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

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## Abstract

The seventy-seven restorer lines of pearl millet [*Pennisetum Glaucum* (L.) R. Br.] were evaluated for nine quantitative characters during summer season 2025 with a view to study the correlation and path analysis for grain yield and its yield contributing characters. The experiment was carried out in Randomized Block Design (RBD) with two replications at Bajra Research Scheme, Govt. College of Agriculture, Dhule. The analysis of variance showed significant differences among genotypes, as indicated by the mean sum of squares for genotypes being significant for all traits. Grain yield plant$^{-1}$ demonstrated positive and significant correlation with productive tillers plant$^{-1}$, panicle girth, 1000 seed weight and dry fodder yield plant$^{-1}$ at both genotypic and phenotypic levels. Conversely, it showed a significant negative correlation with days to 50 per cent flowering and days to maturity at both levels. A non-significant but positive association was observed with plant height and panicle length at both genotypic and phenotypic levels. In path analysis high magnitude direct effect of number of productive tillers plant$^{-1}$ and panicle girth, as well as the highly significant correlation in the desired direction towards grain yield, indicates direct selection based on these characters would help in selecting the high grain yielding genotypes.

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

Pearl Millet [*Pennisetum glaucum* (L.) R.Br.] is one of the millets belongs to family Poaceae (Gramineae), subfamily Panicoideae and genus Cenchurus. It is one of the most important staple cereal crops cultivated extensively in the arid and semi-arid regions of the world (Choudhary *et al*., 2021; Riahi *et al*., 2024. It is the eighth major world cereal and fifth major crop after wheat, rice, maize, and sorghum in India (Singhal *et al*., 2022. Local names of bajra in India are Pearl Millet (English), Bajra (Hindi, Urdu, Punjabi), Sajje (Kannada), Kambu (Tamil), Kambam (Malayalam), Sajjalu (Telugu), Bajri (Rajasthani, Gujarati, and Marathi) (Directorate of Millets Development, Jaipur.

Pearl millet is an important coarse-grain, drought-tolerant, warm-season cereal crop. It is a diploid (2x = 14), annual C4 species. It is considered as cross-pollinated crop (allogamous) especially it shows protogyny condition. The chief pollinating agent is wind (anemophily. India is considered as the secondary centre of diversity (Brunken,1977. Pearl millet is widely grown millet crop in Africa and Indian subcontinents from prehistoric era. Pearl millet is well adopted to grow in dry land condition, low soil fertility, high temperature, etc. It is an underutilized crop with enormous nutritional potential that must be completely utilized, and it has higher grain yield ceiling temperatures (Krishnan and Meera, 2018.

The Government of India has named 2018 as the “Year of Millets,” (Anonymous, 2018) and the FAO Committee on Agriculture (COAG) forum has declared 2023 as the “International Year of Millets” to bring millets into the main stream for leveraging their nutritional rich features and encouraging their development (FAO,2024.

The term correlation coefficient was first used by Karl Pearson in 1902. Correlation analysis is a biometrical technique used to determine the nature and degree of association between various morphological traits, including yield. The path coefficient analysis provides an effective means of finding out direct and indirect causes of association and it measures the direct and indirect contribution of various independent characters on a dependent character in general yield. The technique of path coefficient analysis was developed by Wright (1921) and demonstrated by Dewy and Lu (1959.

## Materials and methods

The experimental material used for the present research consisted of 77 restorer lines of pear millet [*Pennisetum glaucum* (L.) R. Br.], which were obtained from the Bajra Research Scheme, Govt. College of Agriculture, Dhule which were evaluated in Summer-2025. The list of genotypes used in the study is presented in Table 1. Recommended cultural practices were adopted to raise a healthy crop. Observations were recorded on nine characters *viz*., days to 50 per cent flowering, days to maturity, plant height (cm), productive tillers plant$^{-1}$, panicle length (cm), panicle girth (cm), 1000 seed weight (g), grain yield plant$^{-1}$, dry fodder yield plant$^{-1}$. To know the mutual association between seed yield plant$^{-1}$ 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 plan$^{-1}$ and its components :** In the present study, grain yield plant$^{-1}$ (Table 2) showed strong significantly positive genotypic association with productive tillers plant$^{-1}$ (0.684), panicle girth (0.3646) ,1000 seed weight (0.3583) and dry fodder yield plant$^{-1}$ (0.5695. Grain yield plant$^{-1}$ had positive non-significant genotypic association with plant height (0.1578) and panicle length (0.0417. Grain yield per plant showed strong significantly negative genotypic association with days to 50 per cent flowering (-0.1704) and days to maturity -0.1729.

Grain yield plant$^{-1}$ (Table 3) exhibited a strong and significant positive phenotypic correlation with productive tillers plant$^{-1}$ (0.6462), panicle girth (0.3376) , 1000 seed weight (0.332) and dry fodder yield plant$^{-1}$ (0.487. A positive but non-significant association was observed with plant height (0.1474) and panicle length (0.0375. Grain yield per plant showed a significant negative correlation with days to 50 per cent flowering (-0.1692) and days to maturity (-0.1727.

