

## Correlation and Path Analysis Studies in Pearl Millet [*Pennisetum Glaucum* (L.) R. Br.] during Summer Season

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### Abstract

The present investigation was carried out at Bajra Research Scheme, College of Agriculture, Dhule in Summer Season 2024 for evaluation of thirty pearl millet genotypes for correlation and path analysis. The research aims to study correlation and path analysis for grain yield and its yield contributing characters. The analysis revealed that grain yield plant<sup>-1</sup> had a significant positive correlation with traits such as 1000 seed weight and productive tillers plant<sup>-1</sup>. In contrast, days to maturity and days to 50 per cent flowering showed significant negative correlations at both genotypic and phenotypic levels. A non-significant positive correlation was observed with panicle girth, while grain yield plant<sup>-1</sup> exhibited non-significant and negative associations with plant height and panicle length at both genotypic and phenotypic levels. In path analysis the high magnitude direct effect was observed for the characters productive tillers plant<sup>-1</sup>, panicle girth, and 1000 seed weight as well as the highly significant correlation in the desired direction towards grain yield.

**Key words :** Pearl millet; genotypes; phenotypic; genotypic correlation; path analysis.

Pearl millet [*Pennisetum glaucum* (L.) R. Br.] belongs to the family Poaceae (Gramineae), subfamily Panicoideae, and the genus Cenchrus. The term "millet" is broadly used for various types of small-seeded annual grasses FAO and ICRISAT, (1996). It is considered a cross-pollinated (allogamous) crop, exhibiting protogyny (where the female reproductive parts mature before the male ones). The chief pollinating agent is wind (anemophily). Pearl millet is diploid ( $2n = 2x = 14$ ) in nature. Pearl millet originated in South Africa and was first domesticated over 5,000 years ago. It was introduced into India approximately 3,000 years ago, where it is considered a secondary centre of diversity Brunken, (1977). The crop is known by various local names, such as Bajra in Hindi, Sajje in Kannada, and Kambu in Tamil.

Correlation analysis is a biometrical technique used to determine the nature and degree of association between various

morphological traits, including yield. Path coefficient analysis further partitions the correlation coefficients into direct and indirect effects to assess the relative contribution of each variable to yield. The technique of path coefficient analysis was developed by Wright (1921) and demonstrated by Dewey and Lu (1959). Grain yield in pearl millet is generally low, primarily due to its cultivation under harsh environmental conditions, characterized by low rainfall, poor soil fertility, and minimal input management. Therefore, analyzing the contribution of physiological traits to grain yield is essential. A high leaf area index and specific leaf weight are desirable traits for achieving higher yields under stress conditions Chauhan and Senboku, (1996). High chlorophyll content is also a favorable characteristic, as it reflects a low degree of photo inhibition in the photosynthetic apparatus, thereby reducing carbohydrate losses and enhancing grain growth Farquhar *et al.*, (1989).

## Materials and methods

The experimental materials used for the present research consisted of 30 local genotypes of pearl millet [*Pennisetum glaucum* (L.) R. Br.], which were obtained from the Bajra Research Scheme, College of Agriculture, Dhule. The experiment was carried out under randomized block design (RBD) with two replications, using 30 genotypes of pearl millet at Bajra Research Scheme, College of Agriculture, Dhule during Summer 2024. Recommended cultural practices were adopted to raise a healthy crop. Observations were recorded on eight characters viz., days to 50 per cent flowering, days to maturity, plant height (cm), productive tillers plant<sup>-1</sup>, panicle length (cm), panicle girth (cm), 1000 seed weight (g), grain yield plant<sup>-1</sup>. To know the mutual association between seed yield plant<sup>-1</sup> and its component characters correlation coefficient were computed. For estimation of the direct and indirect effect of yield contributing characters path analysis were calculated. Statistical analysis for ANOVA is done by the method given by Panse and Sukhatme (1995). Analysis of covariance was worked out by Singh and Choudhary (1977). Correlation coefficient by Johnson *et al.* (1995) and path analysis as suggested by Dewey and Lu (1959).

