Original Research Article

Deciphering on Pearl Millet Grain Yield under Drought Using Genotypic, Phenotypic Correlation and Path Coefficient Analysis

Abstract

Yield is a complex trait that is controlled by a large number of genes. A study was conducted to evaluate the relationship between yield and its components in pearl millet using correlation and path studies. In the current study, significant genotypic and phenotypic correlations were found among eighteen yield contributing traits in pearl millet hybrids. The positively correlated traits days to 50% flowering, plant height, and panicle length per plant with grain yield Plant^{-1} was implying the importance of these traits in selection for yield. The Correlation studies could be used to determine the extent and nature of relationships between yield and yield contributing characters in order to determine the influence of each character on grain yield. Grain yield plant^{-1} was used as a dependent character in path-coefficient analysis at the genotyping level. Plant height and panicle length were the independent variables (cm). The highest positive and direct effect was found for days to 50 percent flowering (0.9946) followed by panicle diameter (cm) (0.5726). When compared to other characters, these traits contributed the most to higher grain yield; thus, selecting for these traits aids in yield improvement.

Keywords: Correlation, Yield, Pearl Millet, Path Coefficient, Drought, Genotype,

Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.], popularized as bajra (2n = 14) belongs to the family *Poaceae* (earlier *Gramineae*) and is highly cross-pollinated crop with protogynous condition (**Animasaun *et al.*, 2019**). It is heterogenous as well as heterozygous in nature. In India, pearl millet ranks fourth amongst the most widely cultivated food crop after rice, wheat, and maize. Total cultivable area covers 6.93 million ha throughout the nation and secures 8.61 million tons of annual production and 1,243 kgha^{-1} of productivity (**Directorate of Millets Development, 2020**). Pearl millet is thought to be originated in West Africa (**Vavilov, 1950**). Although it is grown all over the world, Nigeria, Pakistan, Sudan, and Saudi Arabia contribute as the major pearl millet growing countries throughout the globe. In India, the major pearl millet growing states are Rajasthan, Maharashtra, Gujarat, Uttar Pradesh and Haryana, covering nearly 90% acre.

Ali *et al*., 2003 reported nutritional value for pearl millet of about 92.5% dry matter, 2.1% ash, 2.8% crude fiber, 7.8% crude fat, 13.6% crude protein, and 63.2% starch.

Drought is one of the most important abiotic stress factors affecting plant growth and development (**Bruce *et al*., 2002**). Drought tolerant crop varieties are the best option for good production, crop yield improvement, and yield stability under drought stress conditions. Selection of the lines/cultivars/genotypes that perform best under stress conditions is one of the major goals of drought breeding programs. However, due to the low heritability of drought tolerance and the complexity of the situation, as well as a lack of effective selection procedures, the development of drought-resistant crop cultivars is hampered.

As early as 1951 (**Rao *et al*., 1951**), attempts were made in India to produce pearl millet hybrids, and commercial exploitation of heterosis began after the availability of the male sterile line Tift 23A from Georgia, USA (**Burton, 1958**). Estimates of correlation between yield and other characters are helpful in selecting desired plant characteristics for a successful breeding program. The correlation coefficient calculates the degree of association as well as the genetic or non-genetic relationship between two or more characters, which is used to make selection decisions. The correlation coefficient is split into measures of direct and indirect effects of a set of independent variables on the dependent variables in path analysis (**Searle 1961**).

Correlation studies are used to determine the nature and extent of relationships between yield and other yield attributing traits in order to better understand the traits that influence yield. A plant breeder's primary goal is to improve yield and stability. As a result, correlation analysis of a particular trait with other yield-related traits is critical for selecting lines with higher yield. The correlation coefficient can be partitioned into direct and indirect effects using path coefficient analysis. The goal of this study was to determine the genotypic and phenotypic correlations, as well as the direct and indirect contributions of various traits to yield.

Materials and Methods

For the current study, eighteen hybrids of pearl millet were collected from the Rajasthan Agriculture Research Institute, Durgapura, Jaipur under the supervision of S.K.N.A.U, Jobner. These hybrids were planted in a three-replication randomized block design. Each hybrid was planted in a two-row experimental plot measuring 1 meter in length, with 45 x 10 cm inter and intra row spacing. The hybrids were tested in two replications over two years under well-watered and water-stressed conditions. Days to 50% flowering, plant height (cm), panicle length (cm), panicle diameter (cm), and grain yield per plant were all recorded (g). In each replication, observations were made on five randomly selected plants from each plot.

Statistical analysis

To better understand the associations and relationships between traits, the genotypic and phenotypic correlation coefficients were calculated using the method described by **Singh and Chaudhary (1977)**. Path analysis was used to divide the genotypic and phenotypic correlation coefficient into direct and indirect effects in order to establish a cause and effect relationship between the traits, as suggested by **Dewey and L**

RESULTS AND DISCUSSIONS

Grain yield is a complex trait that is influenced by a number of factors. As a result, character association was investigated in the current study to assess the relationships between yield and its components in order to improve the usefulness of selection.