Grain yield plant$^{-1}$ demonstrated a strong, positive, and significant correlation with productive tillers plant$^{-1}$, panicle girth, 1000 seed weight and dry fodder yield plant$^{-1}$ at both genotypic and phenotypic level. Conversely, it showed a significant negative correlation with days to 50 per cent flowering and days to maturity at both levels, signifying that early flowering genotypes tend to have higher yield potential by Srivastava *et al*. 2022) and Ausiku *et al*. 2025. A non-significant but positive association was observed with plant height and panicle length at both genotypic and phenotypic level.

Similar results were confirmed by Patil *et al*.,(2021) test seed weight, fodder yield plant$^{-1}$, ear head girth, number of productive tillers, ear head length, 50 per cent flowering, plant height; Kumar Ravindra *et al*.,(2022) revealed a significant and negative association of days to 50% flowering and days to maturity with seed yield; Andhale *et al*.,(2024) plant height, productive tillers, panicle girth, panicle length, test seed weight, days to 50 per cent flowering, days to maturity; Bisoriya *et al*. 2025)for numbers of productive tillers, and 1000-seed weight , plant height ,negative correlations were observed between days to 50% flowering and SYPP; Singh & Chaudhary (2026) for days to 50% flowering , days to maturity, productive tillers plant$^{-1}$, panicle girth, 1000-grain weight and fodder yield plant$^{-1}$; Sirsat *et al*. 2026) for days to maturity, days to 50 per cent flowering 1000 seed weight and productive tillers plant plant$^{-1}$.

**Association between Component characters :** Days to 50 per cent flowering had a significant positive correlation with days to maturity at both genotypic and phenotypic level, as indicated by the above results. At both genotypic and phenotypic level, it also showed a significant negative correlation with plant height and dry fodder yield plant$^{-1}$. Additionally, at both genotypic and phenotypic level, it showed non-significant negative correlations with panicle length and while non-significant positive correlation was observed with panicle girth, 1000 seed weight and productive tillers plant$^{-1}$.

Days to maturity had a significant positive correlation with days 50 per cent to flowering and non-significant positive correlation was observed with panicle length and panicle girth as shown in the above results. At both the genotypic and phenotypic level, plant height and dry fodder yield plant$^{-1}$ had a significant and negative correlation. At both genotypic and phenotypic level, indicated a non-significant and

**Table 1.** List of seventy-seven restorer lines(R lines) of pearl millet

| Genotype | Source | Genotype | Source | Genotype | Source |
|---|---|---|---|---|---|
| IC-DHLBIR-2024-1 | ICRISAT | IC-DHLBIR-2024-27 | ICRISAT | IC-DHLBIR-2024-53 | ICRISAT |
| IC-DHLBIR-2024-2 | ICRISAT | IC-DHLBIR-2024-28 | ICRISAT | IC-DHLBIR-2024-54 | ICRISAT |
| IC-DHLBIR-2024-3 | ICRISAT | IC-DHLBIR-2024-29 | ICRISAT | IC-DHLBIR-2024-55 | ICRISAT |
| IC-DHLBIR-2024-4 | ICRISAT | IC-DHLBIR-2024-30 | ICRISAT | IC-DHLBIR-2024-56 | ICRISAT |
| IC-DHLBIR-2024-5 | ICRISAT | IC-DHLBIR-2024-31 | ICRISAT | IC-DHLBIR-2024-57 | ICRISAT |
| IC-DHLBIR-2024-6 | ICRISAT | IC-DHLBIR-2024-32 | ICRISAT | IC-DHLBIR-2024-58 | ICRISAT |
| IC-DHLBIR-2024-7 | ICRISAT | IC-DHLBIR-2024-33 | ICRISAT | IC-DHLBIR-2024-59 | ICRISAT |
| IC-DHLBIR-2024-8 | ICRISAT | IC-DHLBIR-2024-34 | ICRISAT | IC-DHLBIR-2024-60 | ICRISAT |
| IC-DHLBIR-2024-9 | ICRISAT | IC-DHLBIR-2024-35 | ICRISAT | IC-DHLBIR-2024-61 | ICRISAT |
| IC-DHLBIR-2024-10 | ICRISAT | IC-DHLBIR-2024-36 | ICRISAT | IC-DHLBIR-2024-62 | ICRISAT |
| IC-DHLBIR-2024-11 | ICRISAT | IC-DHLBIR-2024-37 | ICRISAT | IC-DHLBIR-2024-63 | ICRISAT |
| IC-DHLBIR-2024-12 | ICRISAT | IC-DHLBIR-2024-38 | ICRISAT | IC-DHLBIR-2024-64 | ICRISAT |
| IC-DHLBIR-2024-13 | ICRISAT | IC-DHLBIR-2024-39 | ICRISAT | IC-DHLBIR-2024-65 | ICRISAT |
| IC-DHLBIR-2024-14 | ICRISAT | IC-DHLBIR-2024-40 | ICRISAT | IC-DHLBIR-2024-66 | ICRISAT |
| IC-DHLBIR-2024-15 | ICRISAT | IC-DHLBIR-2024-41 | ICRISAT | IC-DHLBIR-2024-67 | ICRISAT |
| IC-DHLBIR-2024-16 | ICRISAT | IC-DHLBIR-2024-42 | ICRISAT | IC-DHLBIR-2024-68 | ICRISAT |
| IC-DHLBIR-2024-17 | ICRISAT | IC-DHLBIR-2024-43 | ICRISAT | IC-DHLBIR-2024-69 | ICRISAT |
| IC-DHLBIR-2024-18 | ICRISAT | IC-DHLBIR-2024-44 | ICRISAT | IC-DHLBIR-2024-70 | ICRISAT |
| IC-DHLBIR-2024-19 | ICRISAT | IC-DHLBIR-2024-45 | ICRISAT | IC-DHLBIR-2024-71 | ICRISAT |
| IC-DHLBIR-2024-20 | ICRISAT | IC-DHLBIR-2024-46 | ICRISAT | IC-DHLBIR-2024-72 | ICRISAT |
| IC-DHLBIR-2024-21 | ICRISAT | IC-DHLBIR-2024-47 | ICRISAT | IC-DHLBIR-2024-73 | ICRISAT |
| IC-DHLBIR-2024-22 | ICRISAT | IC-DHLBIR-2024-48 | ICRISAT | IC-DHLBIR-2024-74 | ICRISAT |
| IC-DHLBIR-2024-23 | ICRISAT | IC-DHLBIR-2024-49 | ICRISAT | IC-DHLBIR-2024-75 | ICRISAT |
| IC-DHLBIR-2024-24 | ICRISAT | IC-DHLBIR-2024-50 | ICRISAT | IC-DHLBIR-2024-76 | ICRISAT |
| IC-DHLBIR-2024-25 | ICRISAT | IC-DHLBIR-2024-51 | ICRISAT | IC-DHLBIR-2024-77 | ICRISAT |
| IC-DHLBIR-2024-26 | ICRISAT | IC-DHLBIR-2024-52 | ICRISAT | | |

