results and Discussion

It is well established that the silk yield in silkworm is contributed by more than 21 characters (Thiagarajan *et al.* 1993). It is therefore, obvious that the superiority of the breed is to be assessed by a number of economic traits. In the present study, fifteen important traits are considered to find out the elite bivoltine breeds.

The mean performance of the bivoltine breeds is presented in Table 2. Significant difference was observed among the breeds for all the traits evaluated, except total larval duration. The breeds, NB_7 (183.00 hr), NB_{18} (183.00 hr) and CC-1 (184.00 hr) recorded significantly shorter fifth instar larval duration. While, CSR-2 (188.00 hr), SH-6 (190.00 hr), KPGA (199.00 hr) and KSO-1 (206.00 hr)

Table 2. Mean performance of bivoltine breeds for larval growth and grainage traits.

Breeds	Fifth instar larval duration (h)	Total larval duration (h)	Chawki larval weight (g 10^{-1} larvae)	Mature larval weight (g 10^{-1} larvae)	Silk product-ivity (cg day^{-1})	Survival (%)	Pupation (%)
SH-6	190^{abc}	625	2.200^{a-d}	44.965^{bc}	3.980^{abc}	85.00 (67.26)$^{a!}$	96.33 (78.96)$^{a!}$
NB7	183^{a}	625	1.885^{cd}	41.015^{c}	3.755C	77.33 (61.58)^{abc}	92.66 (74.35)^{bcd}
KPGA	199^{a-d}	649	2.285^{a-d}	43.785^{bc}	4.065^{abc}	82.16 (65.03)^{abc}	96.00 (78.72)^{ab}
KPGB	200^{a-d}	650	1.860^{d}	42.335C	3.315C	75.33 (60.26)^{bc}	95.00 (77.14)$^{a-d}$
CC-1	184^{a}	628	2.215^{a-d}	45.785^{abc}	4.335^{abc}	77.16 (61.49)^{abc}	97.00 (80.04)^{a}
CSR-2	188^{ab}	641	2.495^{ab}	49.805^{ab}	5.230^{a}	82.33 (65. 18)^{abc}	91.83 (73.41)^{d}
CSR-27	219^{d}	661	2.290^{a-d}	43.220^{bc}	3.985^{abc}	80.67 (63.92)^{abc}	95.00 (77.19)$^{a-d}$
KSO-1	206^{a-d}	622	2.445^{abc}	52.235^{a}	5.160^{ab}	84.50 (66.82)^{ab}	95.00 (77.19)$^{a-d}$
APS-5	211^{bcd}	649	2.145^{a-d}	46.785^{abc}	3.935^{abc}	81.33 (64.42)^{abc}	92.17 (73.75)^{cd}
NB4D2	217^{d}	627	2.215^{a-d}	44.230^{bc}	3.825^{bc}	84.83 (67.09)^{a}	95.50 (77.81)^{abc}
NB_{18}	183^{a}	601	1.865^{d}	40.805C	4.185^{abc}	78.33 (62.26)^{abc}	94.16 (76.03)$^{a-d}$
CSR-4	218^{d}	636	2.610^{a}	45.525^{abc}	4.065^{abc}	79.17 (62.86)^{abc}	91.83 (73.40)^{d}
CSR-6	210^{bcd}	617	2.125^{a-d}	40.165^{c}	4.015^{abc}	75.83 (60.56)^{abc}	95.50 (77.81)^{d}
CSR-26	21Q^{bcd}	616	2.370^{a-d}	44.465^{bc}	4.305^{abc}	74.83 (59.91)^{c}	95.84 (78.23)^{abc}
APS-4	220^{d}	653	1995^{bcd}	40.455^{c}	3.165C	74.67 (59.82)^{c}	95.00 (77.10)$^{a-d}$
APS-8	211^{bcd}	660	2.275^{a-d}	42.865^{bc}	4.045^{abc}	74.66 (59.79)^{c}	96.33 (78.96)^{a}
NP-2	214^{cd}	623	2.320^{a-d}	50.300^{ab}	4.265^{abc}	80.50 (63.86)^{abc}	96.33 (78.97)^{a}
FTest	*	NS	*	**	**	**	**
S.Em±	8.606	-	0.119	1.559	0.280	1.910	0.717

Table 2. (Contd…)

Breeds	Pupal weight (g 10^{-1} pupae)	Fecundity (No.)	Cocoon weight (g 10^{-1} cocoon	Cocoon shell weight (g 10^{-1} shell	Cocoon shell ratio (%)	Coccon yield 25 dfls	Cocoon filament length (m)	Denier
SH-6	15.555^{abc}	513^{cd}	18.825^{bcd}	3.155^{bcd}	16.84 (24.22)^{bc*}	11.345^{de}	863.17^{cde}	2.53^{ab}
NB7	13.915^{bcd}	549^{abc}	16.910^{cd}	2.885^{cd}	17.01 (24.36)^{bc}	11.730^{cd}	816.33^{de}	2.08^{a}
KPGA	17.145^{a}	543^{abc}	20.6 10^{ab}	3.370^{bcd}	16.35 (23.84)^{c}	11.820^{cd}	952.67^{a-d}	2.69^{ab}
KPGB	14.145^{bcd}	592^{abc}	16.940^{cd}	2.760^{d}	16.33 (23.81)^{c}	11.950^{cd}	805.50^{de}	2.74^{ab}
CC-1	16.235^{abc}	501^{d}	19.650^{abc}	3.320^{bcd}	16.88(24.26)^{bc}	14.140^{ab}	83717^{cde}	2.46^{ab}
CSR-2	16.245^{abc}	57?^{abc}	20.370^{abc}	4.050^{ab}	19.90 (26.49)^{ab}	14.675^{a}	1066.17^{ab}	2.73^{ab}
CSR-27	14.470^{a-d}	529^{bcd}	18.550^{bcd}	3.565^{a-d}	19.74 (26.37)^{ab}	12.090^{cd}	1011.84^{abc}	2.63^{ab}
KSO-1	17.325^{a}	551^{abc}	22.925^{a}	4.455^{a}	19.32 (26.07)^{abc}	13.795^{ab}	1121.50^{a}	3.00^{b}
APS-5	14.755^{a-d}	531^{a-d}	18.425^{bcd}	3.440^{bcd}	18.68 (25.6 l)^{abc}	12.935^{bc}	730.006	2.04^{a}
NB4D2	16.010^{abc}	625^{a}	19.640^{abc}	3.445^{bcd}	17.61 (24.81)^{abc}	11.710^{cd}	880.83^{cde}	2.66^{ab}
NB_{18}	14.545^{a-d}	618^{ab}	17.915^{bcd}	3.195^{bcd}	17.85 (24.99)^{abc}	9.365^{f}	730.00^{e}	2.81^{ab}
CSR-4	14.940^{a-d}	531^{a-d}	18.740^{bcd}	3.690^{a-d}	19.66 (26.3 l)^{ab}	12.455^{cd}	1096.84^{a}	2.63^{ab}
CSR-6	13.630^{cd}	564^{abc}	17.255^{bcd}	3.525^{bcd}	20.36 (26.82)^{a}	10.450^{ef}	1114.17^{a}	2.49^{ab}
CSR-26	15.500^{abc}	567^{abc}	19.235^{bc}	3.755^{abc}	19.72 (26.37)^{ab}	13.955^{ab}	968.84^{a-d}	2.93^{ab}
APS-4	12.440^{d}	554^{abc}	15.710^{d}	2.900^{cd}	18.46 (25.44)^{abc}	10.480^{ef}	894.17^{b-e}	2.97^{b}
APS-8	14.970^{a-d}	565^{abc}	18.570^{bcd}	3.540^{a-d}	19.08 (25.91)^{abc}	13.675^{ab}	895.67^{b-e}	248^{ab}
NP-2	16.660^{ab}	550^{abc}	20.570^{ab}	3.800^{abc}	18.22 (25.27)^{abc}	14.835^{a}	912.20^{b-e}	2.94^{b}
FTest	**	**	**	**	**	**	**	*
S.Em±	0.617	19.530	0.737	0.197	0.673	0.273	39.153	0.170

! Figures in parentheses are angular transformed values, * Significant at 5 per cent, ** Significant at 1 per cent, NS- Non significant In vertical columns, means followed by similar letters are not different statistically by Duncan's multiple range test (CD = 0.05)

recorded on par fifth instar larval duration with NB7. The chawki larval weight was highest in CSR-4 (2.610 g 10^{-1} larvae), except NB7, KPGB, APS-4 and NB_{18} rest of the breeds were on par with CSR-4. The mature larval weight was significantly more in KSO-1 (52.235 g 10^{-1} larvae), followed by NP-2 (50.300 g 10^{-1} larvae), CSR-2 (49.805 g 10^{-1} larvae), APS-5 (46.785 g 10^{-1} larvae), CC-1 (45.785 g 10^{-1} larvae) and CSR-4 (45.525 g 10^{-1} larvae) and stastically all were on par. CSR-2 (5.230 cg^{-1} day) exhibited highest silk productivity, except NB_7 (3.755 cg^{-1} day), KPGB (3.315 cg^{-1} day) and APS-4 (3.165 cg^{-1} day) rest of the breeds were on par with CSR-2. The survival rate was significantly more in most of the breeds, except KPGB (75.33%), CSR-26 (74.83 %), APS-4 (74.67 %) and APS-8 (74.66 %). In rest of the breeds it varied from 85.00 per cent (SH-6) to 75.83 per cent (CSR-6). The pupation was highest in CC-1 (97.00 %), SH-6 (96.33 %), APS-8 (96.33 %) and NP-2 (96.33 %) and least in CSR-2 (91.83 %) and CSR-4 (91.83 %). The pupal weight was highest in KSO-1 (17.325 g 10^{-1} pupae) and KPGA (17.145 g 10^{-1} pupae), except KPGB (14.145 g 10^{-1} pupae), NB7 (13.915 g 10^{-1} pupae), CSR-6 (13.630 g 10^{-1} pupae) and APS-4 (12.440 g 10^{-1} pupae) rest of the breeds were on par with KSO-1. The fecundity was significantly more in NB_4D_2 (625), except CSR-27 and SH-6 rest of the breeds were on

Table 3. Evaluation index values for larval growth and development.

Breeds	Total larval duration	Fifth instar larval duration	Mean EI (Larval duration)	Chawki larval weight	Mature larval weight	Silk productivity	Survival	Pupation	Pupal weight	Fecundity
SH-6	44.75	40.06	42.40	49.47	50.94	48.71	65.46	59.18	52.68	44.82
NB7	44.56	34.79	39.67	34.95	39.77	43.43	44.54	37.32	40.18	48.99
KPGA	58.51	46.70	52.60	53.44	47.61	49.45	57.73	57.19	64.76	47.45
KPGB	59.18	47.20	53.19	33.85	43.50	34.96	39.09	51.23	41.98	59.54
CC-1	46.11	35.04	40.58	50.34	53.27	54.66	44.09	63.15	57.81	44.40
CSR-2	54.05	37.93	45.99	62.90	64.63	71.91	58.18	32.35	57.93	55.79
CSR-27	65.67	61.87	63.77	53.50	46.00	47.80	53.64	51.23	44.40	43.91
KSO-1	43.01	51.72	47.36	60.89	71.50	70.56	64.09	51.23	66.17	49.45
APS-5	58.51	55.23	56.87	48.97	56.09	48.93	57.46	46.34	48.58	48.32
NB4D2	45.62	59.49	52.55	50.10	48.87	44.78	65.00	54.21	56.13	67.87
NB_{18}	30.81	34.79	32.80	33.97	39.18	51.70	47.27	46.26	44.96	66.12
CSR-4	50.76	60.50	55.63	68.25	52.53	49.41	49.55	32.35	48.00	44.32
CSR-6	39.91	54.73	47.32	45.99	37.37	48.38	40.45	54.21	37.98	52.74
CSR-26	39.33	54.98	47.15	57.21	49.52	54.05	37.72	56.19	52.23	53.29
APS-4	61.02	62.13	61.57	39.98	38.19	31.97	37.27	51.23	28.95	50.03
APS-8	64.80	55.35	60.07	53.14	45.01	49.03	37.27	59.18	48.20	52.91
NP-2	43.40	57.49	50.44	55.05	66.04	53.28	53.18	59.18	61.08	49.03

Table 3. (Contd…)

Breeds	Cocoon weight	Cocoon shell weight	Cocoon shell ratio	Cocoon yield	Cocoon filament length	Denier	Mean EI
SH-6	49.70	46.93	46.72	45.08	47.20	46.23	50.24
NB7	38.61	36.48	39.96	45.52	41.46	29.83	40.08
KPGA	60.11	47.90	35.01	46.08	52.34	51.82	51.60
KPGB	38.77	33.68	34.89	46.92	40.60	53.80	42.52
CC-1	54.53	46.61	38.98	60.81	43.13	43.53	50.40
CSR-2	58.69	63.70	61.52	64.20	61.39	53.32	58.96
CSR-27	48.12	52.39	60.36	47.83	57.05	49.66	50.45
KSO-1	73.53	73.14	57.21	58.60	65.80	63.11	63.48
APS-5	50.40	51.53	52.45	53.17	43.58	45.63	50.11
NB4D2	54.46	49.67	44.48	45.39	46.61	50.98	52.19
NB18	44.43	43.77	46.25	30.52	34.58	56.14	45.01
CSR-4	49.21	55.36	59.74	50.11	63.83	49.96	51.74
CSR-6	40.59	51.46	64.99	37.42	65.21	44.79	47.81
CSR-26	52.11	56.90	60.22	59.66	53.63	60.71	54.11
APS-4	31.64	36.82	50.77	37.59	47.67	62.15	41.86
APS-8	48.25	51.83	55.43	57.88	47.79	44.37	50.02
NP-2	59.85	57.83	49.02	65.22	49.13	60.95	56.83

par with NB_4D_2. While, least eggs were obtained in CC-1 (510 eggs). The cocoon weight was highest in KSO-1 (22.925 g 10^{-1} cocoons), followed by KPGA (20.610 g 10^{-1} cocoons), NP-2 (20.570 g 10^{-1} cocoons), CSR-2 (20.370 g 10^{-1} cocoons) and NB_4D_2 (19.640 g 10^{-1} cocoons) and all were on par. The shell weight was highest in KSO-1 (4.455 g 10^{-1} shells), CSR-2 (4.050 g/shells), NP-2 (3.800 g 10^{-1} shells), CSR-26 (3.755 g 10^{-1} shells), CSR-4 (3.690 g 10^{-1} shells), CSR-27 (3.565 g 10^{-1} shells) and APS-8 (3.540 g 10^{-1} shells). The cocoon shell ratio was highest in CSR-6 (20.36 %), except CC-1, KPGB, KPGA, NB7 and SH-6 rest of the breeds were on par with CSR-6. The cocoon yield was significantly high in NP-2 (14.835 kgs 25^{-1} dfls) and CSR-2 (14.675 kg 25^{-1} dfls), followed by CC-1 (14.140 kg 25^{-1} dfls), CSR-26 (13.955 kg 25^{-1} dfls), KSO-1 (13.795 kg 25^{-1} dfls) and APS-8 (13.675 kg 25^{-1} dfls) and were on par. The cocoon filament length was more in KSO-1 (1121.50 m), CSR-6 (1114.17 m) and CSR-4 (1096.84 m). While, CSR-2 (1066.17 m), CSR-27 (1011.84 m), CSR-26 (968.84 m) and KPGA (952.67 m) were on par with KSO-1. The cocoon filament was finer in most of the breeds except NP-2, APS-4 and KSO-1.

The average evaluation index value for larval duration was in desired in NB_{18} (32.80), NB7 (39.67), CC-1 (40.58), SH-6 (42.40), CSR-2 (45.99), CSR-26 (47.15), CSR-6 (47.32) and KSO-1 (47.36). While, in rest of the traits contributing to silk yield, the breeds, KSO-1 (63.48), CSR-2 (58.96), NP-2 (56.83), CSR-26 (54.11), NB_4D_2(52.19), CSR-4 (51.74), KPGA (51.60), CSR-27 (50.45), CC-1 (50.40), SH-6 (50.24), APS-5 (50.11) and APS-8 (50.02) recorded the average index value above 50 (Table 3).

The study revealed that all the seventeen breeds exhibited their superiority in various traits. KSO-1 and CSR-2 showed better performance in thirteen traits studied and NP-2 for eleven traits. KPGA, CC-1, CSR-4 and CSR-26 were superior in ten traits each. While, APS-5, NB_4D_2, NB_{18} and CSR-6 recorded their superiority for eight and SH-6 for seven traits. Rest of the breeds viz., NB_7, KPGB, NB_{18}, CSR-6 and APS-4 found to be inferior for the traits studied as they scored less than 50 average multiple traits evaluation index value. These observations confirm the established fact that superiority in one or a couple of traits may not reflect the overall merit of the genotype (Vidyunmala *et al*. 1998). Since, the comprehensive merit of the genotypes over a range of traits depends on relative superiority of many individual traits, selection need to be based on multiple traits analysis comprising viable, quantitative and qualitative traits. It is highly imperative to consider the contribution of various traits to the overall silk output as opined by Singh and Subba Rao (1993).

Multiple traits evaluation index method of Mano *et al.* (1993) has become a very useful tool for evaluation and identification of promising silkworm breeds/hybrids and is widely being applied by many silkworm breeder (Jaiswal and Goel, 2003; Naseema Begum *et al*. 2003, Ramesh Babu *et al*. 2005). Considering the average evaluation index value for the larval duration SH-6, NB7, KPGB, CC-1, CSR-2, KSO-1, NB_{18}, CSR-6 and CSR-26 can be used as a promising parents for evolving shorter larval duration hybrids. While, based on the average evaluation index values of the traits contributing for the silk production, SH-6, KPGA, CC-1, CSR-27, KSO-1, APS-5, CSR-2 NB_4D_2, CSR-4, CSR-26, APS-8 and NP-2 were found to be promising by recording more than 50 average multiple traits index value. By considering the rearing performance and multiple traits index values the above mentioned breeds may be used as a potential parents for developing a productive hybrids

suitable to the agro climatic conditions of non traditional region of the tropics.

References

Bongale, U. D. and Raghuraman, K. 1999. Bivoltine in Karnataka. Indian Textile 109(4): 20-23.

Dandin, S. B., Basavaraja, H. K. and Suresh Kumar, N. 2005. Silkworm Breeds and Hybrids at Galore. Central Silk Board, Bangalore,p.47.

Dandin, S. B., Jayaswal, J. and Giridhar, K. 2000. Handbook of Sericulture Technologies, Central Silk Board, Bangalore, pp. 117-198.

Datta, R. K. 2000. Silkworm breeding in India; Present status and new challenges. Natl. Conf. Strat. Seri. Res. Dev., Central Ser. Res. and Traini. Inst., Mysore, 16-18, Nov., pp. 12-20.

Jaiswal, K. and Goel, R. 2003. Evaluaiton and identification of promising bivoltine hybrids of silkworm, *Bombyx mori* L. for monsoon and spring season of Uttar Pradesh. Int. J. Indust. Entomol., 6(2): 183-190.

Mano, Y., Nirmal Kumar, S., Basavaraja, H. K., Mal Reddy, N. and Datta, R. K. 1993. A new method to select promising silkworm breeds/combinations. Indian Silk, 31(10), p. 53.

Naseema Begum, A., Rekha, M., Basavaraja, H. K. and Ahasn, M. M. 2003. Evolution and indentification of thermo tolerant hybrids in the silkworm, *Bombyx mori* L. Int. J. Indust. Entomol., 6(2): 171-178.

Ramesh Babu, M., Lakshmi, H., Prasad, J., Seetharamulu, J., Chandrashekharaiah and Goel., A. K. 2005. Evaluation and selection of potential bivoltine parents for silkworm (*Bombyx mori* L.) breeding. Indian J. Seric., 44: 82-91.

Singh, T. and Subba Rao, G. 1993. Multiple trait evaluation to select useful silkworm (*Bombyx mori* L.) hybrid genotypes. Italian Entomol., 6: 370-382.

Snedecor, G.W. and Cockhran, W.G. 1979. Statistical Mehtods. Iowa State Univ. Press, Ames, Iowa, p.593.

Thiagarajan, V., Bhargava, S.K., Ramesh Babu, M. and Nagaraju, B. 1993. Differences in seasonal performance of twenty six strains of silkworm, Bombyx moriL. (*Bombyx mori* L.). J. Lepidoptera Soc. America, 47: 331-337.

Vidyunmala, S., Narasimha Murthy, B. and Sivarami Reddy. 1998. Evaluation of new mulberry silkworm (*Bombyx mori* L.) hybrids (multivoltine x bivoltine) through multiple traits evaluation index. J. Entomol. Res., 22: 49-53.

J. Agric. Res. Technol., 37 (1) : 077-082 (2012)

Diversity of Fluorescent Pseudomonads from Western Ghats of Uttara Kannada District of Karnataka for *in-vitro* Phosphate Solubilization*

D. V. Indi[1] and A. R. Alagawadi[2]
Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad - 580 005 (India)
(Received : 20-12-2010)

Abstract

Out of 133 fluorescent pseudomonad isolates from Uttara Kannada district of Karnataka, 86 isolates were tentatively identified as *Pseudomonas fluorescens*, 45 as *P. aeruginosa* and 2 as *P. aureofaciens*. Out of 133 isolates, 70 were positive for P solubilization on Pikovskaya's agar. The diameter of the zone of P solubilization ranged from 7 mm (DF 521(3), MDF 59(8) and SEF 43(2)) to 20 mm (DDF 164(1)). The isolates released 4.05 to 48.15 and 11.85 to 60.60 per cent Pi from TCP after 7 and 14 days of incubation respectively. After 7 days of incubation, DF 521(1) recorded the highest Pi released (48.15 %) followed by EGF 67(1), MDF 309(2), SEF 232(1), MDF 329(4) and DF 521(3). After 14 days, DDF 101(3) was significantly superior (60.60% Pi) to all others followed by SEF 233(1), DF 521(1) and SEF 386(2) with 57.93, 50.23 and 47.76 per cent Pi released respectively and were significantly superior to the rest of the isolates. At 7 days of incubation, the least pH (4.16) was noted in SEF 386(2) followed by DF 521(1), MDF 360(2), DDF 39(4) and DF 521(3) whereas after 14 days, DDF 101(3) recorded significant reduction in pH (pH 3.48) followed by SEF 232 (1), MDF 235 (1), SEF 357 (2) and MDF 329 (4). The decrease in pH of the medium and the amount of Pi released had a non-significant but positive correlation (r = +0.152) at 7 days whereas at 14 days, they had highly significant positive correlation (r = +0.342**). The studies on organic acid production profile of the 24 efficient isolates showed 18 isolates each to produce gluconic and succinic acid, 9 to produce citric acid and 22 to produce an unidentified acid. The overall results indicated the existence of diversity among the isolates with respect to phosphate solubilization.

Key words : Fluorescent pseudomonads, diversity, plant growth promoting rhizobacteria, phosphate solubilization, organic acids.

Amongst the plant growth promoting rhizobacteria, fluorescent pseudomonads have emerged as the largest and potentially the most promising group owing to their rapid growth, aggressive soil and root colonization, simple nutritional requirements and a wider preference for different organic substrates. Many members of the fluorescent pseudomonads are beneficial to crop plants due to their multi-functional properties of nutrient mobilization, production of plant growth promoting substances and biocontrol ability. They are known for the potential to solubilize insoluble inorganic phosphates (Jha *et al*. 2009 and Buch *et al*. 2010). The P solubilizing fluorescent pseudomonads have been isolated from coconut rhizosphere (Nair and Subba Rao, 1997), forest soils (Di Simine *et al*. 1998) and alkaline and Ca-rich soils with low available P (Gulati *et al*. 2008). Thus, the fluorescent pseudomonads play an important role in sustaining agricultural production through disease control and plant growth promotion.

The present investigation was undertaken to study the diversity of fluorescent pseudomonads from different forest soils of Western Ghats of Uttara Kannada district of Karnataka state with respect to phosphate solubilization.

*Part of Ph.D, thesis submitted by the senior author to University of Agricultural Sciences, Dharwad.

1. Asstt. Professor, CSRS, Padegaon and 2. Dean (Agri.), A.C., Bijapur.

Materials and Methods

The research work was undertaken to characterize and identify 133 fluorescent pseudomonads isolated from different forest soils of the Western Ghats of Uttara Kannada district of Karnataka state and maintained in the culture bank of Department of Agricultural Microbiology, University of Agricultural Sciences, Dharwad and study their diversity with respect to *in-vitro* solubilization of insoluble inorganic phosphorus.

Table 1. Zone of P solubilization on Pikovskaya's agar and per cent Pi released in TCP broth by the fluorescent pseudomonad isolates.

Isolates	Zone of P solubilization on TCP (mm)	% Pi realeased from TCP		Decrease in pH of medium	
		7 DAI	14 DAI	7 DAI	14 DAI
Dry deciduous forest (DDF) :					
DDF 101 (2)	11.0	25.64	35.07	5.15	4.66
DDF 101 (3)	13.0	12.97	60.60	5.10	3.48
DDF 103 (1)	11.0	6.94	26.82	4.62	4.22
DDF 103 (2)	10.0	26.40	28.60	4.62	4.17
DDF 103 (4)	8.0	6.79	25.24	4.57	4.15
DDF 164 (1)	20.0	21.13	23.01	4.89	4.47
DDF 164 (2)	11.0	26.76	28.45	4.95	4.57
DDF 248 (1)	13.0	10.44	28.60	5.09	4.92
DDF 348 (1)	12.0	11.81	32.50	4.84	4.41
DDF 38	8.0	22.65	34.13	4.57	4.21
DDF 39 (4)	9.0	10.14	32.20	4.34	4.32
DDF 40	12.0	12.01	35.07	4.69	4.29
DDF 70	10.0	6.54	23.01	4.95	4.34
Degraded forest (DF) :					
DF 139 (1)	10.0	19.97	29.04	5.09	4.86
DF 139 (2)	9.0	5.52	30.52	4.62	4.21
DF 440 (1)	8.0	9.73	41.44	5.07	4.10
DF 503	9.0	7.35	25.04	4.65	4.28
DF 521 (1)	10.0	48.15	50.23	4.19	3.98
DF 521 (3)	7.0	30.26	42.52	4.35	4.24
DF 75	10.0	20.88	24.50	4.66	4.20
Evergreen forest (EGF) :					
EGF271 (1)	10.0	13.48	17.83	5.09	5.02
EGF 271 (2)	12.0	7.75	24.50	5.11	4.90
EGF 275(1)	12.0	28.13	28.50	5.11	4.59
EGF 277	11.0	8.56	39.16	4.59	4.14
EGF 280 (2)	11.0	14.04	15.41	5.57	5.02
EGF 280 (3)	12.0	21.49	24.79	4.83	4.42
EGF 284 (1)	10.0	9.17	20.25	4.55	4.11
EGF 285 (1)	8.0	7.15	26.92	5.21	4.64
EGF 285 (2)	11.0	9.83	26.82	4.99	4.66
EGF 316 (1)	9.0	10.85	24.15	4.99	4.61
EGF 334 (1)	12.0	10.34	21.04	5.12	4.62
EGF 334 (6)	10.0	24.58	27.71	4.70	4.20
EGF 343 (4)	9.0	20.07	22.27	4.75	4.41
EGF 357 (4)	9.0	9.98	20.74	4.93	4.41
EGF 359 (3)	12.0	11.91	21.63	5.39	4.94
EGF 374 (2)	8.0	9.68	22.08	5.24	5.07
EGF 395 (1)	11.0	23.36	28.10	4.99	4.54
EGF 396 (3)	9.0	5.83	22.42	4.67	4.38
EGF 506 (1)	10.0	7.40	23.41	5.22	4.63
EGF 507(1)	9.0	20.58	22.08	4.70	4.29
EGF 67 (1)	8.0	44.50	45.19	4.71	4.61

All the 133 isolates were studied for morphological and biochemical characters as per the standard procedures given by Barthalomew and Mittewar (1950), Anonymous (1957) and Cappuccino and Sherman (1992). The ability of the isolates to grow at 4°C and 41°C temperature and utilize different carbon sources *viz*., glucose, meso-inositol, trehalose, L-arginine, L-valine and β-alanine for growth was also studied.

For studying functional diversity, the isolates were tested for solubilization of tricalcium phosphate (TCP) by spotting 10 µl overnight cultures on Pikovskaya's agar, incubating at 28-30°C for 2-3 days and observing for clear zone of solubilization of TCP around the colony. The diameter of the zone of TCP solubilization was measured. Seventy isolates positive for P solubilization on agar medium were further subjected to quantification of Pi released in TCP broth (Pikovskaya, 1948) after 7 and 14 days of incubation by using phosphomolybdic blue colour method (Jackson, 1973). The reduction in pH of TCP broth from initially adjusted pH of 7.0 was also noted after 7 and 14 days of

Table 1. contd.

Isolates	Zone of P solubilization on TCP (mm)	% Pi realeased from TCP		Decrease in pH of medium	
		7 DAI	14 DAI	7 DAI	14 DAI
Moist deciduous forest (MDF) :					
MDF 176 (3)	10.0	12.77	16.20	5.02	4.63
MDF 202 (1)	11.0	4.05	11.85	5.60	4.66
MDF 235 (1)	8.0	7.96	29.93	4.62	3.80
MDF 309 (2)	12.0	37.10	39.31	5.16	4.85
MDF 321 (2)	12.0	14.34	17.38	4.93	4.37
MDF 329 (2)	11.0	9.07	35.36	4.79	4.25
MDF 329 (4)	10.0	30.46	39.56	4.79	3.97
MDF 360 (2)	8.0	9.38	27.56	4.32	4.17
MDF 420 (1)	9.0	13.84	40.79	5.12	5.01
MDF 448 (1)	9.0	8.72	32.74	5.78	5.06
MDF 449 (1)	10.0	26.56	32.55	4.60	4.10
MDF 481	10.0	9.32	32.74	4.59	4.19
MDF 512 (1)	12.0	29.14	31.21	5.28	5.13
MDF 518 (2)	10.0	20.17	25.34	5.09	4.56
MDF 56 (1)	10.0	22.75	26.22	4.90	4.70
MDF 59 (1)	8.0	6.49	22.18	4.71	4.15
MDF 59 (8)	7.0	12.82	27.46	4.48	4.33
MDF 68 (3)	11.0	6.03	26.47	4.69	4.10
Semi-evergreen forest (SEF) :					
SEF 177 (2)	8.0	19.26	21.38	4.75	4.21
SEF 232 (1)	11.0	30.51	40.60	4.46	3.78
SEF 233(1)	11.0	20.27	57.93	4.87	4.52
SEF 340 (2)	10.0	15.31	23.31	5.20	4.69
SEF 357 (2)	12.0	11.61	30.13	4.37	3.82
SEF 357 (3)	9.0	7.55	18.92	4.62	4.24
SEF 386 (2)	9.0	13.63	47.76	4.16	4.09
SEF 389 (1)	8.0	7.10	25.63	4.61	4.12
SEF 43 (2)	7.0	9.68	13.98	5.07	4.50
SEF 494 (1)	12.0	18.55	19.95	4.76	4.26
SEF 494 (2)	11.0	12.77	22.47	5.45	5.09
S.E.±		0.24	0.28	0.01	0.01
C.D. at 1 %		0.88	1.05	0.04	0.05
Correlation (r value) of Pi released with decrease in pH of the medium				+0.152	+0.342**

Where, DAI = Days after inoculation

incubation so as to monitor the change in pH and study its correlation with the Pi released. A total of 24 isolates showing high P solubilization in TCP broth were further studied for the profile of organic acids produced by using paper chromatography (Gaur, 1990). The statistical analyses of the data were carried out and the critical differences were calculated at P = 0.01 wherever F tests were significant (Panse and Sukhatme, 1985).

Results and Discussion

On the basis of morphological and biochemical and physiological characteristics and their capability to grow at 4°C and 41°C temperature, 86 isolates were tentatively identified as *Pseudomonas fluorescens*, 45 as *P. aeruginosa* and two as *P. aureofaciens*.

The data on zone of TCP solubilization on Pikovskaya's agar, Pi released in TCP broth and reduction in pH of the broth after 7 and 14 days are presented in Table 1. Out of 133 isolates, 70 showed clear zone of TCP solubilization on Pikovskaya's agar plates and the diameter of zone ranged from 7 mm (DF 521(3), MDF 59(8) and SEF 43(2)) to 20 mm (DDF 164(1)). These 70 isolates were studied for quantitative estimation of Pi released in Pikovskaya's broth. After 7 days of incubation, the amount of Pi released from TCP ranged from 4.05 to 48.15 per cent. The isolate DF 521(1) was significantly superior (48.15 %) to the others. The isolates, EGF 67 (1), MDF 309 (2), SEF 232 (1), MDF 329 (4) and DF 521 (3) released 44.5, 37.10, 30.51, 30.46 and 30.26 per cent Pi respectively and were significantly superior to remaining isolates. After 14 days of incubation, the amount of Pi released by the isolates ranged from 11.85 to 60.60 per cent. DDF 101 (3) was significantly superior (60.60 %) to all others followed by SEF 233 (1), DF 521 (1) and SEF 386 (2) which released 57.93, 50.23 and 47.76 per cent Pi respectively and were significantly superior to the rest of the isolates. Megha *et al*. (2007) reported P solubilizing ability of fluorescent pseudomonads from Western Ghats of Uttara Kannada district wherein the zone of TCP solubilization ranged from 2 to 14 mm with the release of 1.78 to 15.44 per cent Pi from TCP. Naik *et al*. (2008) isolated 95 fluorescent pseudomonads from banana rhizosphere and found 50 of them to solubilize TCP. Gulati *et al*. (2008) identified 12 isolates of fluorescent pseudomonads exhibiting high solubilization of TCP in liquid culture.

At 7 days, the least pH (4.16) was noted in SEF 386(2) followed by DF 521(1), MDF 360(2), DDF 39(4) and DF 521(3) which reduced the pH to 4.19, 4.32, 4.34 and 4.35

Table 2. Profile of different organic acids produced by high phosphate solubilizing fluorescent pseudomonad isolates.

Isolates	Gluconic acid	Citric acid	Tartaric acid	Malic acid	Succinic acid	Oxalic acid	Unidentified acid
DDF 101 (2)	+	+	–	–	–	–	+
DDF 101 (3)	+	+	–	–	+	–	+
DDF 348 (1)	–	–	–	–	+	–	+
DDF 38	+	–	–	–	–	–	+
DDF 39 (4)	–	–	–	–	+	–	+
DDF 40	+	–	–	–	–	–	+
DF139 (2)	–	–	–	–	+	–	+
DF 440 (1)	+	–	–	–	+	–	+
DF521 (1)	+	+	–	–	+	–	+
DF521 (3)	+	–	–	–	+	–	+
EGF 277	+	+	–	–	–	–	+
EGF67(1)	+	+	–	–	+	–	+
MDF 309 (2)	+	+	–	–	–	–	–
MDF 329 (2)	+	+	–	–	–	–	+
MDF 329 (4)	+	–	–	–	+	–	+
MDF 420 (1)	+	–	–	–	+	–	+
MDF 448 (1)	+	–	–	–	+	–	+
MDF 449(1)	–	–	–	–	+	–	+
MDF 481	–	–	–	–	+	–	+
MDF 512 (1)	–	–	–	–	+	–	+
SEF 232 (1)	+	–	–	–	+	–	+
SEF 233 (1)	+	+	–	–	+	–	+
SEF 357 (2)	+	–	–	–	+	–	–
SEF 386 (2)	+	+	–	–	+	–	+

Where, + Produced, – Not produced

respectively. At 14 days, DDF 101(3) recorded the least pH (3.48) followed by SEF 232(1), MDF 235 (1), SEF 357 (2) and MDF 329 (4) which reduced the pH to 3.78, 3.80, 3.82 and 3.97 respectively. At 7 days of incubation, decrease in pH of the broth had a non-significant but positive correlation (r = 0.152) with the amount of Pi released while they had a highly significant positive correlation (r = 0.342**) at 14 days. Jha *et al*. (2009) also reported decrease in pH of the medium during TCP solubilization by 3 fluorescent pseudomonad strains due to the production of organic acids.

The organic acid production profile of 24 efficient isolates showed that, in all four acids were produced (Table 2). Five isolates *viz*., DDF 101(3), DF 521(1), EGF 67(1), SEF 233(1) and SEF 386(2) showing high P solubilization, produced four acids each. Nine isolates produced three acids each whereas, ten isolates produced two acids each. Eighteen isolates each produced gluconic and succinic acid, 9 produced citric acid and 22 produced an unidentified acid. None of the isolates produced tartaric, malic and oxalic acids. Production of organic acids is a major mechanism involved in P solubilization. Gluconic acid was the most common acid produced by 18 of the 24 isolates indicating the probable existence of direct oxidation pathway involving the membrane bound glucose dehydrogenase for utilization of glucose. Gluconic acid is the commonly produced organic acid by P solubilizing fluorescent pseudomonads (Van Schie *et al*. 1984, Goldstein, 1995 and Di Simine *et al*. 1998). The role of citric acid in P solubilization has been envisaged by Vassileva *et al*. (2000). In the present studies, the high levels of solubilized P and synthesized organic acids in efficient isolates together with decreased pH of the medium confirm their role in P solubilization. The overall results indicated the existence of diversity among the isolates with respect to phosphate solubilization.

References

Anonymous. 1957. Manual of Microbiological Methods, McGraw Hill Book Co. Inc., New York.

Barthalomew, J. W. and Mittewar, T. 1950. A simplied bacterial stain. Stain Tech. 25: 153.

Buch, A., Archana, G. and Naresh Kumar, G. 2010. Heterologous expression of phosphoenolpyruvate carboxylase enhances the phosphate solubilizing ability of fluorescent pseudomonads by altering the glucose catabolism to improve biomass yield. Bioresource Tech. 101(2): 679-687.

Cappuccino, J. G. and Sherman, N. 1992. Microbiology: A Laboratory Manual, The Benjamin/Cummins Publ. Co. Inc., California.

Di Simine, C. D., Sayer, J. A. and Gadd, G. M. 1998. Solubilization of zinc phosphate by a strain of *Pseudomonas fluorescens* isolated from forest soils. Biol. Fertil. Soils 28: 87-94.

Gaur, A. C. 1990. Phosphate Solubilzing Microorganisms as Biofertilizer, Omega Scientific Publ., New Delhi, India.

Goldstein, A. H. 1995. Recent progress in understanding the molecular genetics and biochemistry of calcium phosphate solubilization by gram negative bacteria. Biol. Agric. Hort. 22: 185-193.

Gulati, A., Rahi, P. and Vyas, P. 2008. Characterization of phosphate-solubilizing fluorescent pseudomonads from the rhizosphere of seabuckthorn growing in the cold deserts of Himalayas. Curr. Microbiol. 56(1): 73-79.

Jackson, M. L. 1973, Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.

Jha, B. K., Pragash, M. G., Cletus, J., Raman, G. and Sakthivel, N. 2009. Simultaneous phosphate solubilization potential and antifungal activity of new fluorescent pseudomonad strains, *Pseudomonas aeruginosa*, *P. plecoglossicida* and *P. mosselii*. World J. Microbiol. Biotechnol. 25(4): 573-581.

Megha, Y. J., Alagawadi, A. R and Krishnaraj, P. U. 2007. Multiple beneficial functions of fluorescent pseudomonads of Western Ghats of Uttara Kannada district. Karnataka J. Agric. Sci. 20(2):.

Naik, P. R., Sahod, N., Goswami, D., Ayyadurai, N. and Sakthivel, N. 2008. Genetic and functional diversity among fluorescent pseudomonads isolated from the rhizosphere of banana. Microb. Ecol. 56(3): 492-504.

Nair, S. K. and Subba Rao, N. S. 1997. Distribution and activity of phosphate solubilizing microorganisms in the rhizosphere of coconut and cocoa under mixed cropping. J. Plant. Crops 5: 67-70.

Panse, V. S. and Sukhatme, P. V. 1985. Statistical Methods for Agricultural Workers, ICAR, New Delhi.

Pikovskaya, R. I., 1948. Mobilization of phosphorous in soil in connection with vital activity of some microbial species. Mikrobiologiya 17: 302-370.

Van Schie, J. J., Vadijken, J. P. and Kuenen, J. G. 1984. Non-coordinated synthesis of glucose dehydrogenase and its prosthetic group PQQ in *Acinetobacter* and *Pseudomonas* species. FEMS Microbiol. Letters 24: 133.

Vassileva, M., Azcon, R., Barea, J. M. and Vassileva, N. 2000. Rock phosphate solubilization by free and encapsulated cells of *Yarowia lipolytica*. Process Biochem. 35: 693-697.

J. Agric. Res. Technol., 37 (1) : 082-086 (2012)

Seasonal Incidence of Two Spotted Spider Mite (*Tetranchus urticae* Koch.) on Gerbera under Polyhouse Condition

V. D. Dhage[1], M. M. Suryawanshi[2], A. S. Dhane[3] and S. S. Shelke[4]
Department of Entomology, College of Agriculture, Pune - 411 005 (India)
(Received : 27-02-2011)

Abstract

Seasonal incidence of two spotted spider mite (*Tetranychas urticae* Koch.) on gerbera under polyhouse condition showed highly significant positive correlation with RH-I and RH-II. Regression analysis indicated that the 57 and 63 per cent variation in mite population on leaves and flowers, respectively was caused due to meteorological parameters.

Key words : *Tetranychus urticae*, two spotted spider mite, Gerbera.

Gerbera (*Gerbera jamesonii* Hooker) occupies 4th, position among the top ten cut flowers (Palsingh, 2001). The plant is commonly known as Transvaal Daisy, Sarbeton daisy, Agrican daisy (Rajhans, 2003).

Gerbera is attacked by 10 insect pests, several acari, 3 nematodes and 7 fungal diseases (Karoly and Gyozo 1999) .Of the pests attacking polyhouse gerbera, the two spotted spider mite, *Tetranychus urticae* Koch, is one of the most destructive pest (Bhattacharya, 1997). The pest is of regular occurrence in Maharashtra state and has become a serious menace. The two spotted spider mite, *Tetranychus urticae* Koch, Acarina : Tetranychidae) is a devastating pest in polyhouse cultivation (Jhansi Rani and Mohan, 1997). A heavy infestation causes leaves to yellow and drop. Webs of the mites in heavy infestation may cover foliage and flowers, leads to cause considerable economic damage to crop (Gill and Sanderson, 1998).

The small size, fast developmental rate and high reproductive potential make it difficult to control them. Further major problem associated with their control is development of resistance to acaricides. Climatic factors play, important role in suppressing the pest population.

1. M.Sc (Agri.) student, 2. Manager, 3. Jr. Res. Asstt. and 4. Asstt. Professor.

Consideration of effect of meteorological parameters on red spider mite. (*T. urticae*) is very much essential. The present investigation determines the effect of meteorological parameters on incidence of mite (*T. urticae*) on gerbera.

Materials and Methods

The investigation was carried out under polyhouse condition at Hi-Tech Floriculture and Vegetable Project, College of Agriculture, Pune (Maharashtra) during last week of March 2008 to last week of October 2008 on gerbera cultivar Full-moon in a plot size 4.50 x 0.60 m with spacing 30 x 30 cm.

The population count was taken at weekly interval (meteorological weeks). For this purpose, five plants from each treatment were selected at random and tagged for recording observations of pest. One flower and three leaves each from upper, middle and lower

Table 1. Seasonal incidence of mites (*Tetranychus urticae* Koch) on gerbera under polyhouse condition.

