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Study on heritability genetic advance and genetic variability in maize genotypes (*Zea mays* L.)

Anurag Tripathi, SS Verma, Kamendra Singh, NK Singh and Sundip Kumar

Abstract
The present study was conducted at GBPUA & T Pantnagar Uttarakhand during Kharif 2015 to study various parameters of genetic variability, broad sense heritability and genetic advance estimates in inbred line of maize. Analysis of variance revealed that the mean sum of squares due to genotypes showed significant differences for all the 11 characters studied. Traits grain yield/ha, days to 50% tasselling, days to 50% silking, number of kernels per row, 100-kernel weight were showed high heritability accompanied with high to moderate genotypic and phenotypic coefficient of variation and genetic advance in both the environments (OPD and HPD).Which indicates that most likely the heritability is due to additive gene effects and selection may be effective in early generations for these traits. Whereas high to moderate heritability along with low estimates of genetic advance were observed for days to 50 per cent tasselling, days to 50 per cent silking, ear length and number of kernel rows per ear.

Keywords: Maize, Heritability, Genetic Advance, Genotypic and Phenotypic coefficient of variation, optimum plant density, high plant density (OPD and HPD) (PCV and GCV)

Introduction
Maize is cultivated in a wide range of environments in India that reflects its wider adaptability. Globally, 67 percent of maize is used for live stock feed, 25 percent for human consumption and rest for industrial purposes. Among cereals, maize is rich in starch, proteins, oil and sucrose, due to which it has assumed significant industrial importance. Maize and its main by-products starch, syrup, glucose, gluten and oil are used in diversified industries like alcohol production, textile, paper, pharmaceuticals, cosmetic industry, edible oil industry, poultry feed and many chemical industries. Maize protein "Zein" has significant quantities of vitamin A, nicotinic acid, riboflavin, vitamin E and phosphorus. Maize oil obtained from germ of kernel is rich in polyunsaturated fatty acids and also contains high level of natural anti-oxidants; hence maize oil is ideal for heart patients. Maize is a highly cross pollinated and high productivity. It offers tremendous scope for the plant breeders for genetic improvement. Genetic variability among individuals in population offers effective selection. The magnitude of genetic variability present in population is of paramount importance for the success of any plant breeding program. Heritability alone provides no indication of the amount of genetic improvement that would result from selection of individual genotypes. Hence knowledge about genetic advance coupled with heritability is most useful.

Materials and Methods
The present experiment was carried out at GBPUA& T Pantnagar during kharif 2015 in two plant density environments in 57(45 $F_{1S,}$ 10 inbred parents two checks) lines of maize genotypes. Each entry was sown in two rows of four meters length with a spacing of 75 cm between rows and 20 cm between the Plants. The data on eleven quantitative characters namely, plant height, ear length, ear diameter, number of kernel rows per ear, number of kernels per row, 100 kernel weight, and grain yield were recorded on five randomly selected competitive plants in each replication, whereas days to 50 per cent tasselling, days to 50 per cent silking, anthesis to silking interval, were recorded on plot basis. The mean values of each trait were used for statistical analysis. Analysis of variance was done for partitioning the total variation into variation due to treatments and replications according to procedure given by Panse and Sukhatme.

Heritability in broad sense was calculated by the formula given by Burton and Devane. The estimates of genetic advance were obtained by the formula given by Johnson.

