J. Agric. Res. Technol., 49 (2) : 240-244 (2024) https://doi.org/10.56228/JART.2024.49202

Evaluation of the Most Effective Chemical Fungicides, Bio-agents and Plant Extracts Against Rust of Pea *In-vivo*

A.V. Bhosale[1], V. M. Karade[2], C. T. Kumbhar[3], R. M. Khadtare[4], V. M. Rajenimbalkar[5], S. S. Shinde[6]
Department of Plant Pathology and Agricultural Microbiology,
College of Agriculture, Pune - 411 005 (India)
(Received : 10.08.2023 Accepted : 03.12.2023)

Abstract

The fieldexperiment was conducted in RBD design with 7 treatments and 3 replications under natural conditions to assess the efficacy of bioagents, plant extracts and chemical fungicides. The observations recorded at pre-treatment, just before each spray and 10 days after last spray, shown that among all the treatments, the lowest value of PDI was observed for propiconazole (0.1%) at 21.12%, with the highest per cent disease control of 56.24%, proving it to be the most effective treatment on rust. All of the treatments outperformed control about the rust resistance.The pod yield of pea was significantly low in control plot due to high disease severity. 76.47% and 62.41% increase in pod yield over the control was recorded in plot treated with propiconazole (0.1%) and hexaconazole (0.05%), respectively.

Key words : Pea, Rust, plant extracts, bioagents, fungicides, disease severity, disease control.

Pea (*Pisum sativum* L.) is a valuable vegetable as well as pulse crop all over the world, is also known as 'Matar' or Garden pea. It belongs to the family Fabaceae and a self-pollinated crop. Green peas are the number-one processed vegetable in modern world. Pea farming is impacted by a variety of biotic and abiotic stressors. Rust, powdery mildew,fusarium wilt, and other fungi-related illnesses fall under the most prevalent biotic stressors. Garden peas are frequently afflicted with fungi-related diseases including powdery mildew and rust. Rust is a serious disease of pea that is brought on by Uromyces fabae (Pers.) de Bary and has a global distribution. It can cause major production losses, especially when outbreaks begin early in the growing season and during humid and temperate springs (Sillero *et al*., 2006). According to Rashid and Bernier (1986), rust can harm pea plants by reducing their photosynthetic area and causing pustules to grow on their stems, leaves, and occasionally their pods. Within a short period of time, this disease causes a very high yield reduction. Pea rust that is macrocyclic and autoecious (Singh and Tripathi 2012). According to Upadhyay and Singh (1994), they result in losses of 30–40% every year.The use of fungicide to manage plant diseases is a beneficial strategy. Fungicide-based plant disease management can occasionally produce positive outcomes. However, inappropriate fungicide use mostly results in global disasters, pollution of the environment, and the emergence of pathogen resistance (Brewer and Larkin, 2005). Therefore, it is imperative to use alternate safe, effective ways against such diseases or at the very least, to rationalise their application, in order to overcome these challenges.

Material and Methods

Experimental site : The research was conducted at the experimental farm and the section laboratory in the Department of Plant Pathology at the College of Agriculture, Pune.

1. and 6. M.Sc., 2. Associate Professor and 3. 4. and 5. Assistant Professor.

Seed : Pea variety 'Golden pea' showing increasing susceptibility to powdery mildew and rust was used for field trial.

Methods

***In-vivo* field experimental details :** The experiment was conducted in the experimental farm of Plant Pathology Section, College of Agriculture, Pune during *Rabi*, 2022. The experimental plot was laid out in a Randomized block design (RBD) having three replications for each treatment. Distance between the blocks (replication) and between the plots was 1.0 meter and 0.50 meter, respectively. There were 21 plots for the study. Two fungicides, two bio-agents and two plant extract were selected for evaluation against powdery mildew and rust of pea under field condition. Different treatments were assigned randomly to the unit plot (3.0 m x 2.40 m). Pea variety 'Golden Pea' showing increasing susceptibility to powdery mildew and rust disease was used for field trial. All recommended agronomic practices were followed during whole cropping season. Details of the treatments & field layout are presented as below:

1. Experimental design : Randomized block design (RBD)
2. Crop season : *Rabi*, 2022
3. Name of crop : Pea
4. Variety : Golden Pea
5. No. of treatments : 07
6. No. of replication : 03
7. Plot size : 3.0 x 2.40 meter
8. Row-to-row distance : 30 cm
9. Plant-to-plant distance : 15 cm
10. Date of sowing : 18 October, 2022
11. Fertilizer dose/ha : 25:60:60 kg NPK + 15 t FYM

Treatment details : T_1 = Effective fungicide - 1 in lab study (*Propiconazole* - 0.1%), T_2 = Effective fungicide - 2 in lab study (*Hexaconazole* - 0.05%), T_3 = Effective bioagent^{-1} in lab study (*Pseudomonas fluorescens* - 1 x 10^6 cfu ml^{-1}), T_4 = Effective bioagent - 2 in lab study (*Trichoderma harzianum* -5%), T_5 = Effective plant extract - 1 in lab study (Neem leaf (*Azadiracta* indica))-10%), T_6 = Effective plant extract - 2 in lab study (Garlic clove (*Allium sativum*)-10%) and T_7 = Control (without any fungicide/bioagent/ plant extract).

Methods of recording observations on rust disease intensity : Each plot was visited for recording the incidence and per cent leaf area infection owing to rust. Data were recorded visually by observing the symptoms. Five plants were selected randomly from each plot and labelled for easy detection of their location while recording the observations. Disease intensity recorded by randomly selected plants from each bottom, middle and top leaves from 05 plants on 0-9 scale suggested by Mayee & Datar (1986) for rust. Per cent disease index (PDI) calculated by using the formula given by Wheeler (1969) and Audichy and Thakore (2000).

$$\text{Disease intensity (\%)} = \frac{\text{Sum of all (Number of leaves x Diseased grade)}}{\text{Total leaves observed in a set x Maximum grade}} \times 100$$

Table 1. Disease severity scale for evaluation of pea rust (Mayee and Datar, 1986)

Disease score	Description	Disease reaction
0	No symptoms on leaf.	Highly resistant (HR)
1	Rust pustules small, scattered covering 1% or less of leaf area.	Resistant (R)
3	Rust pustules more in number covering 1-10% of leaf area.	Moderately Resistant (MR)
5	Typical rust pustules covering 11-25% of leaf area.	Moderately Susceptible (MS)
7	Typical rust pustules covering 26-50% of leaf area.	Susceptible (S)
9	Typical rust pustules covering 51% or more of leaf area	Highly Susceptible (HS)

Result and Discussion

Per cent disease intensity of rust recorded prior to application of the chemical fungicides, bio-agents and plant extracts showed statistically non-significant differences in the disease intensity. Thus, the disease severity prior to application of the chemical fungicides, bio-agents and plant extracts was statistically equal in all the experimental plots, which ranged between 1.31 and 1.56%. Thus, the disease intensity prior to application of fungicides was almost uniform in all the plots.

Perusal of the data recorded just before the second spray (10 days after the first spray) showed statistically significant differences in the disease intensity of rust, due to different treatments of the chemical fungicides, bio-agents & plant extracts, which ranged between 15.79 and 28.96%. However, the least disease intensity to the tune of 15.79% was observed in the plots sprayed with Propiconazole @ 0.1%. This treatment was non-significantly followed by Hexaconazole@ 0.05%, which had the disease intensity of 16.92%. The highest disease intensity 28.96% was recorded in the untreated control plots. Data pertaining to rust disease intensity recorded at 10 days after the final spray (10 days after the second spray) clearly unveiled statistically significant differences in the disease intensity, due to different treatments of the chemical fungicides, bio-agents & plant extracts, which ranged between 21.12 and 48.26%. Nonetheless, among the treatments experimented, the least disease intensity of 21.12% was observed in the plots that had application of Propiconazole @ 0.1%. This treatment was non-significantly followed by Hexaconazole @ 0.05%, which had the disease intensity of 24.51%. In consequence, these two treatments were significantly superior over the rest of treatments in reducing the disease severity, which reduced intensity to the tune of 56.24 and 49.22%, respectively, in comparison to untreated control. The highest disease intensity 48.26% was observed in the untreated control plots.