M.W.	Meterological parameters					Average survival population	
	T_{max}	T_{min}	RHI	RHII	BSH	Mites leaf^{-1}	Mites flower^{-1}
14	34.80	18.50	75.00	26.00	9.50	49.28	30.15
15	39.20	21.30	61.00	20.00	9.10	58.65	37.40
16	38.90	20.80	55.00	16.00	10.50	52.87	35.72
17	39.90	24.10	62.00	23.00	8.80	53.12	34.69
18	37.60	22.50	59.00	27.00	10.60	48.40	31.46
19	37.00	23.10	73.00	26.00	10.70	46.14	27.65
20	36.60	24.30	72.00	36.00	11.30	47.66	28.12
21	37.80	24.30	75.00	38.00	4.20	48.08	32.34
22	38.70	25.40	72.00	35.00	2.00	55.82	34.42
23	32.10	23.60	85.00	72.00	2.90	42.66	24.68
24	29.60	24.10	83.00	68.00	2.50	38.88	23.56
25	30.40	23.30	83.00	60.00	4.40	37.72	21.96
26	29.90	23.70	87.00	75.00	4.70	38.14	23.37
27	28.90	25.40	84.00	71.00	5.00	58.30	37.16
28	29.70	23.20	85.00	63.00	1.40	30.92	22.84
29	27.50	22.90	88.00	75.00	2.00	32.67	19.92
30	29.80	23.00	90.00	77.00	0.20	29.44	23.40
31	27.80	22.80	92.00	82.00	1.80	24.12	14.84
32	26.30	21.80	86.00	62.00	7.10	19.08	11.60
33	27.80	22.70	90.00	58.00	5.50	21.71	24.28
34	30.10	21.60	91.00	70.00	3.80	20.16	8.87
35	32.00	23.30	91.00	76.00	0.90	17.96	18.46
36	28.70	22.40	90.00	75.00	3.40	16.62	7.92
37	28.50	22.40	90.00	49.00	8.50	22.84	13.52
38	28.00	21.40	89.00	61.00	7.10	26.40	17.64
39	32.40	23.20	93.00	48.00	7.00	34.68	26.66
40	31.90	21.80	89.00	74.00	8.90	39.74	30.28
41	34.20	21.50	91.00	75.00	9.90	45.69	33.65
42	34.70	18.90	89.00	38.00	9.70	56.88	32.37
43	32.90	16.00	88.00	30.00	9.70	18.62	7.92
44	30.20	17.20	86.00	31.00	7.80	41.66	8.74

RH = Relative humidity, BSH = Bright sunshine hour.

canopy of the plants were considered for recording the observation. The mite count was taken with the help of 10X magnifying lens, according to the method followed by Hole and Salunkhe (2005). Meteorological parameters were recorded during that period.

Results and Discussion

On leaf : The data presented in Table 1 revealed that mite population build up started from 14th meteorological week at weekly average, T_{max}, T_{min}, RH-I, RH-II and B S.H. were 34.80, 18.50°C, 75, 26 per cent and 9.50 hrs., respectively. Thereafter the population was increased and recorded its first peak (58.65 average mites leaf^{-1}) at 15th meteorological week when weekly average, T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 39.20, 21.30°C, 61, 20 per cent 10 hrs., respectively. At 27th meteorological week, it was suddenly increased and 2nd peak (58.30 mites leaf^{-1}) was observed when weekly average T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 28.90, 25.40°C, 84, 71 per cent and 5.00 hrs., respectively.

Thereafter the population was started to decrease and reached its lowest population (16.62 mites leaf^{-1}) at 36th meteorological week when weekly average, T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 28.50, 22.40°C, 90, 75 per cent and 3.40 hrs. respectively.

The pest population was started to increase from 37th meteorological week and reached its 3rd peak at 42nd meteorological week when weekly average, T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 34.70, 18.90°C, 89, 38 per cent and 9.70 hrs., respectively. During 43rd meteorological week there was suddenly decline in pest population.

On flower : It could be observed from the data presented in Table 1, that mite population build up started from 14th meteorological week at weekly average, T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 34.80, 18.50°C, 75, 26 per cent and 9.50 hrs., respectively. Thereafter the population was increased and recorded its first peak (37.40 average mites/flower) at 15th meteorological week when weekly average, T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 39.20, 21.30°C, 61, 20 per cent and 9.10 hrs., respectively. Then the population remains somewhat constant up to 26 meteorological week. At 27th meteorological week i.e. last week of May, it was suddenly increased and 2nd peak of mite population (37.16 average mites flower^{-1}) was observed when weekly average, T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 28.90, 25.40°C, 84, 71 per cent and 5.00 hrs., respectively.

Table 2. Correlation and regression co-efficient values of mites on leaf and flower of gerbera with respect to weather parameters.

Wheather parameters	Correlation co-efficient		Regression co-efficient	
	Mites on leaf	Mites on flower	Mites on leaf	Mites on flower
Maximum temperature	0.726**	0.685**	1.78	1.53
Minimum temperature	0.142	0.356*	0.98	1.42
Morning relative humidity	-0.669**	-0.602**	-0.26	-0.13
Evening relative humidity	-0.554**	-0.368*	0.06	0.15
Bright sunshine hours	0.398*	0.289*	0.67	0.71
A value	-	-	76.00	79.00
R value	-	-	0.57	0.63

*, ** significant at 5 and 1 per cent respectively.

Thereafter, the pest population was started to decrease and reached its lowest population (7.92 avg. mites flower^{-1}) at 36th meteorological week when weekly average. T_{max}, T_{min}. RH-I, RH-II and B.S.H. were 28.70, 22.40°C, 90, 75 per cent and 3.40 hrs., respectively.

The pest population was started to increase from 37th meteorological week and attained its 3rd peak, in 41st meteorological week when weekly average, T_{max}, T_{min}, RH-I, RH-II and B.S.H. were 34.20, 21.50 °C, 91, 75 per cent and 9.90 hrs., respectively. During 43rd meteorological week there was suddenly decline in pest population.

Correlation : Correlation analysis of *Tetranychus urticae* Koch, population on leaf with meteorological parameters revealed highly significant positive correlation with T_{max} (r=0.726) and positive non significant correlation with T_{min} (r=0.142) and significant positive correlation with B.S.H. (r=0.398), while it was highly significant negative correlation with RH-I (r= -0.669) and RH-II (r= -0.544). The present finding showed that fluctuation in mite population was significantly and positively correlated with T_{max} and bright sunshine hours but non significant and positively correlated with T_{min}, whereas significantly and negatively correlated with RH-I and RH-II. It indicated that dry weather found to be congenial for mite multiplication. The results are confirmative with the result of Hole and Salunkhe (2005).

Correlation analysis of *Tetranychus urticae* Koch, population on flower with meteorological parameters showed highly significantly positive correlation with T_{max} (r = 0.685) and positive significant correlation with T_{min} (r = 0.356) and B.S.H. (r = 0.289) while it was highly significant negative correlation with RH-I (r = -0.602) and significant negative correlation with RH-II (r = -0.368).The present finding suggested that the fluctuation in mite population with weather parameters T_{max}, T_{min} and bright sun shine hours were significantly positively correlated while it was significant negative with RH-I and RH-II. The results are in confirmative with the results of Hole and Salunkhe (2005).

Mutiple regression : The significant positive regression coefficient of T_{max} (1.78), T_{min} (0.98) and B.S.H. (0.67) indicated that an increase in T_{max} by one unit could increase mites population by 1.78 per cent and increase in T_{min} by one unit could increase mite population by 0.98 per cent. Further by increase in B.S.H. by one unit could increase mite population by 0.67 per cent. However, significant negative regression coefficients of RH-I (-0.26) and positive regression coefficients of RH-II (0.06) indicated that decrease in RH-I by one unit could increase mites incidence by 0.26 per cent and increase in RH-II by one unit could increase mite incidence by 0.06 per cent. The multiple regression constant was 75.67, while R^2 value was 0.57, which indicated 57 per cent variation in mite population due to the meteorological parameters, *viz*., T_{max}, T_{min}, B.S.H, RH-I, RH-II and 43 per cent was caused due to other factors.

The significant positive regression coefficient of T_{max} (1.53), T_{min} (1.42) and B.S.H (0.70) on flower indicated that an increase in T_{max} by one unit could increase mites population by 1.53 per cent and increase in T_{min} by one unit could increase mite population by 1.42 per cent. Further by increase in B.S.H by one unit could increase mites population by 0.70 per cent. However, significant negative regression coefficient of RH-I (-0.13) and positive regression coefficient of RH-II (0.15) indicated that decrease in RH-I by one unit could increase mites incidence by 0.13 per cent and increase in RH-II by one unit

could increase mites population by 0.15 per cent. The multiple regression constant was 79.00, while R^2 value was 0.63, which indicated 63 per cent variation in mite population due to meteorological parameters and 37 per cent due to other factors.

References

Bhattacharya, H. K. 1997. Floriculture management. Floriculture Today Mag. Dec. pp 15-23.

Gill, S. and Sanderson, J. 1998. Mites In : Ball identification guide to greenhouse pests and beneficial. Ball Publ., 335, North River Street. Batavai Illionis 60570, USA. pp. 167-212.

Hole, U. B and Salunkhe, G. N. 2005. Studies on the relative resistance of rose cultivars to two spotted spider mite (*Tetranychus urticae* Koch.) J. Maharashtra agric. Univ. 30(3): 316-317.

Jhansi Rani B. and Jagan Mohan, N. 1997 Pest management in gerbera Novenyvendelem. 35(9): 443-457.

Karoly, T. C. and Gyozo, F. 1999. Pest management in gerbera. Novenyvendelem. 35(9): 443-457.

Palsingh, H. K. 2001. Agro Techniques for gerbera cultivation in India. Floriculture Today - 5(9): 913.

Rajhans, K. 2003 Advances in production of gerbera cut flowers. Floriculture Today, 7(1): 32-34.

J. Agric. Res. Technol., 37 (1) : 086-089 (2012)

Content Analysis of Marathi Newspaper Agrowon with Special Reference to Sources of Farm Information

M. C. Jadhav[1] and S. B. Shinde[2]
Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 31-12-2007)

Abstract

Maximum coverage (49.64 per cent) was given to agricultural information. It was followed by horticultural and non-agricultural information in case of advertisements, maximum coverage was given on-agricultural advertisements which were followed by agricultural and horticultural advertisements. Among sources for getting articles from State Agricultural Universities, the MPKV, Rahuri was topped (73.67 per cent). It was followed by MAU, Parbhani (10.36 per cent), MAFSU, Nagpur (7.57 per cent), Dr. PDKV, Akola (4.76 per cent) and Dr. BSKKV, Dapoli (3.64 per cent). The various valuable innovations are being disseminated from MPKV among the farming community for elevating their, socio-economic status.

Key words : SAU, sources of information, credibility, ICAR institutes, developmemt departments, NGO's.

The extension agencies are trying to transfer the farm technology to the farming community through various extension teaching methods. Among various mass media, print media play an important role in dissemination of farm information amongst the rural society. In the print media, newspaper plays unique role. Majority of farmers reading newspaper are interested to read matter related to farming. The Sakal group of newspapers have launched Agrowon, the firstever daily in India completely devoted to agriculture in 2005. Agrowon generate confidence among the farmers and

1. M.Sc. (Agri.) student, 2. Professor of Agril Extension.

facilitate them with information to go global. The information on areas like agriculture and horticulture is being published in the newspaper. It was felt essential to know the extent to which the agricultural, horticultural and non-agricultural information was covered by Agrowon. Further, farm information required in these areas is received by the newspaper from various credible sources *viz*., SAU's, Development Departments, Private Institutes, Private Personnel and other such sources. By keeping in view these aspects, the study was conducted with the objectives to analyse the agricultural areas covered in the Agrowon newspaper and sources of getting farm information.

Materials and Methods

'AGROWON' a farm marathi newspaper was considered purposefully for the study. The issues published in one year that is 19 April, 2005 to 18 April 2006 were considered. Every third issue making the sample size of 122 issues were selected. Firstly, each issue of newspaper was read carefully and total space covered by horticultural, agricultural, non-agricultural information and advertisements were counted and was measured in square centimerters. The sources of farm information used by the newspaper as SAUs. Development Department of Government, ICAR Institutes, Private institutes, NGOs, interested farm writers, Editors article, progressive farmers and other writers were counted. The data were collected with the help of the proforma designed for the study. The figures are expressed in terms of frequencies and percentage for simple comparison and for drawing meaningful conclusions.

Results and Discussion

Space covered : The findings regarding space covered by the horticultural, agricultural information, non-agricultural information and advertisements given in Table 1.

Table 1 indicate that the information to advertisement ratio was 92:8. It is a sign of a sound and healthy newspaper. It was observed that maximum (65.11 per cent) newspaper space was allotted to the horticultural and agricultural information. Agricultural and horticultural information occupied 49.64 and 15.47 per cent of the space, respectively. Non-agricultural information occupied 26.81 per cent space in the newspaper. As regards the advertisements, agricultural advertisements had occupied 2.82 per cent of the total space and horticultural advertisements had occupied 1.17 per cent of the total space. The non-agricultural advertisements had occupied 4.09 per cent of the total space of the newspaper.

The agricultural and horticultural advertisements together occupied equal space to that of non- agricultural advertisements. This also showed that the newspaper contents under study were rural oriented. Such findings were also been reported by Sawant and Shinde (1999) and Abdulha (2000).

Source of information : In Agrowon newspaper articles play an important role in

Table 1. Types of information and space covered in the agrowon.

Newspaper content	Space covered in sq.cm (n=1742160)	Per cent
Information :		
Horticultural	269495	15.47
Agricultural	864885	49.64
Non-agricultural	467015	26.81
Total	1601395	91.92
Advertisements :		
Horticultural	20423	1.17
Agricultural	49135	2.82
Non-agricultural	71207	4.09
Total	140765	8.08
Grand total	1742160	100.00

disseminating the agricultural information amongst the farmers. The editor needs contents or information for newspaper from various sources *viz*., SAUs, development departments, goverment institutes, private institutes and private personnel. This information was collected and is given in Table 2.

Table 2 showed that among sources for articles, private personnel ranked first (72.00 per cent) followed by without source (18.24 per cent). As regard the SAUs Rahuri, Parbhani, Akola, Dapoli and Nagpur were the sources for getting the farm information. The contribution of State Agricultural Universities was 5.85 per cent followed by Editorial (2.00 per cent) to the total number of sources of farm information.

The personnel from the various development departments *viz*., agriculture, horticulture, animal husbandry, irrigation, soil conservation, meteorology and co-operation have also contributed in supplying farm information to Agrowon and their contribution was only 0.62 per cent. This figure shows less than one per cent farm information from Development Departments. So also the private institutes contributed less than 1.00 per cent (i.e. 0.62 per cent) followed by Govterment institutes (0.38 per cent) and other sources (0.29 per cent). Other information sources were advocates, professors from non agricultural colleges, some political persons and institutes. These findings are in line with the findings of Kadam and Karande (1991) and Patil (2000).

Sources for getting articles : In the newspaper, State Agricultural Universities was major and credible source for getting articles which were timely and useful for the farmers. The frequencies of respective type were worked out and are presented in Table 3.

The State Agricultural Universities namely M.P.K.V., Rahuri, M.A.U., Parbhani, Dr. P.D.K.V., Akola, Dr. B.S.K.K.V., Dapoli and M.A.F.S.U., Nagpur were the major sources for getting the farm information. The Mahatma Phule Krishi Vidyapeeth, Rahuri 73.67 per cent) had highest contribution of farm information in Agrowon Newspaper, followed by Marathwada Agricultural University (10.36 per cent), Maharashtra Animal and Fisheries Science University, Nagpur (7.57 per cent), Dr. Punjabrao Deshmukh Krishi Vidyapeeth, Akola (4.76 per cent) and Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth,Dapoli (3.64 per cent).

Amonst the State Agricultural Universities, Mahatma Phule Krishi Vidyapeeth, Rahuri was major source for farm information, followed by

Table 2. Sources for getting articles.

Source of article	Frequency (n = 6101)	Per cent
State Agricultural Universities	357	5.85
Development Departments	38	0.62
Government Institutes	23	0.38
Private institutes	38	0.62
Private personnel	4393	72:00
Editorial	122	2.00
Without source	1113	18.24
Others	17	0.29
Total	6101	100.00

Table 3. Farm information received from state universites

State agruculture universities	Frequency (n = 357)	Per cent
M.P.K.V., Rahuri	263	73.67
M.A..U., Parbhani	37	10.36
Dr. P.D.K.V., Akola	17	4.76
Dr. B.S.K.K.V., Dapoli	13	3.64
M.A.F.S.U., Nagpur	27	7.57
Total	357	100.00

MAU, Parbhani and MAFSU, Nagpur. Very less farm information was provided by Akola and Dapoli Universities. The efforts may be made by the Agrowon for getting more farm information from these SAUs for the benefit of farmers from the respective areas.

The findings are in line with the results of Patil (2000) who had reported that MPKV, Rahuri (20.08 per cent) had highest contribution, followed by PKV, Akola (3.48 per cent), KKV, Dapoli (3.07 per cent) and MAU, Parbhani (1.33 per cent).

Implications : It is necessary to make efforts for providing additional space for the horticultural information in the newspaper because Government of India and Maharashtra have been giving special emphasis on National Horticulture Mission. More emphasis is needed on coverage of information on agricultural and horticultural advertisements than on non-agricultural advertisements. The efforts are needed for motivating farm scientists from the SAUs having less contribution and extension personnel from various Development Departments for contributing farm information.

References

Abdullah, M. A. 2000. Content analysis of agricultural information appeared in Syrian farm weekly from Damascus, Syria. M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri, M.S., India.

Kadam, K. K. and Karande, A. G. 1991. Content analysis of Maharashtra Journal of Extension Education. Maharashtra J. Extn. Edn. 2: 18-23.

Patil, S. P. 2000. Content analysis of farm magazine Baliraja. M.Sc. (Agri.) thesis submitted to M.P.K.V., Rahuri, M.S., India.

Sawant, G. K. and Shinde, S. B. 1991. Typology of agricultural information in marathi dailies. Maharashtra J. Extn. Edn. 10(2): 4-7.

J. Agric. Res. Technol., 37 (1) : 090-093 (2012)

Knowledge and Adoption of Food Grains Storage Practices by the Farm Women

P. J. Uplap[1], S. S. Khandave[2] and D. R. Thorat[3]
College of Agriculture, Pune - 411 005 (India)
(Received : 28-11-2009)

Abstract

Study on knowledge and adoption of storage food grain practices revealed that 100 per cent farm women had knowledge of recommended food grain storage practices *viz*., sieving of food grains, separation. of broken food grains, separating the infested food grains, sun drying, protecting food grains from moisture and keeping gunny bag away from wall, keeping stored place in good hygienic condition and use of trap to control rodent. The 95.82 per cent of the respondents adopted the method of sun drying, 94.11 per cent of farm women adopted the method of separation of infested food grains, while 75.88 per cent of them adopted the method of sieving of food grain and 59.42 per cent adopted the method of separation of broken food grains, 41.17 per cent adopted the practice of proper sun drying, while 22.95 per cent adopted the use of chemical powder, 14.70 per cent of farm women adopted the practice of rearing cat and use of aluminium phosphide whereas 9.41 per cent adopted the practice to keep the store place airy and in good hygienic condition.

Key words : Food grain, storage, practices.

Farm Women play a pivotal role in agriculture and other subsidiary occupations. Studies in the past indicated that farm women participated in most of farm operations. One of this is storage of food grain. Their participation in post harvest practice *viz*., threshing and storage is relatively more important than other practices. Therefore it becomes very necessary to know their knowledge level and the methods adopted by them in food grain storage. Knowledge is the total number of recommended practices of food grain storage known to the farm women while adoption means continuous use of recommended technologies, food grain practices by farm women performing storage activity. So while performing the storage activity many technical and economical barriers are experienced. With this regards, the study will throw light in determining the extent of knowledge and adoption of various practices in respect of food grain storage practices.

Materials and Methods

The study was carried in the College development block Pune. Out of 112 villages, 10 villages were randomly selected for the purpose of study. A list of farm women who engaged in performing various farm operations was prepared. From the list of 350 farm women, total 170 farm women were selected by using random sampling method.

An interview schedule was prepared so as to get accurate information. Suitable questions were included to determine, the knowledge and adoption of food grain storage practices by the farm women. The statistical tool and test such as frequency and percentage, have been used in the study.

Results and Discussion

Mechanical control method : Almost 100 per cent of farm women had knowledge in

1. M.Sc.(Agri.) student, 2. and 3. Asso. Professor of Extension.

respect of mechanical control method i.e. sieving of food grains after threshing separation of broken food grains and separating the infested food grains.

The data regarding adoption of food grain storage practices indicaled that most of farm women (94.11) per cent were practicing method of separating infested food grains. Majority of them (75.88%) were sieving the food grain after threshing and 59.41 per cent of farm women were adopting the practice of separating broken food grains by sieving.

Table 1. Knowledge and adoption of recommended natural method of storage of food grain practices by farm women.

Method	Knowledge			Adoption		
	Complete	Partial	No.	Complete	Partial	No.
Sun drying	170 (100)	-	-	70 (41.17)	-	100 (58.88)
Protection from moisture :						
Proper dunnage	170 (100)	-	-	70 (41.17)	-	100 (58.88)
Use of wooden planks	169 (99.41)	-	1 (0.59)	4 (2.35)	-	166 (97.65)
Keeping gunny bags on plastic paper	160 (94.11)	-	10 (5.89)	4 (2.35)	-	166 (97.66)
Keeping gunny bags away from wall	170 (100)	-	-	42 (24.71)	-	128 (75.29)

Table 2. Knowledge and adoption of recommended storage structure of food grain storage by farm women.

Method	Knowledge			Adoption		
	Complete	Partial	No.	Complete	Partial	No.
Improved grain kothi	27 (15.88)	-	143 (84.12)	10 (5.88)	-	160 (94.11)
Silo kothi	10 (5.88)	-	160 (94.12)	-	-	170 (100)
Barrel	98 (57.64)	-	72 (42.36)	7 (4.11)	-	163 (95.88)
Pucca bin	20 (11.76)	-	150 (88.24)	-	-	170 (100)

Table 3. Knowledge and adoption of recommended chemical control measures of food grain storage by farm women.

Method	Knowledge			Adoption		
	Complete	Partial	No.	Complete	Partial	No.
Use of chemical powder	50 (29.41)	-	120 (70.59)	39 (22.95)	-	131 (77.05)
Use of EDB ampoules and Aluminium phosphate	17 (10.00	-	153 (90.00)	9 (5.29)	6 (3.53)	155 (71.18)

Table 4. Knowledge and adoption about maintenance of store place of food grain storeage practices by farm women.

Method	Knowledge			Adoption		
	Complete	Partial	No.	Complete	Partial	No.
Keeping stored place airy	167 (98.23)	-	3 (1.77)	16 (9.41)	-	154 (90.58)
Spraying of insecticide	27 (15.88)	-	143 (84.12)	13 (7.65)	-	157 (92.35)
Keeping stored place in good hygienic condition	170 (100)	-		16 (9.41)	-	154 (90.88)

Natural method : The data regarding knowledge of natural method indicated that 100 per cent of farm women had knowledge about sun drying of food grain, protecting the food grain from moisture, proper dunnage and keeping gunny bags away from wall. This finding were in line with Srivastava *et al*. (1979). Also 99.41 per cent of farm women had knowledge about use on wooden plank and 94.11 per cent of them had knowledge of keeping gunny bags on plastic paper. As far as adoption of natural method (Table 1) is concerned, it was revealed that 95.88 per cent of women were practising method of sun drying, 41.17 per cent were practising proper dunnage. This finding was in line with Srivastava *et al*. (1979). The 24.7 per cent of the women were keeping distance between gunny bags and wall, while very few (5.88%) of them had used wooden plank and 2.35 per cent keeping gunny bags on plastic paper.

Storage structures for food grain storage : The data on knowledge of using various storage structures (Table 2) indicated that majority (57.64%) of farm women had knowledge about storage structures like barrel, 15.88 per cent had knowledge of improved grain kothi, while 11.76 per cent had knowledge about pucca bin and very few 5.88 per cent had knowledge about silo kothi as a storage structure. Regarding the adoption of storage structures, data indicaied that 5.88 per cent of farm women were using improved grain kothi, while 4.11 per cent of them were adopting barrel as a storage structure. Not a single woman had either used silo kothi or pucca bin for storage.

Chemical control : The 29.41 per cent and 10.00 per cent of farm women had knowledge in respect of use of chemical powder *viz*., boric powder and use of fumigant like EDB respectively (Table 3). However, only 22.95 per cent of farm women were adopting the practices of using chemical powder. This findings was in line with Dixit *et al*. (1996) and very few of them (5.29%) were using EDB as fumigant. The finding was in line with Chandargi (1980).

Maintenance of stored place : Almost all the farm women (Table 4) had knowledge about keeping stored place in good hygienic condition. Most 98.23 per cent of them had knowledge to keep godown ventilated while only 15.88 per cent of the farm women had knowledge of spraying of insecticides. Very few (9.41%) farm women were practicing the methods of keeping stored place ventilated and keeping stored place in good hygenic condition and 7.65 per cent were practicing the spraying of insecticides at storing place.

Control from rodents : Almost all 100 per cent of the farm women (Table 5) had knowledge about use of trap and 98.82 per cent had knowledge of rearing cat. However, about one fourth (24.11%) had knowledge about use of zinc phosphide for killing rats. As regards the use of these practices nearly equal proportion (14.70%) of the farm women had

Table 5. Knowledge and adoption of recommended practice of rodent control of food grain storage practices by farm women.

Method	Knowledge			Adoption		
	Complete	Partial	No.	Complete	Partial	No.
Rearing cat	168 (98.82)	-	2 (1.18)	25 (14.70)	-	145 (85.30)
Use of trap	170 (100)	-	-	22 (12.95)	-	148 (87.05)
Use of zinc or aluminium phosphide	41 (24.11)	-	129 (75.89)	25 (14.70)	-	145 (82.35)

reared cat and used the zinc phosphide and aluminium phosphide for control of rats and 12.95 per cent of them had followed the practice of using trap.

References

Chandargi, D. M. 1980. An experimental study on impact of training on knowledge and adoption behaviour of farm women in Dharwad, Belgaum and Karwar district of Karnataka State. M.sc.(Agri) thesis. Dept of Extension UAS. Dharwad.

Dixit, J. P., Bhagwat, D. V. and Namdev, K. M. 1996. A survey of traditional versus insecticidal method of grain storage by farmers. Abst. A Seminar on post harvest technology for rural development. Hapur (U.P.) Govt. of India.

Srivastava, P. K., Tripathi, B. P., Girish, G. K. and Krishnamurthy, K. 1979. Study of assessment of losses."Bull Grain Tech. 11(2).

J. Agric. Res. Technol., 37 (1) : 093-095 (2012)

Training Needs of Farm Women Regarding Food Grain Storage Practices

P. J. Uplap[1], S. S. Khandave[2] and D. R. Thorat[3]
College of Agriculture, Pune - 411 005 (India)
(Received : 28-11-2009)

Abstract

The majority (65.89%) of the farm women were of opinion that training is more important in respect of use of scientific storage structures followed by identification of insect pests i.e 62.95 per cent, 53.52 per cent used preventive measures at stored place. A very small proportion (7.64%) of farm women expressed that training is more necessary in protection of food grain from rodents. The 98.23 per cent of farm women expressed that training should be conducted at village level, while 1.77 per cent expressed that training should be organized at taluka place. Large majority (78.34%) of farm women preferred one day training whereas 21.76 per cent of them suggested that training should be organized for 2 to 3 days. Nearly 50.58 per cent farm women suggested that training should be organized by Panchayat Samiti, 27.66 per cent suggested that training should organized by Agriculture Department and 21.76 per cent of them suggested that training should be organized by Agricultural Universities. An experience in storage of food grains was significant at 0.05 per cent level while education, size of land, social participation, crops to be grown and knowledge of storage of food grain were significant at 0.01 per cent level whereas age, caste, family size, annual income, social rank in family was not significant with training needs.

Key words : Training needs, scientific storage practice, storage structure, preventive measure.

Farm women play a significant role in agriculture and thereby directly or indirectly contributing for developing Indian economy. For empowerment of women, training is an important component for upgrading the knowledge and skills. Studies proved that improper methods of food grain storage leads to great loss and which could not get the remunerative price for their produce. Hence there is immense need to impart trainings on these aspects. The present study was therefore conducted with the objectives to identify the areas of training, nature and period of training and relationship between the socio-economic

1. M.Sc.(Agri.) student, 2. and 3. Asso. Professor of Extension.

Table 1. Training needs of farm women regarding storage of food grains.

Training needs	Respondent (n = 170)		
	More necessary	Necessary	Not necessary
Method to be used	59 (34.71)	92 (54.11)	19 (11.18)
Storage structure	112 (65.89)	30 (17.64)	28 (16.47)
Use of chemical	98 (57.65)	51 (30)	21 (12.35)
Precaution in using chemical	107 (62.95)	35 (20.58)	28 (16.47)
Protection of food grain from rodents	13 (7.64)	137 (80.59)	20 (11.76)
Use of preventive measure at stored place	91(53.52)	20 (11.76)	59 (34.72)
Identification of insects, pest and its nature of damage and control	108 (63.53)	42 (24.71)	20 (11.76)

characteristics and training needs.

Materials and Methods

The study was carried in the college development block Pune. Out of 112 villages, 10 villages were randomly selected for the purpose of study. A list of farm women who performed the village activity and expressed the training needs for the same purpose were prepared. From the list of 350 farm women, 170 farm women were selected by using random sampling method.

An interview schedule was prepared in order to get accurate information. Suitable questions were included to determine the training needs of farm women. The statistical tool and test have been used in the study.

Results and Discussion

The data from Table 1 indicated that majority (65.89%) of farm women were of opinion that training is more necessary in respect of use of scientific storage structure followed by 63.53 per cent of farm women needed training in identification of insect and pests. This finding was in line with Nikam *et al*. (1992). A very small proportion (7.64%) of farm women expressed that training is more necessary in protection of food grains from rodents. The 80.59 per cent felt training is necessary in case of protection of food grains from rodents. This finding is in line with Verma and Dahiya (1994).

Data regarding the period and place of training mentioned in Table 2 revealed that majority (98.23%) of farm women expressed that training to be conducted at village level.

Table 2. Distribution of farm women according to the place of training suggested by them.

Particulars	Respondent farm women (n = 170)	
	No.	Per cent
Place of training :		
At village level	167	98.23
At taluka level (score 7 to 11)	3	1.77
Period of training :		
One day	133	78.24
Two to three days	37	21.76

Table 3. Personnel/Institution arranging the training programmes.

Particulars	Respondent farm women (n = 170)	
	No.	Per cent
Panchayat Samiti	86	50.58
Agriculture Department	47	27.66
Agriculture Universities	37	21.76
Total	170	100

Table 4. Relationship between the characteristics of the respondent and their training need.

Variables	Co-efficient of co-relation 'r' value
Age	0.1332 NS
Education	0.3238**
Caste	-0.1395 NS
Family size	0.0753 NS
Size of land	0.3068**
Annual income	0.1415 NS
Social rank in the family	0.0814 NS
Social participation	0.4040**
Crops grown by family	0.2119*
Experience in storage of food	0.1642*
Knowledge of storage of food	0.3501**

*Significant at 0.01 per cent level, NS = Non Significant
**Signifieant at 0.05 per cent level, DF = 168

The finding was in line with Mankar *et al.* (1990) while only (1.77%) expressed that training should be organized at taluka place. Whcreas, majority (8.34%) of farm women suggested that training should be of one day duration, while 21.76 per cent of them suggested that training should be organised for 2 to 3 days. These findings are in line with Bhalerao and Ayaskar (1999).

Data regarding organization of training stated that 50.58 per cent of farm women suggested that training should organized by Panchayat Samiti and 27.66 per cent suggested that it should be organized by Agricultural Department, while 21.76 per cent suggested that training should be organized by Agricultural Universities.

Socio-economic characteristics and their training needs : The personal and socio-economic characteristics (Table 4) of farm women i.e. education, size of land holding, social participation, number of crops grown, experience and knowledge of food grains showed positive and significant relationship with the extent of training needs towards storage of food grain, while age, caste, family size, annual income, social rank in family showed non significant relationship with training needs. Similar results were reported by Garav and Kamble (1995), Mande (1999) and Shinde *et al*. (2002).

References

Bhalerao, V. S. and Ayaskar, S. R. 1999. Training program on locally available resources. Maharashtra J. of Exten. Edn. 18-19. 257-258.

Gurav, K. V. and Kamble, L. P. 1995. Training need of rural women. Maharashtra J. of Exten. Edn. XIV pp. 93.

Mande, J. V. 1999. A study of training needs of farm women with special reference to post harvest technology. M.Sc. (Agri.) thesis, Mahatama Phule Krishi Vidyapeeth, Rahuri.

Nikam, T. R. and Bhagat, R. 1992. Training needs of tribal farmers Maharashtra J. of Exten. Edn. XI: 291-294.

Sinha, S. K., Sinha, Kalpana and Singh, Madan. 2002. Co-relates of farm women training need perception in rice technology. MJEE XXI 1: 75-77.

Verma, T. and Dahiya, Rajesh. 1994. Impact of post harvest technology on farm women Maharashtra J. of Exten. Edn. 12:70-75.

J. Agric. Res. Technol., 37 (1) : 096-101 (2012)

Attainable Productivity of Major Crops in Western Maharashtra

C. A. Nimbalkar[1], B. H. Khan[2], V.S. Wani[3] and S. D. Shinde[4]
Department of Statistics, Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 10-06-2010)

Abstract

In Western Maharashtra, districtwise log-quadratic equation resulted in the optimum attainable productivity of selected major crops. Most of the crops under study have attained the maximum productivity in all the districts except Nandurbar and Solapur, where the improvement in available technology needed to enhance the productivity. More attention may be paid to pigeonpea (tur) and sunflower crop in Western Maharashtra because there is still scope to increase their productivity in all the districts. The overall productivity of the crops under study can be attained maximum by introducing the improved technology.

Key words : Log-quadratic equation, growth rates, optimum productivity, Western Maharashtra.

Various studies revealed the production-capacity of all cultivated crops in the Maharashtra and the country. The productivity levels of different crops in different soils and climatic conditions have been exploited with the help of available agro-technologies to the considerable extent (producible capacity). Many estimates, predictions and forecasts are being made by the research workers every year to alarm the people, the Government and the policy makers about the productivity of each crop and agriculture as a whole. Now, people, farmers, research workers and the Government are bound to think over the severity of production problem in consideration of increasing population. The development of production technology is continued by which the productivity of crops in different soil is enhanced attainable productivity. Therefore, new technologies are demanded by farmers for further more production. Hence, an attempt has been made to estimate the performance, growth rates and the optimum productivity of major crops in ten districts of Western Maharashtra.

Materials and Methods

The data of three crops each from cereals, pulses and oilseeds taken for the period 1985-86 to 2007-08 from Epitome of Maharashtra (Anonymous, 1985-2007).

The data of yield (productivity) of three crops each from Cereals : *Kharif* jowar, wheat and bajra; Pulses : Gram, tur and mung and Oil seeds : *Kharif* groundnut, safflower and sunflower were taken. For estimating growth rates and optimal productivity, the following nonlinear regression is used (Snedecor and Cochran, 1967). $Y = e^{a+bt+c\ t**2}$

Which is the log-quadratic functional relationship between productivity (Y) and time factor t in years used to explain the growth and growth process in the field.

$\therefore$ Log $Y = a + bt + c\ t^2$ or i.e. $Y' = a + bt + c\ t^2$ Where, b is the growth rate and c is the acceleratory growth rate per annum. If c is

1. and 2. Associate Professors, 3. Assistant Professor and 4. Sr. Res. Asstt.

positive (c > 0) then there is an acceleration (an increase) in growth rate of yield i.e. the productivity attained the minimum w.r.t. time factor. If c is negative (c < 0) then there is deceleration (decrease) in growth rate of yield i.e. the productivity attained the maximum w.r. t. time factor. If c ≅ 0, then, there is a constant growth rate during the period under study.

The optimum periods and yields for each crop in each districts were obtained by -b/2c.

The same methodology was applied by the various authors, Raju *et al.* (1993), Upender (1993) and Narayana (2009) in different studies.

Results and Discussion

Table 1 revealed that the yield (kg ha^{-1}) varying from 847 (Nandurbar) to 1904 (Kolhapur) for *kharif* jowar; 1031 (Nandurbar) to 1798 (Kolhapur) for wheat and 340 (Dhule) to 781 (Sagali) for bajra. Among the pulses, the gram ranged from 496 (Solapur) to 748 (Jalgaon), for tur 312 (Solapur) to 694 (Jalgaon) and for mung 422 (Pune) to 617 (Dhule). In case of oilseeds, *kharif* groundnut ranged from 479 (Solapur) to 1655 (Kolhapur), safflower 357 (Solapur) to 558 (Nandurbar) and sunflower 482 (Solapur) to 772 (Kolhapur).

Overall performance (average yield kg ha^{-1}) of MPKV jurisdiction were 1311 for *kharif* jowar, 1426 for wheat, 566 for bajra, 607 for gram, 501 for tur, 492 for mung, 929 for *kharif* groundnut, 453 for safflower and 562 for sunflower.

By using log-quadratic equation of yield with time t, Table 2 exhibited growth rate of *kharif* Jowar, wheat, bajra and gram are significant, while accelerated growth rates are decreasing in Nasik district. All the crops achieved maximum productivity of which *kharif* jowar and bajra were significantly maximum except tur.

Dhule : The growth rate of bajra is positively significant while tur is negative. The accelerated growth rates of almost all crops were negative except wheat, gram, tur and sunflower. All the crops attained the maximum except tur.

Nandurbar : The growth rates for tur and safflower were negatively significant. Accelerated growth rate were positive except for mung. No crop attained optimum except mung.

Table 1. Performance of major cereals, pulses and oilseeds production in different districts in Western Maharashtra (kg ha^{-1}).

District	Cereals			Pulses			Oil seeds		
	***Kharif* jowar**	**Wheat**	**Bajara**	**Gram**	**Tur**	**Mung**	***Kharif* groundnut**	**Safflower**	**Sunflower**
Nasik	1128	1275	664	542	641	604	740	551	490
Dhule	1217	1310	781	628	547	617	686	426	566
Nandurbar	874	1031	689	619	525	600	627	558	567
Jalgaon	1741	1631	936	748	694	501	709	453	596
Pune	1069	1402	645	585	539	422	1164	482	555
Ahmednagar	1210	1376	518	553	432	430	826	456	548
Solapur	847	1090	383	496	312	426	479	357	482
Kolhapur	1904	1798	411	719	452	474	1655	-	772
Satara	1500	1539	473	569	451	501	1270	423	547
Sangali	1175	1415	340	627	451	437	926	406	548
Western Maharashtra	1311	1426	566	607	501	492	929	453	562

Table 2. Quadratic equation and optimum of productivity.

District	Crop	R^2	a	b	c	Optimum period	Optimum yield
Nasik	Kh jowar	0.356	2.887	0.042*	-0.000**	1995-96	949
	Wheat	0.651	2.872	0.029**	-0.001	1999-00	1431
	Bajra	0.461	2.404	0.059**	-0.002*	1999-00	588
	Gram	0.512	2.533	0.025*	-0.001	1997-98	473
	Tur	0.118	2.912	-0.022	0.001		
	Mung	0.542	2.491	0.028	0	#	-
	Kh. G'nut	0.233	2.582	0.039	-0.001	2004-05	853
	Safflower	0.230	2.801	0.001	-0.001	1985-86	435
	Sunflower	0.020	2.715	-0.005	0	#	-
Dhule	Kh jowar	0.262	2.866	0.029	-0.001	1999-00	1030
	Wheat	0.617	2.939	0.014	0	#	-
	Bajra	0.315	2.563	0.047*	-0.001	2007-08	1140
	Gram	0.372	2.628	0.019	0	#	-
	Tur	0.274	2.956	-0.041*	0.001		
	Mung	0.149	2.595	0.036	-0.001	2002-03	397
	Kh. G'nut	0.065	2.683	0.023	-0.001	1996-97	889
	Safflower	0.268	2.714	0.027	-0.002	1991-92	517
	Sunflower	0.118	2.698	0	0	#	-
Nandurbar	Kh jowar	0.178	3.175	-0.067	0.007		
	Wheat	0.813	3.179	-0.058	0.009*		
	Bajra	0.161	2.939	-0.056	0.007		
	Gram	0.520	2.834	-0.060	0.008		
	Tur	0.854	2.939	-0.169**	0.016**		
	Mung	0.326	2.775	0.034	-0.005	2000-01	382
	Kh. G'nut	0.395	2.829	-0.067	0.009		
	Safflower	0.538	2.836	-0.051*	0.004		
	Sunflower	0.418	2.715	-0.024	0.004		
Jalgaon	Kh jowar	0.388	3.041	0.029*	-0.001	1999-00	1635
	Wheat	0.621	2.883	0.042**	-0.001	2005-06	1846
	Bajra	0.238	2.758	0.036*	-0.001	2002-03	944
	Gram	0.674	2.607	0.032**	-0.001	2000-01	675
	Tur	0.033	2.895	-0.012	0	#	-
	Mung	0.032	2.619	0.012	0	#	-
	Kh. G'nut	0.293	2.552	0.042	-0.001	2005-06	823
	Safflower	0.056	2.763	0.007	0	#	-
	Sunflower	0.389	2.935	-0.030**	0.001*		
Pune	Kh jowar	0.252	3.040	0.008	-0.001	1988-89	1420
	Wheat	0.448	2.968	0.024*	-0.001	1996-97	1541
	Bajra	0.672	2.504	0.046**	-0.001**	2007-08	861
	Gram	0.377	2.601	0.024*	-0.001	1996-97	698
	Tur	0.058	2.608	0.016	0	#	-
	Mung	0.214	2.407	0.029	-0.001	1999-00	512
	Kh. G'nut	0.470	2.902	0.039**	-0.002**	1994-95	1114
	Safflower	0.011	2.619	0.008	0	#	-
	Sunflower	0.091	2.825	-0.016	0.001		
A'nagar	Kh jowar	0.142	2.996	0.024	-0.001	1996-97	1148
	Wheat	0.293	3.056	0.006	0	#	-
	Bajra	0.515	2.161	0.090*	-0.003**	1999-00	574
	Gram	0.259	2.585	0.024	-0.001	1996-97	629
	Tur	0.117	2.446	0.027	-0.001	1998-99	516
	Mung	0.095	2.412	0.031	-0.001	2000-01	431
	Kh. G'nut	0.233	2.738	0.037*	-0.002*	2003-04	613
	Safflower	0.039	2.503	0.021	-0.001	1995-96	686
	Sunflower	0.176	2.856	-0.024	0.001		

Table 2. Contd.

District	Crop	R^2	a	b	c	Optimum period	Optimum yield
Solapur	Kh jowar	0.200	3.054	-0.015	0	#	-
	Wheat	0.135	2.875	0.025	-0.001	1997-98	800
	Bajra	0.630	2.165	0.068**	-0.002**	2001-02	468
	Gram	0.204	2.412	0.036	-0.001	2002-03	432
	Tur	0.183	2.698	-0.059	0.002*		
	Mung	0.475	2.284	0.028	0	#	-
	Kh. G'nut	0.179	2.647	-0.014	0.001		
	Safflower	0.007	2.551	-0.017	0.001		
	Sunflower	0.036	2.572	0.017	-0.001	1993-94	492
Kolhapur	Kh jowar	0.326	3.255	0.015	-0.001	1992-93	2602
	Wheat	0.661	3.036	0.031**	-0.001**	2000-01	1786
	Bajra	0.307	2.363	0.032	-0.001	2000-01	411
	Gram	0.409	2.731	0.017*	0	#	-
	Tur	0.037	2.692	-0.006	0	#	-
	Mung	0.138	2.538	0.014	0	#	-
	Kh. G'nut	0.278	3.134	0.022*	-0.001*	1996-97	1470
	Sunflower	0.078	2.791	0.004	0	#	-
Satara	Kh jowar	0.258	3.061	0.030*	-0.001*	1999-00	1860
	Wheat	0.600	2.965	0.029*	-0.001	1999-00	1852
	Bajra	0.468	2.248	0.074*	-0.003**	1996-97	693
	Gram	0.170	2.645	0.012	0	#	-
	Tur	0.036	2.678	-0.003	0	#	-
	Mung	0.058	2.570	0.018	-0.001	1993-94	638
	Kh. G'nut	0.118	3.062	0.013	-0.001	1991-92	698
	Safflower	0.209	2.358	0.058*	-0.003*	1994-95	344
	Sunflower	0.272	2.892	-0.027*	0.001		
Sangli	Kh jowar	0.239	3.035	0.021	-0.001	1995-96	1470
	Wheat	0.708	2.864	0.040**	-0.001**	2004-05	1708
	Bajra	0.038	2.330	0.032	-0.001	2000-01	424
	Gram	0.676	2.366	0.067**	-0.002**	2001-02	741
	Tur	0.038	2.686	-0.005	0	#	-
	Mung	0.020	2.527	0.017	-0.001	1993-94	638
	Kh. G'nut	0.316	2.883	0.026*	-0.001*	1997-98	962
	Safflower	0.274	2.245	0.073*	-0.003*	1996-97	383
	Sunflower	0.219	2.885	-0.025	0.001		
Western Maharashtra	Kh jowar	0.214	3.047	0.019	-0.001*	1994-95	1329
	Wheat	0.651	2.959	0.023*	0	#	-
	Bajra	0.530	2.443	0.051**	-0.002**	1997-98	664
	Gram	0.538	2.590	0.025*	-0.001	1997-98	553
	Tur	0.064	2.758	-0.011	0	#	-
	Mung	0.497	2.490	0.029**	-0.001*	1999-00	551
	Kh. G'nut	0.276	2.865	0.023*	-0.001*	1996-97	1267
	Safflower	0.159	2.630	0.016	-0.001	1992-93	486
	Sunflower	0.109	2.809	-0.014	0.001		

: constant growth rate, *,** indicates significant at 5 and 1 % , respectively.