Results and Discussion

Analysis of variance revealed that there are significant differences for all the 11 quantitative traits studied which was presented in Table 1. Grain yield kg/ha (2127344.50) in HPD and (1493461.88) in OPD showed highest genetic variability followed by plant height (429.59), number of kernels per row (11.83),100-kernel weight (18.30), ear height (262.21) whereas Low genetic variability was observed in days to 50 per cent silking (2.71) and days to 50 per cent tasselling (2.25), ear length (2.51), ear diameter (0.13) in HPD and (1493461.88) in OPD showed highest genetic variability followed by plant height (280.31), number of kernels per row (15.23),100-kernel weight (19.49), ear height (117.73) whereas Low genetic variability was observed in days to 50 per cent silking (3.25) and days to 50 per cent tasselling (2.75), ear length (1.94) in OPD. High estimates of genotypic variance and phenotypic variance were recorded for grain yield, plant height, ear height, 100-kernel weight and number of kernels per row thus indicating presence of sufficient inherent genetic variance over which selection can be effective. Similar results were reported by Rather, Jawaharlal, Anshuman and Rajesh. High to moderate PCV and GCV recorded for grain yield, ear height, 100-kernel weight, number of kernels per row, plant height, ear length and ear girth as presented in Figure 1. Suggesting sufficient variability and offers scope for selection. Similar results of PCV and GCV values for grain yield and other traits were reported by Zahid Mahmood and Abirami. highest level of broad sense heritability estimate was observed for number of kernel row/ear (58%), plant height (49%), days to 50 % silking (49 %), grain yield (48%), days to 50% tasselling (40%), ear diameter (37%), 100-kernel weight (32%), ear length (29%) in Table 2. The highest genetic advance in the percentage of mean was recorded for anthesis to silking interval (15.04), days to 50% tasselling (19.80), grain yield (16.80), ear eight (10.95), plant height (6.74), number of kernel/row (2.03)number of kernel row/ear (6.30), ear diameter (4.37), ear length(6.47), 100- kernel weight (7.94) in HPD. In OPD the highest genetic advance in percentage of mean was observed for number of kernel row/ear (12.42), grain yield (11.38), 100-kernel weight (10.11) whereas anthesis-silking interval (7.78), ear length (4.70), number of kernel/row (5.46) had moderate genetic advance in percentage of mean and days to 50% silking (2.15), and days to 50% tasselling (2.31) had lowest low genetic advance in percentage of mean under OPD. High values of heritability in broad sense indicate characters are less influenced by environmental effects. Similar results were reported by Chen, Satyanarayan and Kumar and Ojo. Heritability and genetic advance are important selection parameters. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. Hence knowledge about genetic advance coupled with heritability is most useful. Character exhibiting high heritability may not necessarily give high genetic advance. High heritability should be accompanied with high genetic advance to arrive more reliable for genetic improvement. Expected genetic advance as per cent of mean indicates the mode of gene action in the expression of a trait, which helps in choosing an appropriate breeding method. High heritability with high estimates of genetic advance was observed for grain yield, plant height, ear height. High heritability with moderate estimates of genetic advance were observed for number of kernels per row and 100-kernel weight. High to moderate heritability along with low estimates of genetic advance were observed for days to 50 per cent tasselling, days to 50 per cent silking, shelling percentage, ear length, days to maturity, ear girth and number of kernel rows per ear were presented in Table 2. High heritability accompanied with high to moderate GCV and Genetic advance in case of Yield per plant, plant height, ear height, number of kernels per row and 100-kernel weight indicates that most likely the heritability is due to additive gene effects and selection may be effective in early generations for these traits. Whereas number of kernel rows per ear, days to 50 per cent tasselling, days to 50 per cent silking, shelling percentage and days to maturity exhibited moderate to high heritability along with low GCV and days to 50 per cent tasselling, days to 50 per cent silking, shelling percentage, ear length, days to maturity, ear girth and number of kernel rows per ear exhibited moderate to high heritability along with low genetic advance indicating non-additive gene action and provides limited scope for improvement of traits through selection. Similar results were reported by Zahid Mahmood, Thanga Hemavathy, Jawaharlal, and Anshuman.

Table 1. Analysis of variance for yield and yield component characters in maize.

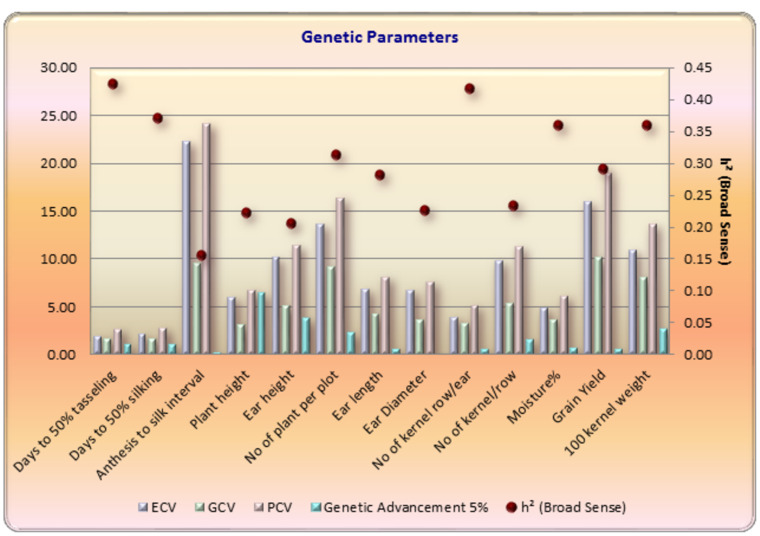

Table 1: Analysis of variance for important economic characters in maize under HPD and OPD environments