In general, genotypic correlations were shown to be stronger than phenotypic correlations, indicating that, despite the importance of phenotypic correlation, there is a considerable influence of environment.

Table 1 shows the genotypic correlations between all of the pairs of characters studied. Grain yield per plant was significantly related to days to 50 percent flowering (0.762), followed by plant height (0.657), panicle length (0.446).

These findings are similar to those of earlier studies in pearl millet on various traits, such as grain yield, panicle length (Om Vir Singh and Singh 2016), days to 50 percent flowering (**Izge *et al*., 2006**), and plant height. (**Shashikant *et al*., 2012**).

These finding supports **Bello *et al*., (2001)** and **Khairwal *et al*.,** (1999) findings in pearl millet. Negative correlation with panicle diameter (-0.0348). Similar observations were also reported for days to panicle diameter (**Abubakar *et al*., 2020**).

The phenotypic correlations between all of the pairs of traits analyzed are shown in Table 2. Grain yield was positively correlated to days to 50 percent flowering (0.521), followed by plant height (0.278), panicle length (0.2339). Negative correlation with panicle diameter (-0.0531). Similar observations were also reported for days to panicle diameter

By partitioning the correlation, the path coefficient analysis allows separation of the direct and its indirect effects through other variables (**Wright, 1921**).

The characters with the strongest direct effect on grain yield were days to 50 percent flowering (0.9946), panicle diameter (0.5726) according to the path coefficient analysis at the genotypic level.

The strong relationship between grain yield per plant and the days to 50 percent flowering, panicle length and panicle diameter proved to be the key determinant **(Rakesh *et al*., 2015**).

Furthermore, in the current study, plant height (-0.3339) and panicle diameter (-0.2735) **Patil and Jadeja** (2005) had a negative direct effect on grain yield. For genotypic path coefficient analysis, the residual effect was 0.908. Because the residual effect is so highly significant, it means that all of the characters studied had a positive impact on grain yield.

Table.1. Genotypic Correlation coefficients for different traits in hybrids of pearl millet

Traits	DF	PH	PL	PD	GY
DF	1	0.762**	0.3519	-0.6031**	0.2987
PH		1	0.6575**	-0.097	0.2707
PL			1	0.446*	0.0407
PD				1	-0.0348
GY					1

*, ** Significant at 5 and 1 per cent level. DF = days to 50% flowering, PH = plant height meter, PL = panicle length cm, PD = panicle diameter, GY = grain yield plant $^{-1}$

Table.2. Phenotypic Correlation coefficients for different traits in hybrids of pearl millet

Traits	DF	PH	PL	PD	GY
DF	1	0.521**	0.1573	-0.394**	0.0422
PH		1	0.278*	-0.0551	0.1875
PL			1	0.2339*	-0.041
PD				1	-0.0535
GY					1

*, ** Significant at 5 and 1 per cent level. DF = days to 50% flowering, PH = plant height meter, PL = panicle length cm, PD = panicle diameter, GY = grain yield plant $^{-1}$

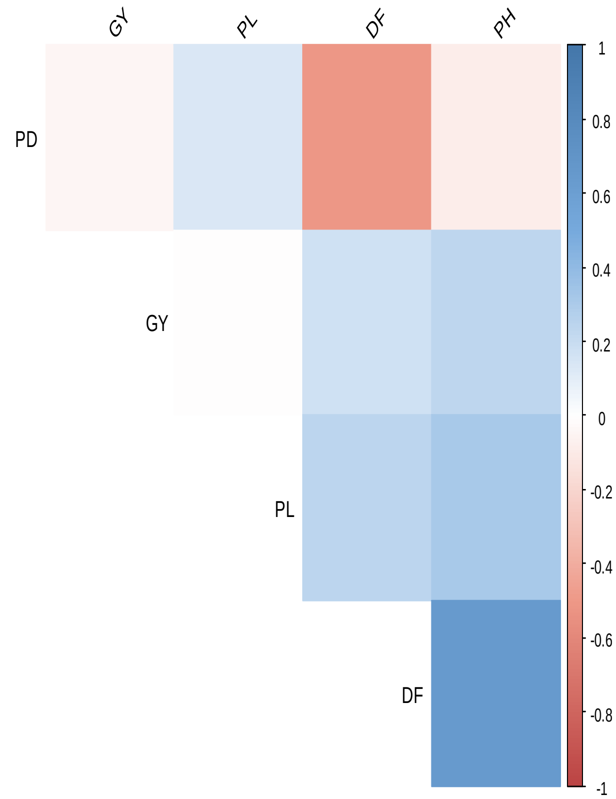

Fig :1 Correlalogram

Table.2 Direct and indirect effects (genotypic level) of yield contributing traits on grain yield plant^{-1} (g) in hybrids of pearl millet