## Result and discussion

### Correlation coefficient

**Association between grain yield plant<sup>-1</sup> and its components :** In the present study, grain yield plant<sup>-1</sup> (Table 2.) showed strong significantly positive genotypic association with 1000 seed weight (0.6438) and productive tillers plant<sup>-1</sup> (0.4464). Grain yield plant<sup>-1</sup> had positive non-significant genotypic association with panicle girth (0.0294). grain yield plant<sup>-1</sup> showed strong significantly negative genotypic association with days to maturity (-0.2125) and days to 50 percent flowering (-0.1794). While grain yield plant<sup>-1</sup> had non-

significant and negative association with plant height (-0.0757) and panicle length (-0.0548).

Grain yield plant<sup>-1</sup> (Table 3) exhibited a strong and significant positive phenotypic correlation with 1000 seed weight (0.6209) and productive tillers plant<sup>-1</sup> (0.4214). A positive but non-significant association was observed with panicle girth (0.0140). Grain yield plant<sup>-1</sup> showed a significant negative correlation with days to maturity (-0.2036) and days to 50 percent flowering (-0.1725). Additionally, non-significant and negative associations were recorded with plant height (-0.0760) and panicle length (-0.0453).

Grain yield plant<sup>-1</sup> demonstrated a strong, positive, and significant correlation with 1000 seed weight and productive tillers plant<sup>-1</sup> at both genotypic and phenotypic levels. Conversely, it showed a significant negative correlation with days to maturity and days to 50 percent flowering at both levels. A non-significant but positive association was observed with panicle girth, while non-significant and negative correlations were recorded with plant height and panicle length at both genotypic and phenotypic levels.

Similar results were confirmed by, Annamalai R. *et al.*, (2020) number of productive tillers; Patil *et al.*, (2021) test seed weight, ear head girth, number of productive tillers, ear head length, 50 percent flowering,

**Table 1.** List of thirty genotypes of pearl millet during summer season

Genotype	Genotype	Genotype	Genotype
DHLGB-1	DHLGB-9	DHLGB-17	DHLGB-25
DHLGB-2	DHLGB-10	DHLGB-18	DHLGB-26
DHLGB-3	DHLGB-11	DHLGB-19	DHLGB-27
DHLGB-4	DHLGB-12	DHLGB-20	DHLGB-28
DHLGB-5	DHLGB-13	DHLGB-21	DHLGB-29
DHLGB-6	DHLGB-14	DHLGB-22	DHLGB-30
DHLGB-7	DHLGB-15	DHLGB-23	
DHLGB-8	DHLGB-16	DHLGB-24	

plant height; Kamble *et al.*, (2022) days to flowering, days to maturity, plant height, panicle length, test weight; Shashibhushan *et al.*, (2022) productive tillers plant<sup>-1</sup>, panicle length; Aswini *et al.*, (2023) for plant height; Andhale *et al.*, (2024) plant height, productive tillers, panicle girth, panicle length, test seed weight. days to 50 percent flowering, days to maturity.

### Association between Component characters :

Days to 50 percent flowering had a significant positive correlation with days to maturity and panicle girth at both genotypic and phenotypic levels, as indicated by the above results. At both genotypic and phenotypic levels, it also showed a significant negative correlation with 1000 seed weight. At the genotypic level, days to 50 percent flowering exhibited a non-significant positive correlation with plant height, whereas at the phenotypic level, it showed a non-significant negative correlation with plant height. Additionally, at both genotypic and phenotypic levels, it showed non-significant negative correlations with panicle girth and productive tillers plant<sup>-1</sup>. Days to maturity had a significant positive correlation with days 50 percent to flowering, and panicle length as shown in the above results. At both the genotypic and phenotypic levels, productive tillers plant<sup>-1</sup> and panicle girth had a significant and negative correlation. At both genotypic and

phenotypic levels, indicated a non-significant and negative correlation with 1000 seed weight and plant height.

Plant height exhibited a non-significant positive correlation with productive tillers plant<sup>-1</sup> and 1000 seed weight at both genotypic and phenotypic levels, according to the above results. At both levels, it also showed a non-significant negative correlation with panicle length, panicle girth, and days to maturity. At the genotypic level, plant height had a non-significant positive correlation with days to 50 percent flowering, while at the phenotypic level, it showed a non-significant negative correlation with the same trait. Number of productive tillers per plant had a significant and positive correlation with panicle girth, and 1000 seed weight at both genotypic and phenotypic levels. At both genotypic and phenotypic levels, it demonstrated a non-significant and positive correlation with plant height. The productive tillers plant<sup>-1</sup> demonstrated a significant and negative correlation with days to maturity, and non-significant and negative correlation with panicle length and days to 50 percent flowering at both genotypic and phenotypic levels. Panicle length had a significant and positive correlation with days to 50 % flowering, days to maturity, At both genotypic and phenotypic levels. The non-significant and negative correlation with