Jalgaon : The growth rates of *kharif* jowar, wheat, bajra and gram were positively significant, while tur and sunflower negatively significant. The accelerated growth rates of all crops were negative except for tur, mung and safflower crops. All the crops attained the maximum except tur, mung, safflower and sunflower.

Pune : The growth pattern in Pune district was observed that, wheat, bajra, gram and *kharif* groundnut were positively significant, while sunflower was negative. The accelerated growth rates were negative except for tur, sunflower and safflower crops. All the crops except sunflower attained the maximum of which bajra and *kharif* groundnut attained the significant maximum in this district.

Ahmednagar : This district followed increasing growth rates for all the crops except sunflower, out of which bajra and *kharif* groundnut were significantly increasing. The accelerated growth rates were all negative except wheat and sunflower. Except sunflower all the crops attained the maximum of which bajra and *kharif* groundnut were with significantly maximum productivity.

Solapur : This district showed significant growth rate for bajra only and the accelerated growth rates were positive for *kharif* jowar, tur, mung, *kharif* groundnut and safflower. Wheat, bajra, gram and sunflower achieved the maximum of which bajra exhibited significantly maximum productivity.

Kolhapur : This district also shown significant growth rate for wheat, gram and *kharif* groundnut, while the accelerated growth were negative except for gram, tur, mung and sunflower. *Kharif* jowar, wheat, bajra and *kharif* groundnut attained maximum of which wheat and groundnut significantly maximum.

Satara : The district Satara recorded significant growth rate for *kharif* jowar, wheat, bajra, safflower and negative for sunflower. The accelerated growth rates were all negative except for gram, tur and sunflower. Except sunflower all crops attained maximum, of which *kharif* jowar, bajra and safflower were significantly maximum.

Sangali : This district followed the same pattern of Satara for wheat, gram, *kharif* groundnut and safflower, while the accelerated growth rates were negative except for tur and sunflower. Except sunflower, all the crops attained the maximum of which wheat, gram, *kharif* groundnut and safflower were with significantly maximum productivity.

Western Maharashtra : The overall growth rate pattern for Western Maharashtra

Table 3. Attainment of optimum productivity of selected crops in Western Maharashtra.

District	Cereals			Pulses			Oil seeds		
	***Kharif* jowar**	**Wheat**	**Bajara**	**Gram**	**Tur**	**Mung**	***Kharif* groundnut**	**Safflower**	**Sunflower**
Nasik	–	–	–	–	+	–	–	–	+
Dhule	–	–	–	–	+	–	–	–	+
Nandurbar	+	+	+	+	+	–	+	+	+
Jalgaon	–	–	–	–	+	–	–	–	+
Pune	–	–	–	–	–	–	–	–	+
Ahmednagar	–	+	–	–	–	–	–	–	+
Solapur	+	–	–	–	+	–	+	+	–
Kolhapur	–	–	–	–	+	–	–		+
Satara	–	–	–	–	+	–	–	–	+
Sangali	–	–	–	–	+	–	–	–	+
Western Maharashtra	–	–	–	–	+	–	–	–	+

+ : Minimum, – : Maximum

shown significant for wheat, bajra, gram, mung and *kharif* groundnut, but the accelerated growth rates were negative except for wheat, tur and sunflower, because, farmers might have not used the recommended practices given by the Agricultural Universities. Gram and safflower attained the maximum whereas *kharif* jowar, bajra, mung and *kharif* groundnut attained significantly maximum productivity.

Significant maximum productivity attained for bajra in Nasik, Pune, Ahmednagar, Solapur, Satara districts as well as in Western Maharshtra. In case of *kharif* jowar, Nasik, Satara and Western Maharashtra, while for *kharif* groundnut, Pune, Ahmednagar, Kolhapur, Sangali and Western Maharshtra attained the maximum productivity. Similarly, wheat in Kolhapur and Sangali, safflower in Satara and Sangali, gram in Sangali and mung in Western Maharshtra exhibited the attainment of significant maximum productivity (Table 3). The improvement in available technologies for these crops in respective districts may accelerate the growth rates of productivities. Hence, the crops can attained maximum productivity by introducing the improved technology in Western Maharashtra.

It is briefed that, all the crops under study except tur and sunflower attained the maximum productivity in all the districts except Nandurbar and Solapur, where the improvement in available technology or development of new technology needed to enhance the productivity. More attention may be paid to tur and sunflower crops for increasing the yield by means of proper use of available technologies. The overall productivity of the crops can be attained maximum by introducing the improved technology.

It is concluded that, most of the crops under study have attained the maximum productivity in all the districts except Nandurbar and Solapur, where the improvement in available technology needed to enhance the productivity. More attention may be paid to tur and sunflower crop in Western Maharashtra because there is still scope to increase their productivity in all the districts.

References

Anonymous. 1985-2007. Districtwise General Statistical Information of Agricultural Department. Part II-Epitome of Agriculture in Maharashtra. Commissionorate of Agriculture, Government of Maharashtra.

Narayana, B. 2009. Is the growth rate in agriculture constant? The case of Andhra Pradesh - An empirical analysis. Agriculture Situation in India. 665-669.

Raju, V. P., Shareef, S. M., Prasad, Bhavani and Bharati, S. V. 1993. Performance of oilseeds and pulses in Andhra Pradesh. UAE 48(3).

Snedecor, G. W. and Cochran, W. G. 1967. Statistical Methods. Iowa State Univ. Press., Iowa.

Upender, M. 1993. Growth and instability in area, production and productivity of groundnut in Andhra Pradesh. UAE 48(3).

J. Agric. Res. Technol., 37 (1) : 102-106 (2012)

Impact of Participation in SHG with Reference to Technological Change in Agriculture

M. S. Bhairamkar[1], V. G. Patil[2], and A. J. Nirban[3]
Department of Extension Education,
Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli - 415 712 (India)
(Received : 21-07-2010)

Abstract

The study was conducted in Ratnagiri and Sindhudurg district of Konkan region. The results made it clear that the respondents had changed the crop production technology to a satisfactory level after becoming the members of SHGs. Further, the members had shown interest in changing some of the technologies related to their subsidiary occupations such as animal husbandry, fruit processing, horticulture and marketing.

Key words : Self help groups, impact, technological change.

Self help group (SHG) can be used as a group method of technology transfer. In Konkan region many of the SHG have started various agricultural enterprises. It has been observed that theses enterprises have helped the members in improving their socio-economic condition and also adoption of new technology in their own farms.

However, a systematic studies have not been conducted to evaluate the technological change occurred due to participation in SHG. Considering this, an attempt was made in the present study to understand the development made by the individual members of SHG in agriculture and related enterprises and to know the technology change occurred in agriculture and allied enterprises of the practicing farmers.

Materials and Methods

The study was conducted during 2006-07 in Ratnagiri and Sindhudurg districts of Konkan region. From these districts, 21 SHGs were purposively selected based on their agriculture and allied enterprises. All the 173 members of these groups were contacted personally with the help of well structured pre-tested interview schedule.

Technological change was defined as the change occurred in the practices followed by the practicing farmers after becoming member of SHG in respect of land development, irrigation, crop production, horticulture, dairy farming, poultry farming, goat farming, fisheries, post harvest technology and marketing. It was measured with help of standard scale developed for the purpose

The final scale consisting of 71 items (technologies) was administered on the practicing farmer members of the SHGs. The responses on applicable technologies to a particular respondent were obtained on a three point continuum namely, 'low' 'medium' and 'high' change with weightage of 1, 2 and 3, respectively. Thus, the technological change score of the respondents was calculated by adding the score of only those technologies which were applicable to farming situation of the concerned. The overall technological change score of the respondents was converted into technological change index by using the following formula.

1. Sr. Res. Asstt., 2. Professor (CAS) and 3. Head of Deptt.

$$\text{Technological change index} = \frac{\text{Obtained technological change score}}{\text{Obtainable technological change score}} \times 100$$

Results and Discussion

Technological change occurred : A close look at Table 1 revealed that more than 70.00 per cent of the respondents had made change in major crop production practices in order to get more yield, except the practices of nursery management and crop protection. Techno-logical change had also noticed in animal husbandry in terms of purchased of improved broiler strains (23.12 per cent) and backyard poultry (17.34 per cent), while 19.07 per cent and 10.98 per cent respondents had purchased crossbred cattle and improved buffalo breeds, respectively. Whereas, 17.34 per cent each of the members had started feeding concentrates and green fodder to their animals only after joining SHG.

The technological change was also reported in horticulture in terms of conversion of inferior trees into superior ones (18.49 per cent), followed by using mango harvester (15.02 per cent),rejuvenation of old fruit orchards (11.56 per cent) and using loranthus cutter (10.40 per cent).

Table 1. Distribution of the respondents according to change made by them in agricultural technology after participation in SHG.

Agricultural technology	Respondents (N = 173)			
	Change occurred	Extent of change		
		Low	Medium	High
Land development :				
Contour sowing	20 (11.56)	11 (6.35)	9 (5.20)	-
Vegetative bunds	-	-	-	-
Bench terraces	-	-	-	-
Water harvesting structures	1 (0.57)	1 (0.57)	(0.00)	-
Land leveling	17 (9.82)	9(5.20)	8 (4.62)	-
Irrigation :				
Dug / Bore well	19 (10.98)	6 (3.46)	13 (7.51)	-
Pump on well	13 (7.51)	3 (1.73)	10 (5.78)	-
PVC pipeline	3 (1.73)	-	3 (1.73)	-
Drip irrigation system for orchards	4 (2.31)	2 (1.15)	2 (1.15)	-
Sprinkler irrigation for vegetable crops	4 (2.31)	2 (1.15)	2 (1.15)	-
Micro sprinkler system for nursery management	2 (1.15)	-	2 (1.15)	-
Crorp production :				
Preparatory tillage :				
Ploughing immediately after harvest of first crop	136 (79.10)	90 (52.02)	44 (25.43)	2 (1.15)
Ploughing the field with iron plough / tractor / power tiller	133 (76.87)	87 (50.28	44 (25.43)	2 (1.15)
Recommended dose of FYM / compost	137 (79.19)	91 (52.60	44 (25.43)	2 (1.15)
Varieties and Seeds :				
HYVs	143 (82.65)	72 (41.61	66 (38.15)	5 (2.89)
Recommended seed rate	126 (72.83)	66 (38.15	58 (33.52)	2 (1.15)
Seed treatment against soil borne diseases	41 (23.69)	17 (9.98)	20 (11.56)	4 (2.31)

Table 1. Cond.

Agricultural technology	Respondents (N = 173)			
	Change occurred	Extent of change		
		Low	Medium	High
Nursery management :				
Raised beds of recommended size	16 (9.24)	11 (6.35)	3 (1.73)	2 (1.15)
Recommended spacing	33 (19.07)	19 (10.98)	12 (6.93)	2 (1.15)
Transplanting / planting :				
Recommended age of seedling	148 (85.54)	87 (50.28)	59 (34.10)	2 (1.15)
Recommended spacing	124 (71.62)	73 (42.19)	46 (26.58)	5 (2.81)
Recommended method of transplanting / planting	123 (71.09)	71 (41.04)	50 (28.90)	2 (1.15)
Nutrient management :				
Recommended NPK dose through :				
Chemical fertilizers	133 (76.87)	53 (30.63	78 (75.00)	2 (1.15)
Green manure	62 (35.83)	22 (12.71)	38 (21.96)	2 (1.15)
Bio-fertilizers	18 (10.40)	3 (1.73)	13 (7.51)	2 (1.15)
Crop protection :				
Recommended levels of insecticides / pesticides	15 (8.67)	3 (1.73)	10 (5.78)	2 (1.15)
Recommended levels of fungicides	5 (2.89)	1 (0.57)	2 (1.15)	2 (1.15)
Spray pump / Duster	19 (10.98)	5 (2.89)	10 (5.78)	4 (2.31)
Pest and disease resistant varieties	147 (84.97)	64 (36.99)	74 (42.77)	9 (5.20)
Harvesting and threshing :				
Harvesting as per maturity indices	146 (84.39)	63 (36.41)	74 (42.77)	9 (5.20)
Improved harvesting tools	126 (73.56)	52 (30.05)	65 (37.57)	9 (5.20)
Improved threshers	39 (22.54)	20 (11.56)	15 (8.67)	4 (2.31)
Horticulture :				
Conversion of inferior trees into superior ones	32 (18.49)	20 (11.56)	5 (2.89)	7 (4.04)
Rejuvenation of old fruit orchards	20 (11.56)	14 (8.09)	3 (1.73)	5 (2.89)
Density planting	10 (5.78)	8 (4.62)	2 (1.15	-
Non-traditional fruit crops	10 (5.78)	7 (4.04)	3 (1.73)	-
Growth regulators	1 (0.57)	1 (0.57)	-	-
Mango harvester	26 (15.02)	13 (7.57)	13 (7.57)	-
Loranthus cutter	18 (10.40)	13 (7.57)	5 (2.89)	-
Dairy farming :				
Crossbred cattle	33 (19.07)	22 (12.71)	11 (6.35)	-
Improved buffalo breeds	19 (10.98)	13 (7.51)	6 (3.46)	-
Cattle housing system	17 (9.82)	12 (6.93)	5 (2.89)	-
Vaccination against diseases	17 (9.82)	8 (4.62)	9 (5.20)	-
Proper milking method	-	-	-	-
Feeding urea treated paddy straw	2 (1.15)	-	2 (1.15)	-
Feeding concentrates	30 (17.34)	14 (8.09)	14 (8.09)	2 (1.15)
Feeding green fodder	30 (17.34)	15 (8.67)	13 (7.50)	2 (1.15)
Preservation of feed and fodder e.g. silage and hay making	-	-	-	-
Management tools	14 (8.26)	4 (2.31)	8 (4.62)	2 (1.15)

Table 1. Cond.

Agricultural technology	Respondents (N = 173)			
	Change occurred	Extent of change		
		Low	Medium	High
Poultry farming :				
Improved broiler strains	40 (23.12)	23 (13.29)	17 (9.82)	-
Deep litter system	-	-	-	-
Cage system	-	-	-	-
Improved poultry equipments	-	-	-	-
Vaccination against diseases	25 (14.45)	16 (9.24)	9 (5.20)	-
Backyard poultry	30 (17.34)	19 (10.98)	11 (6.35)	
Goat farming :				
Rearing of Indian breeds	12 (6.93)	7 (4.04)	5 (2.89)	-
Rearing system	-	-	-	-
Feeding concentrates and top feeds	9 (6.93)	6 (3.46)	3 (1.73)	-
Vaccination against diseases	6 (3.46)	4 (2.31)	2 (1.15)	-
Managements tools-chaff cutter	6 (3.46)	4 (2.31)	2 (1.15)	-
Fisheries :				
Improved processing methods	-	-	-	-
Improved transport and packing methods	-	-	-	-
Improved storage methods	8 (4.62)	4 (2.31)	4 (2.31)	-
Improved drying methods	8 (4.62)	4 (2.31)	4 (2.31)	-
Post harvest technology :				
Processed fruit products	23 (13.29)	21 (12.13)	2 (1.15)	-
Preservatives in fruit processing	-	-	-	-
Improved drying methods	-	-	-	-
Machinery	18 (10.40)	13 (7.51)	5 (2.89)	-
Marketing practices :				
Co-operative marketing	29 (16.76)	23 (13.29)	6 (3.46)	-
Grading of the products	28 (16.18)	22 (12.71)	6 (3.46)	-
Storing finished products	4 (2.31)	2 (1.15)	2 (1.15)	-

Some improvement in marketing practices was also noticed among the members of SHG, as they had contacted co-operative marketing institutions (16.71 per cent) and started grading of their products (16.18 per cent).

In case of post harvest technology 13.29 per cent members had made processed fruit products. Of them, 10.40 per cent had purchased machinery of their own.

The information regarding change occurred with respect to land development indicated that, 11.56 per cent respondents had adopted contour sowing, while 9.84 per cent of them followed land leveling in their fields.

After joining SHG, 10.98 per cent members had dug well in their fields, while 7.51 per cent of them had installed pump on well.

The change occurred in case of goat

farming was to the small extent, as only 12 members had purchased Osmanabadi male and six members of them had started feeding concentrates, followed vaccination against diseases and purchased chaff cutter.

The data change occurred in fisheries sector was found negligible as only 4.62 per cent respondents had adopted improved storage and drying methods for fish. The results made it clear that the members of self help group had changed the crop production technology to a satisfactory level after participating in SHGs. Further, the members had shown interest in changing some of technology related to their subsidiary occupation such as animal husbandry, post harvest technology, horticulture and marketing. The technology of land development and irrigation are important from the point of view of sustainability, however, this aspect seems to be neglected by the members. It is therefore, necessary to educate the members of SHG in this regard. The results pertaining to technological change made by the members call for educational efforts and policy support to them for bringing the technological change to a higher degree. The results of the study conducted by Arunkumar (2004), Palande, *et al.* (2001) and Senger, *et al.* (1998) are line with the findings of the present study.

References

Arunkumar, T. D. 2004. Profile of self help groups and their contribution for livestock development in Karnataka. M.Sc. (Agri.) thesis submitted to the University of Agric. Sci. Dharwad.

Palande, R. S., Shirke, V. S. and Sawant, G. K. 2001. Impact of national watershed development programme on working conditions of beneficiaries. Maharashtra J. of Exten. Edn. 20: 125-127.

Senger, R. S., Sharma, M. L. and Sharma, P. N. 1988. Impact of community lift irrigation scheme on beneficiary's. Maharashtra J. of Exten. Edn. 17: 358-365.

J. Agric. Res. Technol., 37 (1) : 107-110 (2012)

A Study on Diversification of Cotton Area Under Other Crops

P. P. Wankhade[1], R. T. Katole[2], S. K. Godase[3] and D. M. Mankar[4]
Department of Extension Education, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104 (India)
(Received : 21-07-2010)

Abstract

Findings revealed that more than half of respondents had moderate crop diversification of cotton under other crops. Findings of relational analysis revealed that, land holding, annual income, area under cotton, crop pattern and socio-economic status were found to have negative and significant relatonship with crop diversification of cotton to other crops. Furhei the multiple regression analysis revealed that land holding, cropping pattern were found negative and significantly influenced on crop diversification. Socio-economic status and extension contact were found to have positive and significant influence on crop diversification.

Key words : Diversification, cotton area.

India ranks 1st in world in area under cotton cultivation having 9.53 million ha. sharing 27.94 per cent of world area under cotton (34.10 million ha) with production of 31.00 million bales per year (Anonymous, 2009).

Crop diversification referring to larger crop mix creates a land use conflict among the various crops and crops-groups and non food grains. In this study it relates to the crops like cotton, soybean, pigeonpea, green gram, sorghum, gram, wheat, groundnut, etc. Diversification of agriculture is becoming important as farmers are faced with flowing restrictions of market imbalances between supply and demand for their products and farmers must be fully aware of market trends before he hope to diversify (Patil, 1996).

Crop diversification may be adopted as strategy for profit maximization through receiving the gains of complementary and supplementary relationship for competitive products. It may also act as a powerful tool in minimization of risk in farming business. Under the situation of weather and market induced risk and capital constraints, diversification may help in stabilizing farm income at a higher plane. These considerations make a strong case for crop diversification in Indian conditions. In the context of Indian agriculture, diversification has occurred across and with crops, livestock, horticultural sectors, technological change and government policies accelerate diversification to avoid monocropping. Diversification taking place at micro and macro level and as such this necessitated to undertake study related to the extent of crop diversification and economics of crop diversification.

Materials and Methods

The present study was conducted in Akola Panchayat Samiti where larger area of cotton diversified into other crops. In these Panchayat Samiti cotton area was declined in last 5 years and diversified under other crops. From this Panchayat Samiti 15 villages were selected on the basis of declining area under cotton since, 2003-04. From each village, the farmers whose area under cotton was declined, since 2003-04 were selected by proportionate

1., 2. Asstt. Professor, 3. P.G. student and 4. Professor.

random sampling. Thus, 150 farmers constituted the sample for this study. Data were collected by personally interviewing the respondents with the help of pre-tested and structured schedule. The collected data were tabulated and the statistical tools namely mean, standard deviation, percentage, frequency, correlation and multiple regression analysis were applied for interpretation of findings.

Results and Discussion

Crop diversification : It is operationally defined as change in area under cotton and diverted for cultivation under other crops.Crop diversification referring to larger crop mix creates a land use conflict among the various crops and crop groups like food-grains and non-food grains (Gopalappa, 1996). Crop diversification was measured by obtaining the per cent change in the area under cotton.

It was observed that total area of selected respondents (n=150) under cotton was 364.6 ha during base year (2003-04) and 192.6 ha during the study year (2007-08). Therefore, decrease in the area under cotton was 172 ha. Hence, per cent crop diversification was 47.17 per cent.

From Table 1 it is observed that, the maximum area of cotton crop diversified under other crops like soybean, black gram, green gram, pigeon pea and sorghum respectively. In this sense area under soybean increased in last 3 years. The area under cotton declined since last 5 years because of heavy attack of pest, diseases, less prices in market and unavailability of irrigation facility. Logical reasoning behind this could be that the farmers with medium land holding were unable to try new technology on their farm. The farmers with less annual income could not be able to spent more money on plant protection, fertilizers, etc. The farmer with lower socio-economic status did not possess improved implements required for cotton cultivation. Therefore, the diversification of cotton under other crops is the decision taken by the cotton growers.

During survey, it was observed that cotton growers were diverted towards soybean, pigeon pea, green gram, sunflower, safflower and other crops. This has been done because of uncertainty of cotton crop and fluctuating market prices.

Beside investigation of per cent crop diversification the respondents were also categorized on the basis of crop diversification of cotton under other crops.

Distribution of the respondents according to their crop diversification (Table 2) revealed that majority of the respondents (60.66%) had moderate diversification of cotton under other crops, followed by 27.34 per cent of the respondents had low diversification of cotton

Table 1. Areawise variation of crop in Akola Panchayat Samiti.

Year	Area (ha)					
	Cotton	Soy-bean	Udid	Mung	Tur	*Kharif* jowar
2003-04	386	133	26	112	144	148
2004-05	363	151	8	115	146	164
2005-06	409	11	21	87	152	173
2006-07	414	101	16	154	108	152
2007-08	359	180	22	259	105	118
2008-09	338	222	3	142	129	116

Table 2. Distribution of respondents according to their crop diversification.

Crop diversification	Respondents (n=150)	
	Number	Percentage
Low	41	27.34
Moderate	91	60.66
High	18	12.00
Total	150	100.00

while 12.00 per cent of respondents had high diversification of cotton under other crops. Thus, it could be concluded that majority of respondents (60.66%) had moderate diversification under other crops. Similar finding was reported by Patel (2003), who observed that majority of the respondents had moderate diversification under other crops.

Relational analysis : The data depicted in Table 3 revealed that age, education, soil type, risk preference and market orientation were found to have non-significant correlation with crop diversification, that means these variables has no effect on crop diversification. Similar findings were reported by (Patel, 2003) who found that age, education and risk preference had non-significant co-rrelation with crop diversification.

However, out of the variables, land holding, annual income, area under cotton, cropping pattern, socio-economic status and extension contact had significant correlation with crop diversification, that means these variables has influence on the crop diversification. Similar findings were reported by Patel (2003).

The variables, land holding and annual income had negative and significant correlation. Whereas, extension contact were found to have positive and significant. Another two variables such as cropping pattern and socio-economic status showed negative and highly signincant correlation with crop diversification. Similar findings were reported by Tingre *et al*. (2006).

The present findings indicated that due to decrease in land holding, annual income, area under cotton, cropping pattern and socio-economic status of cotton growers, there was increase in crop diversification of cotton towards other crops. While higher in extension contact of cotton growers resulted into higher crop diversification of cotton towards other crops.

Multiple Regression Analysis : It is evident from the data in Table 4 that the coefficient of multiple determination (R^2) of eleven independent variable was 0.6075. It means that 60.75 per cent of total variation in crop diversification level was explained by the

Table 3. Coefficient of correlation of selected characteristics of cotton farmers with crop diversification.

Variables	r' values
Age	0.1013NS
Education	0.0803NS
Land holding	-0.1503*
Annual income	-0.1833*
Area under cotton	-0.5017**
Soil type	-0.0171NS
Cropping pattern	-0.2432**
Socio-economic status	-0.6366**
Extension contact	0.1204*
Risk preference	-0.0333NS
Market orientation	0.0642NS

* Significant at 0.05 level of probability, ** Significant at 0.01 level of probability, NS=Non Significant

Table 4. Multiple regression analysis of crop diversification with their independent variables.

Variable	Regression coefficient b' values	S.E. (B)	t' values
Age	0.1427	0.1421	1.0040NS
Education	0.2727	0.3416	0.7985NS
Land holding	5.9353	0.7935	-7.4799**
Annual income	5.1326	0.1734	0.7220NS
Area under cotton	22.3848	1.9104	11.7170**
Soil type	2.4200	1.4239	-1.6995NS
Cropping pattern	2.5082	0.6190	-4.0519**
Socio-economic status	1.3402	0.6145	2.1808*
Extension contact	0.6124	0.3111	1.9826*
Risk preference	0.3014	0.3588	-0.8399NS
Market orientation	0.1771	0.3527	0.5020NS

R^2=0.6075, F=19.4217*

* Significant at 0.05 level of probability, ** Significant at 0.01 level of probability, NS=Non Significant

independent variables selected for the study. However, out of these variables, holding and cropping pattern were found to have negative and highly significant influence on the crop diversification. Whereas, area under cotton was positively and significantly influenced on crop diversification. While, another two variables, namely socio-economics status and extension contact was found to have positive and significant influence on crop diversification.

Therefore, it could be concluded that area under cotton has emerged as an influencing factor for diversification of cotton towards other crops. The findings of the present study were similar to the findings of Patel (2003). Tingre *et al.* (2006) reported that the cropping pattern was highly significant related with crop diversification.

However, the characteristic like, age, education, annual income, soil type, risk preference and market orientation were found to be non significantly related with crop diversification level of respondents. Similar findings were reported by Patel (2003).

Multiple regression analysis revealed that the characteristics *viz*., area under cotton, land holding, cropping pattern, socio-economic status and extension contact were consistent in exerting the influence over crop diversification level of respondents. By and large, it could be concluded from the multiple regression analysis that these variables emerged as crucial variables influencing the crop diversification level of the cotton farmers. When all the 11 variables were fitted in multiple regression equation the coefficient of multiple determination (R^2) comes to 0.6075 and was significant indicating that all variables contributed 60.75 per cent variation in crop diversification of cotton growers.

References

Anonymous. 2009. Area and Production of Cotton, www.google.com

Gopalappa, V. 1996. Crop diversification and income levels in Karim Nagar District of Andhra Pradesh. Indian J. Agric. Econ. 51(3).

Patel, P. L. 2003. Reasons for decline in chilli area and diversification under other crops. M.Sc. (Agri.) thesis submitted to Dr. PDKV, Akola.

Pail, G. R. 1996. Agricultural growth and diversification in Karnataka. Indian J. Agril. Edun. 51(4): 685.

Tingre, A. S., Kakde, S. J. and Bhoyar, S. S. 2006. Cropping pattern changes and crop diversification in Vidarbha region of Maharashtra. PKV Res. J. 30(2): 203-206.

J. Agric. Res. Technol., 37 (1) : 111-116 (2012)

A Study of Self Help Groups Engaged in Agrobased Enterprises

D. M. Mankar[1], R. S. Raut[2] and P. P. Bhople[3]
Department of Extension Education, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola - 444 104 (India)
(Received : 31-08-2010)

Abstract

Nearly half of the respondents from both the enterprises were belonged to young aged category. Majority of the respondents were educated upto middle school. One fourth of the respondents were illiterate. Majority of the respondents from both the enterprises were belonged to nuclear type medium size of family. Ninety per cent of the goat rearing entrepreneurs belonged to an annual income of Rs. 25,001 to Rs. 50,000. Whereas, nearly half of the dairy owners had an annual income below Rs. 25.000. All the respondents were received the training on formation and working of SHGs. Majority of the dairy entrepreneurs and half of the goat rearing entrepreneurs were obtained the training in their respective enterprises. The favorable changes were observed in categories of psychological, cutural, social and economic empowerment.

Key words : SHG, Agrobase enterprises.

The promotion of Self Help Groups (SHGs) by external intervention is of recent origin. There appears to be a fairly good progress of developmental activities which have helped to attain bigger goals like empowerment of rural women. The progress of SHGs is limited in terms of spread. They certainly seems to hold a good potential in the field of rural credit. Based on assessment NABARD has an ambitious plan of expanding SHGs all over the country and promote them as instruments, which can supplement, the institutional agencies in effectively reaching the rural poor. The SHGs have great potential in accelerating pace of rural development, hence it was considered worthwhile to analyze the group development from close quarter to assess the constraints associated with the SHGs.

Objective of the study was to find out personal and socio economic characteristics of women members of SHG and to study their empowerment through agrobased enterprises.

1. Professor and Head, 2. Sr. Res. Asstt. and 3. Asstt. Professor.

Materials and Methods

The present investigation was carried out in AKola, Barshitakli and Telhara talukas of Akola district, Bhatkuli, Chandur Rly. and Nandgaon Khandeshwar of Amravati district and Malegaon, Risod and Washim of Washim district. From these talukas two SHGs engaged in dairy and goat rearing were selected. Thus, 18 SHGs were purposively selected. An ex-post facto research design of social research was used.

All members in the selected SHGs were considered as respondent for the present study. A sample of 91 members from dairy enterprise and 82 members from goat rearing enterprise. Thus, from 18 SHGs, total 173 respondents were selected from three districts. A structured interview schedule was prepared and used for data collection.

Results and Discussion

Age : It was observed from Table 1, that nearly half of the respondents from dairy

enterprise (49.46%) and goat rearing (52.44%) were belonged to young age group i.e. upto 35 years, whereas, slightly higher than one third of respondents from dairy enterprises (35.16%) and from goat rearing (24.39%) were belonged to middle age group. Remaining 15.38 and 23.17 per cent respondents from dairy and goat rearing enterprise respectively were in the old age category. Kashid (2008) had reported similar observations wherein he stated that most of the women were belonged to young age group.

Education : It was noticed that, more than one third of the respondents of both dairy and goat rearing enterprises had educated upto middle school level i.e. 36.26 and 30.49 per cent, respectively, followed by 35.16 per cent of dairy respondents were educated upto primary level, whereas, in case of goat rearing,

Table 1. Distribution of the respondents according to their characteristics.

Particulars	Dairy (n=91)		Goat rearing (n=82)		Total (n=173)	
	No.	%	No.	%	No.	%
Age (years) :						
Young (upto 35)	45	49.46	43	52.44	88	50.87
Middle (36 to 50)	32	35.16	20	24.39	52	30.06
Old (above 50)	14	15.38	19	23.17	33	19.07
Education :						
Illiterate (no schooling)	14	15.38	28	34.15	42	24.28
Primary school (upto 4^{th})	32	35.16	21	25.61	53	30.63
Middle school (5^{th} to 7^{th})	33	36.26	25	30.49	58	33.53
High school (8^{th} to 10^{th})	12	13.19	08	09.75	20	11.56
Family type :						
Nuclear family	66	72.53	61	74.39	127	73.41
Joint family	25	27.47	21	25.61	46	26.59
Family size :						
Small (upto 3 members)	18	19.78	25	30.49	43	24.85
Medium (4 to 7 members)	64	70.33	46	56.10	110	63.59
Big (above 7 members)	09	09.89	11	13.41	20	11.56
Annual income from the enterprises :						
Rs. 10,000 to Rs. 25,000	51	56.04	08	09.76	59	34.10
Rs. 25,001 to Rs. 35,000	28	30.77	48	58.53	76	43.93
Rs. 35,001 to Rs. 50,000	12	13.19	26	31.71	38	21.97
Training received :						
SHG formation and working	91	100.00	82	100.0	173	100.00
Maintenance of account	67	73.63	45	54.88	112	64.74
Dairy	75	82.42	00	00.00	75	43.35
Goat keeping	00	00.00	40	48.78	40	23.12
Candle preparation	47	51.65	49	59.7	96	55.49
Essence stick	47	51.65	49	59.76	96	55.49
Vermi compost	40	43.96	20	24.39	60	34.68
Preparation of value added food	44	48.35	22	26.83	66	38.15
Screen printing	35	38.46	20	24.39	55	31.79

34.15 per cent respondents were illiterate. Meager amount of respondents from dairy unit (13.19%) and goat rearing (9.75%) were educated upto high school level i.e. upto 10th class.

Type of family : The majority of dairy (72.53%) and goat owners (74.39%) had a nuclear type of family, whereas, 27.47 and 25.31 per cent of respondents from dairy and goat rearing enterprises respectively belonged to joint families.

Family size : The (70.33%) of respondents of dairy enterprises and 56.10 per cent of respondents of goat rearing had medium size family i.e. 4 to 7 members in a family. Whereas, 19.78 per cent dairy respondents and 30.49 per cent goat rearing respondents belonged to small family size having upto 3 members in family. Meagre number of respondents from dairy (9.89%) and goat rearing (13.41%) were belonged to large family size having more than 7 members in a family. The findings of Devlatha (2005) and Kashid (2008) also reported that majority of the respondents were belonged to medium family size.

Annual income : The respondents were equally distributed among the three categories i.e. Rs. 10,000 to Rs. 25,000 Rs. 25001 to Rs. 35,000 and Rs. 35001 to Rs. 50,000. Slightly higher than half of the respondents (56.04%) possessed dairy enterprise having annual income between Rs. 10,000 to Rs. 25,000 whereas, 56.53 per cent of goat unit entrepreneurs belonged to the annual income between Rs. 25,001 to Rs. 35,000. Nearly one third (31.71%) of the goat rearing respondents and 13.19 per cent dairy entrepreneurs received an annual income between Rs. 35,001 to Rs. 50,000.

Training received : It was noticed that cent per cent members of the SHG had received the training on SHG formation and working, whereas, 73.63 per cent of dairy respondents and 54.88 per cen of goat rearing respondents had obtained training on maintenance of account. Majority of dairy respondents (82.42%) and 48.78 per cent goat keepers had received the training on dairy and goat keeping respectively. Whereas, more than fifty per cent of the respondents (51.65% dairy and 59.76% goat keepers) obtained training on candle preparation and preparation of essence sticks. Also 43.96, 48.35 and 38.46 per cent dairy respondents and 24.39 por cent, 26.83 and 24.39 per cent goat keepers had availed the training facilities on enterprises like vermicompost, preparation of value added food and screen printing, respectively. These training facilities were provided by MAVIM, Panchayat Samiti, DRDA, MITCON at taluka and village level for duration of 1 to 3 days depending upon the content of practical in the subject of training.

Psychological empowerment : The psychological empowerment of the respondents was observed medium (56.07%) followed by low (35.84%). Meager respondents (3.09%) were observed in high category of psychological empowerment, before joining the SHGs. The tremendous change was observed in psychological empowerment of rural women after joining the SHGs. It was observed that 58.96 per cent of the respondents were belonged to high category of psychologically empowerment followed by 22.54 per cent in medium category. Nearly one fifth of rural women (18.50%) were observed in low category of psychological empowerment even after joining the SHGs. The aspects like self confidence, courage, self sufficiency, security in family, ambitions in business, etc. were included to measure the psychological empowerment. The present findings are supported by the

Table 1. Empowerment of women members.

Areas of empowerment	Before		After		Increase
	No.	%	No.	%	%
Psychological empowerment :					
Self Confidence	28	16.18	133	76.88	60.69
Courage	38	21.97	159	91.91	69.94
Self independence	32	18.50	142	82.08	63.58
Feeling of security in the family	122	70.52	168	97.11	26.59
Professional ambition	12	6.94	121	69.94	63.01
Self image	22	12.72	98	56.65	43.93
		24.47		79.09	54.62
Cultural empowerment :					
Freedom of communication to unknown person	12	6.94	121	69.94	63.01
Freedom to enjoy foods	32	18.50	133	76.88	58.38
Freedom to participate in festival and cultural programme	35	20.23	140	80.92	60.69
Freedom to celebrate rituals and festivals	140	80.92	159	91.91	10.98
Freedom in dressing	35	20.23	159	91.91	71.68
Freedom to visit religious place	98	56.65	110	63.58	6.94
Freedom to decide food for family members	65	37.57	140	80.92	43.35
Freedom to attend marriage ceremony	110	63.58	135	78.03	14.45
		38.08		79.26	34.68
Social empowerment :					
Freedom to avail educational facilities	55	31.79	105	60.69	28.90
Freedom to work outside the house	35	20.23	137	79.19	58.96
Freedom to consult doctors and visit hospitals	65	37.57	95	54.91	17.34
Freedom to take care of health	65	37.57	95	54.91	17.34
Freedom to participate in family planning programme	50	28.90	120	69.36	40.46
Freedom to participate in community welfare programme	45	26.01	135	78.03	52.02
Feeling of self ecurity in the society	122	70.52	168	97.11	26.59
Participation in decision making of children's education	63	36.42	145	83.82	47.40
Participation in decision making of daughters marriage	32	18.50	85	49.13	30.64
Maintenance of dignity in the society	25	14.45	95	54.91	40.46
Creating good social atmosphere	65	37.57	97	56.07	18.50
Participation by family members for special contribution	32	18.50	110	63.58	45.09
Availability and make use of new technology	23	13.29	63	36.42	23.12
Free interactions with friends	62	35.84	120	69.36	33.53
Decision making ability for availability of drinking water	58	33.53	122	70.52	36.99
Decision making availability for collection of fuel	42	24.28	97	56.07	31.79
		30.31		64.63	31.50
Economic empowerment :					
Opportunities in economic development	32	18.50	148	85.55	67.05
Freedom in selection of profession	32	18.50	148	85.55	67.05
Freedom in saving in the form of fixed deposits	42	24.28	152	87.86	63.58
Freedom to open accounts in the banks	42	24.28	152	87.86	63.58
Participation in selecting and applying new technologies in house and profession	30	17.34	95	54.91	37.57
Involvement in decision making for purchase of house	20	11.56	85	49.13	37.57

Table 1. Contd.

Areas of empowerment	Before		After		Increase
	No.	%	No.	%	%
Participation in sell of agricultural produce	25	14.45	65	37.57	23.12
Involvement in purchase of input for business run by family members	32	18.50	92	53.18	34.68
Authority to employ labour	12	6.94	50	28.90	21.97
Freedom to spent amount for hospitality of guests	33	19.08	68	39.31	20.23
Freedom to offer gifts to the relatives	35	20.23	75	43.35	23.12
		17.60		59.38	41.78
Political empowerment :					
Existing political post held	0	0.00	5	2.89	2.89
Freedom to take part actively in the politics	0	0.00	25	14.45	14.45
Information about human rights	22	12.72	168	97.11	84.39
Knowledge about provision and rights of women	25	14.45	170	98.27	83.82
Knowledge about politics and political parties	20	11.56	165	95.38	83.82
		7.75		61.62	53.87

findings of Bhagyalaxmi *et al*. (2003) and Kashid (2008) who reported that majority of women respondents were under medium to high category of psychological empowerment.

Cultural empowerment : cultural aspects of the rural women is controlled by the behavior pattern of the family and the community she belonged was observed that 40.46 per cent of the women belonged to medium category followed by high (38.73%) and low (20.81%) before joining the SHG. Whereas, more than half of respondents were observed in high (55.49%) and 30.64 per cent were found in medium category of cultural empowerment.

Social empowerment : The aspects like freedom to avail educational facilities, free to work outside the house, health check-up, involvement in decision making process in family planning programme, marriage of daughters and sons and other social aspects were included in social empowerment. In was observed that nearly half of respondents (49.13%) belonged to medium category of social empowerment followed by low (28.90%) and high (21.97%) before joining the SHGs. After joining the SHGs, the changes was observed in social empowerment among the members. It was observed that more than half of the respondents (56.07%) belonged to high category of social empowerment followed by medium (30.06%) and low (13.87%). The present findings go to corroborate the findings of Kashid (2008) who observed that majority of the women respondents were highly empowered in social activities.

Economic empowerment : The aspects like opportunities in selecting and participating in the economic development, saving money, opening bank account, introducing new technologies in business and house, participation in decision making in purchase and sale deed of property, input purchase, etc. were considered under the economic empowerment. It was noticed that nearly half of the respondents (49.13%) belonged to low economic empowerment followed by medium (35.84%) and high (15.03%) before joining the SHGs. There was remarkable improvement in economic empowerment of members after joining the SHGs. The 42.19 per cent of the respondents belonged to high category of

economic empowerment followed by medium (39.31%) and low (18.50%) after joining the SHGs.

Political empowerment : This aspects includes, the position in political party and formal institutions, freedom in active participation in politics, information about human rights, women rights and information about politics. It was observed that majority of the respondents (60.69%) were under the low category of political empowerment followed by medium (39.31%) before joining the SHGs. Whereas, majority of them belonged to medium category (76.30%) of political empowerment and 23.70 per cent respondent were observed in low category after joining the SHGs. It could be inferred that, there was no awareness and did not shown interest in the politics. After joining the SHGs, respondents expressed that, if they could get the chance with favorable atmosphere they would take part in the politics. But, non of the respondents were aware about the human rights and laws regarding safe guard the rights of women. The findings of the study were contradiction to the findings of Kashid (2008) who found that majority of women members in low empowerment before joining and in high empowerment category after joining SHG.

It was evident from Ttable 2 that the Psychological empowerment increase over 54.62 per cent, cultural empowerment 34.68 per cent, social empowerment 31.50 per cent, economic empowerment 41.78 and political empowerment 53.87 per cent respectively. The present findings are supported by the findings of Kashid (2008) who reported that after joining of SHG the percentage of women members regarding, psychological empowerment, cultural empowerment, social empowerment, economic empowerment and political empowerment is increased.

It is concluded that nearly half of the respondents from both the enterprises were belonged to young aged category. Majority of the respondents were educated upto middle school. One fourth of the respondents were illiterate. Majority of the respondents from both the enterprises were belonged to nuclear type family with medium size of family. Ninety per cent of the goat rearing entrepreneurs belonged to an annual income of Rs. 25,001 to Rs. 50,000, Whereas, nearly half of the dairy owners had an annual income below Rs. 25,000. All the respondents were received the training on formation and working of SHGs. Majority of the respondents of both the enterprises were obtained training on maintenance and accounting. The favorable changes were observed in categories of psychological, cultural, social and economic empowerment. Many members were participating in the financial decisions of the family, women members were getting support from their husband and other family members which was not available before they joined the group and members in the SHGs are coming out in the open to discuss their problems, which would not have been possible earlier. Women members expressed full factors over their performance and wanted to continue their association with the group.

