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Research Article

Genetic variability and character association analysis in pearl millet single cross hybrids under dry conditions of Rajasthan

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Abstract
The present investigation was conducted to study variability parameters and character association in 50 pearl millet single cross hybrids which were generated by crossing five male sterile lines with 10 genetically diverse restorers in line × tester mating design at ICRISAT, Hyderabad during *Summer*, 2018. These crosses were evaluated during *Kharif*, 2018 at College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. The material was evaluated in randomized block design with three replications. The analysis of variance indicated the presence of significant genetic variability among the single crosses for all the characters studied. The characters like number of effective tillers per plant, plant height, ear head length, ear head diameter and grain yield per plant were highly variable and correlated to each other. Hence, major emphasis should be given on these characters for selection of genotypes in breeding programmes for developing high yielding cultivars in pearl millet.

Key words
Pearl millet, Variability, Character association, GCV, Cross

Introduction

India is a major pearl millet [*Pennisetum glaucum* (L.) R. Br.] producing country in the world and mainly cultivated in the states of Rajasthan, Maharashtra, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh, Uttar Pradesh and Tamil Nadu. It is an important coarse grain crop having drought tolerance and commonly known as bajra in different parts of the India. It is a cross pollinated, diploid (2n=2x=14) and annual C_4 crop with protogynous nature. It is mainly used as dual purpose crop in arid and semi-arid regions of many countries including India. It can thrive under adverse conditions like low rainfall and fertility. The basic aim of any crop improvement programme is to increase yield potential of the concerned crop species. A study on variability available in the material is the pre-requisite for initiating a varietal development programme. Hence, analyzing the nature and magnitude of the heritable genetic variation present in the material is necessary. A successful breeding programme for yield improvement using phenotypic selection is mainly dependent on the nature and magnitude of variation in the available material and role played by the environment in the expression of plant characters. Therefore, analyzing the nature and magnitude of the heritable genetic variation present in the experimental material is necessary. Understanding of the association of different component characters towards grain yield forms the basic requirement for any selection programme. The genotypic correlation provides the association for the heritable part and shows a true picture of effective selection for a trait. Therefore, the present investigation was planned with the objectives to get information on nature and magnitude of variability and association among important traits in pearl millet single cross hybrids.

Materials and Methods

The present investigation was carried out to study variability parameters and character association in 50 pearl millet single cross hybrids which were generated by crossing five male sterile lines (RMS

7A, ICMA 843-22, ICMA 88004, ICMA 93333 and ICMA 97111) with 10 genetically diverse restorer lines in line × tester mating design at ICRISAT, Hyderabad during *Summer*-2018. These crosses were evaluated during *Kharif*-2018 at College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner. The material was evaluated in randomized block design with three replications. Each plot consisted of two rows each of 4 meter length with 60 cm of row spacing and 15 cm of plant to plant spacing within a row. All recommended cultural practices were followed to raise a good crop. The observations were recorded on nine agro-morphological characters namely days to 50% flowering, days to maturity, plant height (cm), number of effective tillers per plant, flag leaf area (cm^2), ear head length (cm), ear head diameter (cm), test weight (g) and grain yield per plant (g). The mean data were subjected to analysis of variance following Panse and Sukhatme (1985). Coefficients of variation were calculated by the formulae suggested by Burton (1952). Heritability in broad sense and genetic advance were estimated as per the formulae given by Johnson *et al.* (1955). The character association between different pairs of characters at the phenotypic and genotypic levels were calculated as described by Singh and Chaudhary (1985)

Results and Discussion

The analysis of variance indicated the presence of significant genetic variability among the single crosses for all the characters studied (Table 1). The analysis of mean, range and different genetic variability parameters for different characters (Table 2) revealed that, large differences in mean values for most of the characters were observed. The character grain yield per plant ranged from 7.22 to 27.20 g, days to 50% flowering from 43 to 55.67, days to maturity from 68 to 82.33, plant height from 102.73 to 184.67 cm, number of effective tillers per plant from 1.07 to 3.40, flag leaf area from 66.21 to 111.76 cm^2, ear head length from 16.40 to 30.33 cm, ear head diameter from 1.85 to 3.26 cm and test weight from 7.28 to 10.95 g.

The estimates of genotypic coefficient of variation (GCV %) ranged from 4.06 for days to 50% flowering to 34.99 for grain yield per plant and the corresponding values for phenotypic coefficient of variation (PCV %) were 4.53 to 48.84, respectively. According to Deshmukh *et al.* (1986), GCV and PCV values greater than 20% are regarded as high, whereas values less than 10% are considered to be low and values between 10 and 20% to be medium. In present investigation, the high values of GCV and PCV were obtained for the characters like grain yield per plant and number of effective tillers per plant, indicating variation for these characters contributed markedly to the total variability and also proved scope for genetic improvement through selection. The high GCV and PCV were also reported earlier in pearl millet by Singh and Singh (2016) for grain yield per plant, plant height, panicle length, panicle diameter, days to 50% flowering and test weight, similarly, Talawar *et al.* (2017) for number of effective tillers per plant, grain yield per plant, test weight and panicle length. In contrast Nehra *et al.* (2017) reported least GCV and PCV for days to 50% flowering, days to maturity and plant height.

