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Correlation Studies and Path Coefficient Analysis for Pearl Millet Hybrids under Hyper Arid Conditions

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Abstract Correlation and path coefficient studies were conducted on 10 metric characters of 120 hybrids of pearl millet. On considering correlation coefficients it revealed that direct selection for higher values of biological yield per plant (g), harvest index (%), number of effective tillers per plant, plant height (cm) and ear head diameter per plant (cm), will be effective in improving grain yield per plant. Path analysis revealed that high positive direct effect was observed for biological yield per plant (g) and harvest index (%). The high positive association of other characters with grain yield per plant (g) was due to indirect effect of plant height and ear head diameter via biological yield per plant (g) and number of effective tiller per plant via harvest index (%) and biological yield per plant (g).

Keywords Correlation, Path coefficient, Grain yield, Direct effects, Indirect effects.

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Introduction

Pearl millet [*Pennisetum glaucum* (L.) R. Br.], 2n=14, locally known as *Bajra*, is an allogamous crop with protogynous nature and belongs to the family Poaceae. Its origin place is Western Africa from there it was introduced into India. Pearl millet is usually cultivated all over the world while India, Nigeria, Pakistan, Sudan, Saudi Arabia are the major pearl millet growing countries in the world including India. Pearl millet is an inmportant coarse grain cereal crop of dry land agriculture. It can easily be grown on light textured soil under low moisture conditions. It is most important and probably most potential crop among the millets. It is extensively cultivated as a dual purpose crop under large areas in Africa, Asia and Australia while grown as forage crop only in sub-tropics of USA.

Pearl millet is very nutritious and staple diet of approximately 10% of the population in India. It is rich in protein with slightly superior amino acid profile. It is a good source of protein (5.8-20.9%), fat (4.1-6.4%), carbohydrate (59.8-78.2%) and also has good amount of minerals, particularly phosphorus and iron (2.8%). It also contains higher amount of carotene which is the pre-cursor of vit A, thiamine (vit B_1), riboflavin (vit B_2) and niacin (vit B_4).

Pearl millet is traditionally grown as rainfed crop mostly under low fertility and rainfall condition. Rajasthan occupies first position in area and production of Pearl millet in India. In Rajasthan, it is culti-

vated on 44.13 lac hectares area with the production of 41.18 lac tonnes and productivity of 933 kg/ha [1]. The average yield of pearl millet in north-western part of Rajasthan is very low ranging from 4 to 5 q/ha. Such low productivity levels are owing to unavailability of high yielding hybrids for arid regions, able to withstand severe moisture stress condition in these very low rain-fall areas.

Development of high yielding hybrids of pearl millet has led to increased productivity and stability largely in the regions with relatively better environments, while regions like Western Rajasthan with arid and semi arid environment, still suffers from low productivity. This is because most of the hybrids recommended for this region resulted from the parents, developed from program not specifically meant for arid areas and hence lacked the desired adaptability and the characteristics required for these areas. The average productivity of pearl millet in zone 1-C is quite low. Its production is very low as compared to area covered by this crop. Therefore, there is a great need to improve production per unit area. With this backdrop the present investigation was undertaken to estimate the correlation and analyze path coefficient among pearl millet hybrids.

Materials and Methods

This investigation was carried out at ARS, Bikaner. The experimental material for present study comprised of 120 test hybrids along with 3 standard checks of pearl millet [*Pennisetum glaucum* (L.) R. Br.] obtained from the AICRP on Pearl millet, ARS, Bikaner. Thus, the experimental material consisted of 123 hybrids. The experimental material was laid out in an augmented design with eight blocks during kharif of 2014. The check hybrids were replicated eight times in 8 blocks. Each block consisted of 15 test hybrids and 3 checks. Thus, there were total 18 entries in each block. Each entry was grown in a plot of single row of 4 meter length. The spacing between row to row was 50 cm and between plant to plant was 15 cm. Normal and uniform cultural operation were followed during the crop season to raise a good crop. The experiment was sown on 23 July, 2014.

Obsevations were recorded on following 10 yield traits : 1. Days to 50% flowering, 2. Days to maturity, 3. Plant height (cm), 4. Number of effective tillers per plant, 5. Ear head length (cm), 6. Ear head diameter (cm), 7. Test weight (g), 8. Harvest index (%), 9. Biological yield per plant (g), 10. Grain yield per plant (g).

Results and Discussion

Correlation

Correlation was computed for different pairs of morphological attributes including grain yield per plant. Correlation coefficients between yield and its attributes are given in Table 1.

The correlations of grain yield per plant (g) were positive and significant with characters like-biological yield per plant (g), harvest index (%), number of effective tillers per plant, plant height (cm), and ear head diameter per plant (cm) . Borkhataria et al. [2] and Ezeaku et al. [3] noticed positive significant correlation for number of effective tillers per plant and plant height (cm) with grain yield per plant (g). Pareek [4] in his augmented design evaluated that grain yield had positive and significant association with plant height (cm), effective number of tillers per plant and ear head diameter per plant (cm). Abuali et al. [5] noticed positive and significant correlation between grain yield per plant and harvest index Bikash et al. [6] noticed that grain yield was positively significant in correlation with harvest index (%), ear head girth per plant (cm), effective tillers per plant and biological yield (g).