Traits	DF	PH	PL	PD
DF	**0.9946**	0.7579	0.35	-0.5998
PH	-0.2545	**-0.3339**	-0.1194	0.0324
PL	-0.0962	-0.0978	**-0.2734**	-0.0399
PD	-0.3453	-0.0556	0.0836	**0.5726**
GY	0.2987	0.2707	0.0407	-0.0348
Partial R2	0.2971	-0.0904	-0.0111	-0.0199

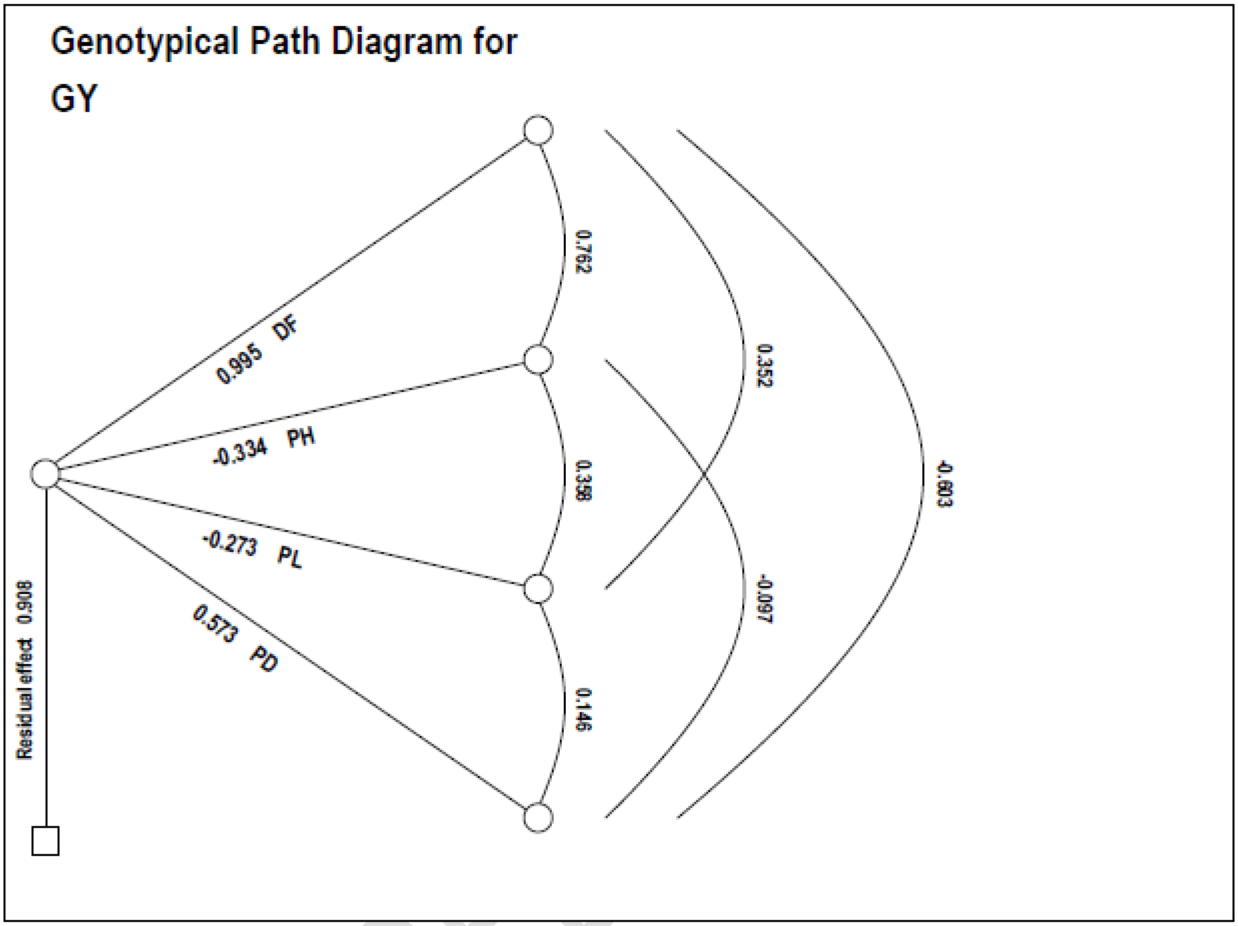

Fig: 2 Genotypic path diagram for grain yield plant^{-1}

CONCLUSION

The key yield contributing traits in pearl millet are, days to 50% blooming, and panicle length, according to correlations and path analysis.

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