negative correlation with productive tillers plant$^{-1}$ and 1000 seed weight.

Plant height exhibited a significant positive correlation with panicle length, productive tillers plant$^{-1}$ and dry fodder yield plant$^{-1}$ at both genotypic and phenotypic level, according to the above results. At both level, it also showed a significant negative correlation with panicle girth, days to 50 per cent flowering, days to maturity and 1000 seed weight. Number of productive tillers plant$^{-1}$ had a significant and positive correlation with plant height, panicle girth, 1000 seed weight, and dry fodder yield plant$^{-1}$ at both genotypic and phenotypic level also non-significant positive correlations with days to 50% flowering. At both genotypic and phenotypic level, it demonstrated non-significant negative correlations with days to maturity and panicle length.

Panicle length, at both genotypic and phenotypic level, it had a significant and positive correlation with plant height and dry fodder yield plant$^{-1}$; also exhibited non-significant positive correlation with and days to maturity as seen in the above results. The non-significant negative correlations with days to 50 per cent flowering, productive tillers plant$^{-1}$, panicle girth and 1000 seed weight.

Panicle girth, at both genotypic and phenotypic level, had a significant and positive correlation with number of productive tillers per plant and 1000 seed weight. At both genotypic and phenotypic level, it demonstrated a non-significant and positive correlation with days to 50 per cent flowering and days to maturity. The panicle girth demonstrated a significant and negative correlation with plant height, and non-significant and negative correlation with panicle length and dry fodder yield plant$^{-1}$ at both genotypic and phenotypic level.

1000 seed weight showed a significant and positive correlation with productive tillers plant$^{-1}$ and panicle girth at both genotypic and phenotypic level. Also, at both genotypic and phenotypic level, it demonstrated a non-significant and positive correlation with days to 50 per cent flowering and dry fodder yield plant$^{-1}$. The 1000 weight demonstrated a significant and negative correlation with plant height, and non-significant and negative correlation with days to maturity and panicle length at both genotypic and phenotypic level.

Dry fodder yield plant$^{-1}$, at both genotypic and phenotypic level, had a significant and positive correlation with plant height, number of productive tillers plant$^{-1}$ and panicle length. At