References

Bhagyalaxmi, K., Gopalkrishna Rao and Reddy, M. S. 2003. Profile of the rural women micro entrepreneurs. J. Res. ANGRU. 31(4): 51-54.

Devalatha, C. M. 2005. Profile study of women self help groups in gadad district of Northen Karnataka. Karnataka J. Agric. Sci. 19(1): 223-224.

Kashid, Komal (2008). Empowerment of rural women through self help groups. M.Sc. (Agri.) thesis Dr.PDKV, Akola.

J. Agric. Res. Technol., 37 (1) : 117-121 (2012)

Development of Thermo-Chemical Pretreatment for Dehulling of Pigeonpea

V. A. Salve[1], P. S. Phirke[2], V. P. Kad[3] and P. A. Turbathmath[4]
Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 01-03-2008)

Abstract

After scarification of grains 8 per cent urea solution was applied in the giain-to-solution ratio of 1:25 and left for 5hr. The levels of temperature and heating time of urea treated grain before milling were found to be 64°C and 5 min, 64°C and 30 sec. for oven and sand medium, respectively. Urea treatment and thermo-chemical pretreatment to pigeonpea grain improved the dehulling index by 25.28 per cent and reduced dehulling time by 51.51 percent.

Key words : Pigeonpea, scarification, thermo-chemical pretreatment, dehulling.

The pigeonpea is mostly consumed in the form of dehulled splits (dal) as dehulling improves its appearance, texture, cooking quality, palatabilily and digestibility. However, pigeonpea considered to be the most difficult grain to mill. Literature revealed that applying urea solution to scarified pigeonpa grain and dehulling in hot condition is an effective pretreatment considerably increasing the dehulling efficiency and decreasing dehulling time (Phirke and Bhole, 1999). It is, therefore, necessary to study the various operational parameters of thermo-chemical pretreatment to pigeonpea grain before dehulling and to evaluate the optimum input conditions for efficient dehulling.

Materials and Methods

Pigeonpea grain (var. C11) was selected as raw material. The moisture content was held constant at 8.20 ± 0.10% w.b. through out the tests over a saturated solution of magnesium chloride at 30°C and 50 per cent relative humidity for 24 h (Oomah *et al.* 1981). It was graded by passing through the sieve 5.96 mm diameter and retained on 4.76 mm sieve.

Sample of 10 grains randomly picked up and their major (a) and minor (c) axes were measured. The surface area of the grain was calculated by using the mathematical expression (Mohsenin, 1986) as $S = \pi e^2 + (ac/2e)\sin^{-1}e$, where a and c are, respectively the major and minor axes of the ellips of rotation and e is the eccentricity given by $e = [1-(c/a)^2]^{0.5}$. Random 1000 grains were selected and weighed accurately using an electronic balance. Average of five readings are reported. The percentage of seed coat in whole grain was determined by soaking three samples each with 25 grains in distilled water (50°C, 2hr) and removing the seed coat by knife and fork, manually. The weight of whole grain (W_h) and the pearled grain (W_p) after complete seed coat removal, were taken by drying to the original moisture content. The seed coat content (S_c) was expressed as percentage of whole grain as $S_c = 100 (W_h - W_p)/W_h$. Specific heat at difierent grain temperature was determined by method of mixture. The sample of known weight and temperature was dropped into calorimeter of known heat capacity and

1. STA, 2. Ex-Head. APE. CAE&T, Akola. 3. Assistant Professor, CA. Dhule and 4. Principal Investigator.

temperature. The equilibrium temperature for this measure of sample was then recorded by using thermometer. The expression used to calculate heat capacity of grain was $Cp_1 = [W_1\Delta t_2 Cp_2 + Cp_3\Delta t_2(W_3-W_2)]/W_1\Delta t_1$. Where Cp_1, Cp_2 and Cp_3 is specific heat of sample, calorimeter and water, respectively; $\Delta t_1=t_3-t_2$, $\Delta t_2=t_1-t_3$, t_1 is the temperature of sample, t_2 is the temperature of calorimeter, t_3 is the equilibrium temperature, W_1 is the weight of sample, W_2 is the weight of calorimeter with stirrer and W_3 is the weight of calorimeter with slirrer and water.

The dehulling properties *viz.*, Dehulling Time (DT), Dehulling Index (DI) and Intact Pearled Grain (IPG) were determined when 95 per cent of seed coat was removed from 5g grain sample. The Tangential Abrasive Dehulling Device (TADD) was used for the determination of dehulling characteristics. The flow chart for hot milling is shown in Fig. 1.

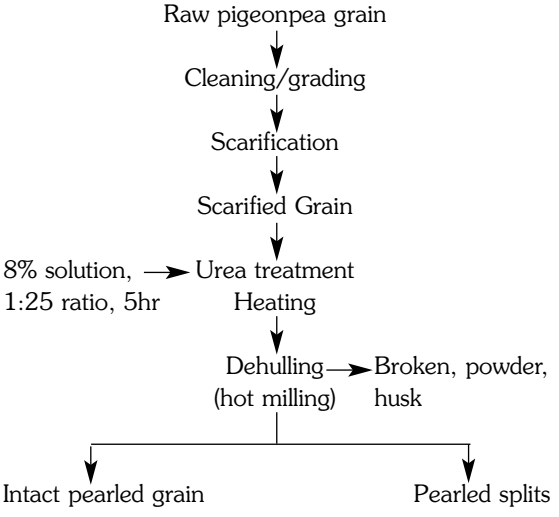

Fig. 1. Flow process chart for hot milling of pigeonpea grain.

The graded pigeonpea grain was scarified in TADD for 12 sec., so as to make an access to the urea solution for loosening the seed coat. This scarification time was determined by maximum scratches on the grain surface but no or least, splits during this operation. After scarification, the grain was treated with 8 per cent urea solution (1:25 solution to grain ratio) and left for 5 hr. The treated grain was then heated in a hot air oven and sand medium so that only seed coat and outer surface of the grain is heated for loosening of seed coat. The grain in hot condition were dehulled in TADD.

Procedure for dehulling : The grinding of 5g samples was done till 95 per cent seed coat removal was achieved. The dehulling time required was noted by a stopwatch. The pretreated samples were then fed to the heating media to heat it to about 64°C. The sample loaded in the sample cup of TADD. After putting the weight on the grain, the rotor disc was rotated for predetermined DT level. The sample was taken out by means of the vaccum sample collector, divided into two parts *viz.*, dehulled sample in cup and abraded fines below the cyclone separator outlet. Both the parts were filled in labeled polyethylene bags separately.

Analysis of samples : The initial weight (Wh) of each sample was 5g. After dehulling. the grain sample was weighted (Wm) and the percentage of abraded fines, from grain (abraded fines) was determined by using the following expression.

$$AF = 100(W_h - W_m)/W_h$$

The percentage seed coat removed (SR) was determined by using the following expression

Table 1. Physical properties of pigeonpea grain.

Physical and thermal properties	Mean
Dimensions mm :	
Major aixis (a)	6.40
Minor axix (b)	4.74
Surface area mm^2	411.89
Test weight, g (1000 grains)	130
Seeds coat content, %	14.33
Specific heat, kJ $kg^{-1}K$	14.01

$SR = 100\ W_S/(S_c/W_h)$

The dehulling index (DI) was calculated by using the relation,

$DI = 0.95S_c/(Af_{95})$

Where AF_{95} was the abraded fines from grain when 95 per cent seed coat removed.

The pearling index (PI) indicated the completely dehulled grain and splits after dehulling out of the total theoretical cotyledon weight available in whole grain.

The PI was determined as $PI = (IPG + PS / 100 - S_c)$

The product recovery (PR) gave an idea of what percentage of whole grain was completely dehulled so that it has the commercial value or useful for consumption.

$PR = 100PI/(1\text{-}S_c/100)$

Input parameters (factors) namely heating time and heating temperature were optimized for the urea treatment by hot milling. Grain was scarified for 10 sec (Ethiwe and Reichert, 1987) for better penetration of urea solution to the uronic acid responsible for holding the seed coat tightly with cotyledons.

The response surface methodology (RSM) was used for the experimental design for optimization of heating temperature (x_1) and heating time (x_2). Dehulling index (DI) and dehulling time (DT) were the two responses considered for optimization of input variables using central composite rotatable design. The different levels selected for the heating temperature were 46, 50, 60 and 74°C were as heating time levels selected as 2.2, 3, 5, 7 and 7.8 seconds.

Results and Discussion

Grain properties : The physical and thermal properties of pigeonpea were studied which were responsible directly or indirectly for

Table 2. Effect of grain heating temperature and heating time on the dehulling index and dehulling time (oven).

Heating temperature (x_1), °C	Heating time, (x_2) min	Dehulling index	Dehulling time, s
50	3.0	0.789	6.08
70	3.0	0.857	5.70
50	7.0	0.810	6.19
70	7.0	0.853	4.63
46	5.0	0.789	6.11
74	5.0	0.859	4.72
60	2.2	0.848	5.70
60	7.8	0.820	5.19
60	5.0	0.853	4.84
60	5.0	0.836	5.45
60	5.0	0.852	4.80
60	5.0	0.853	5.30
60	5.0	0.840	5.20

Table 3. Performance of urea treatment and hot milling process (heated in oven).

Methods	Dehulling index	Product recovery %	Intact pearled grain, %	Dehulling time, s
Urea/hot milling	0.830	80.80	39.50	5.0
Traditional method	0.746	68.60	31.70	16.5
Increase/decrease, %	11.26	17.78	24.60	(-)69.70

Table 4. Performance under sand medium open pan for different dehulling time.

Dehulling time (DT) s	Seeds coat removal, (SR) %	Abraded fines, (AF), %	Dehulling index (DI)
5	53.67	14.73	0.52
6	65.80	16.56	0.56
7	80.14	16.36	0.70
8	95.15	15.52	0.88
9	97.63	20.86	0.67
10	97.72	27.81	0.50

dehulling of the cultivar C11. All the properties were determined at 8.20 ± 0.10% m.c. (w.b) (Table 1).

Grain heating time and temperature in oven : The experimental results for hot miiling in oven of scarified and pretreated pigeonpea grain are presented in Table 2. After the regression of this data, the partial regression coefficients were obtained to yield the following equations.

The analysis of variance indicated that both the models possessed a non significant lack of fit with 89.00 and 96.3 per cent variability explained. The magnitude of partial regression coefficient in equation (a) and (b) showed that an increase in heating temperature increase in DI but for DT, both the factors reduced the response. This increase in DI and decrease in DT clearly indicated that the dehuliing quality was improved due to making the seed coat brittle by the application of heat (Shyeth *et al*. 1980) which facilitated its easy removal.

$$Y_{DT} = 0.84 + 0.027x_1 - 0.002x_2 - 0.01x_1^2 - 0.005x_2^2 - 0.007x_1x_2 \quad (a)$$

$$Y_{DT} = 5.13 + 0.488x_1 - 0.21x_2 + 0.198x_1^2 + 0.213x_2^2 - 0.295x_1x_2 \quad (b)$$

The results obtained in the present study were similar to the findings reported by the earlier researcher (Phirke and Bhole, 2000). The same results might be due to the same heating mechanisms and durations.

Considering DT = 5 sec., the treated samples were dehulled to test the adequacy of the mathematical model developed with DT = 5 sec. constant. Dehulling index, product recovery and intact pearled grain, were determined for this purpose with five replications and the results are shown in Table 3.

Performance under sand medium open pan for different dehulling time : The grain was kept in sand medium under open pan condition. In order to achieve the required optimum temperature of 64°C the sand temperature increased to 105°C and the sample was heated upto 30 sec. The dehaulling time varied from 5 to 10 sec. The test was replicated three times.

The results of hot milling after heating pigeonpea grain in open pan sand medium are shown in Table 4 and Table 5.

Table 5. Comparision of treatment under sand medium open pan and traditional method.

Methods	Dehulling index	Product recovery %	Intact pearled grain, %	Dehulling time, s
Urea/hot milling	0.88	80.23	39.92	3.00
Traditional method	0.746	68.60	31.70	16.5
Increase/decrease, %	17.96	16.95	25.93	(-)51.51

Table 6. Performance under sand medium grain heater for different dehulling time.

Dehulling time (DT) s	Seeds coat removal, (SR) %	Abraded fines, (AF), %	Dehulling index (DI)
5	50.92	14.79	0.49
6	66.19	16.60	0.57
7	73.67	16.53	0.63
8	94.97	15.68	0.86
9	96.15	20.86	0.66
10	96.53	27.86	0.49

Table 7. Comparision of treatment under sand medium grain heater and traditional method.

Methods	Dehulling index	Product recovery %	Intact pearled grain, %	Dehulling time, s
Urea/hot milling	0.86	79.43	39.64	8.00
Traditional method	0.746	68.60	31.70	16.5
Increase/decrease %	15.28	15.78	20.04	(-)51.51

From the Table 4 it is found that the maximum dehaulling index of 0.88 was obtained when dehaulling time was 8 sec. The seed coat removal and abraded fines were obtained as 95.15 and 15.52 per cent respectively under same condition.

The increase in grain temperature was observed with 105°C sand temperature for 30s residential time. However, for final grain temperature of 64°C could be achieved at sand temperature of about 115°C sand temperature. This might be due to the loss of heat from rotating drum surface.

The results of this dehaulling are presented in Table 6 and Table 7. Similar results were obtained from hot milling when the grain was heated through sand medium open pan and sand medium grain heater both. Thus, the maximum dehulling index of 0.86 was observed for dehulling time of 8 sec. The seed coat removal and abraded fines were obtained as 94.97 and 15.68 per cent respectively.

The average seed coat content was found to be 14.13 per cent. The respective optimum levels of temperature and heating time of urea treated grain before milling were found to be 64°C and 5 min. 64° and 30 sec. for oven and sand medium (open pan and grain heater), respectively. Under the above optimum conditions, the product recovery, dehulling index and dehulling time for var. C11 were 80.80 per cent, 0,83 and 5 sec. oven heating, 80.23 per cent, 0.88 and 8 sec. for sand medium open pan and 79.43 per cent, 0.86 and 5 sec. for sand medium grain heater, respectively. Urea/hot milling (Thermo-chemical pretreatment) improved the dehulling index by 15.28 per cent (i.e. 0.86) by reducing dehulling time by 51.51 per cent (i.e. 8 sec).

References

Ethiwe, A. O. E and Reichert, R. D. 1987. Variability in dehulling quality of cowpea, pigeonpea and mungbean cultivars determined with the tangential abrasive dehulling device. Cereal Chem. 64: 86-90.

Mohsenin, N. N.1986. Physical Properties of Plant and Animal Materials. Gordon and Breach Sci. Publ. New York. pp-51.

Oomah, B. D., Reichert, R. D. and Youngs, C. G. 1981. A novel, multisample, tan tangential abrasive dehulling device. Cereal Chem. 58: 392-395.

Phirke, P. S. and Bhole, N. G. 1999. The effect of pre-treatment on the strength and dehulling properties of pigeonpea grain. Internat. J. of Food Sci. and Technol. 34: 107-113.

Phirke, P. S. and Bhole, N. G. 2000. Pretreatment of pigeonpea grain for improvement of dehulling characteristics. Internat. J. of Food Sci. and Technol. 35: 305-313.

Shyeth, B. J., Rodda, E. D. and Nelson, A. I. 1980. Evaluation of new soybean dehuller. Transaction of the American Soc. of Agric. Eng., 23: 230-232.

J. Agric. Res. Technol., 37 (1) : 122-125 (2012)

Hydraulic Studies of Microsprinklers

R. D. Bansod[1]
College of Agriculture, Pune - 411 005 (India)
(Received : 11-07-2010)

Abstract

At the rated pressure (2 kg cm^{-2}), the maximum value of UCC (94.74%) was recorded for MS-V at 3 x 3 m microsprinkler spacing followed by MS-III (92.5%), MS-II (92.06%), MS-I (91.01%) and MS-IV (87.52%) at the same pressure and spacing. More than desired value (70%) of UCC was reported only for MS-I for all pressures under consideration and for spacings 3 x 3 m to 7 x 7 m which indicates its superiority over other types ofmicrosprinklers. A fairly good value of DU (78.00%) was recorded at all pressures and at 3 x 3 m and 4 x 4 m spacing for all the microsprinklers except MS-IV. At rated pressure, the DU values recorded for MS-I, MS-II, MS-III, MS-IV and MS-V were 91.47, 96.90, 92.61, 91.35 and 96.75 per cent, respectively.

Key words : Microsprinklers types, spacing, pressure.

The degree of uniformity, obtainable with a sprinkler system, depends largely on the water distribution pattern and spacing of the sprinklers (Keller and Bliesner, 1990). If the microsprinkler system is operated in low wind condition, during morning or evening hours, the effect of wind velocity and direction on uniformity of water application can be minimized. However microsprinkler spacing and operating pressure becomes the devastating factors in affecting the uniformity.

The information, on effect of these factors on uniformity coefficient, need to be generated for commercially available makes of microsprinklers. This information will be helpful for engineers for choosing the type of sprinkler and working conditions (operating pressure, sprinkler spacing, etc) in order to achieve high water distribution efficiency.

Materials and Methods

The experiment was conducted in College of Technology, G.B. Pant University of Agriculture and Technology, Pantnagar for uniformity evaluation of five different makes of microsprinklers, designated as M-I, M-II, M-III, M-IV and M-V, at different pressures and spacing combinations.

The guidelines repoted earlier for sprinkler distribution testing for research purpose (ASAE, 2003) and Indian Standards: BIS (1984) were used for the study.

Experiment was conducted on the concrete floor having slope less than 2 per cent. The tests were conducted during early in the morning and late evening hours, as drifting and evaporation losses were the minimum due to lower sunshine and wind velocity. The catch cans were placed in rectangular array at the spacing of 0.5 x 0.5 m and the observations on water collected in catch cans during one hour was recorded. The quantity of water collected in catch cans was measured and converted into precipitation rate, mm hr^{-1}. Keeping in view the recommended operating pressure range for all types of microsprinklers, three operating pressures 1.0, 1.5 and 2.0 kg cm^{-2} were

1. Asso. Professor of Agril. Engineering.

selected for studying their effect on various uniformity coefficients. The riser height of 35 cm was kept constant for each observation.

Overlapping patterns and uniformity of water application : The emitting device, either sprinkler or microsprinkler, apply water in circular manner to obtain radial wetted area. Under normal condition each quarter of the circle receive same depth of water. Considering this, the distribution characteristics and uniformity coefficients for one-quarter area were developed utilizing the depth distribution data of a single nozzle and the overlapping patterns of various microsprinklers spacing were obtained. The uniformity coefficients given by Christiansen (1941) and Merriam and Keller (1978), were computed and compared for each of the overlapping patterns of 3 x 3 m, 4 x 4 m, 5 x 5 m, 6 x 6 m, 7 x 7 m, 8 x 8 m, 9 x 9 m and 10 x 10m.

Results and Discussion

Christiansen's uniformity coefficient (UCC) : It was observed that UCC decreased (Table 1) with increase in spacing between the microsprinkler and decrease in operating pressure and vice-versa. The UCC is less affected by change in pressure however much affected by change in microsprinkler spacing. The maximum value of UCC (94.74 %) was recorded for MS-V at 2.0 kg cm^{-2} pressure and 3 x 3 m microsprinkler spacing followed by MS-III (92.5 %), MS-II (92.0 %), MS-I (91.01 %) and MS-IV (87.5 %) at the same spacing and pressure. For all spacing and pressure the UCC values were recorded more than 39 per cent for MS-I and more than 70 per cent for all pressures and spacing smaller than 7 x 7 m which showed its better performance over other types of microsprinklers. Each type of microsprinkler except MS-IV has shown the positive UCC values for 1.5 and 2.0 kg cm^{-2} pressure at all spacing.

Distribution uniformity (DU) : Higher values of DU were recorded for all microsprinklers at 2.00 kg cm^{-2} pressure (Table 2). At this rated pressure the DU values were in the range of 0.40 to 91.47, 0 to 96.90, 0.12 to 92.61, 0 to 90,35 and 0.18 to 96.75 per cent for MS-I, MS-II, MS-III MS-IV and MS-V. The overall DU values were better for MS-I followed by MS-V at all pressures and spacing. It indicated that the water depth received in lower one-quarter wetted area in case of MS-I and MS-II was less deviated from mean as compared to other types of microsprinklers. The sharp reduction in DU value was observed

Table 1. Christiansen's uniformity coefficient (%) for microsprinklers.

Pressure (kg cm^{-2})	Microsprinklers spacing (m)	Make of microsprinklers				
		MS-I	MS-II	MS-III	MS-IV	MS-V
1	3 x 3	90.75	89.10	89.80	84.10	90.56
	4 x 4	87.69	82.80	87.67	58.77	84.43
	5 x 5	81.97	72.47	81.14	30.00	83.90
	6 x 6	78.45	59.48	75.58	1.09	78.30
	7 x 7	74.93	35.04	55.84	0	56.90
	8 x 8	66.41	11.53	41.95	0	36.49
	9 x 9	51.79	0	25.27	0	15:22
	10 x 10	39.29	0	8.88	0	0
1.5	3 x 3	90.85	89.26	92.3	86.80	91.42
	4 x 4	89.20	83.90	88.11	80.50	88.37
	5 x 5	83.40	76.12	87.37	50.96	85.90
	6 x 6	79.92	68.91	75.92	20.43	80.63
	7 x 7	76.60	59.82	60.96	0	68.36
	8 x 8	67.00	48.09	42.63	0	47.14
	9 x 9	56.50	24.27	26.36	0	25:31
	10 x 10	41.79	4.34	9.28	0	5.81
2	3 x 3	91.03	92.06	92.50	87.52	94.74
	4 x 4	90.84	84.39	89.41	81.92	92.37
	5 x 5	86.64	79.33	87.45	58.03	86.31
	6 x 6	80.88	75.57	80.62	38.74	83.07
	7 x 7	77.78	67.08	63.78	6.13	79.14
	8 x 8	69.55	54.24	47.92	0	71.99
	9 x 9	58.57	36.35	29.80	0	57.70
	10 x10	42.68	17.37	11.36	0	38.98

in MS-IV (followed by MS-II) at all wider spacing. In case of MS-III the DU values were sharply reduced from 6 x 6 m to 10 x 10m spacing.

Increased distribution uniformity was recorded for closer microsprinkler spacing as was observed for Christiansen's uniformity coefficients. The higher distribution uniformity, similar to uniformity coefficients, was recorded for higher operating pressure. Similar trend of results were obtained by Seginer (1963), Sakore (1992) and Shinde and Darade (1993).

It is concluded that uniformity of water application (uniformity coefficient) decreased with increase in microsprinkler spacing and decrease in operating pressure. More deviation of water depth from mean depth was recorded in increased wetted areas and therefore, reduced uniformity coefficient was observed in wider spacing.

The variation in overall distribution of water in the overlapped area was less affected by pressures however, more affected by microsprinkler spacing. More than desired value (70%) of UCC was recorded only for MS-I for all pressures under consideration and for spacing 3 x 3 m to 79 x 7m which indicated its superiority over other types of microsprinklers. A fairly good value of DU (78%) was recorded at all three pressures and at 3 x 3 m and 4 x 4 m spacing for all the microsprinklers except MS-IV. It indicated that the water depth received in lower one-quarter wetted area of 3 x 3 m and 4 x 4 m spacing was less deviated from the average depth for all types of microsprinklers except MS-IV. Considering the overall uniformity of water application at all pressures and microsprinkler spacing, the performance of MS-I was the best followed by MS-V, MS-III, MS-II and MS-IV.

Table 2. Distribution uniformity for microsprinklers.

Pressure (kg cm^{-2})	Microsprinklers spacing (m)	Distribution uniformity (per cent)				
		Make of microsprinklers				
		MS-I	MS-II	MS-III	MS-IV	MS-V
1	3 x 3	90.13	91.90	88.55	81.10	83.98
	4 x 4	86.24	85.41	87.10	46.90	77.84
	5 x 5	74.23	70.66	86.50	15.80	76.77
	6 x 6	73.80	37.60	55.36	0.00	70.70
	7 x 7	63.97	9.62	41.00	0.00	47.53
	8 x 8	55.07	0.00	27.00	0.00	23.10
	9 x 9	29.16	0.00	13.45	0.00	0.00
	10 x 10	0.13	0.00	0.04	0.00	0.00
1.5	3 x 3	90.56	92.84	90.90	88.98	86.00
	4 x 4	87.84	89.00	88.59	70.10	83.00
	5 x 5	73.20	75.65	87.78	37.09	82.03
	6 x 6	71.00	45.15	56.70	10.65	77.60
	7 x 7	66.81	23.08	42.01	0.00	52.09
	8 x 8	57.50	16.45	34.89	0.00	25.00
	9 x 9	27.60	0.00	17.03	0.00	6.99
	10 x 10	0.23	0.00	0.05	0.00	0.04
2	3 x 3	91.47	96.90	92.61	90.35	96.75
	4 x 4	87.65	90.24	89.84	75.12	88.31
	5 x 5	79.65	78.90	87.11	44.67	78.70
	6 x 6	74.35	69.20	66.31	15.69	73.34
	7 x 7	64.72	61.46	45.54	8.24	71.97
	8 x 8	58.12	44.16	36.87	0.00	66.70
	9 x 9	33.64	17.12	19.33	0.00	42.70
	10 x10	0.40	0.00	0.12	0.00	0.18

References

ASAE Standards., 2003. Procedure for sprinkler distribution testing for research purpose. S 330.1 St. Joseph, MI:USA.

Christiansen, I. E., 1941. The uniformity of application of water sprinkler systems. Agril. Engg. 22(3): 89-92.

Hart, W. E. 1961. Overhead irrigation pattern parameters. Agri. Engg. 42(7): 354-355.

IS:10802-1984. Method for determination of radius of throw of agricultural sprinklers. p.7.

Keller, Jack, and Ron D. Bliesner. 1990. Sprinkle and Trickle Irrigation. Publ. by Van Nostrand , New York. P:68-72.

Merriam, J. L. and Keller, J. 1978. Farm irrigation system

evaluation: A guide for management. Utah State Univaffljy, Logan, Utah, p. 255.

Shinde, U. R. and Darade, R. S. 1993. Field evaluation of hydraulic performance of static micro-sprinkler irrigation. J. of Maharashtra Agric. Univ. 22(3): 341-342.

Seginer, I. 1963. Water distribution from a medium pressure sprinkler. J. of Irri. and Drain. Div., 89 (IR II): 13-19.

Wilcox, J. C. and Swailes, W. E. 1947. Uniformity of water distribution pattern from rotary sprinklers. 351: 217-228.

J. Agric. Res. Technol., 37 (1) : 125-129 (2012)

Effect of Feeding Detoxified Blank Sorghum on Growth Performance, Feed Conservation Efficiency and Carcass Traits of Broiler Chicks

S. V. Daphale[1], S. A. Dhage[2], Y. G. Fulpagare[3] and B. D. Patil[4]
Department of Animal Science and Dairy Science,
Mahatma Phule Krishi Vidyapeeth, Rahuri - 413 722 (India)
(Received : 20-05-2008)

Abstract

The total gain in body weight up to 6th week of experimental chicks was highest in T_0 (1.896 kg) followed by T_1, T_3 and T_2 (1.752, 1.686 and 1.422 kg), respectively. Significant differences were observed for feed conversion efficiency. Treatments T_1 and T_3 were at par for FCR which indicated that feeding of detoxified sorghum had similar effect on growth as that of normal-sorghum. Non significant differences were observed for dressing percentage and meat:bone ratio. It was thus concluded that the black sorghum can be used as feed ingredient in broiler ration after detoxification. The 2.5 per cent ammnonia treatment can serve the purpose of detoxification.

Key words : Broiler, detoxified black sorghum, aflatoxin.

The biggest impediment for the growth of poultry industry has been the cost of feed. Maize is extensively used in the poultry ration as a potential source of energy which is not adequate in present situation. Maharashtra is one of the leading states for sorghum production and if proximate composition of maize and sorghum is compared, it is more or less equal to that of maize. But due to tropical climate and untimely rains before harvest, sorghum grains show moldy growth and locally known as black sorghum. The moldy growth is favored by humidity and temperature.

Ultimately this makes grains unfit for consumption which have toxic effect when fed and hence causes great economic losses. Several studies have demonstrated that this toxin can be nullified by various detoxification methods, like sun drying, heat treatment, alkali treatment or liquor ammonia treatment. Considering the availability of black sorghum at cheaper rate the experiment on use of black sorghum in poultry feed has been undertaken.

Materials and Methods

One day old Vencob broiler chicks were purchased from Baramati Agro-hatcheries. They were reared under uniform management conditions upto first three days. Then forty

1. M.Sc.(Agri.) student, 2. and 4. Asstt. Professor and 3. Professor.

eight chicks were weighed individually and randomly divided into four groups of twelve each considered as twelve replications and each group was designated as a treatment. All chicks were numbered by affixing the aluminum tags for recording its experimental observation.

The experimental feed was prepared by using commercial broiler mash (Manufactured by Hindustan lever Ltd. Bombay), plus normal- or black sorghum or detoxified -black-sorghum after coarse grinding, in 2:1 proportion. The different type of diets were formulated as T_0 = 150 g BSM/BFM, T_1 = 100 g BSM/BFM + 50 g normal sorghum, T_2 = 100 g BSM/BFM + 50 g black sorghum, T_3 = 100 g BSM/BFM + 50 g detoxified black sorghum (BSM = Broiler Starter Mash offered for 1-3 weeks, BFM = Broiler Finisher Mash offered for 4-6 weeks)

Detoxification of black sorghum : Liqour ammonia (2.5 %) was thoroughly mixed with coarsely ground black sorghum. Before offering it to birds it was exposed to air to disappear the ammonia.

Feed conversion efficiency (FCE) : The feed conversion efficiency was calculated as,

$$FCE = \frac{\text{Body weight gain}}{\text{Feed consumed}} \times 100$$

Feed conversion ratio (FCR) : The feed conversion ratio was calculated as, the ratio of feed consumption to weight gain during specific period.

$$FCR = \frac{\text{Feed consumed}}{\text{Body weight gain}}$$

Digestion trial : A digestion trial was conducted during 6th week on five chicks from each treatment for a period of 7 days. The feed intake and droppings excreted were recorded bird wise daily for determination of digestibility coefficient. The samples of feeds, feed ingredients and droppings were analysed for proximate nutrients as per the standard method of AOAC (1984).

Carcass traits : At the end of experiment five birds were randomly selected from each group for the carcass study. They were kept in

Table 1. Average chemical composition of feed ingredients and experimental ration.

Feed ingradient		**Percentage of proximate components (%)**					
		DM	**CP**	**EE**	**CF**	**NFE**	**TA**
BSM		94.00	25.81	5.00	4.97	55.82	8.40
BFM		93.50	20.13	6.00	5.16	59.51	9.20
Normal sorghum		91.80	10.06	4.60	3.60	79.20	2.00
Black sorghum		91.40	9.18	5.00	3.88	79.54	2.40
Detoxified black sorghum		92.30	11.44	4.30	3.65	77.81	2.80
Treatment				**Experitimental rations**			
BSM based diets	T_0	94.00	25.81	5.00	4.97	55.82	8.40
	T_1	93.27	20.56	4.87	4.51	63.61	6.27
	T_2	93.13	20.27	5.00	4.61	63.73	6.40
	T_3	93.43	21.02	4.77	4.53	63.15	6.53
BFM based diets	T_0	93.50	20.13	6.00	5.16	59.51	9.20
	T_1	92.93	16.77	5.53	4.64	66.07	6.80
	T_2	92.80	16.48	5.67	4.73	66.19	6.93
	T_3	93.10	17.23	5.43	4.66	65.61	7.07

separate cages and fasted for the period of 12 hrs. prior to slaughter.

Statistical analysis : The data collected during the experimental period was subjected to statistical analysis as per Snedecor and Cocharan, (1967).

Results and Discussion

Chemical composition of feed ingredients and experimental ration : From the results (Table 1) it is seen that ammonia treatment lowered the EE, CF and NFE in black sorghum, while Cp and TA in black sorghum increased by 2.26 and 0.04 per cent after liquor ammonia treatment. These results are in agreement with Brekke *et al.* (1977) and Khan (1998).

Average weekly feed intake (kg) : It has been revealed from the data that average weekly feed intake of broiler chicks under all four treatments differed significantly ($P < 0.05$).The average weekly feed intake was the highest in T_0 and followed by T_1, T_3 and T_2 treatments, respectively. Further it was observed that the T_2 group showed consistently lower feed intake in different weeks over other groups. This indicated that the addition of black sorghum had adverse effect on palatability of diets. Similarly the daily DM intake was 91.45, 89.86, 83.29 and 87.29 g in T_0, T_1, T_2 and T_3, respectively. The overall DM intake of 88.00 g was observed. The average feed intake per group per week was 0.216 kg at first week and increased upto 0.893 kg at the end of sixth week, indicates that as the age of chicks advances the average weekly feed intake was also found to be increased. Average weekly feed intake by T_0 group and T_1 group indicated that the incorporation of normal sorghum in commercial ration decreased feed intake significantly. While feed intake by T_3 and T_2 group indicated that there was increase in feed intake, when detoxified black sorghum is used

Table 2. Average digestibility coefficients of proximate nutrients of experimental feeds.

Treatment	Apparent digestibility coefficient				
	DM	CP	EE	CF	NFE
T_0	71.51	82.02	21.56	81.06	80.26
T_1	59.67	81.88	18.66	81.91	77.27
T_2	68.54	81.44	7.25	81.33	75.30
T_3	69.44	78.23	20.27	83.68	78.16

Table 3. ANOVA for average digestibility coefficients of proximate nutrients of experimental feeds.

Source of variation	M.S.S. values				
	DM	CP	EE	CF	NFE
Replication	1.063	11 .629	6.699	12.430	13.035
Treatment	7.760	16.063	220.126	6.938	21.172
Error	0.325	8.326	3.040	7.579	15.054
SE(±)	0.255	1.290	0.780	1.231	1.735
CD (0.05)	0.786	NS	2.403	NS	NS

Table 4. Effect of feeding detoxified black sorghum on growth performance, feed conversion efficiency and carcass traits of broiler chicks.

Particulars	Treatments			
	T_0	T_1	T_2	T_3
Weekly feed intake (kg)	0.640	0.629	0.583	0.611
Total gain in body weight (kg)	1.896	1.752	1.422	1.686
Weekly gain in body weight (kg)	0.316	0.292	0.273	0.281
Daily gain in body weight (g)	45.143	41.714	33.857	40.143
Feed conversion efficiency (%)	49.375	46.423	40.652	45.990
Feed conversion ratio (FCR)	2.025	2.154	2.460	2.174
Dressing percentage (%)	71.744	71.143	69.157	71.292
Meat:Bone ratio	9.208	9.170	9.068	9.107
Total feed cost/bird (Rs.)	38.90	31.78	27.11	29.77
Cost of feed per kg gain in body weight	20.52	18.14	19.06	17.66

in feed formulation instead of black sorghum.

Digestibility : From the data presented in Table 2 and 3 it was revealed that the DM digestibility was significantly ($P<0.05$) highest in T_0 followed by T_1, T_3 and T_2 treatments, respectively. CP digestibility showed non significantly decreasing trend from T_0 followed by T_1, T_2 and T_3 treatments, respectively. T_3 ration was formulated from ammoniated sorghum which caused increase in nitrogen and ultimately in CP contents. However, from the results it appeared that because of inability of poultry birds to utilize NPN the increase in CP is of no use for synthesis. CF digestibility was found to be highest in T_0 and lowest in T_2 treatments. This decrease in apparent digestibility coefficient of CF may be because of more CF contents of experimental feed T_2. The results are in agreement with Khan (1998).

Growth performance : The statistical analysis of data (Table 4) revealed that the average total gain in body weight was highest in T_0 followed by T_1, T_3 and T_2 treatments, respectively. The differences in treatments for total gain in body weight were significant ($P < 0.05$). Treatment T_0 was significantly superior to other three treatments where as T_2 was significantly lower than other treatments. Treatments T_1 and T_3 were at par which showed that incorporation of either normal sorghum or detoxified black sorghum had similar effect on average total gain in body weight. These results are in agreement with Sahoo (1994). Similar results were obtained for average weekly and daily gain in body weight, which clearly indicated that black sorghum had adverse effect on normal growth rate of birds and commercial feed was observed to be more suitable.

Feed conversion efficiency : The feed conversion efficiency was found to be better in T_2 as compared with other treatments. Treatments T_1 and T_3 were at par which indicated that feeding of detoxified sorghum had similar effect as that of normal sorghum on growth of chicks. These results are in agreement with Sakhawat (1989).

Feed conversion ratio : The experimental feeds had significant effect on average FCR which was lowest in treatment T_0 and highest in treatment T_2. The differences in the treatments T_1 and T_3 were non significant ($P < 0.05$). This showed that normal sorghum formulated ration and detoxified black sorghum formulated ration were utilized by birds for body building purpose at similar rate.

Carcass traits : The statistical data, revealed non significant differences in dressing percentage for T_0, T_1 and T_3 treatments, however treatment T_2 had significantly less dressing percentage than other treatments.

Table 5. ANOVA for effect of feeding detoxified black sorghum on growth performance, feed conversion efficiency and carcass traits of broiler chicks.

Source of variation	Weekly feed intake	Total gain in body weight	Weekly gain in body weight	Daily gain in body weight	Feed conversion efficiency	Feed conversion ratio (FCR)	Dressing percentage	Meat: bone ratio	Total feed cost bird^{-1}	Cost of feed kg^{-1} gain in body weight
Replication	0.000	0.001	0.000	0.530	0.621	0.008	0.346	0.004	1.559	0.596
Treatment	0.045	0.476	0.079	269.862	157.237	0.394	6.552	0.019	312.891	16.785
Error	0.000	0.001	0.000	0.653	0.915	0.007	0.631	0.010	1.046	0.566
SE(±)	0.002	0.010	0.001	0.233	0.276	0.025	0.355	0.044	0.295	0.217
CD (0.05)	0.006	0.029	0.004	0.672	0.795	0.072	1.095	NS	0.851	0.626

This suggest that black- sorghum formulated ration had adverse effect on dressing percentage when compared with other treatments. There were non significant differences in meat:bone ratio due to different dietary treatments. This suggested that addition of normal sorghum or detoxified black sorghum in broiler mash had no effect on meat:bone ratio. The mortality in chicks during experimental period was nil.

Feed cost : It has been observed that the average total cost of the experimental feed per bird for 6 weeks was significantly ($P < 0.05$) highest in treatment T_0 followed by T_1, T_3 and T_2 treatments, respectively. These results indicated that feed cost can be significantly reduced by addition of sorghum in poultry ration. The feed cost per kg gain in body weight was the highest in treatment T_0, where as lowest in treatment T_3. This suggested that inclusion of detoxified black sorghum in broiler diet is economical.

Thus it can be concluded that the black sorghum can be used as feed ingredient in broiler ration after detoxification. The 2.5 per cent ammonia treatment can serve the purpose of detoxification.

References

A.O.A.C. 1984. Official Methods of Analysis 14th Ed. Association of official analytical chemists. Washington, D.C.

Brekke, O. L., Sinnihuber, R. O., Pepnnski, A. J., Wales, J. H., Putnam, G. B., Lee, D. J. and Ciegler, A. 1977. Aflatoxin in corn: Ammonia inactivation and bioassay with rain bow traut. Appl. Environ. Microbiol. 34: 34-37.

Khan, M. F., Hussain, A., Ayaz, M., Siddique, M. and Kausar, R. 1998. Chemical treatment of mouldy maize grains with aqueous ammonia and its feeding value to broiler chicks.

Sahoo,P. K. 1994. Various dietary modifications and their effects on birds with aflatoxicosis. Poult. Adv. 11(9): 45-50.

Sakhawat, A., Hamid, A. and Shah, F. N. 1989. Effect of detoxified feed on the performance of broiler chicks. Pakistan J. of Scientific and Industrial Res. 32(6): 416-418.

Snedecor, E. W. and Cocharan, W. G. 1967. Stalistical methods. 6th ed. Iowa State Univ. Press Ames, IOWA, USA.

J. Agric. Res. Technol., 37 (1) : 130-134 (2012)

Draftability of Crossbreds, Dangi, Khillar and Local Non-Descript Bullocks under Konkan Region of Maharashtra

D. J.Bhagat[1], N. N. Prasade[2] and R. G.Burte[3]
Department of Animal Husbandry and Dairy Science, College of Agriculture, Dapoli - 415 712 (India)
(Received : 20-12-2010)

Abstract

During the ploughing operation it was observed that crossbred, Dangi and Khillar pairs of bullocks developed higher draft, speed and covered more area than nondescript bullocks. The average draft, speed and area covered by crossbred, Dangi, Khillar and local nondescript bullocks were 45.9, 45.33, 45.21 and 42.6 kg, 44.4, 44.6, 46.0 and 41.9 meters per minute and 277.8, 282.9, 288.7 and 272.8 sq. meters hr^{-1}, respectively. The increase in physiological parameters during ploughing operation was higher in crossbred bullocks than Dangi, Khillar and local nondescript bullocks. The results indicated that the draft power of crossbred Dangi and Khillar bullocks was significantly higher than local non-descript bullocks during ploughing operation in *kharif*, *rabi* and summer seasons in hot and humid climate of the Konkan region of Maharashtra.

Key word : Crossbred bullocks, Dangi, Khillar, draftability, ploughing, physiological parameters.

The draft animals are important source of power in many developing countries including India. The introduction of cross breeding programme in the country for increasing the milk production, has generated an equal number of crossbred males as that of females. These males are important for tillage, transportation and other agricultural works where mechanization is not feasible either due to low and fragmented land holding or poor economical condition of farmers. The draft animals are useful not only as a source of power but also as a replacing non-renewable source of energy and organic manure.

The environmental parameters affect not only production but also work efficiency of all breeds of cattle and buffaloes. Therefore, the present study was undertaken on evaluation of draftability of crossbred, Dangi, Khillar and local nondescript bullocks during ploughing operation with local wooden plough in hot and humid climate of Konkan region.

Materials and Methods

The average body weight of crossbred bullocks, Dangi, Khillar and local nondescript bullocks was 375, 360, 350 and 320 kg. respectively. During the course of the study these animals were offered dry fodder *ad libitum* and concentrate mixture @ 1 kg $animal^{-1}$ day^{-1}. Animals have easy and free access to clean water all the time. On the day of trial the work was started at 8.00 hrs. In the trial the bullocks were put to ploughing operation for a period of 6 hrs. in a day with 15 minutes rest after every 2 hrs. continuous work i.e. morning 8 to 10 hrs. work and 15 minutes after rest 10.15 to 12.15 hrs works and afternoon 14.30 to 16.30 hrs continuous works. This schedule was repeated for three days.

Every day in the beginning and at every 2

1. Associate Professor, 2. Assistant Professor and 3. Head.

hrs of intervals of working period the rectal temperature, pulse rate and respiration rate of the experimental bullocks were recorded. The pull exerted by each pair in kilogram was recorded with the help of spring dynamometer joined to the beam of plough. Value of draft corrected for angle of pull (cos θ) was computed as described by Maurya and Devadatta (1982).

The working speed of the bullocks during ploughing operations was recorded in the beginning and at the end of the every working period with the help of watch in second to cover the distance from one end of the field to the other end. The distance between two ends of the field was measured in meter. The area ploughed (ha.) during every working period was also recorded. This trial was repeated in *kharif rabi* and summer seasons.

Results and Discussion

On an average (Table 1) the draft required during ploughing operation with local wooden plough by crossbred, Dangi, Khillar and local bullocks was 45.9, 45.3, 45.2 and 42.6 kg, respectively. The draft observed by the crossbred, Dangi and Khillar bullocks was significantly higher than the draft by local non-descript bullocks.

The average working speed developed during ploughing operation by the Khillar (46 m^{-1} min.) was significantly higher than the crossbred (44.4 m $min.^{-1}$), Dangi (44.5 m $min.^{-1}$) and local bullocks (41.9 m $min.^{-1}$). However, the significant differences were not observed between the speed in crossbred and Dangi bullocks. The result of the present study compared favourably with those of Acharya *et al*. (1979), who reported the same average

Table 1. Average draft, speed, area covered during ploughing operation with local.