These results are similar to the findings reported by Basandrai *et al*. (2013) where the rust disease severity was shown to be effectively controlled by propiconazole 25 EC (23.7%) and hexaconazole 5 EC (26.1%) when compared to

Table 2. Per cent disease intensity of rust of pea disease of pea influenced by chemical fungicides, bio-agents & plantextracts *in-vivo* (*Rabi*, 2022)

Treatments	Conc.	Per cent disease intensity (PDI) of Rust			
		Just before first spray	Just before 2^{nd} spray (10 days after 1^{st} spray)	10 days after final spray (10 days after 2^{nd} spray)	Per cent disease reduction over control
T_1 - Propiconazole	0.1%	1.40 (6.80)	15.79 (24.76)	21.12 (27.36)	56.24
T_2 - Hexaconazole	0.05%	1.50 (7.03)	16.92 (24.29)	24.51 (29.67)	49.22
T_3 - *Pseudomonas fluorescens*	1 x 10^6 cfu ml^{-1}	1.46 (6.94)	17.10 (23.42)	24.80 (32.45)	48.62
T_4 - *Trichoderma harzianum*	5%	1.56 (7.17)	17.33 (24.43)	25.58 (29.87)	47.00
T_5 - Neem (*Azadiracta indica*)	10%	1.31 (6.57)	17.54 (24.60)	28.79 (32.87)	40.34
T_6 - Garlic (*Allium sativum*)	10%	1.49 (7.02)	18.31 (25.34)	29.45 (30.38)	38.99
T_7 - Absolute control	-	1.52 (7.09)	28.96 (32.56)	48.26 (44.01)	-
S.E.(m)±	-	0.005	1.010	1.797	-
CD (5%)	-	NS	3.111	5.538	-

Note : Figures in parentheses are arcsine transformed values

Table 3. Pod yield of pea influenced by application of chemical fungicides, bio-agents and plant extracts during *rabi*, 2022

Treatments	Conc.	Pod yield per plot (Kg)	Pod yield (t ha^{-1})	Per cent increase over control
T_1 - Propiconazole	0.1%	3.43	4.77	76.47
T_2 - Hexaconazole	0.05%	3.16	4.39	62.41
T_3 - Pseudomonas fluorescens	1 x 10^6 cfu ml^{-1}	2.71	3.77	39.47
T_4 - Trichoderma harzianum	5%	2.97	4.13	52.79
T_5 - Neem (Azadiracta indica)	10%	3.1	4.31	59.45
T_6 - Garlic (Allium sativum)	10%	2.56	3.56	31.71
T_7 - Absolute control	-	1.95	2.70	-
S.E.(m)±			0.374	
CD (5%)			1.153	

52.2% in control.Upadhyay *et al.* (2016) obtained results that the *Trichoderma harzianum* and *Pseudomonas fluorescens* showed maximum inhibition to germination of the rust spores, which was supported by the findings of Vey *et al.* (2001), Nagendra and Kumar (2011), Junid *et al*. (2013) and Bhattacharjee and Dey (2014). Current study demonstrated that; when applied at a 10% concentration, Neem (Azadiracta indica) and garlic (Allium sativum) were considerably beneficial at controlling pea rust disease when compared to a control plot.

Effect of chemical fungicides, bio-agents and plant extracts treatments on pod yield of pea *in-vivo*

Peapod were harvested replication and treatment wise and yields were converted to t ha^{-1} before subjecting to statistical analysis and are represented below:

Perusal of the data explicitly revealed statistically significant differences in the pod yield, due to different treatments of the fungicides, bioagents and plant extracts which ranged between 2.7 and 4.77 t ha^{-1}. However, among the treatments experimented, the highest pod yield 4.77 t ha^{-1} was harvested from the plots that had application of T_1 i.e., propiconazole @ 0.10%. This treatment was non-significantly followed by T_2 i.e., hexaconazole @ 0.05% which yielded 4.39 t ha^{-1}. In consequence, these two treatments were significantly superior over the rest of treatments in augmenting pea pod yield, which increased the yield to the tune of 76.47% and 62.41%, respectively, in comparison to untreated control. The least pea pod yield (2.7 t ha^{-1}) was harvested from the untreated control plots.