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

| Characters | Days to 50% flowe-ring | Days to matu-rity | Plant height at matu-rity (cm) | Produc-tive tillers plant$^{-1}$ | Panicle length (cm) | Panicle girth (cm) | 1000 Seed wt. (g) | Dry fodder yield plant$^{-1}$ (g) | Grain yield plant$^{-1}$ (g) |
|---|---|---|---|---|---|---|---|---|---|
| Days to 50% flowering | 1.0000 | 0.8752** | -0.3033** | 0.0029 | -0.0239 | 0.1299 | 0.0142 | -0.2005** | -0.1704* |
| Days to maturity | | 1.0000 | -0.2749** | -0.0559 | 0.0155 | 0.0444 | -0.0729 | -0.2262** | -0.1729* |
| Plant height at maturity (cm) | | | 1.0000 | 0.1962* | 0.4082** | -0.3556** | -0.1904* | 0.843** | 0.1578 |
| Productive tillers plant$^{-1}$ | | | | 1.0000 | -0.062 | 0.3127** | 0.3947** | 0.7908** | 0.684** |
| Panicle length (cm) | | | | | 1.0000 | -0.081 | -0.0372 | 0.2542** | 0.0417 |
| Panicle girth (cm) | | | | | | 1.0000 | 0.6952** | -0.0134 | 0.3646** |
| 1000 Seed weight (g) | | | | | | | 1.0000 | 0.1154 | 0.3583** |
| Dry fodder yield plant$^{-1}$ (g) | | | | | | | | 1.0000 | 0.5695** |

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

both genotypic and phenotypic level, it demonstrated a non-significant and positive correlation with 1000 seed weight. Dry fodder yield plant$^{-1}$ demonstrated a significant and negative correlation with days to 50 per cent flowering and days to maturity, and non-significant and negative correlation with panicle girth at both genotypic and phenotypic level.

Similar findings were reported by Kali *et al*. 2018); Annamalai *et al*. 2020); Dadarwal *et al*. 2020); Patil *et al*. 2021); Kumar Ravindra *et al*. 2022); Rani *et al*.,(2022); Shashi Bhushan *et al*. 2022); Andhale *et al*. 2024); Mundiyara *et al*. 2024); Bisoriya *et al*. 2025); Singh & Chaudhary (2026); Sirsat *et al*. 2026.

**Path Analysis :** Genotypic and phenotypic path coefficient analyses were conducted between grain yield and each of the eight contributing traits, as well as among the traits themselves, to assess their direct and indirect effects on seed yield plant$^{-1}$. The results are presented in Tables 4 and 5.

**Direct effect of yield components on grain yield plant$^{-1}$ :** Out of the seven yield components studied in the genotypic path coefficient analysis, the number of productive tillers plant$^{-1}$ (0.6619) had the highest positive direct effect on grain yield per. This characteristic demonstrated a most significant and positive correlation with plant grain yield (rg=0.684. For panicle girth (0.2454), similar results were observed along with significant and positive correlation with plant grain yield (rg=0.3646. The positive direct effect of panicle length (0.0823) and plant height (0.0545) were on plant grain yield, although there was a non-significant positive correlation with these characters (rg=0.0417) and (rg=0.1578), respectively. Days to 50 per cent flowering (-0.2815) exhibited highest negative direct effect on plant grain yield and a significant negative correlation (rg=-0.1704. Grain yield plant$^{-1}$ was positively affected by days to maturity (0.0996), with a significant and negative correlation (rg=-0.1729) with grain yield. Dry fodder yield plant$^{-1}$ (-0.0464) and 1000 seed weight (-0.0434) had the least negative direct effect on grain yield plant$^{-1}$ and had significant and positive correlation (rg=0.5695) and (rg=0.3583), with it respectively.

In the phenotypic path coefficient analysis, the number of productive tillers plant$^{-1}$ (0.5969) had the highest positive direct effect on grain yield plant$^{-1}$. This characteristic demonstrated a most significant and positive correlation with

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

| Characters | Days to 50% flowe-ring | Days to matu-rity | Plant height at matu-rity (cm) | Produc-tive tillers plant$^{-1}$ | Panicle length (cm) | Panicle girth (cm) | 1000 Seed wt. (g) | Dry fodder yield plant$^{-1}$ (g) | Grain yield plant$^{-1}$ (g) |
|---|---|---|---|---|---|---|---|---|---|
| Days to 50% flowering | 1.0000 | 0.7852** | -0.2893** | 0.0059 | -0.021 | 0.1342 | 0.0157 | -0.1721* | -0.1692* |
| Days to maturity | | 1.0000 | -0.2349** | -0.0578 | 0.0297 | 0.0326 | -0.0376 | -0.169* | -0.1727* |
| Plant height at maturity (cm) | | | 1.0000 | 0.184* | 0.3845** | -0.3298** | -0.1712* | 0.7177** | 0.1474 |
| Productive tillers plant-1 | | | | 1.0000 | -0.0806 | 0.2827** | 0.3238** | 0.7196** | 0.6462** |
| Panicle length (cm) | | | | | 1.0000 | -0.0589 | -0.012 | 0.2174** | 0.0375 |
| Panicle girth (cm) | | | | | | 1.0000 | 0.6252** | -0.011 | 0.3376** |
| 1000 Seed weight (g) | | | | | | | 1.0000 | 0.1066 | 0.332** |
| Dry fodder yield plant-1 (g) | | | | | | | | 1.0000 | 0.487** |

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

plant grain yield (rp=0.6462. For panicle girth (0.1913) and 1000 seed weight (0.0309), moderate positive direct effect on grain yield plant$^{-1}$ were observed along with significant and positive correlation with plant grain yield (rp=0.3376) and (rp=0.332), respectively. The positive direct effect of panicle length (0.0842) and plant height (0.0293) were on plant grain yield, although there was a non-significant positive correlation with these characters (rp=0.0375) and (rp=0.1474), respectively. Days to 50 per cent flowering (-0.209) exhibited highest negative direct effect on plant grain yield and a significant negative correlation (rp=-0.1692. Grain yield plant$^{-1}$ was positively affected by days to maturity (0.0227), with a significant and negative correlation (rp=-0.1727) with grain yield. Dry fodder yield plant$^{-1}$ (-0.0464) on the other hand, had the least negative direct effect on grain yield plant$^{-1}$ and had significant and positive correlation (rp=0.487) with it.