Seasons	Cross-bred	Dangi	Khillar	Local	Mean (kg)	S.E.±	CD at 5%
Average draft (kg) :							
Kharif	44.1	43.4	43.6	40.4	42.9	-	-
Rabi	45.3	45.1	45.1	41.3	44.2	-	-
Summer	48.3	48.1	47.2	46.4	47.5	-	-
Mean	45.9	45.3	45.2	42.6	44.8	0.215	0.63 1
S.E.±	-	-	-	-	0.3	-	-
CD at 5 %	-	-	-	-	0.7	-	-
Average speed (m $min.^{-1}$) :							
Kharif	44.8	44.8	45.2	41.6	44.0	-	-
Rabi	46.8	46.8	48.5	43.9	46.5	-	-
Summer	42.4	42.2	44.3	40.3	42.3	-	-
Mean	44.6	44.6	46.0	41.9	44.3	0.233	0.654
S.E.±	-	-	-	-	0.3	-	-
CD at 5 %	-	-	-	-	0.8	-	-
Average area covered (sq. m hr^{-1}) :							
Kharif	278.1	282.5	285.5	270.1	290.5	-	-
Rabi	294.1	300.2	320.6	290.5	298.9	-	-
Summer	266.8	266.4	270.0	258.0	265.3	-	-
Mean	277.8	282.9	288.7	272.8	281.1	1.251	3.668
S.E.±	-	-	-	-	1.4	-	-
CD at 5 %	-	-	-	-	4.2	-	-

speed of 2.68 and 2.42 km hr^{-1} in case of crossbred and indigenous bullocks during ploughing operation for four hours.

The average area covered during ploughing operation with local wooden plough in an hour by Khillar (288.7 sq. m.) was significantly higher than the Dangi (282.9 sq. m.), crossbred (277.8 sq. m.) and local bullocks (272.8 sq. m.). Anand and Sundersan (1974) compared ploughing capacity of crossbred and Haryana bullocks during six hours of working in different seasons and reported that Haryana ploughed more area during the same period and same season than crossbred bullocks. The area ploughed in square meters was 2970, 2860 and 2440 by crossbred bullocks during winter, hot dry (summer) and hot humid summer (rainy) seasons, respectively. The corresponding values for Haryana bullocks were 3320, 3070 and 2903 square meter, respectively.

The bullocks have recorded significantly higher draft 47.5 kg in summer season followed by 44.2 and 42.8 kg in *rabi* and *kharif*. The average speed of 46.5 m. $minute^{-1}$ was significantly higher in *rabi* season than 44 and 42.3 m. $minute^{-1}$ in *kharif* and summer season respectively. The average area covered (298.9 sq. m.) was significantly higher in *rabi* season and followed by 290.54 and 265.3 sq. m. in *kharif* and summer seasons respectively. The

Table 2. Average physiological responses during ploughing operation with local wooden plough by bullocks in different seasons.

Season	Crossbreed			Dangi			Khillar			Local			SE±	CD at 5%
	Initial	Final	Increased	Initial	Final	Increased	Initial	Final	Increased	Initial	Final	Increased		
Temperature (° F) :														
Kharif	98.92	101.66	2.86	99.25	101.78	2.53	99.53	101.85	2.38	99.55	101.81	2.26	0.053	0.15
Rabi	98.82	101.52	2.71	99.10	101.30	2.23	99.44	101.62	2.18	99.59	101.72	2.13	0.070	NS
Summer	99.00	101.92	2.88	99.14	101.82	2.68	99.42	101.70	2.24	99.80	101.71	2.04	0.063	0.185
Mean	98.91	101.74	2.82	99.16	101.63	2.48	99.46	101.75	2.28	99.64	101.75	2.14	-	-
SE±	0.046	0.061	0.055	-	-	-	-	-	-	-	-	-	-	-
CD at 5 %	NS	0.179	0.160	-	-	-	-	-	-	-	-	-	-	-
Respiration rate (minute^{-1}) :														
Kharif	17.06	55.33	38.26	17.06	53.13	36.06	18.13	51.06	39.93	18.00	47.00	31.00	0.174	0.509
Rabi	17.00	51.86	34.86	17.00	50.26	33.26	16.33	45.93	29.60	16.00	46.20	30.20	0.387	1.136
Summer	17:13	59.40	42.26	17.26	57.00	39.73	17.06	56.49	39.66	16.33	54.93	38.60	0.371	1.089
Mean	17.06	55.53	38.46	17.10	53.46	36.35	17.17	51.08	33.70	16.73	50.04	33.26	-	-
SE±	0.150	0.035	0.321	-	-	-	-	-	-	-	-	-	-	-
CD at 5 %	0.441	0.983	0.943	-	-	-	-	-	-	-	-	-	-	-
Pulse rate (minute^{-1}) :														
Kharif	44.73	77.06	32.33	44.13	75.36	31.13	44.93	70.93	26.80	46.00	70.33	24.00	0.251	0.735
Rabi	44.13	74.80	30.66	44.66	73.93	29.26	45.20	72.00	26.80	45.26	68.20	22.93	0.644	1.888
Summer	47.00	79.46	32.46	45.66	76.13	30.20	47.26	75.26	28.20	46.00	73.06	27.00	0.602	1.766
Mean	45.28	77.11	31.72	44.82	75.11	30.19	45.80	72.73	.27.27	45.75	70.53	24.64	-	-
SE±	0.217	0.558	0.521	-	-	-	-	-	-	-	-	-	-	-
CD at 5 %	0.636	1.635	1.529	-	-	-	-	-	-	-	-	-	-	-

draft developed in different seasons by bullocks during ploughing operation was significantly different due to difference in moisture content of soil. The moisture content in soil decreased, the draft required increases as Rapte (1982) studied the draft requirement of various bullock drawn implements in deep black soil under different moisture levels. It was noted that maximum draft was required to plough in the soil containing more than 35 per cent moisture. The minimum draft was recorded to plough at 28.2 per cent soil moisture level. However, this draft requirement rose during ploughing when soil moisture reduced by less than 10 per cent.

In *kharif* season the temperature, respiration rate and pulse rate at initial and final of ploughing operation for the crossbred were 98.92 and 101.66°F, 17.06 and 55.33 minute^{-1}, 44.53 and 77.06 minute^{-1}, respectively. The corresponding figures for Dangi 99.2 and 101.78°F, 17.06 and 53.13 minute^{-1}, 44.13 and 75.36 minutes^{-1}, Khillar 99.53 and 101.85°F, 18.13 and 51.06 minute^{-1}, 44.93 and 70.93 minute^{-1} and local bullocks 99.55 and 101.81°F, 18.00 and 47.00 minute^{-1}, 46.00 and 70.33 minute^{-1} respectively.

In *rabi* season the temperature, respiration rate and pulse rate at initial and final of ploughing operation for the crossbreed were 98.82 and 101.52°F, 17.00 and 51.86 minute^{-1}, 44.13 and 74.80 minute^{-1} respectively. The corresponding figures for Dangi 99.1 and 101.3°F, 17.00 and 50.26 minute^{-1}, 44.66 and 73.93 minutes^{-1}, Khillar 99.44 and 101.62°F, 16.33 and 45.93 minute^{-1}, 45.20 and 72.00 minute^{-1} and local bullocks 99.59 and 101.72° F, 16.00 and 46.20 minute^{-1}, 45.26 and 68.2 minute^{-1}, respectively.

In summer season the temperature, respiration rate and pulse rate at initial and final of ploughing operation for the crossbreed were 99.00 and 101.92°F, 17.13 and 59.40 minute^{-1}, 47.00 and 79.46 minute^{-1} respectively. The corresponding figures for Dangi 99.14 and 101.82°F, 17.26 and 57.00 minute^{-1}, 45.66 and 76.13 minutes^{-1}, Khillar 99.42 and 101.7°F, 17.06 and 56.44 minute^{-1}, 47.26 and 75.26 minute^{-1} and local bullocks 99.8 and 101.7°F, 16.33 and 54.93 minute^{-1}, 46.00 and 73.06 minute^{-1}, respectively.

During ploughing operation the average rectal temperature (2.82°F), respiration rate (38.46 min.$^{-1}$) and pulse rate (31.72 min.$^{-1}$) of crossbred bullocks were significantly more than Dangi, Khillar and local bullocks.

The temperature of bullocks increased during ploughing operation in Dangi, Khillar and local bullocks 2.48, 2.28 and 2.14°F. The respiration rate of bullocks was also found to be increased during operation in Dangi (36.46), Khillar (33.73) and local bollocks (33.26) respectively. The pulse rate of bullock was also increased during operation in Dangi (30.19), Khillar (26.26) and local bullocks (24.64), respectively.

The average temperature of bullocks 2.5°F was significantly increased in *kharif* season than 2.3°F in *rabi* season. The average respiration rate of,bullocks (40.06 min.$^{-1}$) was significantly increased in summer season than in *kharif* and *rabi* season. The average pulse rate of all the breeds of bullocks was at par in summer (28.6 minute^{-1}), *kharif* (28.5 6 min.$^{-1}$) and *rabi* (27.41 min.$^{-1}$) seasons. Acharya *et al*. (1979) noted that the crossbred bullocks showed significant rise in respiration and pulse rate over the indigenous bullocks during summer and rainy seasons. During *rabi* season the physiological parameters i.e. temperature, respiration rate and pulse rate were lower than in *kharif* and summer seasons. These results

obtained are in accordance with those reported by Singh *et al*. (2007) in Haryana bullocks during work.

It is concluded that the crossbred, Dangi and Khillar bullocks showed significantly higher draft, speed and covered more area as compared to local non-descript bullocks during ploughing operations in *kharif*, *rabi* and summer season. The Khillar bullocks ploughed higher area with higher speed as compared to the other breeds of bullocks. All the breeds of bullocks required higher draft in summer season and covered more area with higher speed in *rabi* season. The crossbred bullocks showed increased physiological reactions than other breeds of bullocks during ploughing operations. The rectal temperature, respiration rate and pulse rate increased in summer and *kharif* seasons as compare to *rabi* season.

References

Acharya, S., Mishra, M. and Nayk, J. B. 1979, Working capacity and behavior of crossbred versus non descript indigenous bullocks under Orissa condition. Indian J. Dairy Sci., 32: 37-42.

Anand, Usha and Sundersan, D. 1974, Crossbred bullocks can contribute to agriculture operations. Indian Farm. 24: 27-29.

Maurya, N. L. and Devadatta, D. S. K. 1982. Work performance of crossbred bullocks. Indian J. Dairy Sci., 35(1): 26-30.

Rapte, S. L. 1982. Draft requirement of various bullock drawn in deep black soil under different moisture levels. Nat. Sem. on Draft Animal Power in India. Indian Inst. of Manag. Bangalore, 17-17th, 1982.

Singh, S. V., Upadhyay R. C. and Kumar P. 2007. Effect of carting on physiological and pulmonary dynamics in Haryana bullocks during summer and winter season. Indian J. of Dairy Sci., 60(3): 202-205.

RESEARCH NOTES

J. Agric. Res. Technol., 37 (1) : 135-136 (2012)

Economics of Integrated Nutrient Management in Ginger

Use of organic and biofertilizers not only improve soil health but also help to sustain crop productivity. The organic matter content of Indian soil is less than one per cent and very difficult to increase due to tropical climate of the country. Thus, for Indian conditions, concept of integrated nutrient management is more appropriate rather than purely organic or inorganic farming and is an eco-friendly best way to attain sustainability in agriculture. Therefore, the experiment on the effect of integrated nutrient management on economics of ginger was undertaken.

A field experiment was conducted at Agronomy Farm, College of Agriculture, Pune-5 during summer, 2006 in a randomized block design with three replications. The treatments consisted of T_1 : Absolute control, T_2 : Only recommended dose of FYM (25 t ha^{-1}), T_3 : Recommended dose of fertilizer (RDF-75:50:50 kg NPK ha^{-1}), T_4 : RDF + 25 t FYM ha^{-1}, T_5 : 10 t FYM ha^{-1} + *Azotobacter* + *Acetobacter* + PSB, T_6 : 50% N (urea) + 50% N (neem cake), T_7 : 75% N (urea) + 25 % N (neem cake), T_8 : 50% N (urea) + 50% N (vermicompost), T_9 : 75% N (urea) + 25 % N (vermicompost), T_{10} : 50% N (urea) + 50 %N (FYM), T_{11} : 75% N (urea) + 25% N (FYM), T_{12} : 50% N (urea) + 50 % N (poultry manure) and T_{13} : 75% N (urea) + 25% N (poultry manure).

The cost of cultivation of ginger (Table 1) was numerically higher in the treatment 50 per cent N through RDF + 50 per cent N through poultry mannure (Rs. 125243 ha^{-1}). It was closely followed by the treatment FYM 10 t ha^{-1} + Azot. + Acet. (Rs. 124643 ha^{-1}). The cost of cultivation was reduced in the subsequent treatments with those of different

Table 1. Economics of integrated nutrient management in ginger.

Treatment	Rhizome yield (t ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Gross monetory return (Rs. ha^{-1})	Net monetory return (Rs. ha^{-1})	Benefit: cost ratio
T_1 : Absolute control	12.50	118643	375000	256357	2.2
T_2 : FYM 25 t ha-1	13.22	132143	396600	261457	2.1
T_3 : RDF (75:50:50)	22.37	120843	671100	550257	2.1
T_4 : RDF + FYM 25 t ha-1	30.50	135343	915000	779657	3.5
T_5 : FYM 10 t ha-1 + Azot. + Acet.	15.28	124643	458400	333757	2.3
T_6 : 50% N (urea) + 50% N (neem cake)	29.43	332361	882900	750539	3.5
T_7 : 75% N (urea) + 25% N (neem cake)	19.18	124812	575400	450588	2.8
T_8 : 50% N (urea) + 50% N (vermicompost)	27.22	132873	816600	683727	3.4
T_9 : 75% N (urea) + 25% N (vermicompost)	18.24	126958	547200	420242	2.1
T_{10} : 50% N (urea) + 50% N (FYM)	25.33	133343	759900	626557	3.3
T_{11} : 75% N (urea) + 25% N (FYM)	17.17	127193	531300	404107	2.7
T_{12} : 50% N (urea) + 50% N (poultry manure)	32.51	125243	975300	850057	3.8
T_{13} : 50% N (urea) + 50% N (poultry manure)	20.42	123343	612600	489457	3.0
S.Em.±	0.64	-	-	-	-
C.D. at 5%	1.87	-	-	-	-

organic mannures. The cost of cultivation was the lowest (Rs. 118643 ha^{-1}) with the control.

The maximum gross monetary returns was obtained with the application of 50 per cent N through RDF + 50 per cent N through poultry mannure (Rs. 975300 ha^{-1}), followed by treatment with RDF + 25 t FYM ha^{-1} (Rs. 915000 ha^{-1}). The least gross monetary returns were receivied with the control (Rs. 375000 ha^{-1}).

The use of 50 per cent N through RDF + 50 per cent N through poultry manure (Rs. 850057 ha^{-1}) and recommended dose of fertilizer (Rs. 779657 ha^{-1}) are beneficial for obtaining the net profit. The highest benefit: cost ratio was obtained with 50 per cent N through RDF + 50 per cent N through poultry manure (3.77). It was, closely followed by recommended dose of fertilizer (3.46). The benefit cost ratio of 50 per cent N through RDF + 50 per cent N through poultry manure is beneficial, economical and suitable for cultivation of ginger. Same results were found by Das *et al.* (1994), Chandel and Chakor (1998), Gaikwad *et al.* (1998) and Meerabai *et al*. (2001).

K. K. Dhasade
A. A. Shaikh
A. D. Tambe

Mahatma Phule Krishi Vidyapeeth,
Rahuri - 413 722 (India)
August 25, 2008.

References

Chandel, B. S. and Chakor, I. S. 1998. Economic evaluation of crop management research recommendation of farmers adoption- a study on ginger cultivation in Himachal Pradesh. Indian J. agric. Econ. 53 (1): 53-60.

Das, P. K., Mohd-Yusuf, Hegde, M. R., Singh, S. P. and Prasad, C. 1994. Appropriate technologies for risk reduction in rainfed horticulture crops with special references to coconut. Technol. for minimizing risk in rainfed agriculture. 142-155.

Gaikwad, S. H., Thorve, P. V. and Bhole, B. D. 1998. Economics of ginger (*Zingiber officinale* Rosc.) production in Amaravati District (Maharashtra). J. Spices and Aromatic Crops. 7(1): 7-11.

Meerabai, M., Jayachandran, B. K., Asha, K. R. and Geetha, V. 2001. Booting spice production under coconut gardens of Kerala yield maximization of ginger with balanced fertilization. Better Crops Int. 15(1): 25-27.

J. Agric. Res. Technol., 37 (1) : 136-140 (2012)

Intra-specific and Inter-specific Hybridization Studies in Seeded x Seedless Grapes (*Vitis* sps.)

Grape cultivation in India has been reported since 1338 and the varietal improvement through hybridization has started from nineteen sixties onwards. Randhawa and Sharma (1960), Singh, *et al.* (1979) and Singh (1983) studied the flowering and pollinations in grapes. Inter-specific hybridizations in grapes have been done by Patil and Patil (1993, 1997) and Patil, *et al*. (1992). The effect of seedless pollen parents on fruit and seed characters of seeded varieties of *Vitis* sps, through intra-specific or inter-specific hybridizations was not done so far, hence in present paper attempt has been made. The seedless (male) parent Beauty Seedless, Kishmish Beli and Thompson Seedless whearas seeded (female) parents Anab-e-shahi, Bhokari, Cheema sahebi, Gulabi, Kalisahebi and Pandharisahebi of *V. vinifera* seeded (female)

parents Bangalore Blue, Bangalore Purple and Catawba of *V. labrusca*, Champanel of *V. champini* and James of *V. rotundifolia* were used.

Intra and inter specific hybridizalion was carried out by adopting the conventional method of emasculation and pollination. Pollen fertility was recorded with viability test using aceto-carmine. Data on pollination, berry set, seeds extracted, floater seed percentage and seed germination were recorded. Data recorded on above characters presented in Table 1. broadly suggest berry set percentage to be relatively more in the combinations with Beauty Seedless parent and higher floater seed percentage in crosses involving Thompson Seedless. Pollen fertility of three seedless parents was 95 per cent in Beauty Seedless, 75 per cent in Kishmish Beli and 92 per cent in Thompson Seedless.

Berry set : Among the three seedless male parents, maximum berry set was noted, when Beauty Seedless was used as male parent. Maximum percentage was in the combination with Gulabi followed by Anab-e-shahi. Even with Kishmish Beli the berry set percentage was more (48.4%). All these male parents had differential effect on individual grape cultivars for berry set. Similar observations have been reported by Randhawa and Sharma (1960). Low berry set may be due to differential receptivity of stigma or pollen tube growth may be arrested in style/ovary or ovule, cytoplasmic or genetic factors affecting pollen fertility and relative homology among pairing gametes. Among the three seedless parents, Beauty Seedless parent appeared to be the best pollinizer resulting in higher berry set, thus confirming the earlier report of Daulta and Chauhan (1983).

Thompson Seedless pollen used on *vinifera* varieties gave higher berry set in Bhokari and

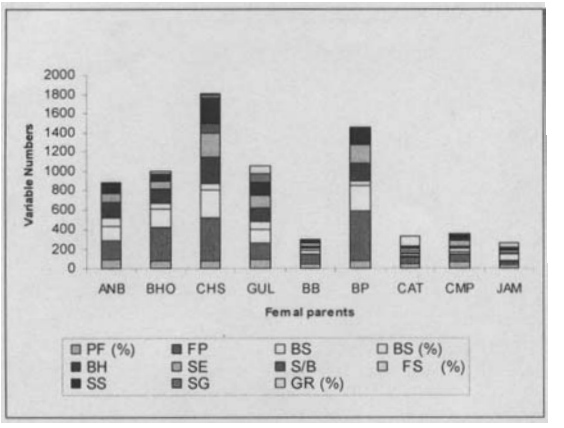

Fig. 1. Pollination with Beauty Seedless.

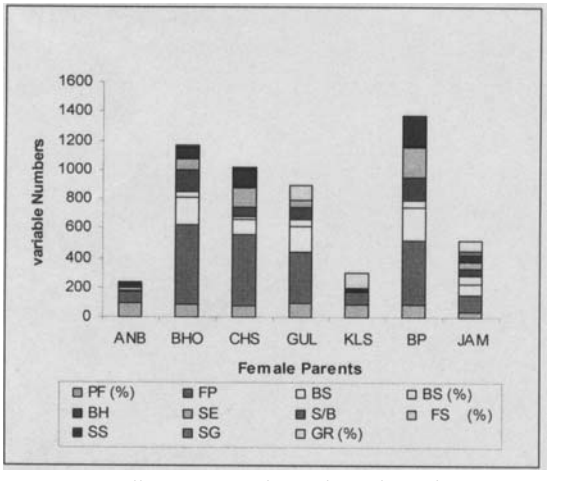

Fig. 2. Pollination with Kishmish Beli.

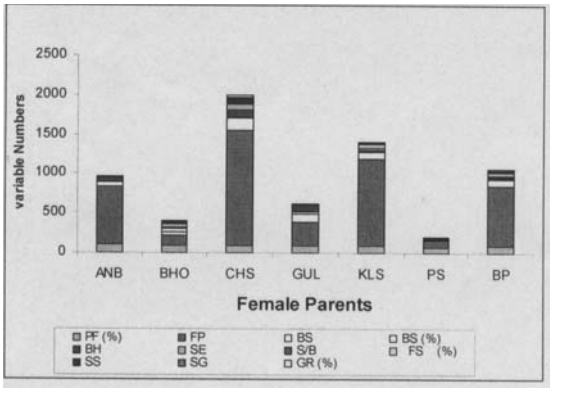

Fig. 3. Pollination with Thompson Seedless

Gulabi and low berry set in Pandhari sahebi, Kalisahebi and Anab-e-shahi. Kishmish Beli and Beauty Seedless pollen gave relatively more berry set than by Thompson Seedless in inter-specific combinations. This suggests differential berry set in *vinifera*, *labrusca* and other species, when, these three seedless varieties were used as pollinizer. Singh *et al.* (1979) reported Thompson Seedless and Beauty Seedless as consistently good male parents.

Seeds/Berry : In the combinations with three male parent species, other than *vinifera* the seeds per berry appeared to be markedly more, though differential behavior of this character has been observed within inter-

Table 1. Hybridization studies in seeded x seedless grapes.

Parents	PF (%)	FP	BS	BS (%)	BH	SE	S/B	FS (%)	SS	SG	GR (%)
Male parent :											
Beauty Seedless	95										
Female parents :											
Anab-e-shahi	95	190	154	81	150	101	0.67	0.99	100	1	1
Bhokari	83	339	186	55	151	76	1.32	1.32	75	9	12
Cheema sahebi	80	437	287	66	268	261	0.97	0.38	260	36	14
Gulabi	93	165	139	84	139	128	0.92	0.00	128	97	76
Bangalore Blue	42	112	29	26	22	29	1.32	3.45	28	-	-
Bangalore Purple	82	505	257	51	185	185	1.00	2.70	180	2	1
Catawba	41	68	16	24	16	19	1.19	15.79	16	15	94
Champanel	70	78	26	33	24	51	2.13	1.96	50	5	10
James	36	30	18	60	15	22	1.47	9.09	20	9	45
Male parent :											
Kishmish Beli	75										
Female parents :											
Anab-e-shahi	95	75	13	17	13	11	0.85	0.00	11	-	-
Bhokari	83	539	186	35	151	76	0.50	7.90	70	9	13
Cheema sahebi	80	480	98	20	70	123	1.76	8.94	112	11	10
Gulabi	93	347	168	48	90	48	0.53	1.00	-	-	-
Kalisahebi	82	92	8	9	3	4	1.33	1.00	-	-	-
Bangalore Purple	82	438	222	51	153	215	1.40	5.85	203	3	2
James	36	115	72	63	45	47	1.04	0.00	47	29	62
Male parent :											
Thompson Seedless	92										
Female parents :											
Anab-e-shahi	95	737	63	9	50	-	-	-	-	-	-
Bhokari	83	130	50	39	20	34	1.70	13.33	30	2	7
Cheema sahebi	80	1475	159	11	80	75	0.94	6.66	70	22	31
Gulabi	93	297	95	32	80	-	-	-	-	-	-
Kalisahebi	82	1113	79	7	30	27	0.90	18.52	22	-	-
Pandhari sahebi	75	86	4	5	3	9	3.00	44.44	5	-	-
Bangalore Purple	82	772	87	11	30	42	1.40	4.71	40	-	-

PF = Pollen Fertility, FP = Flowers Pollinated, BS = Berry Set, BH = Berry Harvested, SE = Seeds Extracted, S/B = Seeds/Berry, FS = Floater Seeds, SS = Seeds Sown, SG = Seed Germination, GR = Germination.

specific combinations. It is conspicuous to note in combinations of Thompson Seedless with *vinifera* cultivars the range of seeds per berry is from 0-3, the latter being in Pandhari sahebi where number of berries obtained was less, whereas in Anab-e-shahi and Gulabi though number of berries obtained were more, there was no seed set in the berries. Similar differential behavior was noted with Kishmish Beli pollen on *vinifera* cultivars. in combinations af Beauty Seedless and other seeded varieties, seeds per berry were in the range of 0.67 to 2.13. Even other species the Beauty Seedless pollen resulted in relatively higher number of seeds per berry. On the whole in combinations of Beauty Seedless the seeds per berry were more. Based on these observations, it may be suggested that, there are variations in berry set and seed set on the same female parents by different seedless parents. Likewise, there are variations in berry set and seed set on different female parents by the same seedless parents.

Floater seeds : The floater seeds are empty and sinker seeds are viable having good germination. The percentage of floater seeds was more in combinations of Kishmish Beli and Thompson Seedless with *vinifera* cultivars, though with others species this percentage was very low. Relatively, the floater seed percentage was less when Beauty Seedless was used as pollen parent. Similar observations were reported by Singh *et al*. (1979).

Seed germination : Out of the 23 combinations, in four combinations, there were no sunken seeds and in five combinations, there was no germination. Maximum seed germination was noted in inter-specific combinations of *Vitis rotundifolia* - James with Kishmish Beli and Beauty Seedless. However, in combinations of Foster Seedlings with Perlettee, Delight, Beauty Seedless and Thompson Seedless, Uppal *et al*. (1977) noted low germination in the combinations with Beauty Seedless and Thompson Seedless. Similar results have been reported by Singh (1983). There are different reports on effect of pollen parents on seed germination. Amramov and Jelenkovic (1961), Uppal *et al*. (1974), Singh *et al.* (1979) and Singh (1983) reported some influence of pollen parents on hybrid seed germination. Where as Olmo (1935) observed seed germination being independent of pollen parents, though Singh (1983) suggested definite effect of parental combinations on hybrid seed germination, although maternal parent also has its role to play. On the basis of above observations it may be, suggested that three seedless male parents have differential effect on sinkers seeds and also on seed germination as noted in combinations of Gulabi and Kalisahebi with Kishmish Beli and Thompson Seedless parents. According to Patil *et al.* (1992), Patil and Patil (1993, 1997), inter specific reciprocal combinations of *vinifera* and *labrusca* revealed differences in berry set,, seeds per berry, floater seeds and seed germination. It might be due to varietals behavior of female parent. Seed germination was more whenever *labrusca* was female parent.

Relationship among the pollinations with seeded x seedless parents shown in Fig. 1-3 . Cheema sahebi is better female parent for Beauty Seedless followed by Bangalore Purple. Likewise, Bangalore Purple and Bhokari were best female parents for Kishmish Beli. Cheema sahebi and Kalisahebi were the best female parents for Thompson Seedless.

In conclusion, fhe pollen grains of Beauty Seedless, Kismish Beli and Thompson Seedless used with seeded varieties of *Vitis vinifera*, *Vilis labrusca*, *Vitis champini* and *Vitis rotundifolia* reveals the Beauty Seedless parents as relatively best pollinizer resulting in higher berry set. Seeds per berry were

markedly more in Vitis species other than *Vitis vinifera*. Floater seed percentage was more in combinations with Kishmish Beli and Thompson Seedless parents. Relatively higher seed germination was observed in inter-specific combinations particularly with *Vitis rotundifolia*. It is, therefore suggested that these three seedless parents to have differential effects on berry set, seeds per berry, sinker seeds as also on seed germination.

S. G. Patil
S. P. Karkamkar
R. V. Kadu

Agharkar Research Institute,
Agarkar Road, Pune - 411 004 (India)
January 25, 2009.

References

Amaramov, L. and Jelenkovic, G. 1961. The influence of parental varieties or. the germination of hybrid seeds in vine. Arh. Poliopr. Nauka, 14(4): 60-73.

Daulta, B. S. and Chauhan, K. S. 1983. Metaxenia studies on fruit set, maturity and quality characters. Haryana J. Hort. Sci. 12: 22-26.

Olmo, H. P. 1935. Empty-seedless ness in varieties of *V. vinifera*. Proc. Amer. Soc. Hort. Sci. 32: 376-380.

Patil, S. G. and Patil, V. P. 1993. Inter-specific hybridization in grapes (Vitis species). Indian J. Hort. 50(1): 3 1 -35.

Patil, S. G. and Patil, V. P. 1997. Reciprocal differences for berry and seed characters in combination of *vinifera* and *labrusca* grapes. Indian, J. Hort. 54(4): 288-291.

Patil, V. P., Patil, S. G. and Honrao, B. K. 1992. Inter-specific hybridization and evaluation of F_1 hybrids. In Proc. Intern. Sympo. Recent Adv. Viticl. Oenol. 100-107.

Randhawa, G. S. and Sharma, R. L. 1960. Studies on flowering and pollination in grapes. Hort. Advance, 4: 21-37.

Singh, R. 1983. Interaction of parental combinations on grape seed germination. Indian J. Hort. 40 (3 and 4): 207-310.

Singh, R., Randhawa, G. S. and Agrawal, P. K. 1979. Effect of different pollinators on seed set in certain male sterile grape cultivars. Indian J. Hort. 36(4): 379-382.

Uppal, D. K., Bajawa, G. S., Chanana, Y. R. and Sandhu, A. S. 1974. Germination of grape hybrid seeds. J. Res. PAU., 11(2): 12-131.

Uppal, D. K., Jawanda, J. S. and Sharma, J. N.. 1977. Seed germination in some inter-varietals crosses in grapes In *Viticulture in Tropics* (Ed. Chadha K. L., G. S. Randhawa and R. N. Pal) HIS, New Delhi, pp. 102-104.

J. Agric. Res. Technol., 37 (1) : 140-142 (2012)

Response to Edible Oils, Chemicals and Packaging Materials on Chemical Parameters of Guava (*Psidium guajava* L.) During Storage cv. Allahabad Safeda

Guava (*Psidium guajava* L.) is fourth most important highly productive, delicious and nutritious fruit crop of the tropical world. Guava is also a rich source of vitamin-C (100 to 160 mg $100g^{-1}$ pulp) and pectin. It is normally consumed fresh as a desert fruit or processed form into various products. However, the fruits are perishable in nature. During harvesting season, there is a glut in the market compelling the farmers to sell their produce at throw away prices. The main objectives of this study to control the rate of respiration, transpiration, ripening and also other undesirable chemical changes and disease infections. It is, however, advisable that the suitability of these methods under a particular condition should be tested before putting them into commercial use. The establishment of a suitable treatment help in market regulation, fetch higher prices and may be equally useful for consumers. Keeping these

facts in view, the present investigation on guava fruits was undertaken.

The experiment was conducted in a completely randomized design with factorial concept involving two factors of edible oils and chemicals and packaging material along with control, at ASPEE College of Horticulture and Forestry, Navsari Agricultural University, Navsari (Gujarat) during the year 2008. For treatments, 3 kg fruits were taken and dipped in BA (100 mg l^{-1}) or NAA(100 mg l^{-1}) with a light coating for a minute with mustard or groundnut oil and packed in brown paper bag or black polyethylene (200 gauge). While control fruits were dipped in distilled water and stored at ambient (27°C) temperature. The initial values are TSS (9.5%), acidity (0.462%), reducing sugars (3.6%), non-reducing sugars (4.04%), total sugars (7.64%) and ascorbic acid (104.52 mg $100g^{-1}$ pulp). Fruits analyzed by method adopting Ranganna (1979).

The effects of different treatments on chemical characteristics are presented in Table-1. The maximum TSS (%), acidity (%) ascorbic acid, total sugars, reducing sugar and non-reducing sugar in guava fruits were noted up to 9^{th} days of storage with BA (100 mg l^{-1}) + light coating with mustard oil (T_3) when fruits were packed in black polythene bag (P_2) as compared to control. This increase in TSS may be due to breakdown of polysacchrides into simple substances by hydrolytic enzymes and low respiration rate (Ramesh and Pal, 2006). The increase in acidity might be due to less loss of metabolites and availability of oxygen in mustard oil coating(Sharma and Dashora, 2001) and lower rate of respiration and ripening in packaging materials (Trivedi and Desai, 2006). The increase in sugars content might be reduced ripening process of fruits by

Table 1. Effect of edible oils, chemicals and packaging materials on chemical characters (%) of guava fruits during 9^{th} day of storage.

Treatment	TSS	Acidity	Ascorbic acid (mg 100^{-1} pulp)	Reducing sugar	Non-reducing sugar	Total sugar
Edible oils and chemicals :						
T_0 = Control	10.87	0.238	125.08	4.07	4.11	8.18
T_1 = Light coating with mustered oil	10.89	0.284	129.08	4.10	4.16	8.27
T_2 = Light coating with groundnut oil	10.88	0.275	128.03	4.08	4.13	8.20
T_3 = BA 100 mg l^{-1} + T_1	11.29	0.328	132.34	4.31	4.36	8.68
T_4 = BA 100 mg l^{-1} + T_2	11.16	0.321	131.57	4.18	4.24	8.42
T_5 = NAA 100 mg l^{-1} + T_1	11.11	0.310	131.78	4.17	4.20	8.37
T_6 = NAA 100 mg l^{-1} + T_2	11.09	0.304	130.19	4.15	4.18	8.33
S.Em. ±	0.11	0.002	1.27	0.03	0.04	0.04
C.D. at 5%	0.31	0.006	3.64	0.09	0.13	0.12
Packaging materials :						
P_0 = No packing	10.92	0.280	127.68	4.11	4.13	8.24
P_1 = Brown paper bag	11.02	0.297	130.09	4.15	4.20	8.35
P_2 = Black polythene bag (200 gauge)	11.19	0.306	130.94	4.19	4.25	8.43
S.Em.±	0.07	0.001	0.83	0.02	0.03	0.03
C.D. at 5%	0.20	0.003	2.38	0.06	0.08	0.08
Interaction (T x P) :						
S.Em.±	0.19	0.003	2.21	0.06	0.08	0.07
C.D. at 5%	NS	NS	NS	NS	NS	NS
C.V. %	2.94	2.03	2.95	2.36	3.14	1.51

retarding respiration and oxidation rates of fruit tissues (Bhadra and Sen, 1999).

R. K. Jat
C. B. Patel
B. V. Padhiar
D. A. Mhetre
M. K. Yadav

ASPEE College of Agriculture and Forestry,
Navsari Agricultural University,
Navsari - 396 450 (India)
July 5, 2009.

References

Bhadra, S. and Sen, S. K. 1999. Studies on effect of various chemical and wrapping treatments on post-harvest storage of custard apple fruits (*Annona squamosa* L.) var. 'Local green'. Envi. And Ecol., 17(3): 710-713.

Ramesh, C. and Pal, R. K. 2006. Influence of active cushioning materials and packaging on shelf life of litchi fruits. Indian J. Hort., 63(l): 31-35.

Ranganna, S. 1979. Manual of analysis of fruit and vegetable products. Tata McGran Hill Publ. Com. Ltd. New Delhi.

Sharma, R. K. and Dashora, L. K. 2001. Effect of mustard oil and benzyl adenine on the shelf life of guava (*Psidium gujava* L.) cv. 'Allahabad safeda'. Haryana J. Hort. Sci., 30 (3 and 4): 213-215.

Trivedi, Y. V. and Desai, M. M. 2006. Effect of pre-cooling on shelf -life and quality of guava (*Psidium gujava* L.) cv. L-49 (Sardar). Crop Prot. Prod., 2(2): 75-78.

J. Agric. Res. Technol., 37 (1) : 142-144 (2012)

Training Needs of Cotton Growers About Plant Protection Measures

In Maharashtra state, Marathawada region covers 7 lakh ha. area under cotton cultivation but productivity is very low (170 kg lint ha^{-1}) due to various reasons. It has been observed that many cotton growers use plant protection measures but neither follow correct procedure nor they prepare recommended spray solutions and thus fail to get desired results. This is due to lack of knowledge and skill. Pest and diseases cause considerable loss, hence plant protection occupies crucial place in crop husbandry (Dhurdeo, 1998).

It is being often widely recognized that if agriculture production is to be increased, the most important step that need to be taken is the training of the farmers in improved method of farming. Thus it is obvious that if increased production has to be ensured, the farmers must be trained. Hence, this study was undertaken with the specific objective, to asses the training needs of cotton gowers about plant protection measures of cotton.

The present study was conducted in Parbhani taluka of Parbhani district of Marathwada region of Maharashtra state in the backdrop of maximum area under cotton cultivation in the whole Parbhani district. From Parbhani taluka, eight villages having highest area under cotton were selected for the study. From each village, 15 cotton gowers were selected by 'n' th method of random sampling.

The data were collected with the help of structured schedule. Simple statistical tools like frequency and percentage were used for analysis of data and for assessing training needs of respondents. Three point, continum, in the need inventory was used by assigning the scores as 3, 2 and 1 for most important, important and less important training need,

Table 1. Training needs in plant protection technology of cotton.

Main areas of plant protection	Most important		Important		Less important	
	Freq.	%	Freq.	%	Freq.	%
Technological area :						
Economic threshold level count	85	70.8	20	16.66	15	12.50
Information on beneficial insects	58	48.33	52.00	43.33	10	08.34
Selection of appropriate time for control of disease and pest	20	16.68	50.00	41.66	50	41.66
Measurement of solutions and chemicals	10	08.33	36.00	30.00	74	61.67
Use of integrated pest management :	52	43.33	58.00	48.33	10	08.34
Cultural control :						
Field sanitation	12	10.00	24	20	84	70.00
Reap plugging	12	10.00	30	25	70	65.00
Crop rotation	06	05.00	24	20	90	75.00
Biological control :						
Use of crysopa	68	56.67	34	28.33	18	15.00
Use of neem kernel extract	52	43.33	50	41.67	18	15.00
Use of *Tricogramma* cards	72	60.00	24	20.00	24	20.00
Use of H N P V	87	72.50	20	16.67	13	10.83
Chemical control :						
Use and selection of chemical for control of diseases pest	68	56.67	34	28.33	18	15.00
Use of plant products	62	51.48	48	40	10	08.53
Use of pheromone traps	85	70.84	20	16.66	15	12.50

respectively.

It is evident from Table 1 that various technological aspects like ETL count and information on beneficial insects were perceived as most important by 70.84 and 48.33 per cent of the respondents, while selection of appropriate time for control of disease and pest (41.66%) was perceived as important area of training and reading measurement of solutions and chemicals (61.67%) was expressed as less important area of training.

Regarding use of Integrated Pest Management, two fifth of the respondents (43.33 and 48.33 per cent) perceived it as most important and important training area of plant protection, respectively.

The data regarding cultural control revealed that about field sanitation, deep ploughing and crop rotation were considered as most important training areas as reported by 10, 10 and 05 per cent of the respondents, respectively. While, field sanitation, deep ploughing and crop rotation were considered as less important areas of training need as expressed by majority of the respondents (70, 65, 75 per cent) respectively.

Regarding training needs on biological

Table 2. Distribution of respondents according to their level of training needs in plant protection technology of cotton.

Category	Number	Percentage
Low	33	27.50
Medium	67	55.84
High	20	16.66
Total	120	100.00

control like use of crysopa, neem kernel extract and Trichogramma cards were most important training needs areas as felt by 56.67, 43.33 and 60.00 per cent of the respondents, respectively. About HNPV majority of respondents (72.00%) felt it as most important training need area.

The data regarding use and selection of chemicals for control of diseases and pests highlighted that more than half of the respondents (56.67 and 51.67 per cent) perceived this as most important area of training need.

It was also clear about use of pheromone traps that majority of the respondents (70.84 per cent) expressed it as most important area of training need.

The data from Table 2 indicated that 55.84 per cent of the respondents hailed from medium level of training needs about, plant protection technology of cotton. Similar findings were also reported by Khandare (2002).

It could be concluded that most important training need on plant protection of cotton perceived by the respondents were, ETL count, use of integrated pest management, use of crysopa, preparation and use of neem kernel extract and use of pheromone traps. Hence, these aspects may be given priority in future training.

A. D. Khandare

Marathwada Agricultural University,
Parbhani - 431 402 (India)
November 28, 2009.

References

Dhurdeo, A. S. 1998. A study on adoption of plant protection technology by the cotton growers. M.Sc. (Agri.) thesis. MAU, Parbhani.

Khandare, A.D. 2002. A study on training needs of cotton growers about plant protection measures. M.Sc.(Agri.) thesis. MAU, Parbhani.

J. Agric. Res. Technol., 37 (1) : 144-146 (2012)

Economic Feasibility of Different Training Systems in Bitter Gourd (*Momordica charantia* L.) cv. Konkan Tara under Konkan Conditions of Maharashtra

The importance of providing supports to the vines has been emphasized by the number of workers *viz*., Abusaleha and Dutta (1994) and Joshi *et al*., (1994) in bitter gourd, Krishna Prasad and Singli (1987), Yadav *et al*., (1989) pointed and Rahman and Hossain (1989) in bottle gourd, emphasised advantages of these supports for efficient disease and pest management, easy harvesting and improving quality of fruits besides high yield.

The main object of the present investigation was to compare the performance and financial implication involved for the training systems and return per rupee invested in installation of the systems under Konkan conditions of Maharashtra.

The experiment was laid out in a randomized block design with five replications during *kharif* season 2002. The treatments included four different training systems *viz*., ground, bush (dry bamboo sticks along with thorny branches), kniffin and Bower system. The seeds were dibbled at 2.5 x 1.0 m spacing in a plot of 5 x 4 m size accommodating ten

plants in each plot. Except ground training system, vines were trained on the support. Waste dry bamboo sticks along with thorny branches were fixed near the plants and vines were allowed to grow on this without disturbing. Kniffin and bower were prepared with the help of iron angles (7' x 2') and galvanized iron wire of 10 and 16 gauge diameter. The jute strings were used for supporting the vines in both kniffin and bower systems.

For studying the economics of crop, the records of additional expenditure on training material, cost of erection and training of vines, required under each treatment was recorded. The gross returns were calculated by considering average selling rate of fruits i.e. Rs. 12 kg^{-1}. An additional yield and percentage increase in yield due to various training systems over ground was calculated. The net additional income was calculated by subtracting the cost of training from additional income accrued due to various training system

While, working out cost of different training systems, one tenth cost of material, particularly iron angles and galvanized iron wire required for kniffin and bower training systems, was considered as the same material can be used conveniently for next ten years. In bush system, 100 per cent the cost of material was considered as dry bamboo along with thorny branches collapsed even before the end of crops. The expenditure incured for bush training system was Rs. 17,500/-, for kniffin training systeny Rs. 36,943/- and for bower training system, Rs. 39,003/- $hectare^{-1}$.

The yield contributing characters like number of fruits, average weight of fruit and total yield was significantly maximum over ground system and increased the productivity over ground system and the increase was ranged from 71.83 to 243.80 per cent in different training systems which in turn fetched additional income over ground system ranging from Rs. 19,620/- to Rs. 66,588/- $hectare^{-1}$.