According to Singh (2001), heritability values greater than 80% are very high, values from 60-79% are moderately high, values from 40-59% are medium and values less than 40% are low. Accordingly, the very high heritability (broad sense) estimates was observed for plant height and days to maturity while moderately high for ear head diameter and ear head length. Similar findings were also reported by Jyothsna *et al.* (2016), Sharma *et al.* (2018) and Singh *et al.* (2018) in pearl millet. Johnson *et al.* (1955) classified genetic advance as percentage of mean (GAM) values from 0-10% are low, 10-20% are moderate and 20% and above are high. Accordingly, the expected genetic advance as percentage of mean was high for grain yield per plant followed by number of effective tillers per plant, plant height and ear head length. The present findings are in close agreement with the earlier reports of Vidyadhar *et al.* (2007), Dapke *et al.* (2014), Dhedhi *et al.* (2015) and Singh *et al.* (2015). The characters like number of effective tillers per plant, plant height, ear head length and grain yield per plant showed relatively higher magnitude for all the variability parameters and considered highly variable in pearl millet.

The genotypic and phenotypic correlation coefficients among the yield and important yield components (Table 3) were worked out. The characters like ear head diameter and number of effective tillers per plant exhibited significant and positive correlation at both genotypic and phenotypic levels with grain yield per plant. The days to 50% flowering and days to maturity exhibited significant and negative correlation at both genotypic and phenotypic levels with grain yield per plant, which is desirable, mainly in dry conditions. The number of effective tillers per plant also exhibited significant and positive correlation at both genotypic and phenotypic levels with plant height. Ear head length and diameter also exhibited positive significant correlation with number of

effective tillers plant whereas test weight with ear head diameter. Present findings are in close agreement with earlier studies of Vidyadhar *et al.* (2007), Singh *et al.* (2015), Talawar *et al.* (2017) and Sharma *et al.* (2018) in pearl millet.

The present study on genetic variability and correlation in pearl millet single crosses suggests that characters like number of effective tillers per plant, plant height, ear head length, ear head diameter and grain yield per plant are highly variable and correlated to each other while days to 50% flowering and days to maturity are correlated with grain yield per plant. Hence, major emphasis should be given on these characters for selection of genotypes in breeding programmes for developing high yielding cultivars in pearl millet.

References

Burton, G. W. 1952. Quantitative inheritance in grasses. Proceeding of 6th international grassland congress, **1**: 277-283.

Dapke, J. S., Shah, D. S., Pawar, G. N. Dhembre, V. M. and Kumar, M. 2014. Genetic variability and character association over environment in pearl millet [*Pennisetum glaucum* (L.) R. Br.] under dryland conditions of Gujarat. *The Bioscan*, **9**(2): 863-867.

Deshmukh, S. N., Basu, M. S. and Reddy, P. S. 1986. Genetic variability, character association and path coefficient analysis of quantitative traits in virginia bunch varieties of ground nut. *Ind. J. Agric. Sci.*, **56**: 515-518.

Dhedhi, K. K., Ansodariya, V. V., Chaudhari, N. N., Sanghani, J. M. and Sorathiya, J. S. 2015. Genetic variability and character association for fodder yield and its related traits in pearl millet over locations under rainfed conditions of Gujarat. *International Journal of Forestry and Crop Improvement*, **6**(2): 110-115.

Johnson, H. W., Robinson, H. F. and Comstock, R. E. 1955. Estimate of genetic and environmental variability in soybeans. *Agronomy Journal*, **47**(7): 314-318.

Jyothsna, S., Patro, T. S. S. K, Ashok, S., Sandhya Rani, Y. and Neeraja, B. 2016. Studies on genetic parameters, character association and path analysis of yield and its components in finger millet (*Eluesine coracana*). *International Journal of Theoretical & Applied Sciences*, **8**(1): 25-30.

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.

Panse, V. G. and Sukhatme, P. V. 1985. Statistical methods for agricultural workers. ICAR, New Delhi. IV Enlarged Edition.

Sharma, B., Chugh, L. K., Sheoran, R.K. Singh, V. K. and Sood, M. 2018. Study on genetic variability, heritability and correlation in pearl millets germplasm. Journal *of Pharmacognosy and Phytochemistry*, **7**(6): 1983-1987.

Singh, B. D. 2001. Plant breeding: principles and methods. Kalyani Publishers, New Delhi, India, pp. 896.

Singh, O. V. and Singh, A. K. 2016. Analysis of genetic variability and correlation among traits in exotic germplasm of pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *Indian J. Agric. Res.*, **50**(1): 76-79.