The current results were in line with the findings of Singh *et al*. (2014) who reported foliar spray with fungicides significantly decreased rust severity and increased grain yield. Similar results were noted by Maharjan *et al*. (2015), Zyton *et al.* (2017) and Ahmed *et al.* (2021).

Conclusion

The lowest value of PDI, 10 days after last spray was observed for the propiconazole (0.1%) at 21.12% and maximum PDC with the tune of 56.24% which turned to be the most effective treatment against rust of pea.The pod yield of pea was significantly low in control plot due to high disease severity. 76.47% and 62.41% increase in pod yield over the control was recorded in plot treated with propiconazole (0.1%) and hexaconazole (0.05%), respectively.

References

Ahmed, N., Abbas Z., Riaz, H., Faried, H. N., Mehmood M. A., Asad, Z. and Ali ,H. R. 2021. Biological Management of Powdery Mildew of Pea (*Pisum Sativum* L). Agricultural Sciences Journal, 3(1), 79-95.

Audichya P. and Thakore B. L. 2000. Management of powdery of Opiumpoppy by systemic fungicides. Journal of Mycology and Plant Pathology. 30(1):103-104.

Basandrai, A. K., Basandrai, D., Mittal, P. and Sharma, B. K. 2013. Fungicidal management of rust, powdery mildew and Ascochyta blight in seed crop of pea. Plant disease research. 28: 22-28.

Bhattacharjee, R. and Dey, U. 2014. An overview of fungal and bacterial biopesticides to control plant pathogens/ diseases. African Journal of Microbiological Research, 8(17): 1749-1762.

Brewer, M. T. and Larkin, R. P. 2005. Efficacy of several potential biocontrol organisms against Rhizoctonia solani on potato. Crop Protection, 24(11), 939-950.

Emeran, A. A., Sillero, J. C., Niks, R. E., and Rubiales, D., 2006. Infection structures of host specialized isolates of Uromyces viciae-fabae and of other species of Uromyces infecting leguminous crops. Plant Disease. 89:17-22.

Junid Mahmoud, J. M., Dar, N. A., Baht, T. A., Baht, A. H. and Baht M. A. 2013. Commercial biocontrol agents and their mechanism of action in the management of plant pathogens. Inter. Journal of Modern Plant and Animal Science. 1(2): 39-57.

Maharjan A., Bhatta, B., Acharya, R. P., Shrestha, S. 2015. Efficacy assessment of treatment methods against powdery mildew disease of pea (*Pisum sativum* L.) caused by Erysiphe pisi var. pisi. World Journal of Agricultural Research, 3(6), 185-191.

Mayee, C. D. and Datar, V. V. 1986. Phytopathometry. Technical Bulletin-1 (Special Bulletin 3), Marathwada Agricultural University, Parbhani. 218p.

Singh, B. R. 2012. Efficacy of some triazole and strobilurin fungicides against pea rust. Plant disease research.27: 162-164.

Singh, S. K. and Tripathi, H. S. 2014. Estimation of yield losses due to field pea rust (Uromyces fabae) severity. Journal of Food Legumes, 27(4), 319-321.

Upadhyay, A. L, Singh, V. K. 1994. Performance of pea varieties/lines against powdery mildew and rust. Annals of Agricultural Research; 7:92-93.13.

Upadhyay, V. K., Medhi, P., Pandey, P., Thengal, S. K. Paul and K. Kushwah. 2019. Rust disease of pea: A review. International Journal of Current Microbiology and Applied Sciences, 8: 416-34.

Wheeler, B. E. J. 1969. An Introduction to Plant Disease, John Wiley Sons Ltd., London.

Zyton Marwa A., Eman O. Hassan. 2017. Effect of the Combination Between Bioagents and Benzothiadiazole (BTH) on Management of Uromyces Pisi the Causal of Pea Rust. American Journal of Life Sciences. Special Issue: Environmental Toxicology. Vol. 5, No. 3-1, , pp. 15-23.