Since, the cost of different training systems is only the variable, the net returns among the systems is compared on the basis of additional income received due to training as against the expenses involved in different training systems and thus, the income per rupee investment was arrived to judge the economic feasibility of the system. The training system had a marked advantage in increasing the return. Bush system had 1.12 per cent economic advantage over ground system and this advantage goes on increasing, as the system becomes stronger and durable. Bower training system was capable to

Table 1. Additional returns due to different training system.

Treatment	Yield (q ha^{-1})	Gross returns	Additional yield (q ha^{-1})	Additional income* (Rs. ha^{-1})	% increase in the yield*	Additional expen-diture (Rs. ha^{-1})	Net additional income (Rs. ha^{-1})	Ratio of add. returns to add. expt.
Ground system	22.76	27,312	-	-	-	-	-	-
Bush system	39.11	46,932	16.35	19,620	71.83	17,500	2,120	1.12
Kniffin system	68.43	82,116	45,67	54,804	200.65	36,943	17,861	1.48
Bower system	78.25	93,900	55.49	66,588	243.80	39,003	27,585	1.70
S. E. ±	0.04	-	-	-	-	-	-	-
C.D. at 5%	1.29	-	-	-	-	-	-	-

* over ground system

turn a single rupee invested in its installation to Rs. 1.70 on an average and was the most capable return earning system. The net additional income due to training was Rs. 2,120/- in bush system, Rs. 17,761/- in kniffin system and Rs. 27,585/- in bower system. The per cent increase in yield over ground system is 71.83, 200.65 and 243.80 in bush, kniffin and bower training systems, respectively. Similarly the income per rupee invested for training system was Rs. 1.12, Rs. 1.48 and Rs. 1.70, respectively. The highest additional returns were obtained with bower training system followed by kniffin system. The similar trend of results were also reported by Rahman and Hossain (1989) in bottle gourd, Joshi *et al.*, (1994) in bitter gourd and Abusaleha and Dutta (1994) in ridge gourd.

In general, bower system of training was found to superior not only from the point of view of increasing productivity *per se* coupled with reasonably low incidence of fruit fly and diseases but it had also proved its economic viability beyond doubt and could safely be adopted by the enterprised but risk ventured vegetable growers who considered the fiscal involvement as the secondary.

S. A. Ranpise
S. S. Bhokare

College of Horticulture,
Pune - 411 005 (India)
December 31, 2009.

References

Abusaleha and Dutta,O. P. 1994. Performance of bitter gourd (*Momordica charantia*) under different training systems. Indian J. Agril. Sci. 64(7): 479-81.

Abusaleha and Dutta, O. P. 1994. Response of ridge gourd (*Luffa acutangula*) to different training systems, Indian J. Agril. Sci., 64(8): 570-71.

Joshi, V. R., Lawande, K. E. and Pol, P. S. 1994. Studies on the economic feasibility of different training systems in bitter gourd. J. Maharashtra agric. Univ., 19(2): 238-240.

Krishna Prasad, V. S. R. And Singh, D. P. 1987. Effect of training in pointed gourd (*Trichosanthes dioica* Roxb.) for growth and yield. Prog. Hort. 19(2): 47-49.

Rahman, A. K. M. and Hossain Monowar, S. M. 1989. Performance of three advance bottle gourd lines grown with trellis and non-trellis. The Punjab Veg. grower, 24: 8-11.

Yadav, J. P., Kirti Singh and Jaiswal, R. C. 1989. Influence of various spacings and methods of training on growth and yield of pointed gourd. Veg. Sci. 16(2): 113-118.

J. Agric. Res. Technol., 37 (1) : 146-149 (2012)

Genetic Association and Path Coefficient Analysis in Indian Mustard

Seed yield is a complex metric trait and is controled by polygenes which is the product of many contributing characters which jointly or singly influence it. It is therefore, essential to have knowledge of interrelationship existing among yield components, which is statistically measured through correlation and partitioning the correlation coefficient into the components of direct and indirect effects. Information on the association between economic yield and its component characters can improve the efficiency of selection. The sound statistical information collected on yield and its component traits facilitate the identification of superior genotypes for a particular agro-climate. Realizing the importance of above mentioned aspects in mustard, the present investigation was undertaken to analyze the

association between seed yield and its component characters and to estimate the direct and indirect effect of different characters on seed yield.

The experimental material comprised of 31 elite genotypes including local check variety, were grown in a randomized block design with 3 replications under optimal crop management practices at the field experimentation center, Department of Genetics and Plant Breeding, Allahabad Agricultural Institute - Deemed University, Allahabad during *rabi* 2007-2008. The spacing in the experimental plot were kept as 30 x 10 cm. Data were collected from five randomly selected plants from each replication for days to 50 per cent flowering, days to maturity, plant height, number of primary branches plant^{-1}, number of secondary branches plant^{-1}, number of siliquae main^{-1} branch, length of siliqua, number of seeds siliqua^{-1}, biological yield plot^{-1}, harvest index, seed yield plant^{-1} and seed yield plot^{-1} and the averages were used for analysis. Standard statistical analysis was employed {Al Jibouri et al. (1958) and Dewey and Lu (1959)}.

Characters *viz*., days to maturity (rp = 0.24, rg = 0.29), plant height (rp = 0.25, rg = 0.38) and biological yield plot^{-1} (rp = 0.22, rg = 0.25) showed significant positive correlation with seed yield plant^{-1} in both phenotypic and genotypic level. Harvest index (rp = -0.27, rg = -1.08) showed significant negative correlation with seed yield plant^{-1} in both phenotypic and genotypic level. The study revealed that the

Table 1. Phenotypic and genotypic correlation coefficient for seed yield and yield contributing traits in 31 Indian mustard genotypes.

Character		Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches plant^{-1}	Secondary branches plant^{-1}	Siliquae main^{-1} branch	Length of siliqua (cm)	Seeds siliqua^{-1}	Biological yield plot^{-1} (g)	Harvest index (%)	Seed yield plant^{-1} (g)
Days to 50% flowering	rp		0.34**	0.13	0.14	-0.19	0.08	0.07	-0.10	0.25*	- 0.32**	0.04
	rg		0.40**	0.17	0.07	-0.30**	0.09	-0.08	-0.10	0.28**	-0.85**	0.001
Days to maturity	rp			0.49**	0.14	-0.15	-0.09	0.35**	-0.24*	0.09	-0.29**	0.24*
	rg			0.62**	0.23*	-0.24*	-0.15	0.66**	-0.52**	0.07	-0.70**	0.29**
Plant height (cm)	rp				0.27**	0.02	-0.06	0.27**	0.15	0.26*	-0.26**	0.25*
	rg				0.26*	-0.03	-0.09	0.52**	0.22*	0.34**	-0.88**	0.34**
Primary branches plant^{-1}	rp					0.55**	0.22*	0.12	0.03	0.27**	-0.11	-0.03*
	rg					0.67**	0.34**	0.05	0.02	0.39**	-0.62**	0.05
Secondary branches plant^{-1}	rp						0.38**	-0.05	0.15	0.26*	0.05	0.0009
	rg						0.43**	-0.07	0.23*	0.29**	0.29**	0.002
Siliquae main^{-1} branch	rp							-0.26*	0.04	0.27**	-0.12	-0.09
	rg							-0.44**	0.07	0.36**	-0.55**	-0.18
Length of siliqua (cm)	rp								-0.12	-0.18	0.05	0.04
	rg								-0.69**	-0.42**	0.58**	-0.02
Seeds siliqua^{-1}	rp									0.34**	-0.13	0.15
	rg									0.43**	-0.40**	0.18
Biological yield plot^{-1} (g)	rp										-0.45**	0.22*
	rg										0.94**	0.25*
Harvest index (%)	rp											- 0.27**
	rg											-0.78**

*, ** Significant level at 5 and 1 per cent of significance respectively.

Table 2. Genotypic path analysis for seed yield per plant and yield contributing traits in 31 Indian Mustard genotypes.

Character	Days to 50% flowering	Days to maturity	Plant height (cm)	Primary branches plant^{-1}	Secondary branches plant^{-1}	Siliquae main^{-1} branch	Length of siliqua (cm)	Seeds siliqua^{-1}	Biological yield plot^{-1} (g)	Harvest index (%)
Days to 50% flowering	-0.21	-0.08	-0.03	-0.01	0.06	-0.02	0.01	0.02	-0.06	0.27
Days to maturity	0.63	0.86	0.97	0.36	-0.37	-0.23	1.04	-0.81	0.12	-0.56
Plant height (cm)	-0.10	-0.39	-0.63	-0.16	0.02	0.05	-0.33	-0.14	-0.22	0.88
Primary branches plant^{-1}	-0.004	-0.01	-0.01	-0.05	-0.03	-0.01	-0.003	-0.001	-0.02	0.03
Secondary branches plant^{-1}	0.04	0.03	0.004	-0.09	-0.14	-0.06	0.01	-0.03	-0.04	-0.04
Siliquae main^{-1} branch	0.005	-0.008	-0.005	0.01	0.02	0.05	-0.02	0.004	0.02	-0.03
Length of siliqua (cm)	-0.006	0.05	0.04	0.004	-0.006	-0.03	0.07	-0.05	-0.03	0.04
Seeds siliqua^{-1}	-0.12	-0.61	0.26	0.03	0.27	0.09	-0.81	0.77	0.50	-0.47
Biological yield plot^{-1} (g)	0.09	0.02	0.11	0.13	0.10	0.12	-0.14	0.14	0.34	-0.45
Harvest index (%)	-0.32	-0.25	-0.35	-0.16	0.07	-0.14	0.15	-0.10	-0.34	0.25
Seed yield plant^{-1} (r)	0.001	0.29	0.34	0.05	0.002	-0.18	-0.02	0.18	0.25	-1.08

R (residual effect) = 0.86

genotypic correlation coefficients were higher than the corresponding phenotypic correlation coefficients. This was due to the effects of environment in modifying the total expression of genotype, altering the phenotypic expression. High genotypic correlation also suggests that there is inherent relationship between the characters studied. This was also supported by the findings of Mahak Singh *et al.* (2003), Mahla *et al*. (2003) and Sirohi *et al.* (2008), that the genotypic correlation was greater than the corresponding phenotypic correlation.

Correlation coefficient of yield contributing characters with yield was untangled into direct and indirect effects to identify the characters as selection criteria for improvement in seed yield. Six characters including days to maturity (0.86), number of siliquae main^{-1} branch (0.05), length of siliqua (0.07), number of seeds siliqua^{-1} (0.77), biological yield plot^{-1} (0.34) and harvest index (0.25) registered positive direct effect on seed yield plant^{-1}. This was supported by the findings of Major Singh and Gyanendra Singh (1997) and Sirohi *et al*. (2008). The other four characters namely days to 50 per cent flowering (-0.21), plant height (-0.63), number of primary branches plant^{-1} (-0.05) and number of secondary branches plant^{-1} (-0.14) exhibited negative direct effect on seed yield.

The results of the present investigation revealed that days to maturity and number of seeds siliqua^{-1} followed by biological yield plot^{-1} exerted high direct influence on seed yield plant^{-1} resulting in a positive and strong correlation. Selection of plants on the basis of these traits is expected to lead to some improvement in seed yield.

Ngashepam Paikhomba
N. R. Rangare

Department of Plant Breeding and Genetics,
College of Agriculture,
Allahabad - 211 007 (India)
December 31, 2009.

References

Al. Jibouri, A. H., Miller, P. A. and Robinson, H. F. 1958. Genotype and environmental variation and co-variation in an upland rice crop of inter specific origin. Agron. J., 50: 626-636.

Dewey, D. R. and Lu, K. H. l959. A correlation and path

co-efficient analysis of components of crested wheat grass seed production. Agron. J., 51: 515-518.

Mahak Singh, Srivastava, R. L., Lalta Prasad and Dixit, R. K. 2003. Studies on heritability and genetic advance in Indian mustard (*Brassica juncea* (L.) Czern and Coss). Advances in Pl. Sc., 16(1): 261-266.

Mahla, H. R., Jambhulkar, S. J., Yadav, D. K. and Sharma, R. 2003. Genetic variability, correlation and path analysis in Indian mustard (*Brassica juncea* (L.) Czern and Coss). Indian J. Genet. and Plant Breed., 63(2): 171-172.

Major Singh and Gyanendra Singh. 1997. Correlation and path analysis in Indian mustard (*Brassica juncea* L.) under mid hills of Sikkim. J. Hill Res., 10(1): 10-12.

Sirohi, S. P. S., Gaurav, S. S., Sanjai Malik, Sirohi, Sandeep and Meenakshi. 2008. Correlation and path analysis of India mustered (*Brassica juncea* [L.] Czern and Cross). Prog. Agric., 8(1): 89-92.

J. Agric. Res. Technol., 37 (1) : 149-151 (2012)

Impact of Different Ecological Situations on Major Diseases and Efficacy of Fungicides Against Blast of Rice

Blast is a major disease of rice caused by *Pyricularia grisea* that still remains as the most serious disease causing severe yield loss in tropics and subtropics (Ou, 1980). Swarna variety of rice is being grown by majority of the farmers in the state because of its palatability and market value but it showed high susceptibility to the diseases. Fungicidal management of blast is the viable option as the disease develops fast under favorable conditions. In India, several fungicides and spray schedules were recommended by several workers (Dubey and Mishra, 1992 and Venkata Rao and Muralidharan, 1983). Hence, the present survey was carried out to compare different ecological situations against major diseases and field efficacy of fungicides was evaluated against blast disease of rice for its management.

A production oriented survey was conducted, during *kharif* 2004 and 2005 crop seasons (last week of August to mid of September) on farmer's fields of Raigarh district at maximum tillering to node formation stage of rice. The study was based on effect of sowing methods (broadcast, line sowing and transplanting), their situation (up and low land)

Table 1. Effect of different fungicides against leaf blast disease of rice.

Fungicide	Conc. (%)	Blast intensity (%)	Reduction in blast (%)	Yield (q ha^{-1})	Yield increase (%)
Tricyclazole	(0.06%)	17.05 (24.36)	70.39	50.82	50.51
Kasugamycin	(0.1%)	18.55 23.30	67.79	48.97	48.64
Haxaconazole	(0.1%)	23.30 (28.83)	59.54	39.14	35.74
Propiconazole	(0.1%)	23.35 (28.53)	59.46	40.50	37.90
SAFF (Carbendazim + Mancozeb)	(0.25%)	28.10 (32.00)	51.21	37.60	33.11
Carbendazim	(0.1%)	30.10 (32.94)	47.74	35.41	28.97
Unsprayed control	-	57.6 (43.47)	-	25.15	-
CD at 5%	-	1.4		1.1	

*Figures in parentheses are arc sin transformed values.

and growing condition (shade and open), which affect disease intensity. Data were collected only for major diseases prevalent in Raigarh district i.e. blast, sheath blight and bacterial blight (Anonymous, 2007). For evaluation of fungicides, a field experiment was conducted at Indira Gandhi Krishi Vishwavidyalaya, Regional Agricultural Research Station, Boirdadar, Raigarh (C.G) during *kharif* 2006 and 2007 in a randomized block design with three replications having 5 x 4 m plot size. Rice variety Swarna was grown as per recommended agronomic practices. The fungicides tested under study were tricyclazole (Gain 0.06%), kasugamycin (Kasu-B 0.1%), hexaconazole (Contaf 0.1%)), propiconazole (Tilt 0.1%), carbendazim (0.1%) + SAFF (0.25%), carbendazim (Bavistin 0.1%) and un sprayed as control. Fungicides were sprayed after the appearance of disease and repeated 20 days after first spray. During survey and field trial, the observations were recorded on 20 hills selected randomly using SES (Anonymous 1996) for diseases *viz*., blast, sheath blight and bacterial leaf blight by adopting 0-9 scale. The per cent disease index (PDI) was calculated as formula given by Wheeler (1969).

Direct sown rice crop up to 5th July showed more disease intensity (23.4% and 28.9%) than transplanted crop (11.3% and 15.4%) during 2004 and 2005, respectively. Similarly, same trend was observed when the crop was sown late i.e. 15th July and onwards where in, 55.6 and 58.9 per cent blast severity was noticed as against 44.6 and 49.5 per cent in transplanted crop during 2004 and 2005, respectively. Further, early sown/transplanted crop had less blast disease intensity than late sown crop. This is an agreement with the findings reported by Singh, 2001a. The sheath blight disease intensity was more in up land situation in all sowing methods i.e. broadcasting, line sowing and transplanting (36.9%, 31.6% and 29.4%) as compared to low land situation (19.6%, 12.4% and 16.6%). In case of sowing methods, broadcasted crop had higher sheath blight severity of 28. 25 per cent than line sowing (22.0%) and transplanted rice (23.0%). Up land situation had more disease intensity of sheath blight due to better survival of sclerotia than low lying wet situation/flooded fields which is in conformity with the report of Singh (2001b). Similarly broadcasting sowing of rice had more disease intensity because of over crowding of plants that is favorable for sheath blight development. These results are consonance with finding of Srinivasan (1980).

The severity of bacterial blight was maximum in crop grown under shaded area (55.4% and 42.6%) than open condition (13.3% and 9.8%) during 2004 and 2005, respectively. Similar findings were also reported earlier by Mahmood and Singh (1970) and Devadath *et al*. (1987).

The pooled result (Table 1) of two years indicated that all the fungicidal treatments showed significantly lower disease intensity and higher grain yield than control. Significantly least disease intensity (17.5%) was observed with spray of tricyclazole followed by kasugamycin (18.55%) and there by these treatments yielded 50.82 and 48.97 q ha^{-1}, respectively. The superiority of tricyclazole for control of blast disease and increasing yield of rice which was also reported earlier (Anonymous, 1994). Further tricyclazole was also recommended for better control of blast of rice by Vijay (2002).

Ajit Kumar Singh
J. R. Patel
Rakesh Banwasi
Anjeet Jangre
C. R. Patel

Regional Agricultural Research Station,

Indira Gandhi Krishi Vishwavidyalaya,
Boirdadar, Raigarh - 496 001 (India)
June 10, 2010.

References

Anonymous. 1994. Directorate of Rice Research, Rajendra Nagar, Hyderabad. Annual Progress Report pp. 1-7l.

Anonymous. 1996. Standard Evaluation System. Internat. Rice Res. Inst., Philippines.

Anonymous. 2007. Production oriented survey. Directorate of Rice Research (ICAR). Rajendra Nagar, Hyderabad pp. 9-10.

Devadath, S., Premlatha Dath, A. and Jain, R. K. 1987. Effect of shade, nitrogen fertilization, water logging and inoculum concentration on the incidence of bacterial leaf blight of paddy caused by *Xanthomonas oryzae*. Indian Phytopath. 40: 529-530.

Dubey, S. C. and Mishra, B. 1992. Evaluation of fungicides against rice blast. Oryza 29: 399-401.

Mahmood, M. and Singh, M. N. 1970. Investigation on bacterial leaf blight of paddy. Sci. and Culture: 170-171.

Ou, S. H. 1980. A look at world wide rice blast disease control. Plant Dis. 64: 439-445.

Singh, R. S. 2001a. Plant disease, VIIth edition. Oxford & IBH Publ. Co. Pvt. Ltd. New Delhi pp. 490-491.

Singh, R. S. 2001b. Plant disease, VIIth edition, Oxford & IBH Publ. Co. Pvt. Ltd., New Delhi, pp. 440.

Srinivasan, S. 1980. Effect of nitrogen and spacing on sheath blight incidence in rice. Internat. Rice Res. Newsletter. 5: 15.

Venkata Rao, G. and Muralidharan, K. 1983. Fungicides and control leaf blast in dry paddy nursery. Indian Phytopath. 36: 355-356.

Vijay, M. 2002. Field evaluation of fungicides against blast disease of rice: Indian J. of Plant Prot. 30: 205-206.

Wheeler, B. E. J. 1969. An introduction to plant disease. John Wiley, London, pp. 301.

J. Agric. Res. Technol., 37 (1) : 151-153 (2012)

Role Performance of Gram Panchayat Members

Grampanchyat is the most potential school of social and political training for the rural masses. It is the key organization for overall progress of the village. The Grampanchayat is not only a decentralized form of administration but is a medium through which Indian rural people can express their administrative, social and economic problems to the upper levels and try to solve them (Shantha Sheela, 2002). Village development is directly related to the role performance by the members of the gram panchayat.

The study was, therefore, undertaken with specific objectives to study the socio-personal, economic and psychological characteristics of the gram panchayat members, their role performance towards village development and relationships.

The present study was undertaken in randomly selected Renapur, Chakur and Shirur Anantpal blocks of Latur district of Marathwada region. From each taluka eight villages were selected and from each village five Gram Panchayat members were randomly selected to comprise 120 respondents.

Data were collected personally by interviewing the respondents with the help of specially designed and pre-tested interview schedule. The statistical methods such as mean, standard deviation, coefficient of correlation; multiple regression were used for analysis of data.

Socio-personal, economic and psychological characteristics : It was observed from the findings that majority of the Gram Panchayat members were middle aged, having primary education, and living in big size family, medium cosmopoliteness, medium mass media exposure, medium social participation, medium socio-economic status and medium work experience, these findings were in conformity with Rewatkar, (2006).

Role performance : Present study clearly indicated that majority of the Gram Panchayat members had medium level of role performance in respect of most of the areas of functioning such as agriculture development, animal husbandry and dairy development, educational and cultural functions, health care, social welfare, public works, defense and vigilance and administrative functions.

Relation of socio-personal, economic and psychological characteristics with role performance : It was revealed that the independent variables *viz*., education, cosmopoliteness, mass media exposure, socio-economic status and work experience were positively and significantly related with role performance of Gram Panchayat members whereas, age and family size established negative and non-significant relationship with role performance. Social participation did not show any relationship with role performance of Gram Panchayat members.

As far as multiple correlation coefficients (R^2) was concerned, it was indicated that selected independent variables explained variation to the extent of 25.30 per cent in role performance of Gram Panchayat. It was also revealed from data that out of 8 independent variables, education had significant effect for determining the role performance of Gram Panchayat members. Similar results were also reported by Bhosale (1997) and Jadhav (2004).

Table 1. Relation of socio-personal, economic and psychological characteristics of Gram Panchayat members with role performance.

Variables	Correlation coefficient (r)	B(i)	S.E.±	t' value
Age	-0.17755	0.0415	0.1240	0.393
Education	0.45064**	0.3873	1.3058	2.754**
Size of family	-0.01968	0.0404	0.3521	0.427
Cosmopoliteness	0.20342*	-0.1097	0.3869	1.044
Mass media exposure	0.40278**	0.1348	0.4144	1.041
Social participation	0.05906	-0.028	0.3244	0.311
Socio-economic status	0.30993**	0.1230	0.1210	1.319
Work experience	0.18829*	0.1224	0.1208	1.447

Bo = 0.09675 'F' value = 4.6991, R^2 = 0.2530

* Significant at 0.01 and 0.05 level of probability.

It was concluded from the findings that majority of the Gram Panchayat members were having medium level of socio-personal. economic and psychological characteristics. Maiority members exhibited medium role performance about functioning in village development activities. Multiple regression analysis highlighted that education was the significant contributor to the role performance of the Gram Panchayat members.

S. R. Bhagwat
G. S. Ankush
J. V. Mande
D. D. Suradkar

Department of Extension Education
College of Agriculture,
Latur - 431 512 (India)
July 21, 2010.

References

Bhosale, S. G. 1997. A study of role perception and role performance of women members in Grampanchayat from Rahuri taluka of Ahmednagar District. M.Sc.

(Agri.) thesis submitted to Mahatma Phule Krishi Vidyapeeth, Rahuri. Pp. 60-97.

Jadhav, S. B. 2004. Role of Grampanchayat members in agriculture development. M.Sc. (Agri.) thesis submitted to Dr. PDKV, Akola. Pp. 40-99.

Rewatkar, A. R. 2006. Comparative study of role perception and role performance of Panchayat Raj members. Ph.D. thesis submitted to MAU, Parbhani.

Shantha Sheela, M. 2002. Performance analysis of elected women presidents in village Panchayat. Ph.D., thesis submitted to Tamil Nadu Agricultural University, Coimbatore. pp. 102-153.

J. Agric. Res. Technol., 37 (1) : 153-156 (2012)

Rainfall and Dry Spell Analysis for Beed

Rainfall has a major role in rainfed agriculture. The rainfall distribution in our country is most uneven and varies considerably from region to region as well as from year to year. South-West monsoon is the chief source of rainfall and is concentrated during four monsoon months at most of the places. In rainfed areas crcp planning is solely dependent on the distribution pattern and amount of rainfall, particularly during *kharif* season.

Beed receives average rainfall of 767 mm. Annual rainfall is comparatively low and its distribution is not uniform. In such a condition only the knowledge of average annual rainfall is not useful in deciding cropping pattern. Hence, knowledge of the dates of onset of effective monsoon, wet spells and dry spells during the different developmental stages of the crops plays an important role.

The location of Beed station is 10° (N) latitude and 75° (E) longitudes. The daily rainfall and evaporation data for 20 years from 1988 2007 were obtained for Beed station. From daily rainfall data total of rainfall in the month per year and number of rainy days was also obtained. From the monthly totals obtained, the normal rainfall for every month, the minimum and maximum rainfall and the average rainy days for each month were computed. Pre-monsoon rains cannot be considered as effective monsocn for agricultural operations. The concept developed by Ashok Raj (1979) on onset of effective monsoon and dry spells was adopted in the present study. Effective monsoon is that monsoon which leaves enough moisture to support agricultural operations. If the average daily evaporation is 'e' mm and after a prolonged dry spell, if it rains on a particular day an amount of 'r' mm of rain, it is assumed that only (r-e) mm of rain will be available for the soil that day. If it rains on the subsequent days, the evaporation loss will be less than e mm. In the light of this, the rainfall of seven day period that leaves at least 10 mm of rain after meeting the evaporative demand is designed as the effective monsoon. According to the date of commencement of a 7 days spell satisfying the criteria can be defined as the date of onset of effective monsoon. The first day's rain in the seven days spell should be more than average daily evaporation (e) of the place. The total rain during the seven days spell should not be less than (5e + 10) mm. At least four out of these seven days should be rainy days with not less than 2.5 mm of rain each day.

The dates of onset of effective monsoon for every year for Beed station were determined by

applying the above three criteria. After identifying the date of onset of effective monsoon Xi (i=1, 2, 3 ….n) in the ith year for a station, the mean date M is computed as follows

$$M = \sum_{I=1}^{n} (Xi / n)$$

Where: n = number of years.

The standard deviation Xi (i = 1, 2, 3... n); dates of effective monsoon is calculated as follows.

$$\sigma = [((\Sigma Xi^2 - (\Sigma Xi)^2/n)/(n-1)]^{1/2}$$

Where,

σ = standard deviation (days) n = number of years

The dry spells were found out by applying the criteria stated by Ashok Raj (1979). The interval between the OEM and the begaining of the first critical dry spell is called the first wet spell. The subsequent wet spells are defined as the interval between two critical dry spells. The duration of the dry spell occurred during monsoon season exceeds a certain period depending on the crop-soil complex of the region, the dry spell is called the first critical dry spell. Duration of 10 days was considered to classify the dry spell as critical during this study (Pujari, 2005). There may occur more than one critical dry spell during every year. The mean dates of starting of critical dry spells were obtained by the same procedure adopted for obtaining the mean dates of OEM.

It was observed that the total of average monthly rainfall for the month from June to

Table 1. Observed dry spells during 1988-2007 at Beed station.

Year	First		Second		Third		Fourth	
	Date	**Days**	**Date**	**Days**	**Date**	**Days**	**Date**	**Days**
1988	June 26	05	July 28	20	-	-	-	-
1989	July 02	06	July 26	10	August 27	11	-	-
1990	June 29	37	August 24	04	September 09	15	October 16	09
1991	June 13	16	July 07	72	-	-	-	-
1992	June 25	16	July 19	20	August 17	10		-
1993	August 07	23	September 07	07	September 28	13	-	-
1994	June 15	14	July 01	04	July 15	45	September 07	28
1995	July 11	10	September 04	07	September 17	27	-	-
1996	July 12	40	September 22	05	October 06	15	-	-
1997	July 08	31	September 10	09	September 25	24	-	-
1998	August 28	04	September 13	10	September 30	04	October 05	07
1999	June 25	11	July 18	13	August 03	35	September 15	09
2000	June 17	13	July 14	25	August 15	06	September 01	27
2001	June 21	42	August 26	20	September 18	07	-	-
2002	August 13	11	August 26	06	September 07	40	-	-
2003	August 16	06	August 29	25	-	-	-	-
2004	August 07	29	September 12	10	September 29	09	-	-
2005	July 31	11	August 25	10	September 1 1	10	September 24	21
2006	June 25	04	July 06	30	August 12	11	August 30	14
2007	June 29	26	August 01	24	September 08	06	-	-

September was 642.88 mm, which was 84.79 per cent of the annual rainfall. Thus it was concluded that the maximum amount of rainfall was received during the month June to September of the year. It can also be seen that average number of rainy days were minimum i.e. 0 days for the months of January, February and March and maximum in August i.e. 8.6 days. The total number of rainy days was 37.55 days in period of one year.

The annnual rainfall averaged over 20 years for Beed station was 758.23 mm. The minimum rainfall of 337.2 mm was recorded during 1991 and maximum rainfall of 1265.8 mm was recorded during 1989. The number of rainy days varied from a minimum of 22 days during 1991 to a maximum of 58 days during 1988 with annual average of 37.6 days for 20 years. Daily evaporation and rainfall data of 20 years for Beed station from 1988-2007 were analyzed to determine dates of onset of effective monsoon (OEM) and dates withdrawal of monsoon during individual years. The criteria stated by Ashok Raj (1979) were used in the analysis. The monsoon starts from first week of June to second week of August. The date of onset of effective monsoon was June 29 with standard deviation of 22 days. It was also observed that effective monsoon ends in between first week of September and last week of October. Mean date of withdrawal of monsoon was found to be October 9.

The dates of commencement and duration of dry spells were determined during every year

Table 2. Critical dry spells (CDS) during the year for Beed station.

Year	First		Second		Third		Fourth		Total
	Date	Days	Date	Days	Date	Days	Date	Days	
1988	June 28	20	-	-	-	0	-	0	01
1989	July 26	10	Aug. 27	11	-	0	-	0	02
1990	June 29	37	Sept. 09	15	-	0	-	0	02
1991	June 13	16	July 07	72	-	0	-	0	02
1992	June 25	16	July 19	20	Aug. 17	0	-	0	03
1993	Aug. 07	23	Sept. 28	13	-	0	-	0	02
1994	June 15	14	July 15	45	Sept. 07	28	-	0	03
1995	July 11	10	Sept. 17	27	-	0	-	0	02
1906	July 12	40	Sept. 17	27	-	0	-	0	02
1997	July 08	31	Sept. 25	24	-	0	-	0	02
1998	Sept. 13	10	-	0	-	0	-	0	01
1999	June 25	11	July 18	13	Aug. 03	35	-	0	03
2000	June 17	13	July 14	25	Sept. 01	27	-	0	03
2001	June 21	42	Aug. 26	20	-	0	-	0	02
2002	Aug. 13	11	Sept. 07	40	-	0	-	0	02
2003	Aug. 29	25	-	0	-	0	-	0	01
2004	Aug. 07	29	Sept. 12	10	-	0	-	0	02
2005	July 31	11	Aug. 25	10	Sept. 1 1	10	Sept. 24	21	04
2006	July 06	30	Aug. 12	11	Aug. 30	14	-	0	03
2007	June 29	26	Aug. 01	24	-	0	-	0	02
Mean	July 14	21	Aug. 21	23	Aug. 27	21	Sept. 24	21	

Critical dry spell : when length of dry spell exceeds 10 days. Average number of CDS : 2

from daily rainfall and evaporation data by using criteria suggested by Ashok Raj (1979). Table 1 showed dates and duration of dry spells determined during every year after the commencement of effective monsoon. There were at least two dry spells during every year. Two dry spells occurred during 1988, 1991 and 2003, where as four dry spells occurred during 1990, 1994, 1998,1999, 2000, 2005 and 2006. Three dry spells occurred during remaining years. The dry spell with highest duration of 72 occurred during 1991. The duration of the remaining dry spells ranged between 4 to 45 days. Total 64 dry spells were observed during the period of 20 years.

Average dates of starting of CDS and length:

First CDS	July 14	Length 21 days
Second CDS	August 21	Length 23 days
Third CDS	August 27	Length 21 days
Fourth CDS	September 24	Length 21 days

Mean dates of wet spells:

First wet spell	June 29 to July 13
Second wet spell	August 4 to August 20
Third wet spell	Sept. 18 to Sept. 23

It was observed (Table 2) that mean number of critical dry spell was two CDS ranged from one to four during every year. It is also observed that only one CDS pccurred during 1988, 1998 and 2003 Maximum four CDS occurred during 2005. Similar observations were also reported by Kundu (1973) and Mishra *et al*. (1996).

M. D. Abuj
A. P. Magar
V. T. Bombale
P. G. Popale
S. A. Birajdar

Department of Soil and Water Conservation Engineering,
Aditya College of Agricultural Engineering and Technology,
Beed - 431 122 (India)
August 31, 2010.

References

Ashok Raj, P. C. 1979. Onset of effective monsoon and critical dry spells. A computer based forecasting technique: IARI Bull. II, WTC; IARI, New Delhi. 21-35.

Pujari, M. S. 2005. Rainfall and dry spell analysis for southern districts of Marathwada region. M.Tech. thesis submitted to College of Agril. Engg. M.A.U., Parbhani.

Kundu, P. S. 1973. Probability anaysis of annual rainfall data. J. of Agril. Engg. 10(2): 21-35.

Mishra, G. N., Sinha, P. K., Shukla, V. D. and Prasad, K. 1996. Rainfall analysis for planning upland rice crop in Bihar plateau. Indian J. of Agril. Sci. 66(7): 393-396.

J. Agric. Res. Technol., 37 (1) : 156-158 (2012)

Development and Performance Testing of Mechanical Rotary Filter for Sugarcane Juice in Jaggery Processing

The cleaning of juice is the first and foremost unit operation in jaggery processing. Thangavely (2007) reported that bagasillo and earth mainly dirt and insoluble present in the juice affected the quality of juice adversely. These suspended substances, if allowed to remain in juice, imparts a disagreeable colour and taste to the gur (Ghosh *et al*. 1998). At

present in traditional jaggery processing plants only single filter screen of about 4 mm hole size is being used by the jaggery manufacturers for juice cleaning which is not enough. The double stage fiiter developed by the AICRP was found effective in cleaning sugarcane juice (Jaswant Singh,1998). However, frequent clogging of second stage screen (0.5 mm) was the main hurdle in adoption of the double stage filters. This necessitates development of auto and continuous type of filtration system.

The mechanical rotary filter was developed under AICRP on Post Harvest Technology operating at Regional Sugarcane and Jaggery Research Station, Kolhapur during the year 2004 and its performance was tested during 2005-06 and 2006-07.

The developed mechanical rotary filter is hollow cylindrical screen rotating along its longitudinal axis. The periphery of the cylinder serves as the filtering surface. It consists of mainly primary filter, secondary rotary filter and power transmission unit. The filter unit is fabricated in 16 gauge thick stainless steel of 304 grade.

Primary filter is small vertical vessel of 300 mm-diameter and 200 mm height. A screen of 2 mm size is placed in at bottom of this vessel. This vessel is attached to the filtration system at a height such that the juice from the crusher will be taken in the vessel easily by gravity. The cleaned sugarcane juice is conveyed to the secondary filter through the pipe fitted at the bottom of primary filter.

The secondary filter consists of screen, cylindrical structure, bearing housings, spirals, clean juice collection tray and impurity collector and semicircular cover. The screen of 0.5 mm (500μ) size is tightly fastened over cylindrical stainless steel structure by clips. The cylindrical structure having diameter 300 mm and length 860 mm, is attached axially to the SS pipe of 25 mm dia. This pipe is placed in the bearing housings placed on either sides of cylinder, to facilitate easy rotation. The bearing housings are fixed on two different elevated frames, prepared from iron angle of 25 x 25 x 3 mm size, with facility of inclination adjustment of rotary screen. Inside of the cylindrical structure spirals are provided close to the surface of screen. When the filter rotates, the juice impurities are carried and conveyed by the spirals up to the impurity collector placed down side. For collection of clean juice stainless steel tray is placed longitudinally below the cylindrical screen. To safe guard the rotary screen and to control the splash of juice outside filter, semicircular cover is mounted.

Power transmission unit : For rotary motion, the cylindrical screen axle is attached to the speed reduction gear box through pulley and 'V' belt arrangement. Power is given by one Hp single phase electric motor. For safety, electric motor and gear box assembly is covered with stainless steel box.

The overall dimensions of the mechanical rotary filter are 1330 x 720 x 770 mm and total weight of the filter is 134 kg. Cost of stainless steel filtration unit is about Rs. 35,000/- while same filter fabricated in mild steel will cost Rs. 13,000/-.

In order to test the capacity and efficiency of mechanical rotary filter and thereby to standardize the filter machine parameters trials were undertaken during the year 2005-06 and 2006-07.

Rotary filter machine parameters :

Inclination of rotary screen : I_1 - 2.5°, I_2 - 3.5°, I_3 - 4.5°

Speed of rotary screen : S_1 - 20 rpm, S_2 - 30 rpm, S_3 - 40 rpm

Screen size : 500µ, 1000µ

Statistical Design : Split plot with three replications.

Effectiveness of rotary filter screen was tested by using the IS:5817:1980 for air screen cleaner (Sahay and Singh, 1994). While testing, 15 litre sugarcane juice was fed to the filter at constant fed rate of 840 kg hr^{-1} for all the test combinations of machine parameters. Sugarcane juice samples were collected from feed, clean juice outlet and impurity outlets at every combinations of filter machine parameters. All the samples were filtered through double layered muslin cloth filter for calculation of fraction of clean juice.

The 500µ screen (S_1) achieved significantly higher efficiency (89.03%) over the 1000µ screen size (S_2) (87.57%). In case of filtration capacity, the screen S2 recorded significantly higher capacity (739.43 kg hr^{-1}) over the screen S_1 (727.07 kg hr^{-1}).

With increase in speed of rotary screen, the filtration efficiency and capacity found decreased. The significantly highest filtrations efficiency (90.96%) with highest capacity (745.23 kg hr^{-1}) was recorded at speed of 20 rpm. The filtration efficiency and capacity found decreased with increase in the inclination of rotary screen. The significantly highest filtration efficiency of 89.66 per cent with highest capacity (744.35 kg hr^{-1}) was recorded at inclination of 2.5°.

The interaction effect between screen size and speed, screen size and inclination and speed and inclination were found significant in respect of both the filtration efficiency and capacity. The overall efficiency and filtration capacity of mechanical rotary filter was 89.88 per cent and 738.88 kg hr^{-1}, respectively.

Conclusion : The mechanical rotary filtration system therefore found effective for cleaning of sugarcane juice in jaggery processing plant. For better performance, the mechanical rotary filtration system should be operated with rotary screen of 500µ. size, positioned at an inclination of 2.5° and rotated at 20 rpm speed.

G. S. Nevkar
D. S. Patil
S. M. More
V. N. Nale

Regional Sugarcane and Jaggary Research Station,
Kolhapur - 416 005 (India)
September 15, 2010.

References

Ghosh, A. K., Shrivasta, A. K. and Agnihotri, V. P. 1998. Production Technology of Lump Sugar - Gur. Daya Publ. New Delhi. Chapt.7, pp. 75.

Jaswant Singh. 1998. Double stage filters. Jaggery and Khandsari Digest. IISR (JK-cell). Tech. Bull. 98-39 pp. 36-38.

Sahay, K. M. and Singh, K. K. l994. Unit operations of agricultural processing. Vikas Publ. New Delhi. pp. 75.

Thangavelu, S. 2007. Chemical composition of juice and jaggery (Gur) in jaggery production- a review. Cooperative Sugar, 38(6), pp. 41-58.

J. Agric. Res. Technol., 37 (1) : 159-160 (2012)

Studies on Biology and Biometrics of Cucumber Leaf Miner (*Liriomyza trifolii* Burgess)

The American serpentine leaf miner, *Liriomyza trifolii* Burgess, is one of the key pests of cucumber reported from all the areas wherever it is grown. Besides cucumber, the pest also infests castor, cotton, tomato, leafy vegetables, gourds, marigold and various weeds (Lakshminarayana *et al.* 1992). Considering the economic importance of the pest and its severe infestation on cucumber crop in Western Maharashtra region, the biology was studied under laboratory conditions.

The seedlings of cucumber variety 'Himangi' were raised individually in small earthen pots of 15 cm diameter in green house during 2005-06. The seedlings of 25-30 days old were then transplanted in wooden insect rearing cages kept in the laboratory at room temperature (27±2°C). The newly emerged pairs of adult leafminer from the field crops, were individually released on these transplanted seedlings for mating and oviposition purpose. The leaves were seen under stereoscopic microscope for recording observation on eggs. The eggs laid by female fly were carefully removed from the leaf tissue by dissecting the leaves with the help of a fine needle and forceps.

The seedlings were observed at every four hourly intervals for recording observations on incubation and development period of each larval instar. The observations were also recorded on pre-pupal and pupal periods and longivity of flies. The freshly emerged pair of flies were released individually on healthy cucumber seedlings for mating and oviposition and counts were taken on number of eggs laid by a female during its life span. The biometrical obervations on different life stages of leafminer were recorded using standarized stage and ocular micrometer. Each observation was recorded by using minimum 25 individuals.

The data on mean durations and measurements of life-stages and fecundity of cucumber leafminer (*L. trifolii*) are presented in Table 1.

It is evident from Table 1 that the egg period of *L. trifolii* and its length and width on 2 to 3 days ranged from 0.19 to 0.22 and 0.06 to 0.13 mm, respectively when reared on leaves of cucumber. Similar observations were also recorded by Mikenberg and Lenteren (1986), Lakshminarayana *et al.* (1992) and Kapadia (1997).

The mean duration of I, II and III larval instar of *L. trifolii* was observed to be 1.4, 1.8 and 2.1 days, respectively on leaves of cucumber, while its mean length and width was found to be 0.38 and 0.18mm, 0.97 and 0.33 mm and

Table 1. Measurement of immature adult life stages and duration of *L. trifolii* reared on Cucumber.

Stage	Length (mm)	Width (mm)	Duration (days)
Egg	0.20 (0.19-0.22)	0.12 (0.06-0.13)	2.5 (2-3)
Larva			
I instar	0.38 (0.34-0.44)	0.18 (0.12-0.24)	1.4 (1-2)
II instar	0.97 (0.93-1.24)	0.33 (0.27-0.44)	1.8 (1-2)
III instar	2.32 (2.07-2.63)	0.65 (0.52-0.76)	2.1 (1.4-2.8)
Pupa	1.76 (1.42-1.94)	0.78 (0.63-0.94)	9.2 (7-11)
Adult			
Male	1.60 (1.41-1.75)	2.49 (2.40-2.73)*	3.2 (2-4)
Female	1.95 (1.83-2.12)	3.08 (2.83-3.34)*	4.3 (3-7)

* Wing expanse

Figures in parentheses indicate ranges

Duration (days) = Pre-Pupa = 2.4 hrs (0.83-3.41 hrs), total life cycle (male) = 20.44, (female) = 21.50,

Fecundity of female = 160.6 eggs (169-183) female^{-1}

2.32 and 0.65 mm, respectively. Mikenberg and Lenteren, (1986); Mikenberg, (1988); Parrella and Bethke, (1988) and Park, (1996) have recorded more or less similar observation on larval development of *L. trifolii* on other hosts such as chrysanthemum etc.

The pre-pupal period varied from 0.83 to 3.41 hrs with mean of 2.4 hrs.

The average length and width of pupa were 1.76 and 0.78 mm, respectively with duration of 7 to 11 days having mean of 9.2 days. Similar observations were recorded by Nadagouda *et al.* (1997) and Park (1996).