**Table 2.** Genotypic correlation coefficient for eight characters in pearl millet during summer season

Characters	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	Productive tillers plant-1	Panicle length (cm)	Panicle girth (cm)	1000 Seed wt. (g)	Grain yield plant-1 (g)
Days to 50 per cent flowering	1.0000	0.9564**	0.0001	-0.1624	0.3663**	-0.2171	-0.2681*	-0.1794*
Days to maturity		1.0000	-0.0359	-0.2997*	0.3418*	-0.2953*	-0.2458	-0.2125*
Plant height at maturity (cm)			1.0000	0.1245	-0.1677	-0.1706	0.0071	-0.0757
Productive tillers plant <sup>-1</sup>				1.0000	-0.1679	0.3300*	0.3156*	0.4464**
Panicle length (cm)					1.0000	-0.1439	-0.1831	-0.0548
Panicle girth (cm)						1.0000	0.0301	0.0294
1000 Seed Weight (g)							1.0000	0.6438**

\*, \*\*Indicates significance at 5 % and 1% level respectively

1000 seed weight, plantheight, productive tillers plant<sup>-1</sup>, paniclelength, paniclegirth both genotypic and phenotypic levels. Panicle girth had a significant and positive correlation with number of productive tillers plant<sup>-1</sup> at both genotypic and phenotypic level. It demonstrated a non-significant and positive correlation with 1000 seed weight. The productive tillers plant<sup>-1</sup> demonstrated a significant and negative correlation with days to maturity, and non-significant and negative correlation with days to 50 percent flowering, plantheight, paniclelength at both genotypic and phenotypic levels.

1000 weight had a significant and positive correlation with number of productive tillers plant<sup>-1</sup> at both genotypic and phenotypic levels, it demonstrated a non-significant and positive correlation with panicle girth and plant height. The 1000 weight demonstrated a significant and negative correlation with days to 50 percent flowering, and non-significant and negative correlation with days to maturity and panicle length at both genotypic and phenotypic levels.

Similar findings were recorded by Annamalai *et al.*, (2020), Patil *et al.*, (2021), Kamble *et al.*, (2022), Shashibhushan *et al.*,(2022) Aswini *et al.*,(2023), Andhale *et al.*, (2024).

**Path analysis :** Genotypic and phenotypic path coefficient analyses were conducted

between grain yield and each of the seven contributing traits, as well as among the traits themselves, to assess their direct and indirect effects on seed yield plant<sup>-1</sup>. The results are presented in Tables 4 and 5.

**Direct effect of yield components on grain yield plant<sup>-1</sup> :**

Out of the seven yield components studied in the genotypic path coefficient analysis, 1000 seed weight (0.5587) and productive tillers plant<sup>-1</sup> (0.3037) exhibited a substantial positive direct effect on grain yield plant<sup>-1</sup> and also showed significant positive correlations with it. Panicle girth (-0.1272) showed a negative direct effect, despite having a significant positive correlation (0.0294) with grain yield, indicating a strong indirect contribution via other traits. Panicle length (0.0676) had a low direct effect and was negatively correlated (-0.0548) with grain yield. Days to 50% flowering (0.1747) exhibited a positive direct effect but had a negative correlation (-0.1794) with grain yield, suggesting the dominance of indirect negative effects. Days to maturity (-0.2168) and plant height (-0.1356) showed negative direct effects and non-significant negative correlations with grain yield.

In the phenotypic path coefficient analysis, 1000 seed weight (0.5400) and productive tillers plant<sup>-1</sup> (0.3205) exhibited the highest positive direct effects on grain yield plant<sup>-1</sup>, along with

**Table 3.** Phenotypic correlation co-efficient for eight characters in pearl millet. during summer season

Characters	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	Productive tillers plant-1	Panicle length (cm)	Panicle girth (cm)	1000 Seed wt. (g)	Grain yield plant-1 (g)
Days to 50 Per cent flowering	1.0000	0.9419**	-0.0080	-0.1320	0.3582**	-0.1903	-0.2574*	-0.1725*
Days to maturity		1.0000	-0.0455	-0.2663*	0.3289*	-0.2551*	-0.2449	-0.2036*
Plant height at maturity (cm)			1.0000	0.1290	-0.1682	-0.1616	0.0244	-0.0760
Productive tillers plant <sup>-1</sup>				1.0000	-0.1630	0.2932*	0.2773*	0.4214**
Panicle length (cm)					1.0000	-0.1333	-0.1756	-0.0453
Panicle girth (cm)						1.0000	0.0161	0.0140
1000Seed Weight(g)							1.0000	0.6209**