Singh, O. V., Gowthami, R. Singh, K. and Shekhawat, N. 2018. Assessment of inter-characters associations in the germplasm of pearl millet *Pennisetum glaucum* (L.) R. Br.] over five years in hot arid climate of Rajasthan, India. *International Journal of Current Microbiology and Applied Sciences*, **7**(1): 3133-3149.

Singh, R. K. and Chaudhary, B. D. 1985. Biometrical methods in quantitative genetic analysis. Kalyani Publishers, Ludhiana, India, pp. 318.

Singh, S., Yadav, Y .P., Yadav, H. P., Vart, D. and Yadav, N. 2015. Genetic variability, character association and path analysis among yield contributing traits in pearl millet [*Pennisetum glaucum* (L.) R. Br.]. *Bioinfolet*, **12**(3A): 640-644.

Talawar, A. M., Girish, G., Channabasavanna, A. S. and M.S. Kitturmath, A. S. 2017. Studies on genetic variability, correlation and path analysis in pearl millet (*Pennisetum glaucum* L.) germplasm lines. *Agric. Sci. Digest*., **37**(1): 75-77.

Vidyadhar, B., Chand, P. and Devi, I.S. 2007. Genetic variability and character association in pearl millet [*Pennisetum glaucum* (L.) R. Br.] and their implications in selection. *Indian J. Agric. Res.*, **41**(2): 150-153.

Table 1. The analysis of variance for different characters in pearl millet single crosses

Source of variation	df	Mean sum of squares								
		DF	DM	PH	ETPP	FLA	EL	ED	TW	GYPP
Replications	2	15.727	5.787	34.426	0.244	589.135	3.010	0.045	1.407	61.200
Treatments	49	28.699**	29.901**	795.923**	0.882**	385.726**	24.602**	0.220**	2.681**	92.462**
Error	98	5.448	2.270	30.558	0.249	202.942	2.866	0.023	0.850	22.196

Where, **=1% level of significance, df=degree of freedom, DF=days to 50% flowering, DM= days to maturity, PH=plant height, ETPP=number of effective tillers per plant, FLA=flag leaf area, EL=ear head length, ED=ear head diameter, TW=test weight and GYPP= grain yield per plant

Table 2. Mean, range and other important variability parameters for different characters in pearl millet single crosses

Characters	Mean	Range		GCV	PCV	$H_{(b)}^2$ (%)	GA (as % of mean)
		Minimum	Maximum				
Days to 50% flowering	48.95	43.00	55.67	5.69	7.42	58.72	8.98
Days to maturity	74.79	68.00	82.33	4.06	4.53	80.23	7.49
Plant height (cm)	148.51	102.73	184.67	10.76	11.38	89.30	20.94
Number of effective tillers per plant	1.82	1.07	3.40	25.23	37.27	45.85	35.20
Flag leaf area (cm^2)	85.94	66.21	111.76	9.08	18.90	23.09	8.99
Ear head length (cm)	22.80	16.40	30.33	11.81	13.95	71.66	20.59
Ear head diameter (cm)	2.70	1.85	3.26	9.48	11.02	74.02	16.80
Test weight (g)	9.59	7.28	10.95	8.15	12.60	41.78	10.85
Grain yield per plant (g)	13.83	7.22	27.20	34.99	48.84	51.34	51.65

Where, $h_{(b)}^2$=broad sense heritability, GA=genetic advance and GCV and PCV=genotypic and phenotypic coefficient of variations, respectively

Table 3. Association analysis in pearl millet among the different characters

Character	Correlation	DM	PH	ETPP	FLA	EL	ED	TW	GYPP
DF	r_g	0.923**	0.223**	-0.335**	0.085	-0.278**	-0.240**	-0.254**	-0.433**
	r_p	0.660**	0.135	-0.253**	-0.07	-0.176*	-0.151	-0.255**	-0.356**
DM	r_g		0.255**	-0.062	0.13	0.065	-0.296**	-0.517**	-0.511**
	r_p		0.221**	-0.11	0.029	-0.019	-0.219**	-0.257**	-0.333**
PH	r_g			0.174*	0.078	0.507**	-0.139	0.11	-0.177*
	r_p			0.180*	0.112	0.436**	-0.066	0.083	-0.035
ETPP	r_g				0.059	0.419**	0.312**	-0.235**	0.332**
	r_p				0.144	0.343**	0.175*	-0.104	0.250**
FLA	r_g					0.368**	0.293**	-0.617**	-0.115
	r_p					0.222**	0.107	-0.108	0.076
EL	r_g						0.019	-0.098	-0.087
	r_p						0.041	-0.063	-0.071
ED	r_g							0.314**	0.599**
	r_p							0.221**	0.462**
TW	r_g								0.019
	r_p								0.114

Where, * and ** represents significant at 5% and 1% level of significance, respectively, r_g=genotypic correlation, r_p=phenotypic correlation, DF=days to 50% flowering, DM= days to maturity, PH=plant height, ETPP=number of effective tillers per plant, FLA=flag leaf area, EL=ear head length, ED=ear head diameter, TW=test weight and GYPP= grain yield per plant

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