The average length and wing expanse of adult were 1.60 and 2.49 mm, respectively for males and 1.95 and 3.08 mm, respectively for females. The mean adult longevity was observed to be 3.2 days in males and 4.3 days in females. The fecundity of female ranged from 99 to 186 eggs with an average of 161.00 eggs female^{-1}. These findings on morphology, size and duration of adult stage as well as fecundity of female were supported by the reports of the work done by Lakshinarayana *et al*. (1992), Singh *et al.* (1996) and Kapadia (1997). Thus the average development period from egg to adult was observed to be 20.44 days in males and 21.50 days for females of *L. trifolii*.

Acknowledgement

The authors are thankful to The Head, Division of Agril Entomology, College of Agriculture, Pune and Head, I.A.R.I. Regional Station, Pune and their staff for providing necessary facilities for carrying out the experiments.

Mendi Hanumappa
V. M. Chavan

I.A.R.I., Regional Station,
College of Agriculture Campus,
Pune - 411 005 (India)
September 15, 2010.

References

Kapadia, M. N. 1997. Biology of leaf miner, *Liriomyza trifolii*, a pest of castor. Nat. Sem. on Ento. in 21st century, Rajasthan, India (30 April-2 May) pp. 201.

Lakshminarayana, M., Basvappa, H. and Singh, V. 1992. Report on the incidence of hitherto unknown leaf miner (Agromyzidae) on castor. J. Oilseed Res., 9(11): 175-176.

Mikenberg, O. P. J. M. and Lenteren, Van. J. C. 1986. The leaf miners, *Liriomyza bryoniae* and *Liriomyza trifolii* (Diptera : Agromyzidae), their parasites and host plants, a review. Wageningen Agric. Univ. papers. 86(2): 50.

Mikenberg, O. P. J. M. 1988. Life history of Agromyzid fly, *Liriomyza trifolii*, on tomato at different temperatures. Ent. Exp. Appl. 48(1): 17-22.

Nadagouda, S., Thulasiram, K., Patil, B. V. and Somasekhar. 1997. Developmental periods of leaf miner, *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae) on different host plants. Karnataka J. agric. Sci., 10(4): 1003-1007.

Park, J. D. 1996. Host ranges and temperature effects on the development of *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae). Korean J. Appl. Ento., 35(4): 302-308.

Parrella, M. P. and Bethke, J. A. 1988. life history of Agromyzid fly *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae). Pan-Pacific ent. 64(1): 17-22.

Singh, H., Malic, V. S. and Kumar, M. 1996. Role of abiotic factors in seasonal abundance and biology of American serpentine leaf miner, *Liriomyza trifolii* Burgess (Diptera: Agromyzidae) on castor. Indian J. Ecol., 23(1): 34-38.

J. Agric. Res. Technol., 37 (1) : 161-163 (2012)

Assessment of Nature and Weight of Callus in Diverse Genotypes of Pigeonpea (*Cajanus cajan* (L.) Millsp)

Cultivated pigeonpea has limited source of genetic variability but wild species of *Cajanus* have many economically important traits like resistance to diseases and pests. The pre fertilization and post fertilization cross ability barriers prevented the utilization of wild species in breeding programme (Ahamad *et al.* 1988). Progress is also made in the field of genetic engineering and tissue culture for crop improvement. For ability to regenerate plants, quality callus are essential to be developed for efficient regeneration system which is used for genetic transformation studies. Keeping this view, the present investigation was undertaken to study the variability and regeneration ability of callus in this crop.

The experiment was carried out at Plant Biotechnology Centre, Dr. B.S. Konkan Krishi Vidyapeeth, Dapoli during 2008-10. Seeds of three genotypes *viz*., Konkan tur-1, ICPL-87 and AKT-8811 were surface sterilized by 10 per cent Teepol 2-3 min., followed by washing under running tap water. Then seeds were quickly dipped in 70 per cent ethanol and further immersed in 0.1 per cent $HgCl_2$ for 3 min followed several washing with autoclaved double distilled water. The treated seeds were soaked for 16 hrs and then used for isolation of explant like embryo axes and embryo axes with single cotyledon. Germinated seeds on ½ MS medium were used for making explant like hypocotyls and such explants were used for callus induction. These explants were inoculated aseptically on different media combinations and placed in controlled humidity and temperature for two weeks for callus induction. After 15-20 days of formation of calli, they were subculrured on another fresh medium containing auxins and shifted under light condition. Observations were recorded as weight and nature of callus after four weeks. Completely randomized design was employed for this experiment. Statistical analysis was carried out by Panse and Sukhatme (1954).

Effect of genotypes : The data regarding weight of callus of three different explants of three genotypes on MS and B_5 are shown graphically in Fig. 1 and 2. Highest amount of callus was observed in genotype ICPL-87 (609.1 mg) followed by genotype Konkan tur-1 (574.3 mg) and AKT-8811 (574.07 mg) irrespective of media and explants.

Effect of explants : Maximum amount of callus was observed in leaf disc explants (656.50 mg) followed by hypocotyls explants (612.1 mg) and embryo axes explants produced 561.4 mg amount of callus. Similar results were recorded by Kumar *et al*. (1983).

Effect of MS media : The significant differences was observed in MS media for weight of callus (730.8 mg) on MS medium supplemented with 0.5 mgl^{-1} 2,4-D irrespective of genotypes and explants. Similarly, average minimum amount of callus was observed (101.7 mg) on MS basal media.

Effect of B_5 media : Average maximum amount of callus was recorded (708.4 mg) on B_5 medium with 0.5 mg l^{-1} 2,4-D (CIM3) while average minimum amount of callus was observed (70.3 mg) on B_5 basal medium.

Genotype x explant interactions : Maximum amount of callus was recorded in genotype ICPL-87 in leaf disc explant (656.5 mg) followed by hypocotyl explant (600.65 mg) in AKT-8811. Embryo axes explant recorded

maximum amount of callus (561.4 mg) in genotype ICPL-87. The minimum amount of callus obtained from hypocotyl explants (490.5 mg) in genotype ICPL-87 on B_5 medium. Similar kind of results were reported by Sudarshana Rao *et al.* (2003).

Explant x medium interaction : The highest amount of callus was observed in leaf disc explant (820.31 mg) on MS medium supplemented with 1.0 mg l^{-1} 2,4-D + 0.5 mg l^{-1} BAP irrespective of genotypes followed by hypocotyl explant (752.2 mg) on MS medium supplemented with 0.5 mg l^{-1} 2,4-D and embryo axes explant recorded (713.5 mg) on MS medium supplemented with 0.5 mg l^{-1} 2,4-D + 0.5 mg l^{-1} BAP. The lowest amount of callus was observed in embryo axes explant (79.1 mg) on MS basal medium. Similar kind of results were also recorded by Gosal and Bajaj (1979). B_5 medium supplemented with 0.5 mg l^{-1} 2,4-D recorded 812.7 mg in hypocotyls explant which was significantly highest irrespective of genotypes, while lowest amount of callus was observed in hypocotyls explant (58.33 mg) on B_5 basal medium. These results are in confirmity with Thatikunta and Baldev (1994).

Genotype x explant x medium interaction : Significant differences in three way interaction effect for weight of callus was observed. Genotype Konkan tur-1 showed highest amount of callus in leaf disc explant (829.3 mg) on MS medium supplemented with 0.1 mg l^{-1} 2,4-D + 0.5 mg l^{-1} BAP followed by ICPL-87 which showed maximum amount of callus in hypocotyls (752.2 mg) on MS medium supplemented with 0.5 mg l^{-1} 2,4-D. These results are in conformity with Pushpalatha *et al.* (2005).

Nature of callus : Among the three genotypes, leaf disc explants of Konkan tur-1 produced whitish yellow colour callus with

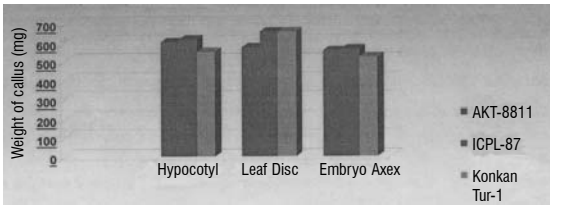

Fig. 1. Weight of callus of expants in three genotype on MS media Explants.

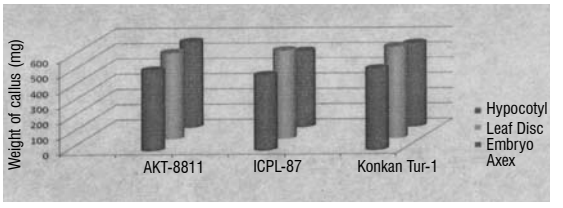

Fig. 2. Weight of callus of three explants in B5 media

friable nature after 5th subculture in the same media. The hypocotyl explant of all genotypes produced hard callus with various colours in different media combinations. This callus remained hard upto 7th subculture and did not show embryogenesis. Similarly, embryo axes explants of Konkan tur-1 produced friable callus in lower levels of 2,4-D. Characteristics of callus in terms of its colour and physical presence play an important role in determining regeneration. Regenerable callus is characterized as friable and cream colour across the plant kingdom. In the present study genotype and nature of callus have played an important role in induction of different types of calli. The MS media supplemented with 2,4-D produced green friable callus. These results are confirmity with Vishu Kumar and Patil (2000) where as B_5 media supplemented with 2,4-D produced compact and hard callus, basal media producing embryonic callus. The differences in callus colour and nature might be due to internal differences of genotype and external effect of different hormonal concentrations in different media combinations.

It is concluded that, the differences in results

revealing for weight and nature of callus might be due to genotypes, explants and endogenous and exogenous levels of growth regulators.

S. N. Sarode
S. V. Sawardekar
S. S. Sawant
S. G. Bhave
N. B. Gokhale

Plant Biotechnology Centre,
Dr. B. S. Konkan Krishi Vidyapeeth,
Dapoli - 415 712 (India)
September 15, 2010.

References

Anonymous. 2007. ICRISAT, Pigeon pea. Co.in.

Ahmad, F., Slinkard, A. F. and Scoles, G. J. 1988. Investigations into the barriers to interspecific hybridization between (*Cicer arietinum* L.) and eight other annual Cicer species. Plant Breed., 100: 193-198.

Gosal, S. S. and Bajaj, Y. P. S. 1979. Establishment of callus tissue cultures of the induction of organogenesis in some grain legumes. Crop Improv. 6(2): 154-160.

Kumar Suresh, A., Reddy Tummala, P. and Reddy G. M. 1983. Plantlet regeneration from different callus cultures of pigeonpea (*Cajanus cajan* L. Millsp). Plant Sci. Lett. 32: 12-15.

Panse, V. G. and Sukhatme, P. V. 1954. Statistical methods for agricultural workers, 2nd Edn. 1967. ICAR, New Delhi.

Pushpalatha, A., Sakhare, S. B., Sarode, V. P. and Sinddanagouda F. 2005. Callus induction and regeneration studies in pigeonpea. Ann. Plant Physiol., 19(2): 247-249.

Sudarshana Rao, G. V., Khetarpal S., Chandra, R., Raj A., Kanth S. and Polisetty R. 2003. Interactive effect of photoperiod and plant growth regulators on *in vitro* regeneration from cotyledonary node explants of pigeonpea (*Cajanus cajan* (L.) Millsp). Indian J. Plant Physiol. pp. 689-692.

Thatikunta Ramesh and Baldev, B. 1994. Callusing response of epicotyl and leaf explants of pigeonpea. Indian J. Plant Physiol. (1): 53-55.

Vishu Kumar, V. and Patil M. S. 2000. Tissue culture studies in pigeonpea. Karnataka J. Agric. Sci., 13(1): 20-28.

J. Agric. Res. Technol., 37 (1) : 163-165 (2012)

Stability for Grain Yield in Pigeonpea

Pigeonpea is an important pulse crop of Maharashtra. However, its production in Maharashtra shows lot of fluctuation from season to season. To stabilize the production and productivity of this important pulse crop, it is essential to develop high yielding varieties with their sustainable production. For this purpose, genotypes endowed with superior productivity levels over a range of eco-geographical conditions are to be evaluated for successfully exploiting their inherent potential. Keeping this in view the present investigation was carried out.

Twenty two genotypes of pigeonpea were grown in a randomized block design with 3 replications during *kharif* 2008-09 at four locations viz., Rahuri, Pune, Niphad and Savalivihir. The row to row spacing was 60 cm and plant to plant was 20 cm. The gross and net plot size were 4.0 x 3.6 m and 3.6 x 2.4 m respectively. The fertilizer dose of 25:50:0 NPK kg ha^{-1} was applied. All the agronomical practices were followed during conduct of the experiment. Data was recorded on grain yield (kg ha^{-1}) and analysed according to the Eberhart and Russel (1966) model.

Analysis of variance revealed significant variances for all the sources of variation (Table 1). Linear component of genotype x environment interaction was significant for yield. It indicated the variable performance of the genotypes over the different environments. Similarly the variances due to genotypes as well as environments were also significant indicating the differences among genotype in a particular environment. Among the 22 genotypes evaluated for their performance for grain yield over environments, except 7 genotypes, *viz*., BDN-2004-3, PT-00-1-2-5-1, PT-00-04-16-2, AKT-221030, AKT-222521, BDN-708, and AKT-9915, all the genotypes differed non-significantly from zero (S2di=0), hence they are stable. Similar results were reported by Holkar *et al.* (1991), Venkatesh (1998), Jagtap and Holkar (2000), Kuchanur, *et al*. (2008) and Patel, *et al.* (2009). However, among these genotypes 8 genotypes *viz*., BDN-2004-3 (1776 kg ha^{-1}), PT-00-1-2-5-1 (1640 kg ha^{-1}), PT-00-12-6-4 (1634 kg ha^{-1}), PT-00-04-16-2 (1630 kg ha^{-1}), AKT-221030(1629 kg ha^{-1}), AKT-222521(1530 kg ha^{-1}), BDN-708 (1491 kg ha^{-1}), and AKT-9915 (1488 kg ha^{-1}), had mean grain yield greater than general mean (1477 kg ha^{-1}). The highest yielding genotype PT-005-7-4-1 (1857 kg ha^{-1}) had the regression coefficient greater than unity as well as highly significant S^2di showing its suitability for above average environment. The only genotype, PT-00-12-6-4 was found to be stable over environments as it has high mean (1634 kg ha^{-1}), bi equal to unity (0.99) and non-significant deviation from regression (S^2di=-0.12). According to Eberhart and Russel (1966) this genotype is an ideal genotype over environments.

Table 1. Pooled analysis of variance for grain yield.

Source	d.f.	Mean square
Genotype	21	15.49*
Environment	3	554.97**
Genotype x Environment	63	6.53**
Environment (Linear)	1	1664**
Genotype + Environment (Liner)	21	5.07*
Pooled deviation	44	6.93**
Pooled error	168	2.33

*, ** significant at 5 and 1 per cent level respectively.

Table 2. Stability performance of pigeonpea genotypes.

Genotype	Mean yield (kg ha^{-1})	Regression coefficient (bi)	Deviation from regression (S^2di)
PT-00-5-7-4-1	1857	1.18	16.58**
BDN-2004-3	1776	1.14	1.76
PT-00- 1-2-5-1	1640	0.90	1.71
PT-00- 12-6-4	1634	0.99	-0.12
PT-00-04-16-2	1630	1.29	-2.26
AKT-221030	1629	1.23	-0.85
AKT-222521	1530	1.46	-2.62
PT-04-31	1520	1.10	0.81
BDN-708 (Ch)	1491	1.10	-3.17
AKT-9915	1488	1.13	4.05
AKPHE-08-1	1456	0.91	14.88**
Vipula (Ch)	1454	1.12	-1.67
TAT-2004-1	1447	1.11	4.81
AKT-9913	1446	1.15	5.48*
AKT-8811 (Ch)	1415	1.23	2.20*
TV-1 (Ch)	1389	1.02	0.55
BDN-2004-2	1386	0.96	12.98**
BSMR-736	1283	0.65	0.19
ICPL-87 (Ch)	1279	0.55	2.50*
BDN-2004-1	1224	0.70	-0.21
BDN-2029	1196	0.61	31.86**
BSMR-853	1111	0.47	-3.75
Mean	1477		

The seven genotypes *viz*., BDN-2004-3, PT-00-1-2-5-1, PT-00-04-16-2, AKT-221030, AKT-222521, BDN-708, and AKT-9915 were having higher mean than the general mean, bi greater than unity and significant deviation from regression (S^2di), hence are suitable for growing in favorable environment. Eberhart and Russel (1966) advocated that a variety with high mean performance ($\bar{X}$), S^2di non

significantly deviating from zero (near to zero) would do better in favorable environment. Among the above seven genotypes, BDN-2004-3 was high yielding (1776 kg ha^{-1}) followed by PT-00-04-16-2 (1630 kg ha^{-1}) and AKT-221030 (1629 kg ha^{-1}).

The genotype, PT-00-1-2-5-1 could do relatively better in unfavorable environments as it has high yield (1640 kg ha^{-1}), regression less than the unity (0.90) and non-significant S^2di (1.71).

Among the other genotypes, Vipula (1454 kg ha^{-1}, bi=1.12, S^2di=-1.67) and TAT 2004-1 (1447 kg ha^{-1}, bi=1.11, S^2di=-4.81) were also average responsive, but having less yield than mean.

Y. R. Pawar
V. B. Shinde
M. R. Bedis
L. B. Mhase
P. N. Harer

Pulses Improvement Project,
Mahatma Phule Krishi Vidyapeeth,
Rahuri - 413 722 (India)
October 25, 2010.

References

Eberhart, S. A. and Russell, W. L. 1966. Stability parameters for comparing varieties. Crop Sci, 6: 36-40.

Holkar, S., Mishra, V. K. and Billore, S. D. 1991. Phenotypic stability of seed yield in pigeonpea (*Cajanus cajan* (L.) Mill). Crop Res. (Hisar) 4: 2147-252.

Jagtap, J. G. and Holkar, S. 2000. Stability analysis in pigeonpea (*Cajanus cajan* (L.)). Indian J. agric. Sci. 70 12: 869-870.

Kuchanur, P. H., Tembhurne, B. R. and Patil, Amargouda. 2008. Stability analysis for yield and yield contributing traits in early pigeonpea under irrigated conditions. Legume Res. 31(4): 276-279.

Patel, P. T., Chauhan, R. M., Parmar, L.D. and Tikka, S. B. S. 2009. Phenotypic stability for yield and related traits in pigeonpea. Legume Res. 32(4): 235-239.

Tyagi, P. C. and Agarwal, M. C. 1995. Phenotypic stability for seed yield in pigeonpea. Indian J. Genet. and Plant Breeding. 55-2, 148-150.

Venkatesh, 1998. Phenotypic stability for grain yield in pigeonpea News Letter No. 5, 41-42.

J. Agric. Res. Technol., 37 (1) : 165-167 (2012)

New Record of *Acerophagus papayae* (N & S) on Papaya Mealybug (*Paracoccus marginatus* (W & G)) in India

The papaya (*Carica papaya* L) crop has been found to be infested with an invasive exotic pest papaya mealybug *Paracoccus marginatus* Williams and Granara de Willink (Hemiptera: Pseudococcidae) and attained the status of major pest of papaya (Heu *et al*. 2007). The pest attacks several genera of host plants, including economically important tropical fruits, vegetables and ornamentals in Maharashtra. It was recorded for the first time in papaya orchards at National Agriculture Research Project (Plain zone), Regional Fruit Research Station, Ganeshkhind, Pune in July, 2010. Besides, severe infestation of papaya mealybug was observed in 16 farmers' orchards in 6 districts of western Maharashtra. The mealy bug colonies were observed with uncountable enormous number of crawlers, second and third instars nymphs and females with big size yellowish ovisacs. The colonies were established at lower surface of leaves along the veins, flowers, buds, fruits, stem, new

sprouts developed on papaya stem and also on the root portion at ground level. The pest infestation was observed mostly on papaya cultivar Taiwan-786 commonly grown by the farmers in Maharashtra.

The parasitoid *Acerophagus papayae* Noyes and Schauff has been reported for the first time in India on 23rd August, 2010 in the papaya orchard infested with papaya mealybug, *Paracoccus marginatus* at the IARI, Regional Station, Baner, Pune, by the team of scientists from AICRP on Biological Control of Crop Pests and Weeds, College of Agriculture, Pune. The parasitoid was collected and got identified from Dr. J. Poorani, Principal Scientist, NBAII, Bangalore as well as Dr. M. Hayat, Principal Investigator, ICAR, Net-work Project on Insect Biosystematics from AMU, Aligarh (U.P.).

The adults of parasitoid (*A. papayae*) were found fast moving on lower surface of leaves and on fruits in papaya mealybug colonies with an average initial population 10-12 adults leaf^{-1}. It was increased upto 90-110 parasitoids leaf^{-1} resulting into the reduction in mealybug population in papaya orchard at IARI Regional Station, Baner, Pune within two months. At the same time soil application of methyl parathion dust, followed by 7-8 sprays of pesticides were carried out in the papaya orchard at Regional Fruit Research Station, Ganeshkhind, Pune. This practice has destroyed the parasitoids which resulted into increase in mealybug population and ultimately there were beyond 80 per cent losses.

The attempts were made for culturing of parasitoid (*A. papayae*) on mealybug colonies developed on potato sprouts under laboratory conditions. About 5000 parasitoids were released inoculatively in the farmer's orchard of Mr. Dattatray Haribhau Kand at Lonikand, Dist. Pune. The observations were recorded at fortnightly interval on parasitoid activity in the farmers' fields where no spray of insecticide was given. In most of the fields, the papaya mealybug was found to be parasitized by *A. papayae* and enormous population (200-220 parasitoids leaf^{-1} and fruit) was observed within 60 days after release. The parasitoid, *A. papayae* was well established in the PMB colonies in the farmer's orchard at Lonikand, Tal. Haveli, Dist. Pune. Besides, the other natural enemies such as *Mallada* sp., *Scymnus* sp., *Spalgis epius*, coccinellids, anthocorids, syrphids, brumoides, and spiders were also observed in association with papaya mealybugs. Thus, this is an example of successful biological control of papaya mealybug with parasitoid, *A. papayae*. On the contrary, the farmer, Mr. Shamrao Sawant at Urulikanchan, Tal. Haveli, Dist. Pune has given 4-5 insecticidal sprays in his papaya orchard wherein neither the mealybug population was controlled nor parasitoid population was buildup which resulted into removal of papaya orchards.

The tiny parasitic wasp, *A. papayae* was established well in the fields and provided excellent biological control of papaya mealybug in papaya orchards in Maharashtra within three months after release. There was as high as 95 per cent decline in papaya mealybug population due to activity of the parasitoid, *A. papayae* in papaya orchards of farmers at Lonikand, Dist. Pune which indicated that the parasitoid is well established in papaya ecosystem. The parasitoid was also distributed to the farmers of village Patharkheda (Jalgaon), Kusumba (Dhule) and Sulawade (Nandurbar) for inoculative release in their highly infested papaya orchards.

The field observations on association of five different species of ants in papaya mealybug colonies were recorded in the papaya orchards feeding on sugary substance, in return ants were observed feeding on parasitoid *A. papayae* and disturbing other bioagents to

provide protection to papaya mealybugs from it's other natural enemies. The papaya mealy bugs are also observed infesting mulberry plantation. But, the pest population was reduced due to natural occurrence of parasitoid, *A. papayae* and lady bird beetle (5-6 grubs and 1-2 adults plant^{-1}).

Based on the field observations, it is concluded that the parasitoid *A. papayae* is well acclimatized to the microclimate of papaya orchard in Maharashtra which has tremendous innate capacity to increase in numbers in short span of 45-60 days and showed the potential for successful bio-suppression of exotic pest, papaya mealy bug in Maharashtra (Muniappan *et al*. 2006).

The papaya mealy bug was also recorded on horticultural crops and weeds during the survey. Besides papaya, the mealybug incidence was noticed on mulberry, guava, khirani (root stock of sapota) acalypha, hibiscus, teak wood and weeds such as parthenium, *deepmal*, *math*, *kena*, *tandulja*, (*Amaranthus*), milkweed, *safed chafa* (*Plumeria*), creeper *Ipomoea*, etc. in western Maharashtra.

R. V. Nakat
D. S. Pokharkar
A. S. Dhane
N. D. Tamboli

AICRP on Biological Control of Crop Pests
and Weeds, College of Agriculture,
Pune - 411 005 (India)
November 10, 2010.

References

Heu, R. A., Fukada, M. and Conant, P. 2007. Papaya mealy bug *Paracoccus marginatius* Williams and Granara de Willink (Hemiptera; Pseudococcidae). State of Hawaii, Department of Agriculture, Honululu, HI.

Muniappan, R., Meyerdirk, D. E., Sengebau, F. N., Berringerand, D. D. and Reddy, G. V. P. 2006. Classical biological control of papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae) In the Republic of Palau. fla. Entomol., 89: 212-217.

J. Agric. Res. Technol., 37 (1) : 167-170 (2012)

Effect of Organic Amendments on Yield and Nutrients Uptake by Rice in Alkali Soils under Cauvery Command Area

Pressmud is an important byproduct of sugar industry. It contains 1.47 per cent P and considerable quantities of K, organic matter, Ca, Mg, S and micronutrients. These values are found to be very low.

The fresh pressmud obtained by the single sulphitation process from the Mysugar factory, Mandya. A long-term manurial experiment on rice has been in progress since 1990-95 on an alkali soil (EC-1.21 dSm^{-1}, pH-9.92). The important properties of the soil are clay 30.5 per cent, carbon 4.31 g kg^{-1}, bulk density 1.52 mg m^{-1}, ESP 53, EC 12.8 c mol (P+) kg^{-1}, calcium carbonate ($CaCO_3$) 3.92 g kg^{-1}, available nitrogen (N) 103 kg ha^{-1}, available phosphorus (P_2O_5) 22.4 kg ha^{-1}, available potassium (K_2O) 162.6 kg ha^{-1}. The amendments were RDF alone (M_0), 100 per cent NPK + FYM @ 15 t ha^{-1} (M_1), 100 per cent NPK + gypsum @ 5 t ha^{-1} (M_2), 100 per cent NPK + pressmud @ 15 t ha^{-1} (M_3), 100 per cent NPK + green manure @ 5 t ha^{-1} (M_4). The experiment was laid in a randomized block

Table 1. Effect of different amendments on grain and straw yield of rice crop and nutrient uptake.

Treatments	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})
NPK alone (control)	2850	5500
NPK + FYM @10 t ha-1	3200	6650
NPK + Gypsum @ 5 t ha-1	4475	7300
NPK + Pressmud @ 1 5 t ha-1	4750	7525
NPK + Green manure @ 5 t ha-1	3925	7100
SEM±	55.85	56.83
CD at 0.005	172.12	175.14

design with four replications. The fertilizers were applied as per recommendations to the crop. Surface drainage was provided in the experimental field.

The soil collected after harvest of rice crop were analyzed for bulk density (Black, 1985), soil pH (potentiometry), electrical conductivity (conductivity bridge), organic carbon, available P (Olsen's extractants) for soil having pH > 7.0, available K (flame photometry), exchangeable Ca and Mg (versanate titration and available sulphur turbidometry) as outlined by Jackson, 1973.

Micronutrients such as Fe, Mn Cu and Zn were extracted with DTPA as described by Lindsay and Norvell (1978) and determined by using atomic absorption spectrophotomcter filled with appropriate hallow cathode lamp under standard conditions.

Grain and straw yield : There was significant increase in grain and straw yield of rice over control due to addition of pressmud followed by gypsum, FYM and green manure (GM) (Table 1). The yield was increaseed by pressmud due to improvements in soil bulk density. Exchange of Na by Ca on the exchange and its subsequent removal and reduction of soil pH, which induced, balanced nutrition after reclamation (More, 1994). Singh *et al.* (1999) and Sharma *et al*. (2001), have observed that application of pressmud for reclamation of soils increased in crop yield.

Nutrients uptake : The uptake of nitrogen, phosphorus and potassium were markedly influenced by the amendments (Table 2). The higher nitrogen uptake was observed due to amendments NPK + pressmud (62.22 kg ha^{-1}) which was followed by NPK + gypsum (56.38 kg ha^{-1}). This may be due to the

Table 2. Effect of different amendments on uptake of major and secondary nutrients by rice crop.

Treatments	N (kg ha^{-1})		P (kg ha^{-1})		K (kg ha^{-1})		Ca (kg ha^{-1})		Mg (kg ha^{-1})		S (kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
NPK alone (control)	32.20	47.53	10.0	12.70	19.93	28.59	8.9	18.9	3.10	8.3	2.1	4.7
NPK + FYM @10 t ha^{-1}	38.4	54.03	12.3	17.22	21.80	31.19	9.61	21.5	3.32	9.61	2.34	5.11
NPK + Gypsum @ 5 t ha^{-1}	56.38	56.83	14.7	20.80	24.5	35.4	10.3	24.1	3.54	11.0	3.40	6.13
NPK + Pressmud @ 15 t ha^{-1}	62.22	58.32	17.6	23.70	28.0	37.7	11.1	26.8	3.76	12.3	3.89	7.90
NPK + Green manure @ 5 t ha^{-1}	47.49	55.09	12.4	18.67	21.95	32.19	9.7	22.0	3.36	9.8	3.0	6.40
SEM±	0.78	0.97	0.76	0.66	0.85	0.85	0.20	0.84	0.07	0.42	0.02	0.08
CD at 0.005	2.42	3.00	2.34	2.06	2.63	2.63	0.62	2.60	0.22	1.31	0.08	0.26

Table 1. Effect of different amendments on uptake of micronutrients by rice crop..

Treatments	Zn (mg ka^{-1})		Fe (mg ka^{-1})		Mn (mg ka^{-1})		Cu (mg ka^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
NPK alone (control)	5.4	8.2	491.1	763.8	22.2	22.5	9.69	13.2
NPK + FYM @10 t ha^{-1}	10.2	15.2	678.6	1088.0	38.7	41.2	26.6	33.2
NPK + Gypsum @ 5 t ha^{-1}	18.9	20.1	1000.1	1843.7	80.5	71.5	75.9	85.8
NPK + Pressmud @ 15 t ha^{-1}	22.5	27.5	1264.2	2346.5	104.9	136.2	104.5	115.9
NPK + Green manure @ 5 t ha^{-1}	13.3	15.6	859.1	1424.7	49.4	48.2	26.2	41.2
SEM±	2.20	0.89	72.0	43.9	1.82	0.84	2.08	2.21
CD at 0.005	6.79	2.75	221.9	135.5	5.61	2.60	6.42	6.91

improvement in the physico-chemical properties of alkali soil and availability of macronutrients in the soil which enhanced uptake of nitrogen content as reported bv Virendra Kumar and Mishra (2001).

Higher phosphorus uptake in grain was recorded with NPK + pressmud (19.40 kg ha^{-1}) which was followed by NPK + gypsum (17.90 kg ha^{-1}). In case of rice straw also the pressmud application could enhance the P uptake. The highest uptake in grain was observed with NPK + pressmud (38.50 kg ha^{-1}). K uptake in rice straw varied from 46.05 kg ha^{-1}, in control to 26.59 kg ha^{-1}. Incorporation of FYM or GM and pressmud enhanced the uptake of K due to dissolution and release of mineral K released during their decomposition (Bharadwaj *et al*. 1994).

Calcium uptake in rice grain was found to be high with NPK + pressmud (13.70 kg ha^{-1}) followed by NPK + gypsum (11.60 kg ha^{-1}). A similar trend was observed in the case of magnesium uptake also. The higher sulphur uptake in grain was associated with NPK + pressmud (8.07 kg ha^{-1}) which was followed by NPK + gypsum (5.81). This finding was in agreement with that of Shinde *et al.* (1993).

Uptake of Fe, Zn and Mn (Table 3) by rice was significantly enhanced due to soil reclamation. It might be due to increased solubility of their compounds. Which are present in sodic soils as higher oxides, hydroxides and carbonates due to reduction of soil pH enabled rice to mobilize high amounts of Fe, Zn and Mn. Effectiveness of pressmud in enhancing Fe. Mn and Zn uptake by rice was higher than that of gypsum. Singh *et al*. (1999) has also reported in the uptake of Fe, N, P and K in rice.

With respect to Cu, though its uptake was significantly higher in soil-amended treatments, no other clear-cut trend as that of Fe, Zn and Mn could be seen. However, incorporation of either FYM or GM and pressmud had noticeably increased Cu uptake in rice.

M. L. Shivalingaiah
H. C. Prakasha
B. R. Jagadeesh
B. G. Shekara
Ayeesha Munawery

Zonal Agril. Research Station,
V. C. Farm, Mandya - 571 405 (India)
December 20, 2010.

References

Anonymous. 1993. Annual Report. Zonal Research and Extension Programmes. Pub. ZARS, V.C. Farm, Mandya.

Bharadwaj, K. K. R. and Abrol, I.P. 1994. National symposium, nitrogen assimilation and crop

productivity, CCSRI. Karnal. pp. 83.

Black, C. A. 1965. Methods of Soil analysis. Part II, Agronomy Monograph. American Society of Agronomy. Madison. Wisconsin. USA.

Jackson, M. L. 1973. Soil Chemical Analysis, Prentice-Hall of India (P) Ltd., New Delhi.

Lindsay, W. L. and Norvell, W. A. 1978. Equilibrium relationships of Zn, Fe, Cu and Mn with EDTA and DTPA in soil. Soil Sci. Soc. of America Proceed., 33: 62-08.

More, S. D. 1994. Effect of farm wastes and organic manures on soil properties, nutrients availability and yield of rice-Wheat grown on sodic vertisol. J. Indian Soc. Soil Sci., 42(2): 253-256.

Sharma, D. P., Mehta, K. K. and Yadav, J. S. P. 2001. Effect of reclamation practices on soil properties and crop .growth on farmer's fields A case study. J Indian Soc. Sci., 49: 356-360.

Shinde, B. N., Patil, T. D., Patil, A. S. and Patil, T. N. 1993. Residual effect of spent wash (Distillery effluent) solids and spent wash pressmud compost on yield and nutrient uptake by wheat. DSTA 43 Annual Conve. part I.P. 83-88.

Singh, N. T., Bhumla, D. R. and Kanwar, J. S. 1999. Effect of gypsum alone and in combination with plant nutrients on crop yields and amelioration of a saline sodic soil. Indian J. Agric. Sci., 39: 1-9.

Virendrakumar and Mishra, B. 2001. Effect of two types of pressmud cake on growth of rice-maize and soil properties. J. Indian Soc. Soil Sci., 39: 109-113.

J. Agric. Res. Technol., 37 (1) : 170-171 (2012)

Response of Single Cut Oat (*Avena sativa* L.) Genotypes to Nitrogen Levels Under Irrigated Condition

Oat (*Avena sativa* L.) is an important winter forage crop grown under irrigated condition of North, North West and Central parts of India. To maintain good health and potential of animals in terms of draft, meat and wool, feeding of good quality fodder is more important. Because of its excellent growth habit, better palatability, high tonnage, good quality forage and economic source of dietary energy, oat has become a promising forage crop for the livestock production. Genetic diversity and location specific variety of fodders are essential for achieving sustainability in agriculture hence, it is necessary to study the behavior and yield potential of newly developed genotypes under different agronomic practices for getting good quality fodder, rich in crude protein and digestibility. Forage plants especially new oat genotypes are heavy feeders and remove large amounts of nutrients from the soil. Nitrogen is an essential primary nutrient for profuse plant growth that plays a pivotal role in quantitative as well as qualitative improvement in productivity of forage production (Kumar *et al*. 1997). Keeping these points in view, present experiment was under taken.

The field experiment was conducted at Forage Crops Research Project, MPKV, Rahuri during *rabi* season of 2009-10. The experiment was laid out in a split plot design with three replications. Treatments comprised of eight oat varieties (SKO-105, SKO-109, NDO-25, Kent, SKO-90, OS-6, JO-03-93, and RO-19) and four nitrogen levels (0, 40, 80 and 120 kg ha^{-1}). The soil of the experimental field was low in available nitrogen (217.8 kg ha^{-1}), medium in phosphorus (14.7 kg ha^{-1}) and high in available potash (431.5 kg ha^{-1}). The crop was fertilized with 60 kg P and 40 kg K per hectare. The N was applied into three equal splits. The 1/3 quantity of N and full dose of P and K were applied as basal dressing. The

Table 1. Mean green forage, dry matter and crude protein yield of oat varieties as influenced by nitrogen levels.

Treatment	GFY (q ha^{-1})	DMY (q ha^{-1})	CPY (q ha^{-1})
Varieties :			
SKO-105	408.81	82.27	7.50
SKO-109	467.14	83.78	7.73
NDO-25	461.09	75.88	7.23
Kent	497.04	97.14	9.20
SKO-90	426.35	83.51	7.67
OS-6	408.99	81.30	7.55
JO-03-93	527.95	99.43	9.38
RO-19 (Phule harita)	528.82	102.03	9.64
S.E.±	11.53	1.99	0.24
C.D. at 5%	34.99	6.04	0.74
N levels :			
0 kg ha^{-1}	296.23	50.91	4.42
40 kg ha^{-1}	457.74	84.19	7.67
80 kg ha^{-1}	550.22	106.27	9.97
120 kg ha^{-1}	558.90	111.29	10.89
S.E.±	10.48	2.39	0.24
C.D. at 5%	29.78	6.80	0.69
Interaction :			
A x B S.E. ±	29.63	6.77	0.68
C.D. at 5%	N.S.	N.S.	N.S.
B x A S.E. ±	28.14	6.19	0.64
C.D. at 5%	N.S.	N.S.	N.S.
CV%	11.09	13.30	14.34

remaining two splits of N were top dressed at 25 and 50 days after sowing. The only single cut was taken at 50 per cent flowering.

Varieties : The green forage, dry matter and crude protein yield differed significantly due to different entries of oat for single cut (Table 1). The variety RO-19 (Phule Harita) recorded significantly higher green forage, dry matter and crude protein yield (528.82, 102.03 and 9.64 q ha^{-1}, respectively) than all other varieties of oat under study except the varieties JO-03-93 and Kent which were at par for green forage yield (527.95 and 497.04 q ha^{-1}), dry matter yield (99.43 and 97.14 q ha^{-1}) and crude protein yield (9.38 and 9.20 q ha^{-1} respectively). Similar results were also reported by Kumar *et al*. (1997) and Pathan *et al.* (2005).

Nitrogen levels : Data presented in Table 1 revealed that, with increasing levels of nitrogen from 0 to 120 N kg ha-1, there was progressive increment of green forage, dry matter and crude protein yields. However, application of 120 kg N ha^{-1} recorded significantly higher green forage yield (558.90 q ha^{-1}), dry matter yield (111.29 q ha^{-1}) and crude protein yield (10.89 q ha^{-1}) as compared to other nitrogen levels. It was found on par with application of 80 N kg ha^{-1} in respect of green forage and dry matter yield. An increase of green forage, dry matter and crude protein yield by 88.67, 118.60 and 146.38 per cent was observed by 120 N kg ha^{-1} over control. These results are in agreement with those reported by Sharma and Bhunia (2001), Pathan *et al*., (2007).

Thus, it could be concluded that, for higher productivity of single cut oat, variety RO-19 should be grown with application of 80 kg N ha^{-1}.

S. H. Pathan
S. R. Chavan

Mahatma Phule Krishi Vidyapeeth,
Rahuri - 413 722 (India)
December 20, 2010.

References

Kumar, Y., Sharma, B. L., Yadav, G. L. and Sharma, P. K. 1997. Nitrogen management in fodder crop of double cut oat (*Avena sativa*). Indian J. Agron. 42(2): 313-315.

Pathan, S. H., Gethe, R. M., Manjare, M. R. and Kadlag, A. D. 2005. Response of multicut oat to spacing and nufogen for forage yield. Forage Res., 31: 150-151.

Pathan, S. H., Bhilare, R. L., Nawale, K. B. and Jadhav, V. T. 2007. Response of multicut oat verities to nitrogen levels. Forage Res., 32: 269-270.

Sharma, S. K. and Bhunia, S. R. 2001. Response of oat (*Avena sativa*) to cutting management, method of sowing and nitrogen. Indian J. Agron. 46(3): 563-567.

J. Agric. Res. Technol., 37 (1) : 172-174 (2012)

Storability of Groundnut Pods as Influenced by Different Packaging Materials

Groundnut seeds have a poor storability index (Oren and Bass 1979) because of their high oil content. The groundnut seed of *rabi,* summer season harvested during April-May do not remain viable for sowing next *rabi* season in Konkan region of Maharashtra. This may be due to high temperature (25-30°C) and humid (above 90% humidity) climatic condition of *kharif* season i.e. June to September. Therefore, different packaging materials were tested for storage of groundnut pods.

The present study was conducted with an objective to identify the suitable packaging materials for storage of groundnut pods (cv. TKG bold) during 2008-09 and 2009-10. The one kg pods harvested during *rabi* season were packed in different packaging material. The first experiment was conducted in a randomized block design with twelve treatments replicated thrice. The treatments were T_1 - Jute canvas (Ambient storage), T_2 - HDPE non laminated bag (Ambient storage), T_3 - Polylined HDPE bag (Ambient storage), T_4 - Cloth bag (Ambient storage), T_5 - Polylined Cloth bag (Ambient storage), T_6 - Polylined Jute canvas (Ambient storage), T_7 - Kanagi, T_8 - Storage bins, T_9- Polylined cloth bag (Cold storage), T_{10} - Polylined Jute canvas (Cold storage), T_{11} - Polylined HDPE bag (Cold storage), T_{12} - Control (Onion bag).

The initial moisture content of groundnut seed was higher (12-13 %) than required for storage (9%), that leads to the lower seed germination than minimum seed certification standards at 4, 6 months of storage. Therefore, in second experiment the pods were packed in packaging materials at two different moisture levels (8% and 10%) and kept for storage.

Table 1. Effect of packaging material on storage of groundnut pods.

Treatment	Germination (%)				Moisture (%)				Field emergence (%)			
	Month after storage				Month of storage				Month after storage			
	0 (Jun)	2 (Aug)	4 (Oct)	6 (Dec)	0 (Jun)	2 (Aug)	4 (Oct)	6 (Dec)	0 (Jun)	2 (Aug)	4 (Oct)	6 (Dec)
T_1 - Jute canvas	82.6	79.3	53.6	22.3	12.6	12.3	12.0	11.6	79.0	74.0	47.6	17.6
T_2 - HDPE non laminated bag	83.6	78.3	54.0	23.3	12.6	12.6	12.3	12.0	79.6	73.6	47.3	18.3
T_3 - Polylined HDPE bag	81.3	77.6	56.3	29.3	12.3	12.6	12.3	13.0	78.0	72.0	51.3	24.6
T_4 - Cloth bag	81.3	79.3	52.3	22.3	13.0	12.3	11.6	11.6	77.6	74.3	47.3	17.0
T_5 - Polylined Cloth bag	82.0	79.6	55.6	29.6	12.6	12.0	12.3	13.0	76.3	74.6	51.0	24.3
T_6 - Polylined Jute canvas	82.3	80.0	56.0	30.3	12.6	12.6	12.3	12.3	75.3	74.3	50.3	25.0
T_7 - Kanagi	80.3	77.6	49.3	20.6	12.6	12.6	12.6	12.6	75.0	71.0	45.0	16.0
T_8 - Storage bins	82.0	77.3	49.6	21.3	12.6	12.3	12.3	12.0	76.0	71.6	45.3	16.0
T_9 - Polylined cloth bag : CS	81.6	78.0	60.3	35.6	12.3	12.3	12.6	12.6	76.0	74.6	55.0	31.0
T_{10} - Polylined Jute canvas : CS	80.6	80.3	61.3	36.6	12.0	12.6	12.0	12.3	73.0	75.3	56.0	31.6
T_{11} - Polylined HDPE bag : CS	81.3	80.3	61.3	33.6	12.6	12.3	12.6	12.6	77.0	75.0	56.0	28.3
T_{12} - Control	81.3	75.6	49.3	20.6	12.3	13.0	12.3	12.0	76.0	69.6	44.0	16.0
SE±	1.1	1.2	0.8	0.7	0.4	0.3	0.4	0.3	0.8	0.5	0.6	0.6
CD at 5%	N.S.	N.S.	2.3	2.2	N.S.	N.S.	N.S.	N.S.	N.S.	1.6	1.9	2.0

Second experiment was conducted in a randomized block design with total seven treatments replicated four times. The treatment were T_1 - Jute canvas, T_2 - Polylined jute canvas, T_3 - HDPE bag, T_4 - Polylined HDPE bag, T_5 - Cloth bag, T_6 - Polylined cloth bag, T_7 - Control.