\*, \*\*Indicates significance at 5 % and 1% level respectively

significant positive correlations. Panicle girth (-0.1137) showed a negative direct effect, despite having a significant positive correlation (0.0140) with grain yield, indicating substantial indirect contributions. Days to 50% flowering (0.0210) had a negligible direct effect but was negatively correlated (-0.1725) with grain yield, suggesting predominant indirect negative effects. Panicle length (0.0777) had a low positive direct effect, yet it also showed a negative correlation (-0.0453) with grain yield. Plant height (-0.1387) and days to maturity (-0.0666) exhibited negative direct effects and non-significant negative correlations with grain yield.

As revealed by the above results, 1000 seed weight, productive tillers plant<sup>-1</sup>, days to 50% flowering, and panicle length exhibited a positive

direct effect on grain yield plant<sup>-1</sup> at both genotypic and phenotypic levels. Conversely, plant height, days to maturity, and panicle girth showed a negative direct effect on grain yield at both levels.

The similar findings were reported by Mundiya *et al.*, (2024) days to 50% flowering, panicle diameter and fodder yield were exerted highest positive direct effect; Sharma *et al.*, (2024) leaf width and dry fodder yield plant<sup>-1</sup> by showing high and positive direct effects towards green forage yield plant<sup>-1</sup>.

**Indirect effect of yield components on grain yield plant<sup>-1</sup> :** Days to 50% flowering had a non-significant and negative correlation with grain yield plant<sup>-1</sup> and contributed through

**Table 4 (A).** Genotypic path co-efficient for eight characters in Pearl millet during summer season

Characters	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	Productive tillers plant <sup>-1</sup>	Panicle length (cm)	Panicle girth (cm)	1000 Seed wt. (g)	Grain yield plant <sup>-1</sup> (g)
Days to 50 per cent flowering	<b>0.1747</b>	0.1671	0.0001	-0.0284	0.0640	-0.0379	-0.0468	-0.1794
Days to maturity	-0.2074	<b>-0.2168</b>	0.0078	0.0650	-0.0741	0.0640	0.0533	-0.2125
Plant height at maturity (cm)	0.0001	0.0049	<b>-0.1356</b>	-0.0169	0.0227	0.0231	-0.0010	-0.0757
Productive tillers plant <sup>-1</sup>	-0.0493	-0.0910	0.0378	<b>0.3037</b>	-0.0510	0.1002	0.0959	0.4464**
Panicle length (cm)	0.0247	0.0231	-0.0113	-0.0113	<b>0.0676</b>	-0.0097	-0.0124	-0.0548
Panicle girth (cm)	0.0276	0.0376	0.0217	-0.0420	0.0183	<b>-0.1272</b>	-0.0038	0.0294*
1000 Seed Weight (g)	-0.1498	-0.1373	0.0039	0.1763	-0.1023	0.0168	<b>0.5587</b>	0.6438**

Residual effect = 0.6980. \*, \*\* Indicates significance at 5 % and 1% level respectively. Bold values indicated direct effect.

**Table 4. (B).** Phenotypic path co-efficient for eight characters in Pearl millet during summer season

Characters	Days to 50% flowering	Days to maturity	Plant height at maturity (cm)	Productive tillers plant <sup>-1</sup>	Panicle length (cm)	Panicle girth (cm)	1000 Seed wt. (g)	Grain yield plant <sup>-1</sup> (g)
Days to 50 per cent flowering	<b>0.0210</b>	0.0198	-0.0002	-0.0028	0.0075	-0.0040	-0.0054	-0.1725
Days to maturity	-0.0627	<b>-0.0666</b>	0.0030	0.0177	-0.0219	0.0170	0.0163	-0.2036
Plant height at maturity (cm)	0.0011	0.0063	<b>-0.1387</b>	-0.0179	0.0233	0.0224	-0.0034	-0.0760
Productive tillers / plant	-0.0423	-0.0854	0.0413	<b>0.3205</b>	-0.0523	0.0940	0.0889	0.4214**
Panicle length (cm)	0.0278	0.0255	-0.0131	-0.0127	<b>0.0777</b>	-0.0104	-0.0136	-0.0453
Panicle girth (cm)	0.0216	0.0290	0.0184	-0.0333	0.0151	<b>-0.1137</b>	-0.0018	0.0140*
1000 Seed Weight (g)	-0.1390	-0.1322	0.0132	0.1498	-0.0948	0.0087	<b>0.5400</b>	0.6209**