As revealed by the above results, number of

**Table 4.** Genotypic path co-efficient for eight characters in pearl millet

| **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)** | **Dry fodder yield plant$^{-1}$ (g)** | **Grain yield plant$^{-1}$ (g)** |
|---|---|---|---|---|---|---|---|---|---|
| Days to 50% flowering | **-0.2815** | -0.2464 | 0.0854 | -0.0008 | 0.0067 | -0.0366 | -0.004 | 0.0564 | -0.1704* |
| Days to maturity | 0.0872 | 0.0996 | **-0.0274** | -0.0056 | 0.0015 | 0.0044 | -0.0073 | -0.0225 | -0.1729* |
| Plant height at maturity (cm | -0.0165 | -0.015 | **0.0545** | 0.0107 | 0.0223 | -0.0194 | -0.0104 | 0.046 | 0.1578 |
| Productive tillers plant$^{-1}$ | 0.0019 | -0.037 | 0.1299 | **0.6619** | -0.0411 | 0.2069 | 0.2612 | 0.5234 | 0.684** |
| Panicle length (cm) | -0.002 | 0.0013 | 0.0336 | -0.0051 | 0.0823 | **-0.0067** | -0.0031 | 0.0209 | 0.0417 |
| Panicle girth (cm) | 0.0319 | 0.0109 | -0.0873 | 0.0767 | -0.0199 | 0.2454 | **0.1706** | -0.0033 | 0.3646** |
| 1000 Seed weight (g) | -0.0006 | 0.0032 | 0.0083 | -0.0171 | 0.0016 | -0.0302 | **-0.0434** | -0.005 | 0.3583** |
| Dry fodder yield plant$^{-1}$ (g) | 0.0093 | 0.0105 | -0.0391 | -0.0367 | -0.0118 | 0.0006 | -0.0054 | **-0.0464** | 0.5695** |
| Residual effect = 0.6760 | | | | | | | | | |

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

**Table 5.** Phenotypic path co-efficient for eight characters in pearl millet

| **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)** | **Dry fodder yield plant$^{-1}$ (g)** | **Grain yield plant$^{-1}$ (g)** |
|---|---|---|---|---|---|---|---|---|---|
| Days to 50% flowering | -0.209 | -0.1641 | 0.0605 | -0.0012 | 0.0044 | -0.0281 | -0.0033 | 0.036 | -0.1692* |
| Days to maturity | 0.0178 | 0.0227 | -0.0053 | -0.0013 | 0.0007 | 0.0007 | -0.0009 | -0.0038 | -0.1727* |
| Plant height at maturity (cm) | -0.0085 | -0.0069 | 0.0293 | 0.0054 | 0.0112 | -0.0097 | -0.005 | 0.021 | 0.1474 |
| Productive tillers plant$^{-1}$ | 0.0035 | -0.0345 | 0.1098 | 0.5969 | -0.0481 | 0.1687 | 0.1933 | 0.4295 | 0.6462** |
| Panicle length (cm) | -0.0018 | 0.0025 | 0.0324 | -0.0068 | 0.0842 | -0.005 | -0.001 | 0.0183 | 0.0375 |
| Panicle girth (cm) | 0.0257 | 0.0062 | -0.0631 | 0.0541 | -0.0113 | 0.1913 | 0.1196 | -0.0021 | 0.3376** |
| 1000 Seed weight (g) | 0.0005 | -0.0012 | -0.0053 | 0.01 | -0.0004 | 0.0193 | 0.0309 | 0.0033 | 0.332** |
| Dry fodder yield plant$^{-1}$ (g) | 0.0026 | 0.0026 | -0.0109 | -0.0109 | -0.0033 | 0.0002 | -0.0016 | -0.0151 | 0.487** |
| Residual effect = 0.7127 | | | | | | | | | |

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

productive tillers plant$^{-1}$, panicle girth, plant height, panicle length, days to maturity, exhibited a positive direct effect on grain yield plant$^{-1}$ at both genotypic and phenotypic levels. Conversely, days to 50% flowering and dry fodder yield plant$^{-1}$ showed a negative direct effect on grain yield at both levels. 1000 seed weight, on the other hand shown direct negative effect on grain yield at genotypic level and direct positive effect on grain yield at phenotypic level.