Days to 50% flowering were positively and significantly associated with days to maturity and negatively with biological yield per plant (g). Days to maturity were positively and significantly associated with plant height (cm). Plant height (cm) had positive and significant correlation with ear head diameter per plant (cm), biological yield per plant (g) and grain yield per plant (g). Number of effective tillers per plant was positively and significantly correlated with harvest index (%), biological yield per plant (g) and grain yield per plant (g). Ear head diameter per plant (cm) had positive and significant correlation with test weight (g) and grain yield per plant (g). Harvest index (%) had positive and significant correlation with grain

Table 1. Correlation coefficient on the basis of adjusted values for differtent characters in Pearl millet. *Significant at $p = 0.05$ and ** Significant at $p = 0.01$.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of effective tillers per plant	Ear length per plant (cm)	Ear diameter per plant (cm)	Test weight (g)	Harvest indes (%)	Biological yield per plant (g)	Seed yield per plant (g)
Days to 50% flowering	1.000	0.371**	0.020	-0.094	0.066	-0.085	0.049	0.072	-0.145*	-0.041
Days to maturity		1.000	0.305**	-0.083	0.068	-0.107	0.003	0.055	-0.039	0.024
Plant height (cm)			1.000	0.101	0.113	0.21*	-0.021	0.008	0.130*	0.151*
Number of effective tillers per plant				1.000	-0.082	0.093	-0.102	0.174**	0.385**	0.45**
Ear length per plant (cm)					1.000	0.078	-0.093	-0.059	0.004	-0.040
Ear diameter per plant (cm)		`				1.000	0.179**	-0.033	0.114	0.145*
Test weight (g)							1.000	-0.067	0.119	0.078
Harvest index (%)								1.000	-0.244	0.571**
Biological yield per plant (g)									1.000	0.615**
Seed yield per plant (g)										1.000

yield per plant (g), biological yield per plant (g) positively and significantly correlated with grain yield (g).

Path Coefficient analysis

Path coefficient analysis was used to partition the direct and indirect effect of all ten characters in correlation of grain yield per plant. Since correlation studies alone are not adequate to establish a clear relationship among the characters, so the assessment of real contribution of individual character towards the grain yield become essential. Both direct as well as indirect effect of independent variables on dependent variables is measured through this analysis. Direct (diagonal) and indirect effects (non-diagonal) of

Table 2. Direct (diagonal) and indirect effects (non-diagonal) of different characters on seed yield per plant pearl millet based on adjested values. Residual Effect = 0.2430.

	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of effective tillers per plant	Ear length per plant (cm)	Ear diameter per plant (cm)	Test weight (g)	Harvest index (%)	Biological yield per plant (g)	Correlation with seed yield per plant (g)
Days to 50% flowering	**0.0211**	0.0027	0.0005	-0.0008	-0.0004	-0.0063	0.0011	0.0555	-0.1147	-0.041
Days to maturity	0.0078	**0.0072**	0.0076	-0.0008	=0.0005	-0.0079	0.0001	0.0421	-0.0309	0.024
Plant height (cm)	0.0004	0.0022	**0.0248**	0.0009	-0.0008	0.0155	-0.0005	0.0062	0.1024	0.151*
Number of effective tillers per plant	-0.002	-0.0006	0.0025	**0.009**	0.0005	0.0068	-0.0023	0.1334	0.3033	0.45**
Ear length per plant (cm)	0.0014	0.0005	0.0028	-0.0007	**-0.0066**	0.0058	-0.002	-0.0452	0.0038	-0.040
Ear diameter per plant (cm)	-0.0018	-0.0008	0.0052	0.0008	-0.0005	**0.0736**	0.0039	-0.0255	0.09	0.145*
Test weight (g)	0.001	0	-0.0005	-0.0009	0.0006	0.0132	**0.022**	0.0511	0.0939	0.078
Harvest index (%)	0.0015	0.004	0.0002	0.0016	0.0004	-0.0025	-0.0015	**0.7635**	-0.1922	0.571**
Biological yield per plant (g)	-0.0031	-0.0003	0.0032	0.0035	0	0.0084	0.0026	-0.1863	**0.7875**	0.615**

different characters on grain yield per plant in pearl millet hybrids are represented in Table 2.

In present study path coefficient analysis was estimated by taking grain yield per plant (g) as dependent variable to partition the correlation coefficient in to direct and indirect effect in order to determine the contribution of different characters towards the grain yield per plant (g). Direct and indirect effect of various characters on grain yield per plant (g) indicated that there is an agreement between direction and magnitude of the direct effect of various characters on grain yield per plant (g). Thus, a significant improvement in grain yield can be expected through selection in the component traits with high positive direct effect. High positive direct effect was observed for biological yield per plant (g) and harvest index (%).While highest direct negative effect was ear head length per plant (cm). Choudhry et al. [7] noticed positive direct effect of biological yield per plot (g) and harvest index (%) on grain yield per plot. The indirect effect of plant height and ear head diameter exhibited via biological yield per plant (g).Whereas, indirect effect of number of effective tillers per plant exhibited via harvest index (%) and biological yield per plant (g). Both these characters resulted positive and significant association with grain yield per plant (g). These results were in consonance with the findings of Sumanth et al. [8].

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