Residual effect = 0.7171. \*, \*\* Indicates significance at 5 % and 1% level respectively. Bold values indicated direct effect.

its indirect effect via positively with days to maturity, panicle length, and plant height, and negatively via., 1000 seed weight, panicle girth, productive tillers plant<sup>-1</sup> at genotypic level. Contrary result observed that Days to 50% flowering was negative correlation with grain yield plant<sup>-1</sup> and contributed through its indirect effect via positively with days to maturity, panicle length, and negatively with 1000 seed weight, panicle girth, productive tillers plant<sup>-1</sup>, and plant height, at phenotypic level.

Days to maturity had a non-significant and negative correlation with grain yield plant<sup>-1</sup> and contributed indirectly through positive effects via productive tillers plant<sup>-1</sup>, panicle girth, 1000 seed weight, and plant height, and through negative effects via days to 50% flowering and panicle length, at both the genotypic and phenotypic levels. Plant height had non-significant and negative phenotypic correlation was exhibited by plant height with grain yield plant<sup>-1</sup> and contributed through its indirect effect via., positively with panicle girth, panicle length, Days to maturity, days to 50% flowering and negatively via. productive tillers plant<sup>-1</sup>, and 1000 seed weight at both genotypic and phenotypic level. Productive tillers plant<sup>-1</sup> had a positive and significant correlation with grain yield. It exerted indirect effects positively through panicle girth, 1000 seed weight, and plant height, and negatively through days to maturity, panicle length, and days to 50% flowering at both genotypic and phenotypic levels.

Panicle length exhibited a non-significant and negative correlation with grain yield plant<sup>-1</sup> and contributed through its indirect effects positively via days to 50% flowering and days to maturity, and negatively via 1000 seed weight, plant height, productive tillers plant<sup>-1</sup> and panicle girth at both genotypic and phenotypic levels.

Panicle girth had a significant and positive correlation with grain yield plant<sup>-1</sup>. It contributed indirectly via positive associations with days to

maturity, days to 50% flowering, plant height, and panicle length, and negative associations with productive tillers plant<sup>-1</sup> and 1000 seed weight at both genotypic and phenotypic levels. 1000-seed weight showed a significant and positive genotypic correlation with grain yield plant<sup>-1</sup> & contributed through its indirect effects positively via productive tillers plant<sup>-1</sup>, plant height, and panicle girth, while negatively via days to 50% flowering, days to maturity, and panicle length at both genotypic and phenotypic levels.

The same findings were reported by Thangasamy and Gomathinayagam., (2003), Meena Kumari *et al.*, (2008), Abuli *et al.*, (2012), Govindaraj and Selvi., (2012), Pallavi *et al.*, (2020), Shasibbushan *et al.*, (2021), Akhare *et al.*, (2023), Goswami *et al.* (2023), Mundiyyara *et al.*, (2024) and Sharma *et al.* (2024). And contrary results were recorded for days to maturity by Pallavi *et al.*, (2020), Akhare *et al.*, (2023).

## Conclusion

Correlation studies at both genotypic and phenotypic levels were conducted to determine the direction and magnitude of associations among various characters. The analysis revealed that grain yield plant<sup>-1</sup> had a significant positive correlation with traits such as 1000 seed weight and productive tillers plant<sup>-1</sup>. In contrast, days to maturity and days to 50 per cent flowering showed significant negative correlations at both genotypic and phenotypic levels. A non-significant positive correlation was observed with panicle girth, while grain yield plant<sup>-1</sup> exhibited non-significant and negative associations with plant height and panicle length at both genotypic and phenotypic levels. In path analysis the high magnitudal direct effect was observed for the characters productive tillers plant<sup>-1</sup>, panicle girth, and 1000 seed weight as well as the highly significant correlation in the desired direction towards grain yield.

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