The similar findings were reported by Dehinwal *et al*. 2016) for day to 50 per cent flowering; Nehra *et al*.,(2017) for 1000 grain weight and number of productive tillers had high direct contribution towards grain yield plant$^{-1}$; by Pallavi *et al*.,(2020) for character viz., days to maturity and plant height; Mundiyara *et al*. 2024) for days to maturity, panicle length, panicle diameter, 1000 grain weight; Surendhar*et al*.,(2024) for number of productive tillers Sirsat *et al*. 2026) productive tillers plant$^{-1}$, panicle length shows high positive direct effect.

**Indirect effect of yield components on grain yield plant$^{-1}$ :** Days to 50% flowering had significant and negative correlation with grain yield plant$^{-1}$ and contributed through its indirect effect via; positively with plant height, dry fodder yield plant$^{-1}$, panicle length and negatively via., days to maturity, panicle girth, 1000 seed weight and productive tillers plant$^{-1}$ at both genotypic and phenotypic level.

Days to maturity had a significant and negative correlation with grain yield plant$^{-1}$ and contributed indirectly through positive effects via days to 50% flowering, panicle girth, panicle length, and through negative effects via plant height, dry fodder yield plant$^{-1}$, 1000 seed weight and productive tillers plant$^{-1}$, at both the genotypic and phenotypic level.

Plant height had non-significant and positive correlation was exhibited by plant height with grain yield plant$^{-1}$ and contributed through its indirect effect via., positively with dry fodder yield plant$^{-1}$, panicle length, productive tillers plant$^{-1}$ and negatively via. panicle girth, days to 50% flowering, days to maturity and 1000 seed weight.

Productive tillers plant$^{-1}$ had a positive and significant correlation with grain yield. It exerted indirect effects positively through number of effective tillers plant$^{-1}$ in grain yield plant$^{-1}$. It contributed indirectly via positive effects through dry fodder yield plant$^{-1}$, 1000 seed weight,

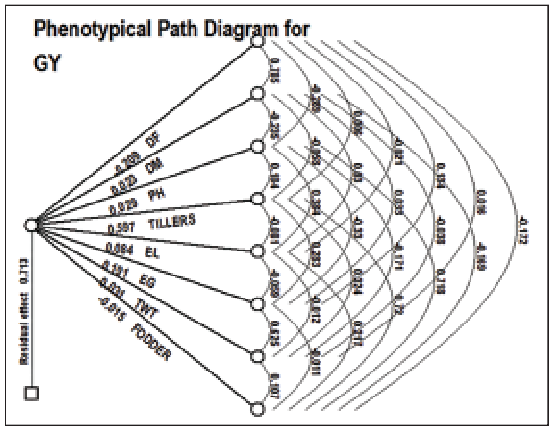


**Fig. 1.** Genotypic path diagram for grain yield.

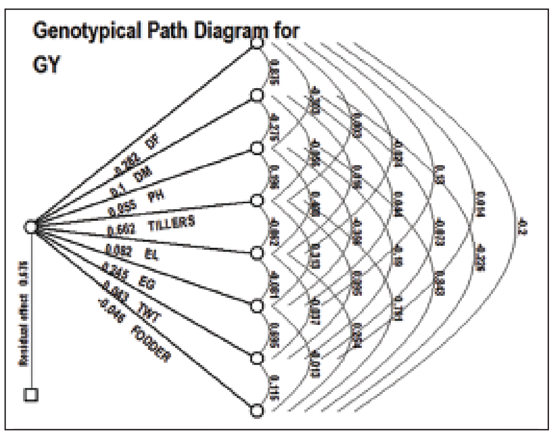


**Fig. 2.** Phenotypic path diagram for grain yield.

panicle girth, and plant height, days to 50% flowering, and negatively through panicle length, days to maturity at both genotypic and phenotypic level.

Panicle length exhibited a non-significant and positive correlation with grain yield plant$^{-1}$ and contributed through its indirect effects positively via plant height, dry fodder yield plant$^{-1}$, days to maturity, and negatively via panicle girth, productive tillers plant$^{-1}$, 1000 seed weight and days to 50 per cent flowering at both genotypic and phenotypic level.

Panicle girth had a significant and positive correlation with grain yield plant$^{-1}$. It contributed indirectly via positive associations with 1000 seed weight, productive tillers plant$^{-1}$, days to 50% flowering and days to maturity, while negative associations with plant height, panicle length and dry fodder yield plant$^{-1}$ at both genotypic and phenotypic level.

1000-seed weight showed a significant and positive correlation with grain yield plant$^{-1}$ at both genotypic and phenotypic level. It contributed through its indirect effects positively via plant height, days to maturity, panicle length, and negatively via panicle girth, productive tillers plant$^{-1}$, dry fodder yield plant$^{-1}$ and days to 50% flowering at genotypic level. On other side It contributed through its indirect effects positively via, panicle girth, productive tillers plant$^{-1}$, dry fodder yield plant$^{-1}$, and days to 50% flowering, and negatively via plant height, days to maturity, panicle length at phenotypic level.