Germination was expressed as the percentage of normal seedlings produced in germination test (in sand). Seed moisture was estimated using oven-drying method and the values expressed on the fresh weight basis (ISTA, 1985). The moisture content levels were achieved by holding the seeds in desiccator under vacuum for 60 days using dry silica gel. The simplest kind of pathological test for seed is by way of visual observation for evidence of diseases symptoms or insect infestation. The observation on germination, moisture content, field emergence, insect infestation and pathogen incidence was recorded at initial and after 2,4 and 6 months of storage.

There was non significant difference (Table 1) in germination per cent at initial stage and 2 months after storage due to packaging material. All the treatments showed higher seed germination percentage than minimum seed certification standards (70%) at initial stage and 2 months after storage. Maximum seed germination was observed in polylined jute canvas (61.3%) and polylined HDPE bag (61.3%) at 4 months of storage which was at par with polylined cloth bag (60.3%). Similarly polylined jute canvas recorded maximum seed germination (36.6%) at 6 months of storage which was at par with polylined cloth bag (35.6%). The germination was declined than minimum seed certification standards in all treatments after 4 and 6 months of storage. There was no significant difference in moisture content of seed due to packaging material. There was no significant difference in field emergence at initial stage. However, at 2, 4 and 6 months of storage there was significant difference in field emergence due to seed packaging material. At 2, 4 and 6 month of storage, polylined jute canvas (CS) recorded maximum field emergence which was at par

Table 2. Effect of packaging material on germination and field emergence of groundnut pods.

Treatment	Germination (%)								Field emergence (%)							
	8% moisture				10% moisture				8% moisture				10% moisture			
	0 (Jun)	2 (Aug)	4 (Oct)	6 (Dec)	0 (Jun)	2 (Aug)	4 (Oct)	6 (Dec)	0 (Jun)	2 (Aug)	4 (Oct)	6 (Dec)	0 (Jun)	2 (Aug)	4 (Oct)	6 (Dec)
T_1 - Jute canvas	80	65	46	21	80	63	45	20	76	60	36	14	76	55	29	10
T_2 - Polylined jute canvas	82	76	59	30	81	75	56	28	78	69	52	20	77	62	48	17
T_3 - HDPE bag	82	70	52	29	82	69	50	27	78	61	36	19	78	58	35	16
T_4 - Polylined HDPE bag	83	82	76	54	82	81	72	52	79	72	61	41	78	70	59	34
T_5 - Cloth bag	81	68	50	27	80	66	48	21	77	62	38	17	77	60	37	12
T_6 - Polylined cloth bag	80	75	69	39	81	72	68	35	76	70	52	31	76	68	41	29
T_7 - Control	81	62	40	15	80	60	37	14	78	58	34	08	77	52	23	6
SE±	0.504	1.1	1.1	0.7	0.6	0.8	0.8	0.7	0.4	1.1	0.9	0.5	0.6	1.0	0.7	0.6
CD at 5%	N.S.	3.4	3.2	2.1	N.S	2.3	2.4	2.2	N.S	3.5	2.6	1.7	N.S	3.1	2.1	1.9

with polylined cloth bag (CS), over rest of the treatments.

The initial seed viability of test sample is generally high and upon storage, there was a gradual loss in germinability of seed. Similar results reported by Robert (1973), Padmanabhan *et al.* (1995) and Sastry *et al*. (2007) regarding the increase in viability of pods in polythene lined gunny bag with fused $CaCl_2$ is attributed to low moisture content and high dehydrogenase activity. There was no incidence of insect and pathogen at initial stage and 4 months after storage of groundnut seed. The polylined jute canvas (CS) and polylined HDPE bag (CS) showed no incidence of insect upto 6 months of storage and no incidence of pathogen upto 4 months.

Data presented in Table 2 revealed that there was non significant difference in germination percentage and field emergence at 8 and 10 per cent moisture at initial stage. Polylined HDPE bag showed significantly maximum seed germination 82 and 81 per cent at 2 month 76 and 72 per cent 4 month and 54 and 52 per cent 6 month of storage due to at 8 and 10 per cent moisture level respectively. Polylined HDPE showed significantly maximum field emergence (72 and 70%) which was at par with polylined jute canvas (69 and 62%) and polylined cloth (70 and 68%) at 8 and 10 per cent moisture content respectively than other treatments. Polylined HDPE bag showed significantly maximum field emergence at 4 month (61 and 59%) and 6 months (59 and 34%) at 8 and 10 per cent moisture level respectively over other treatments. The polylined HDPE bags and polylined cloth bag showed significantly lower incidence of disease and pest than other treatments. Seed viability of groundnut seed pods could be preserved slightly above than seed certification standards (70 per cent) up to 9 months after harvest. If moisture resistant packages like HDPE or LDPE film bags are used for seed storage the seed viability increased (Palanimuthu *et al*. (2005). Basava Gowda (2008) reported among the containers HDPE bag with desiccant maintained higher seed quality parameter.

It can be concluded that, polylined HDPE, polylined jute canvas and polylined cloth bag are suitable packaging material for storage of groundnut pods as they indicated higher seed germination, field emergence and low incidence of pest and disease in hot (23-35°C) and humid (80-90%) condition of Konkan region.

A. K. Shinde
B. B. Jadhav

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth,
Dapoli - 415 712 (India)
December 20, 2010.

References

ISTA. 1985. International rulses for seed testing. Seed Sci. and Tech. 1: 499-514.

Basava Gowda, Reddy, Y. AN. 2008. Effect of Kernel pelleting on storability of groundnut (*Arachis hypogea* L.). Crop Res. 35: 1-2.

Oren, L. J., Brass, E. N. 1979. Principles and practices of seed storage. Castle House, Landon, UK, pp. 275.

Padmanabhan, G., Nagarajan, M., Manian, K. and Annamalainathan, K. 1995 Prolonging seed viability in groundnut (*Arachis hypogea* L.) with calcium chloride. J. of Agron. and Crop Sci. 174(2).

Palanimuthu, V., Ranganna, B. and Kumar, C. 2005. Storage of groundnut seed in coastal region of Kamataka. Mysore J. of Agril. Sci. 39(1).

Robert, E. H. 1973. Predicting the storage life of seeds. Seed Sci. and Tech. 1 : 499-514.

Sastry, D.V.S.S.R., Upadhyaya, H. D. and Gowda, C. L. . 2007. Survival of groundnut seed under different storage conditions. An open Acess J. published by ICRISAT, 5(1).

J. Agric. Res. Technol., 37 (1) : 175-177 (2012)

Effect of Nutrient Management on Green Forage Yield and Quality of Berseem (*Trifolium alexandrium* L.)

Berseem or Egyptian clover (*Trifolium alexandrium* L.), a potential winter forage legume, is one of the most popular crop in north, north-west and central parts of India. It is well known to stimulate milk production in dairy animals. Due to its excellent and quick growth ability after cutting, long duration of green fodder availability (November to April), high green fodder yield, good forage quality, better palatability and digestibility it is extensively grown in irrigated areas of the country during rabi season. Berseem responds positively to application of fertilizers. The time and method of application plays very important role in efficient use of fertilizers. The application of higher rate of fertilizer to soil is associated with fixation, leaching and volatile losses. Soil application also produces residual toxic effects to soil health with problems of fixation of nutrients. Foliar application may constitute the most effective method of fertilizer application. This method provides for more rapid utilization of nutrients and permits the correction of observed deficiencies in less time than would be required in soil treatments. Now a days fertilizer formulation of various grades is available in markets for foliar sprays. In view of this, the present investigation was undertaken.

An experiment was conducted at Forage Crops Research Project, MPKV, Rahuri during *rabi* 2008-09 in a randomized block design with four replications. The seven treatments comprised of different doses of fertilizer [T_1 - GRDF-20:80:40 kg NPK ha^{-1}, T_2 - 100% RDF as basal (20:80:40 kg NPK ha^{-1}) + one foliar spray after 2^{nd} cut, T_3 - 75 % RDF as basal + two foliar spray i.e. one spray after 1^{st} and 2^{nd} cut, T_4 - 50% RDF as basal + two foliar spray i.e. one spray after 1^{st} and 2^{nd} cut, T_5 - 50% N and 100% P and K of RDF as basal + remaining 50% N immediately after 2^{nd} cut, T_6 - 33% N and 100% P and K of RDF as basal + 33% N immediately after 1^{st} cut + 33% of N immediately after 2^{nd} cut, T_7 - 1^{st} foliar spray 10 DAS + 2^{nd} foliar spray after 1^{st} cut + 3^{rd} foliar spray after 2^{nd} cut. Foliar spray of water soluble fertilizer (19:19:19) @ 1 per cent was applied 10 days after respective cut and biofertilizer i.e. *Rhizobium* was applied @ 250 g 10^{-1} kg of berseem seed at the time of sowing uniformly to all treatments. The soil of the experimental field was medium black clay in texture, low in organic carbon (0.29%), and available nitrogen(198.15 kg ha^{-1}), medium in phosphorus (14.65 kg ha^{-1}) and very high in potassium (547.20 kg ha^{-1}). It was alkaline in reaction (pH 8.20). Berseem variety, Wardan was sown at 30 cm apart row to row by using seed rate of 30 kg ha^{-1}. In all three cuts were taken for green forage yield i.e. 1^{st} cut at 55 days after sowing and successive two cuts were taken at an interval of 25 days. The nitrogen content was estimated by following standard method through automatic nitrogen analyzer and crude protein content was estimated by multiplying the nitrogen content with a factor of 6.25.

The results obtained in respect of green forage, dry matter and crude protein yield are presented in Table 1. Significantly higher green forage yield (555.10 q ha^{-1}), dry matter yield (103.91 q ha^{-1}), and crude protein yield (19.10 q ha^{-1}) was recorded in treatment T_3 with the application of 75 per cent recommended dose of fertilizer at the time of sowing and two foliar spray of water soluble fertilizer 19:19:19 after 1^{st} cut and 2^{nd} after 2^{nd} cut, than rest of all the treatments of fertilizer. However, it was closely

followed by treatment T_4 i.e. fertilizer application as 50 per cent basal dose of RDF and two sprays of water soluble fertilizer 19:19:9 after first and second cut (513.18, 91.65 and 17.24 q ha^{-1}, respectively). The results are in accordance with the findings of Mandal and Chakraborty (1998), Rao *et al*. (1999) and Bhilare and Desale (2003). This might be due to the addition of 75 per cent recormnended dose of fertilizer is sufficient for tillering and growth of berseem at early stage. Similarly, for the regrowth of berseem after succeeding cuttings, the nutrient requirement of berseem was might be fulfilled by spraying of 19:19:19 water soluble N, P_2O5 and K_2O fertilizer. The water solubility of 19:19:19 fertilizer might have enhanced the absorption of nitrogen, phosphorus and potassium by the berseem. The absorption of nitrogen is utilized for vegetative growth of berseem and phosphorus enhanced the photosynthetic activity of leaves and root development of berseem fodder. Whereas, the potassium accelerate the translocation of photosynthetes from source of sink. This ultimately reflected in increased green fodder, dry matter and crude protein yield of berseem.

Perusal of data from Table 1 in respect of monetary returns treatment T_3 revealed that, the application of 75 per cent RDF as basal + two foliar sprays, one spray each after 1st and 2nd cut recorded significantly the highest gross monetary returns (Rs. 55510 ha^{-1}), net monetary returns (Rs. 31676 ha^{-1}) and benefit:cost ratio (2.32) over rest of the treatments, which was followed by treatment T_4 i.e. the application of 50 per cent RDF as basal + two foliar spray recorded higher gross monetary returns and benefit:cost ratio of berseem (Rs. 51318, Rs. 27975 and 2.19, respectively). These results are corroborating the findings of Pandey *et al*. (1997), Yadav *et al*. (1988) and Jain and Poonia (2002),

Table 1. Total green forage, dry matter and crude protein yield (q ha^{-1}), gross and net monetary returns (Rs. ha^{-1}) and benefit: cost ratio of berseem as influenced by different fertilizer treatments.

Treatment	Green forage yield (q ha^{-1})	Dry matter yield (q ha^{-1})	Crude protein yield (q ha^{-1})	Gross returns (Rs. ha^{-1})	Net returns (Rs. ha^{-1})	Benefit: cost ratio
T_1 - Basal application of GRDF (20:80:40) NPK + 5 t FYM ha^{-1}	448.72	77.91	14.95	44872	17547	1.64
T_2 - 100% RDF as basal + one foliar spray	464.02	78.80	14.08	46402	24077	2.07
T_3 - 75% RDF as basal + two foliar spray	555.10	103.91	19.10	55510	31676	2.32
T_4 - 50% RDF as basal + two foliar spray	513.18	91.65	17.24	51318	27975	2.19
T_5 - 50% N and 100% P and K of RDF as basal + remaining 50% N immediately after 2nd cut	428.13	69.01	12.43	42813	20488	1.89
T_6 - 33% n and 100% P and K of RDF as basal + 33% N immediately after 1st cut + 33% N immediately after 2nd cut	397.14	61.98	11.01	39714	16989	1.74
T_7 - 1st foliar spray 10 DAS + 2nd foliar spray after 1st cut + 3rd foliar spray after 2nd cut	364.28	57.50	10.24	36428	13068	1.56
S.E.±	5.99	4.10	1.03	260	246	0.01
C.D. at 5 %	17.80	12.17	3.05	772	730	0.03
General mean	452.82	77.25	14.13	45294	21689	1.92

Thus, growing of berseem cultivar Wardan along with application of 75 per cent RDF as basal + two foliar spray of 1 per cent 19:19:19 water soluble fertilizer, first 10 days after first cut and second 10 days after second cut found suitable for producing maximum green forage yield, dry matter yield, crude protein yield and benefit: cost ratio under Rahuri condition.

S. S. Gaikwad
S. H. Pathan
A. B. Kamble

Mahatma Phule Krishi Vidyapeeth,
Rahuri - 413 722 (India)
December 20, 2010.

References

Bhilare, R.L. and Desale, S. S. 2003. Effect of sulphur fertilization on fodder quality of berseem. J. Maharashtra agric. Univ., 28(3): 317-318.

Jain, N. K. and Poonia, B. L. 2002. Determining appropriate number of fodder cutting for higher seed and fodder productivity of Egyptian clover under different dates of sowing J.agric. Sci., 72(9): 553-554.

Mandal, S. and Chakraborty, T. 1998. Effect of phosphorus sources with different doses on growth and yield of berseem. Forage Res., 24(2): 119-120.

Pandey, T. D., Nandeha, K. L. and Saxena, R. 1997. Effect of seed rates and phosphorus levels on forage and seed yields of Utera berseem. Forage Res., 22(4): 239-242.

Rao, C. S., Rao, A. S., Srivastava, S., Singh, S. P. 1999. Crop respose uptake and use efficiency of potassium in berseem and Sudan grass on a Typic Haplustert. J. Potassium Res., 15: 1-4.

Yadav, I. S. P., Shreenath, P. R., Rajpali, S. K. and Sharma, R. K. 1988. Economics and resource use productivity of Egyptian clover for fodder production on small and large farms around Jhansi district. Indian J.Agric.Sci., 59(4): 199-202.

J. Agric. Res. Technol., 37 (1) : 177-180 (2012)

Effect of Different Levels and Sources of Sulphur on Grain Yield and Sulphur Uptake of Rice on Lateritic Soil of Konkan

Available sulphur content in lateritic soils of Konkan is low to medium and raged from 3.47 to 13.15 µg g^{-1} with an average value of 6.9 µg g^{-1} (Kolpe, 1987). Sulphur is one of the most important secondary nutrient, essential for normal growth and development of plant (Beaton and Wanger, 1985). It plays an important role in synthesis of methionine and proteins (Kumme, 1984). Wang *et al*. (1976) suggested that the critical level of soil sulphur is 10 µg g^{-1}. The problem of sulphur deficiency is aggravating recently due to increased use of non-sulphur bearing fertilizers, intensive multiple cropping system and inadequate use of bulky organic manures like FYM. Sulphur deficiency caused by reduction of SO_4^{-2} to SO^-_3 and SO^-_2 under unaerobic condition and become an important growth limiting factor for wetland rice in the developing countries of Asia and Pacific (Wang, 1976). Hence, the present investigation was undertaken with the objectives to find out suitable source and dose of sulphur to rice for increasing the yield.

The field experiment was conducted during *kharif* season of 2007 at Agronomy farm, College of Agriculture, Dapoli using rice (var. Palghar-1). The experimental soil was lateritic in nature with a pH of 5.61, EC of 0.045 dSm^{-1}, organic carbon content 3.04 g kg^{-1} and the available N, P, K and S were reported to be 397.65, 7.58, 246.40 kg ha^{-1} and 1.77 µg g^{-1}, respectively. The experiment was laid out in a factorial randomized block design with nine

treatments and replicated thrice. The treatment comprised of three sources of sulphur *viz.*, gypsum, single superphosphate and bensulf and three levels of sulphur *viz.*, 0, 20 and 40 kg ha^{-1}. Recommended dose of N, P_2O_5 and K_2O was given to treatment plots. Nitrogen was applied in three splits i.e. 50 per cent at the time of transplanting, 25 per cent at maximum tillering stage and remaining 25 per cent at panicle initiation stage. Basal dose of P_2O_5, K_2O and S was applied at the time of transplanting. The rice grain and straw yield was recorded after harvest of crop. Grain, straw and soil samples were analyzed plot wise for sulphur content.

The data presented in Table 1 indicated that there was significant effect of sulphur level on grain yield of rice. The sulphur application @ 40 kg ha^{-1} recorded the highest grain yield (46.70 q ha^{-1}) and significantly superior over lower levels of sulphur application. The increased rice yield by sulphur application might be associated with synthesis of methionine and proteins (Kumme 1984). The results obtained are in accordance with Subbaiah *et al*. (2001), who reported that rice production in lowland areas could be increased by the application of 40 kg S ha^{-1} along with recommended dose of NPK fertilizers. The data regarding the effect of different levels of sulphur

Table 1. Effect of different levels and sources of sulphur and their interaction on grain and straw yield of rice (q ha^{-1}).

S/L	T_1		T_2		T_3		Mean	
	Grain	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**
S_0	27.79	23.15	23.14	19.28	29.97	24.98	26.97	22.47
S_1	34.09	28.40	30.73	25.60	39.36	36.12	34.73	30.04
S_2	46.89	40.74	44.33	37.13	48.89	40.74	46.70	39.54
Mean	36.26	30.76	32.73	27.34	39.41	34.07	-	-
	Levels		**Sources**		**Interaction (L x S)**			
	Grain	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**		
S.E.±	0.95	3.76	0.95	3.76	1.65	6.5		
C.D. at 5%	2.85	11.27	2.85	11.27	NS	NS		

S_0 = No sulphur, S_1 = 20 kg sulphur, S_2 = 40 kg sulphur ha^{-1}, T_1 = gypsum, T_2 = Single sulphur phosphate, T_3 = bensulf

Table 2. Effect of different levels and sources of sulphur and their interaction on uptake of sulphur (kg ha^{-1}) by rice grain and straw at harvest of crop.

S/L	T_1		T_2		T_3		Mean	
	Grain	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**
S_0	5.47	5.11	4.91	4.10	5.87	5.32	5.41	4.84
S_1	7.29	7.07	6.63	6.32	8.73	8.49	7.55	7.29
S_2	11.48	11.69	11.16	10.35	12.85	11.81	11.83	11.28
Mean	8.08	7.96	7.57	6.92	9.15	8.54	-	-
	Levels		**Sources**		**Interaction (L x S)**			
	Grain	**Straw**	**Grain**	**Straw**	**Grain**	**Straw**		
S.E.±	0.21	0.22	0.21	0.22	0.37	0.39		
C.D. at 5%	0.64	0.67	0.64	0.67	NS	NS		

on straw yield revealed that, the highest straw yield 39.54 q ha^{-1} in sulphur application @ 40 kg ha^{-1}. However, it was significantly superior over no sulphur and at par with 20 kg S ha^{-1} (30.04 q ha^{-1}). The results obtained are in conformation with the results obtained by Akhter *et al*. (1994).

The grain yield of rice was found singnificant by the various sources of sulphur application (Table 1). The use of bensulf was found to record the significantly highest grain yield (39.4 q ha^{-1}) over the remaining sources, as gypsum (36.26 q ha^{-1}) and single superphosphate (32.73 q ha^{-1}). These result are in accordance with the result of Raju *et al*. (1992). The soucres of sulphur to rice as bensulf has recorded (34.07 q ha^{-1}) straw yield and at par with gypsum (30.76 q ha^{-1}) and single superphosphate (27.34 q ha^{-1}). The interaction effects between sources and levels of sulphur application were non significant for grain and straw yield of low land rice.

The sulphur uptake by low land rice grain was significantly influenced by the levels of sulphur application (Table 2). The sulphur application @ 40 kg ha^{-1} recorded significantly higher sulphur uptake (11.83 kg ha^{-1}) over zero (5.41 kg ha^{-1}) and 20 kg S ha^{-1} (7.55 kg ha^{-1}). The result are in accordance with the Mohapatra *et al*. (1993). The significant effect of sulphur application was observed in sulphur uptake in rice straw. The sulphur application @ 40 kg S ha^{-1} was recorded highest sulphur uptake (11.28 kg ha^{-1}) and significantly superior over 20 (7.29 kg ha^{-1}) and 0 kg S ha^{-1} (4.84 kg ha^{-1}).

The sources of sulphur application to low land rice significantly influenced the sulphur uptake by rice grain. It was significantly higher in bensulf (9.15 kg ha^{-1}), significantly superior over gypsum (8.08 kg ha^{-1}) and single superphosphate (7.57 kg ha^{-1}). The treatment

Table 3. Effect of different levels and sources of sulphur and their interaction on available sulphur (µg g^{-1}) in soil after harvest of crop.

S/L	T_1	T_2	T_3	Mean
S_0	1.64	1.44	1.60	1.56
S_1	2.23	1.72	1.90	1.95
S_2	2.02	2.13	2.43	2.20
Mean	1.96	1.77	1.98	-
	Levels	**Sources**	**Interaction (L x S)**	
S.E.±	0.06	0.06	0.10	
C.D. at 5%	0.18	0.18	0.31	

receiving bensulf @ 40 kg S ha^{-1} recorded sulphur uptake by rice straw (8.54 kg ha^{-1}) significantly superior over SSP (6.92 kg ha^{-1}) and at par with gypsum (7.96 kg ha^{-1}). The interaction between sources and levels of sulphur application were found non significant for sulphur uptake by low land rice in grain tand straw.

There was significant difference between the levels of sulphur application for soil available S. The sulphur application @ 40 kg ha^{-1} recorded significantly higher value of soil available sulphur (2.20 µg g^{-1}) than 20 (1.95 µg g^{-1}) and 0 kg ha^{-1} (1.56 µg g^{-1}) values of soil available sulphur. The present findings showed that increasing levels of sulphur increased the available sulphur content in soil. Similar results also reported by Arora *et al*. (1988).

The sources of sulphur application to low land rice showed the increased residual soil available suphur at harvest. It was significantly higher in sulphur application through bensulf (1.98 µg g^{-1}) than gypsum (1.96 µg g^{-1}) and single superphosphate (1.77 µg g^{-1}). The interaction between bensulf, source of sulphur application and 40 kg ha^{-1} sulphur level was found to record the significantly higher values of residual soil available sulphur (2.43 µg g^{-1}) over the rest of the interactions.

N. G. Bhope
K. D. Patil
S. A. Chavan

Regional Fruit Research Station,
Vengurle - 416 516 (India)
December 20, 2010.

References

Akhter, I. U., Faiz, S. M. A., Rahman, S. and Rahman, L. 1994. Main and interaction effects of sulphur and zinc on rice. Crop Res. 7(1): 1-7.

Kolpe, S. S. 1987. Forms and distribution of sulphur in rice soils of Konkan region. M.Sc. (Agri.), thesis submitted to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, India (MS).

Kumme, K. F. 1984. Nutrient sulphur-it is worth money BSSF Agric. News. 1:4-9.

Mohapatra, A. R., Mishra, A. K. and Sarkuman, V. 1993. Absorption pattern of secondary nutrients and micro-nutrients by high yielding rice varieties, Indian J. Agric. Sci. 63(9): 586.588.

Raju, R. A., Readdy, K. A. and Reddy, M. M. 1992. Response of rice to sulphur and zinc on coastal alluvial of Andhra pradesh. Indian J. Agron. 39(4): 637-638.

Subbaiah, S.V., Singh, S. P. and Pillai, K. G. 2001. Effect of sulphur nutrition on grain yield of lowland rice. Oryza. 38(1 and 2): 82-83.

Wang, C. H. 1976. Sulphur fertilization of rice. The fertility of paddy soils and fertilizer application for rice. Asia and Pacific Council (ASPAC), Taipei, Taiwan, pp. 149-169.

J. Agric. Res. Technol., 37 (1) : 180-184 (2012)

Response of Brinjal (*Solanum melongena* L.) to Fertilizer Levels and Plant Spacing under Drip Irrigation

Drip irrigation system is one of the advanced methods of irrigation in which water is conveyed through network of pipes, up to root zone of the crop and applied through emitters, firequently. The volume of water supplied through drip is equal to the consumptive use of plants thereby minimizing conventional losses as deep percolation and runoff, which gives better water use efficiency. Due to the introduction of high yielding varieties and improved cultivation practices, demand by the plant for nutrients for growth and devdlopment also increased. The dose of nutrient recommended for cultivation for traditional irrigation methods needs to be increased.

Crop geometry and plant population plays an important role in obtaining higher yield. Optimum plant population for vegetables varies considerably due to the environment under which it is grown. Therefore, it is necessary to quantify optimum plant population by adjusting the spacing. In view of above points, the experiment was conducted to study response of brinjal (*Solanum melongena*) to fertilizer levels and plant spacing, grown with drip irrigation under the lateritic soils of konkan.

A field experiment on brinjal, variety Lanja Local was conducted during rabi season of the year 2007-2008 at the Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli. Soil was clay loam with pH of 5.72. The available N, P_2O5, K_2O was 321.50 kg ha^{-1}, 13.05 kg ha^{-1}, and 252.7 kg ha^{-1} respectively. The experiment consisted of five main plot treatments of fertilizer levels *viz*., F_1 - check basin as per recommendation was treated as control, F_2 - 75 per cent of RDF, below the dripper, F_3 - 100 per cent of RDF, below the dripper, F_4 - 125 per cent of RDF,

below the dripper, F_5 - 150 per cent of RDF, below the dripper. In sub plots plant spacing treatments, S_1 - 90-30x30 cm, S_2 - 90-30x37.5 cm, S_3 - 90-30x45 cm, S_4 - 90-30x60 cm, were accomodated. The experiment was conducted in split plot design with three replications. Poultry manure @ 5 t ha^{-1} was applied uniformly after digging hills (7-8 cm) before transplanting. For F_1, 50 kg N and full dose of P_2O_5 (50 kg ha^{-1}), K_2O (50 kg ha^{-1}) was applied 10 days after transplanting and remaining quantity of 100 kg N was applied in two equal split i.e. 60 and 90 days after transplanting as per recommendation. For F_2, F_3, F_4, and F_3 1/3 quantity of nitrogen and full dose of P_2O_5 and K_2O was applied 10 days after transplanting and remaining 2/3 quantity of nitrogen was applied in 4 equal splits at 30, 50, 70 and 90 days after transplanting. All the chemical fertilizers applied by preparing a small hole (3-4cm deep) below dripper. In this experiment, urea, single super phosphate and muriate of potash fertilizers were used as the source of N, P_2O5 and K_2O. The plot size was variable according to spacing which has accommodated 55,555, 44,218, 37,037 and 27,777 hills ha^{-1} for S_1, S_2, S_3, and S_4 respectively. The drippers for 4lph discharge were used with a spacing of 60 cm. The crop was transplanted on 12th Dec. 2007. The paddy straw mulch @ 10 t ha^{-1} was applied 15 days after transplanting and irrigation was scheduled on pan evaporation data. The operating pressure @ 0.6 kg cm^{-2} was maintained while applying irrigation through drip. The crop was harvested in 11 number of pickings during the period of 19/02/2008 to 14/04/2008. The growth and yield observations were recorded periodically and economics of the treatments was studied by calculating net income and B:C ratio.

At 90 days after transplanting (Table 1) the treatment F_5 (150% of RDF below the dripper)

Table 1. Growth, yield attributes and fruit yield of brinjal influenced by levels of fertilizers and spacing.

Treatment	Plant height at 90 DAT (cm)	Plant spread at 90 (cm)	Functional leaves hill^{-1} at 90 DAT	Branches hill^{-1} at 90 DAT	Fruits hill^{-1}	Average length of fruit (cm)	Weight of fruit hill^{-1} (g hill^{-1})	Average weight of fruit (g fruit^{-1})	Fruit yield (t ha^{-1})
A. Levels of ferlilizers (% RDF below dripper) :									
F_1	63.08	58.88	55.83	6.74	32.56	9.49	725.28	21.44	67.23
F_2	58.60	58.50	54.85	5.87	31.21	9.78	683.47	20.12	54.68
F_3	60.49	57.13	50.11	6.38	32.22	9.79	693.26	22.35	53.73
F_4	62.32	58.53	58.15	7.30	33.49	9.79	705.47	23.06	63.69
F_5	66.30	58.79	61.38	8.01	38.07	10.01	797.61	23.81	74.25
SE±	0.36	0.35	0.58	0.04	0.26	0.05	3.54	0.09	0.51
CD at 5%	1.19	N.S.	1.88	0.14	0.84	N.S.	11.54	0.29	1.67
B. Plant spacing (cm) :									
S_1 - 90-30x30	64.91	55.81	54.33	6.47	31.36	9.6	719.54	20.97	66.44
S_2 - 90-30x37.5	61.53	55.47	53.40	6.5	32.47	9.61	702.85	21.7	58.85
S_3 - 90-30x45	61.03	59.95	57.55	7.07	34.55	9.86	705.92	22.33	62.62
S_4 - 90-3 0x60	61.17	62.25	58.97	7.40	35.66	10.03	755.65	23.62	62.95
SE±	0.26	0.35	0.44	0.03	0.17	0.04	3.56	0.06	0;24
CD at 5 %	0.75	1.0	N.S.	0.1	0.48	N.S.	10.28	0.18	0.68

(RDF= 150 kg N, 50 kg P_2O_5, 50 kg K_2O ha^{-1}

recorded statistically superior values of growth attributes of brinjal *viz*., plant height, number of functional leaves hill^{-1} and number of branches hill^{-1} over rest of the fertilizer levels treatments while the average plant spread was statistically not influenced by the levels of fertilizers. The higher dose of fertilizer (F_5 i.e. 150% of RDF, below the dripper), supplied 50 per cent more nutrient than the recommended dose of fertilizer to the brinjal. Availability of ample amount of macronutrients (NPK) resulted in a better vegetative growth of the crop. Higher number of leaves, superior plant spread, number of branches hill^{-1} in the F_5 fertilizer level (i.e. 225 kg N, 75k g P_2O_5 and 75 kg K_2O ha^{-1}) contributed probably higher chlorophyll content which enabled the crop photosynthetically more active and therefore, resulted in a superior growth attributes over rest of the fertilizer levels. These findings were in agreement with Suthar *et al*. (2005).

In case of yield attributing characters namely number of fruits hill^{-1} weight of fruits hill^{-1} (g hill^{-1}) and average weight of fruit (g fruit^{-1}) and brinjal fruit yield (74.25t ha^{-1}) of treatment F_5 (150% of RDF, below the dripper) recorded statistically superior values over the rest of the fertilizer levels, while the average length of fruit was not influenced statistically by fertilizer levels. This might be due to more availability of source under the treatment F_5 (150% of RDF,

Table 2. Input cost, total cost, yield, gross income, net income and benefit cost ratio as influenced by levels of fertilizers and spacing.

Treatment	Yield of fruit (t ha^{-1})	Input cost (Rs. ha^{-1})	Total cost (Rs. ha^{-1})	Gross income (Rs. ha^{-1})	Net income (Rs. ha^{-1})	Benefit cost ratio	Field water use efficiency (t ha^{-1} cm)
F_1S_1	64.43	97254	163253	257720	94467	1.57	0.74
F_1S_2	63.01	94894	159557	252040	92438	1.57	0.72
F_1S_3	71.75	92584	160792	284600	123808	1.75	0.82
F_1S_4	70.32	90424	159223	281280	122057	1.76	0.81
F_2S_1	58.57	80367	159330	234280	74950	1.47	1.59
F_2S_2	49.04	78414	150698	196160	45465	1.30	1.33
F_2S_3	55.58	76177	152455	222320	69865	1.45	1.51
F_2S_4	55.53	74797	150814	222120	71360	1.47	1.51
F_3S_1	59.79	81214	161130	239160	78030	1.48	1.63
F_3S_2	50.24	79264	152492	200960	48460	1.31	1.37
F_3S_3	47.83	77414	124073	191320	62247	1.54	1.30
F_3S_4	57.04	75644	152808	223160	75352	1.49	1.55
F_4S_1	70.34	82069	169159	281360	112201	1.66	1.91
F_4S_2	62.64	80119	161754	250560	88806	1.54	1.70
F_4S_3	62.76	78269	159679	251040	91361	1.57	1.71
F_4S_4	59.05	76499	155144	236200	81056	1.52	1.61
F_5S_1	79.07	82928	175980	316280	140300	1.79	2.15
F_5S_2	69.34	80978	167222	277360	110138	1.65	1.89
F_5S_3	75.79	79128	169367	303360	133593	1.78	2.06
F_5S_4	72.80	77258	165311	291200	125889	1.76	1.98
Between two spacing same fertilizer level			Between two spacing same or different fertilizer levels				
S.E.±	1.18		S.E.±	2.51			
C.D. at 5%	3.42		C.D. at 5%	7.10			

below the dripper) than rest of the fertilizer levels which resulted into more production of sink compared with rest of the fertilizer level. Similar type of findings were also reported by Shinde *et al*. (2002) and Patel *et al*. (2006).

Treatment S_1 (plant spacing 90-30 x 30cm) recorded significantly superior plant height over the remaining spacing treatments, while the statistically superior values of remaining growth parameters namely number of branches hill^{-1} and number of functional leaves hill^{-1} at 90 days after transplanting, in S_4 (plant spacing 90-30 x60cm) over the rest of spacing treatments. The statistically superior values for yield attributes *viz*., weight of fruits hill^{-1} and average weight of fruit were recorded by S_4 (plant spacing 90-30x60cm) over the rest of plant spacing levels. Number of functional leaves hill^{-1} and average length of fruit were not differed statistically. The closer spacing treatment (S_1) recorded significantly superior plant height due to the higher plant population, which reduced the space available for plant spread and thereby resulted in increased plant height. Statistically superior values for most of the growth and yield attributes were recorded by S_4 due to the wider spacing. The treatment S_1 (plant spacing 90-30x30cm) recorded significantly superior fruit yield (66.44 t ha^{-1}) over rest of the treatments. The plant population in the treatments S_1, S_2, S_3 in comparison with S_4 was 80, 59, 33 per cent higher, respectively, due to the higher plant population in comparison with remaining treatments. The treatment S_4 recorded significantly superior fruit yield.

The treatment combination F_5S_1 (150% of RDF, below the dripper + plant spacing 90-30x30 cm) recorded (Table 2) significantly superior fruit yield (79.071 ha^{-1}) due to combined effect of higher fertilizer dose and closer spacing. Similar findings were also reported by Vijay Kumar *et al*. (1996).

The cost of drip unit for brinjal was Rs. 99,864 ha^{-1} (Table 2). The highest input cost was observed in the treatment combination F_1S_1, while highest total cost (Rs. 1,75,980 ha^{-1}) and gross income (Rs. 3,16,280 ha^{-1}) was recorded in treatment F_5S_1 (150% of RDF + 90-30 cm spacing). With highest net income (Rs. 1,40,300) and B:C ratio (1.79).

Drip irrigation treatment saved about 57.67 per cent of irrigation water over the check basin irrigation treatment. The highest field water use efficiency was recorded (2.15 ha^{-1} cm) by the treatment F_5S_1. Considering water is more scarce resource, the water thus saved can be used to cultivate the additional area by adopting drip irrigation which is also economically viable.

It could be concluded from present investigation under drip irrigation that the treatment combinations of fertilizer dose of 225 kg N, 75 kg P_2O_5 and 75 kg K_2O hectare^{-1} with closer plant spacing of 90-30x30 cm produced statistically superior fruit yield of brinjal and highest net profit and B:C ratio and utilized 36.65 ha-cm of water, with saving of 57.67 per cent of irrigation water over check basin irrigation.

T. M. Nayakawadi
P. P. Shinde
S. M. Salunkhe
P. D. Khambal

Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth,
Dapoli - 415 712 (India)
January 9, 2011.

References

Patel, R. S., Patel, P. G. and Patel, M. M. 2006. Effect of irrigation and nitrogen on growth and yield of brinjal under drip system. J. Maharashtra Agric. Univ., 31(2): 173-175.

Shinde, P. P., More, V. G., Ramteke, J. R. and Chavan, S. A. 2003. Response of brinjal to fertigaion. J. Maharashtra Agric. Univ., 27(3): 260-262.

Suthar, M. R., Singh, G. P. R. and Lal, M. 2005. Growth and fruit yield of brinjal (*Salomon melongenl* L.) as influenced by planting dates and fertility levels. Crop. Res. 30(1): 77-79.

Vijaykumar, A., Arunachalam, M. and Suthanthirapandian, I. R. 1996. Influence of mother crop nutrition and spacing on seed yield and quality of brinjal. South Indian Hort., 43(5 and 6): 152-153.

TABLES - Type tables in double-space on separate pages, each one referred to in the text and numbered with Arabic numerals (e.g. Table 1). The title of each table should identify its contents so that reference to the text is not necessary. Title and column heading should be brief. Unnecessary descriptive matter should be avoided. Column and row heading with footnotes should be self explanatory. Capitalize only the first letter of the first word of each column and row heading. Use lower case letter from the end of alphabet (x,y,z) to identify tabular footnotes. Use lower case letters from the beginning of alphabet (a,b,c) or asterisks with explanatory footnotes at 5% level, capitals for significance at 1% level.

FIGURES - Identify graphs, line drawings and photographs with consecutive Arabic numbers, as Fig. 1, Fig. 2. Place figures after tables. Photographs must be clear, glossy prints. Original graphs and drawings must be in Indian ink or equivalent on plain, white drawing paper. Letter in Indian ink with a lettering guide large and bold enough to permit reduction. Each figure should be referred to in the text. The title of paper and fig. number should be placed in pencil on the back of each fig. for identification.

TRADE OR BRAND NAMES - Trade or brand names are not used in permanent literature. State trade or brand names only in parentheses. The active ingredient, chemical formula, purity and diluent or solvent may be stated in the text. Capitalize the first letter of trade or brand names.

ABBREVIATION - In both text and tables except for the first word in a sentence long words or terms used repeatedly should be abbreviated usually without a period (e.g. a.m. ppm. m. °C, N, P, K, K_2SO_4). Use standard abbreviations. Names of organic chemicals and other terms, abbreviated for the reader's convenience should be spelled out first with parenthetical abbreviation used.

ARABIC NUMERICALS - Use Arabic numericals in all cases except the beginning of sentence or where the use would be unclear.

SEPARATES / REPRINTS - Ten copies will be supplied free of cost.

ADVERTISEMENT - Advertise of Agro-based industries will be published on Cover Page No. 2 and 3 full page at the cost of Rs. 4000/- and 3000/- respectively.

CORRESPONDENCE - Business correspondence, remittances, subscriptions, change of address etc. should be addressed to **The Editor-in-Chief, Journal of Agriculture Research and Technology, College of Agriculture, Pune - 411 005, INDIA.**

The correspondence regarding exchange of journal should be done with the Dean, Faculty of Agriculture of respective Agricultural University in Maharashtra State (India).

Journal of Agriculture Research and Technology is published thrice in a year preferably in the month of January, May and September. The Journal is devoted to papers on original research in any branch of Agricultural Sciences. The contribution of papers is open to the subscribers only.

A company dealing in Fertilizers, Agricultural Equipments, Pesticides, Insecticides, Fungicides, etc. and paying an amount of Rs. 15,000/- and above can become a Sustaining Associate of the Journal. The Sustaining Associates will be allowed to publish free of cost a full page advertisement once in a year. The Life Members, Patrons and Sustaining Associates will be supplied free of cost a copy of each number of a volume.

Registered with the Registrar of Newspaper for India under R.No. 27971/76

PREPARATION OF MANUSCRIPT

Authors are urged to have one or more colleagues, read the manuscript critically prior to submission. Submission implies non-submission elsewhere and if accepted, no future publication without the consent of the Editorial Board.

Submit with a covering letter one original and one copy of the manuscript typewritten on one side, on bond paper (22x28 cm) and double space including title, abstract, text, literature cited, tables, headings and figure legends. One copy should be without author's name, address and acknowledgement. Footnotes should be avoided. Liberal margins should be left for Editorial marking. Number the pages of title, text, literature cited, tables and figures in that order. Tables and captions of figures should be separate and every sheet of manuscript should be numbered. A serial number, assigned to each new manuscript accompanies its acknowledgement to the author who submitted it. Refer to that number in all subsequent correspondence.

MODE OF SUBMISSION - Authors should submit the review / research article / note alongwith prescribed "Article Certificate" directly to the Journal with a copy of it to the Director of Research / Dean / Head of the Institution and, after its publication, a copy of reprint of the paper for his record.

TITLE - The title should be unique and concise description of the paper. It should not exceed 10 to 15 words. Names of the authors should be centered directly below the title. The name and location of the senior author/institution (The institution where most of the research work is conducted) is centered below the author's name. The designations and addresses of the author/s are foot noted.

ABSTRACT - The abstract is placed on the next line after Institution's name on page 1. It should be a concise summation of the findings and should include names of organisms, effects of major treatments and major conclusions. It should not exeed 5 per cent of the length of the paper.

KEY WORDS - A list of additional Key words may be included below the abstract.

HEADINGS - Centre and capitalize first letters of main headings of the paper i.e. Abstract, Materials and Methods, Results and Discussion and References. Do not centre secondary headings. Place the secondary headings with the first letter of the word capitalized at the beginning of the paragraph.

STYLE - Manuscripts must conform to current standards of English style and usage. The first person pronoun is accepted and often preferred for clarity. Main clauses should usually be stated first. The introduction without a heading should state clearly why the research was conducted with reference to earlier work. Give enough information on methods to indicate how the research was conducted so that the reader will have confidence in the validity of the result. Omit details unless it is method paper. Present results succinctly with emphasis on main effects. Use tables and figures to illustrate the text, interprete the results in discussion. Brief conclusion can terminate the discussion. Complex conclusions should form a separate section. Underline the botanical/scientific names.

RERERENCES - List citations alphabetically by names of authors and type them after the text. The form should be in the order of names of the authors, year, subject title, name of publication (in Roman), Vol. and inclusive page numbers.

EXAMPLES :

Dorsey, M.J. and Bushnall, J.W. 1920. The hardiness problem. Proc. Amer. Soc. Hort. Sci. 17:210-224.

Snedecor, G.W. 1956. Statistical Methods. 5th Edn. Iowa State Univ. Press, Ames, Iowa, pp.534.

Whiteside, W.F. 1973. A study of light as influenced by time and planting date on growth of onion (*Allium cepa* L.) in the glasshouse and the field. Ph.D. thesis, Univ. of Illinois at Urbana-Champaign, pp.53.

(Continued on inside back cover)

Edited and Published by Dr. P. N. Harer at College of Agriculture, Pune 411 005.
Typeset Processed and Printed by : Flamingo Business System, 19, Laxminagar Comm. Complex-1, Pune-411 009. Tel. : 24214636

Date of Issue : January, 2012
Date of Publication : January 01, 2012