Dry fodder yield plant$^{-1}$ had a significant and positive correlation with grain yield plant$^{-1}$. It contributed through its indirect effects positively via days to maturity, days to 50% flowering, panicle girth, and negatively via plant height, productive tillers plant$^{-1}$, panicle length and 1000 seed weight at both genotypic and phenotypic level.

The same results were recorded by Salunke *et al*. 2006) found that dry fodder weight per plant; Govindaraj and Selvi. 2012); Dehinwal *et al*. 2016); Nehra *et al*. 2017); Talawar *et al*. 2017); Dadarwal *et al*. 2020); Pallavi *et al*. 2020); Akhare *et al*. 2023); Mundiyara *et al*. 2024); Singh & Chaudhary (2026); Sirsat *et al*. 2026.

## Conclusion

Correlation studies at both genotypic and phenotypic levels were conducted to determine the direction and magnitude of associations among various characters. In the present study, genotypic correlations were generally higher than the corresponding phenotypic correlations indicated that most of these associations are genetically controlled and less influenced by the environment. The correlation study revealed that Grain yield plant$^{-1}$ demonstrated a strong, positive, and significant correlation with productive tillers plant$^{-1}$, dry fodder yield plant$^{-1}$, panicle girth and 1000 seed weight 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, signifying that early flowering genotypes tend to have higher yield potential. A non-significant but positive association was observed with plant height and panicle length at both genotypic and phenotypic levels. In path analysis the high magnitude direct effect of number of productive tillers plant-1 and panicle girth, as well as the highly significant correlation in the desired direction towards grain yield. The findings indicate that direct selection based on these traits would aid in identifying high-yielding genotypes.

## References

Akhare, M. B., Bagade, A. B., Patil, M. D., Haloli S. L., and Ingle P. R. 2023. Path analysis studies in pearl millet [*Pennisetum glaucum* (L.) R. Br.] germplasm. The Pharma Innovation Journal, 12(12): 1614-1618.

Andhale, G. R., Bhavsar, V. V., Goykar, M. B., Pawar, V. Y., and Thorat, V. 2024. "Study of Correlation International Journal of Environment and Climate Change 14 (2) : 30-44.

Anonymous. 2018. The gazette of India. Department of ministry and farmer's welfare. 13th April, 2018. http://www.agricoop.gov.in Accessed on 22th July, 2025.

Ausiku, P. A., Annandale, J. G., Steyn, M. J. and Sanewe, A. 2025. Growth analysis of pearl millet genotypes grown under different management practices. Agronomy, 15(4), 767.

Bisoriya, A., Tripathi, M. K., Mishra, R., Sharma, S., Rajpoot, S. S. and Solanki, R. 2025. Dissecting yield determinants through genetic parameters analysis in diverse restorer lines of pearl millet. Journal of Scientific Research and Reports, 31(7), 881-898.

Brunken, J. N. 1977. A systematic study of Pennisetum sect. pennisetum (gramineae. American jouranal of botany 64(2),161-176.

Choudhary, M. L., Tripathi, M. K., Gupta, N., Tiwari, S., Tripathi, N., Parihar, P. and Pandya, R. K. 2021. Screening of pearl millet [Pennisetum glaucum (L.) R. Br.] germplasm lines against drought tolerance based on biochemical traits. Current Journal of Applied Science & Technology, 40(23), 1-12.

Dadarwal, S. L., Rajput, S. S., and Yadav, G. L. 2020. Studies on correlation and path analysis for grain yield and its components in maintainer lines of pearl millet [*Pennisetum glaucum* (L.) R. Br.] Indian Journal of Current Microbiology and Applied Science. 9(12): 1158- 1164.

Dehinwal, A. K., Yadav, Y. P., Kumar, A., and Shiva, S. S. 2016. Correlation and path coefficient analysis for different biometrical and harvest plus traits in pearl millet [*Pennisetum glaucum* (L.) R. Br.]. Research in Environment and Life Science. 10(5): 407-410.

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

Directorate of Millets Development, Department of Agriculture, Co-operation & Farmers Welfare. Ministry of Agriculture & Farmers Welfare, Government of India, http://millets.dacfw.nic.in/. Accessed on 24th July, 2020.

FAO. 2024. International Year of Millets 2023. Final report. Rome.

Govindaraj, M. and Selvi, B. 2012. Path coefficient analysis in local pearl millet germplasm for grain minerals and agronomic character. Agriculture Science Digest, 32(2): 128-132.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Genotypic and phenotypic correlation in soybean and their implications in selection. Agronomy Journal. 47:477-483.

Kali, S., Sumathi, P., and Babu, C. 2018. Association study of grain yield and nutritional quality traits in pearl millet [*Pennisetum glaucum* (L.) R. Br.] hybrids. International Journal of Current Microbiology and Applied Science, 7(10): 2035-2039

Kali, S., Sumathi, P., and Babu, C. 2018. Association study of grain yield and nutritional quality traits in pearl millet [*Pennisetum glaucum* (L.) R. Br.] hybrids. International Journal of Current Microbiology and Applied Science, 7(10): 2035-2039

Krishnan R. and M. S. Meera. 2018. Pearl millet minerals: effect of processing on bio accessibility. Journal of Food Sciences and Technology. 55: 3362–3372.

Kumar, R., Gupta, P. C., Sanadya, S. K., Kumar, A., Yadav, M. K., and Chandel, D. 2022. Estimation of correlation coefficient and path analysis in hybrids of pearl millet [*Pennisetum glaucum* (L.) R. Br.] The Pharma Innovation Journal; 11(4): 880-882.

Mundiyara, R., Yadav, G. L., Bajiya, R., Singh, I., Khandelwal, V., and Kumari, V. 2024. Character association and path analysis for grain yield and its relative components in pearl millet [*Pennisetum glaucum* (L.) R. Br.] Plant Archives 24 (2) : 214-220

Nehra, M., Kumar, M., Kaushik, J., Vart,D., Sharma,R.K. and Punia, M. S. 2017. Genetic divergence, character association and path coefficient analysis for yield attributing traits in pearl millet [*Pennisetum glaucum* (L) R. Br] inbreds. Chemical Science Review and Letters, 6(21): 538-543.

Pallavi M., Reddy, P, S., Radha Krishna, K.V., Ratnavathi C. V., and Sujatha, P. 2020. Genetic variability, heritability and association of grain yield characters in pearl millet [*Pennisetum glaucum* (L.) R. Br.] 9(3): 1666-1669.

Panse, V. G., and Sukhatme, V. P. 1995. Statistical methods for agricultural workers. ICAR,New Delhi. 4th Edition, 145-150.

Patil, S. H., Wadikar, P. B., Dhutraj, D. N. and Sargar, P. R. 2021. Correlation analysis for grain yield and its components in pearl millet [*Pennisetum glaucum* (L.) R. Br.]. Madras Agricultural Journal, 108(4-6), 169-171.

Rani, R. E. N. U., Khandelwal, V., Ramesh, S. J., Singh, A. M. N. I. N. D. E. R. and Kumar, V. I. N. A. Y. 2022. Genetic variability and association analysis for dry fodder yield and its component traits in pearl millet inbred. Forage Res, 48(1), 57-61.

Riahi, L., Ben-Romdhane, M. and Masmoudi, A. S. 2024. Industrial interests and requirements for improvement of pearl millet, a gluten-free and climate-smart underutilized cereal. Journal of Plant Biotechnology, 51, 9. https://doi.org/10.5010/JPB.2024.51.009.077

Salunke, P. K., Dumbre, A. D., and Rajput, S. D. 2006. Correlation and path analysis in germplasms of pearl millet [*Pennisetum glaucum* (L.) R. Br.]. Journal of Maharashtra Agricultural University.31(1): 16-18.

Shashibhushan, D., Kumar, C. S., and Kondi, R. K. R. 2022. Genetic diversity analysis of Pearl Millet germplasm by cluster analysis. Emergent Life Sciences Research. 8(1): 70-74.

Singh, A. K., and Chaudhary, A. K. 2026. Genetic variability, character association, and path coefficient analysis for yield and micronutrients (Zinc and Iron) traits in pearl millet (*Pennisetum glaucum* L.. Journal of Experimental Agriculture International, 48(4), 452-460. https://doi.org/10.9734/jeai/2026/v48i44175

Singh, R. K., and Choudhary, B. D. 1977. Variance and covariance analysis. “Biometrical methods in quantitative genetic analysis” Kalyani publication, New Delhi. 39-68.

Singhal, T., Satyavathi, C.T., Singh, S.P., Mallik, M., Mukesh Sankar S., Bharadwaj C. 2022. Mapping and identification of quantitative trait loci controlling test weight and seed yield of pearl millet in multi agro-climatic zones of India, Field Crops Research.288:108701.

Sirsat, G. D., Barhate, K. K., Pawar, V. Y., Patil, J. M., Thorat, S.D., Munge, P. S. and Jagtap, P. M. 2026. Correlation and path analysis studies in pearl millet [*Pennisetum glaucum* (L.) R. Br.] during summer season. Journal of Agriculture Research and Technology, 51(2), 254-260. https://doi.org/10.56228/jart.2026.51215

Srivastava, R. K., Yadav, O. P., Kaliamoorthy, S., Gupta, S. K., Serba, D. D., Choudhary, S., and Varshney, R. K. 2022. Breeding drought-tolerant pearl millet using conventional and genomic approaches: achievements and prospects. Frontiers in plant science, 13, 781524.

Surendhar, A., Iyanar, K., Ravikesavan, R. and Nivethitha, T. 2024. Elucidation of Genetic Variability and Trait Association in Pearl Millet [*Pennisetum glaucum* (L.) R. BR.] Genotypes. Ecology, Environment & Conservation. 0971765X), 30.

Talawar A. M., Girish, G., Channabaavanna, A. S., Kitturmath, M. S. 2017. Stidies on genetic variability, correlation and path analysis in pearl millet [*Pennisetum glaucum* (L.) R. Br] germplasm lines. Agricultural Science Digest. 37) 1. 75:77