Source of variation	d.f	Plant density	Days to 50% tasselling	Days to 50% silking	Anthesis to silking interval	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	Number of kernel rows/ear	Number of kernels/row	100-kernel weight (g)	Grain yield (kg/ha)
		HPD	0.36	1.46	0.17	218.84	29.62	0.42	0.01	0.13	1.70	1.33	786275.44
Replication	2	OPD	1.15	1.83	0.55	185.31	3.35	0.28	0.02	0.04	10.36	6.46	384422.03
Treatments	54	HPD	2.25**	2.71**	0.48**	429.59**	262.21**	2.51**	0.09**	1.20**	11.83**	18.30**	2127344.50**
		OPD	2.78**	3.25**	0.37*	280.31**	117.73**	1.94**	0.13**	0.79**	15.23**	19.49**	1493461.88**
Error	108	HPD	0.73	0.68	0.13	108.46	102.25	1.08	0.03	0.27	3.78	7.16	548008.38
		OPD	0.87	1.16	0.23	150.98	65.12	0.88	0.06	0.25	7.83	7.11	597249.06

Significance Levels * = <.05, ** = <.01 and *** = <.001
OPD = Optimum plant density
HPD = High plant density

Table 2: Coefficient of variation, heritability and expected genetic advance for important economic characters under OPD and HPD environments in maize.

Characters	GCV (%)		PCV (%)		ECV (%)		Heritability (%)		Genetic advance		Genetic advance in % of mean	
	HPD	OPD	HPD	OPD	HPD	OPD	HPD	OPD	HPD	OPD	HPD	OPD
Days to 50% tasselling	1.51	1.72	2.37	2.64	1.83	2.01	0.58	0.52	0.91	1.07	1.98	2.31
Days to 50% silking	1.63	1.72	2.32	2.82	1.65	2.24	0.59	0.57	1.16	1.05	2.36	2.15
Anthesis- silking interval	10.92	9.58	16.33	24.28	12.14	22.31	0.45	0.16	0.46	0.17	15.04	7.78
Plant height (cm)	4.68	3.22	6.70	6.84	4.79	6.03	0.49	0.22	14.62	6.39	6.74	3.12
Ear height (cm)	8.89	5.21	15.40	11.48	12.58	10.23	0.33	0.51	8.54	3.83	10.57	4.87
Ear length (cm)	4.55	4.30	8.43	8.12	7.10	6.88	0.29	0.28	0.75	0.64	5.05	4.70
Ear diameter (cm)	3.50	3.66	5.79	7.70	4.61	6.78	0.37	0.23	0.17	0.13	4.37	3.58
No. of kernel rows/ear	4.23	3.32	5.85	5.14	4.04	3.92	0.52	0.42	0.82	0.56	6.30	4.42
No. of kernels/row	5.37	5.48	8.63	11.33	6.76	9.92	0.59	0.23	2.03	1.53	6.89	5.46
100-kernel weight(g)	6.80	8.19	12.02	13.67	9.91	10.95	0.62	0.56	2.17	2.71	7.92	10.11
Grain yield (Q/ha)	11.72	10.25	16.85	19.00	12.11	16.00	0.50	0.49	.70	0.60	16.80	11.38

Conclusion

In the present study high estimates of genotypic and phenotypic coefficient of variation were observed or grain yield (kg/ha), ear height and 100 grain weight, number of kernels per row, plant height and ear length showed moderate estimates of genotypic and phenotypic coefficient of variation suggesting sufficient variability and thus offers scope for genetic improvement through selection. High heritability with high to moderate estimates of genetic advance recorded for Yield per hectare, plant height, ear height, number of kernels per row, 100-kernel weight where careful selection may lead towards improvement for these traits. Hence, provides better opportunities for selecting plant material for these traits in maize.

References

1. Rather AG, Bhatt MA, Zargar MA. Genetic variation in maize *Zea mays* L. Population, in high altitude temperate conditions in Kashmir. Indian Journal of Agricultural Sciences. 2003; 79(3):179-180.
2. Jawaharlal J, Lakshmikantha Reddy G, Sai Kumar R. Genetic variability and character association studies in maize. Agriculture Science Digest. 2011; 31(3):173-177.
3. Anshuman Vashistha, Dixit NN, Dipika, Sharma SK, Marker S. Studies on heritability and genetic advance estimates in Maize genotypes. Bioscience Discovery. 2013; 4(2):165-168.
4. Rajesh V, Sudeer Kumar S, Narsimha Reddy V, Siva Sanker A. Studies on genetic variability, heritability and genetic advance estimates in newly developed maize genotypes *Zea mays* L. International Journal Of Applied Biology and Pharmaceutical Technology. 2013; 4(4):242-245.
5. Zahid Mahmood, Shahid Raiz Mailk, Raheel Akthar, Tariq Rafique. Heritability and genetic advance estimates from maize genotypes in Shishi Lusht a valley of Krakurm. International Journal of Agriculture and Biology. 2004; 2(2):253-257.
6. Abirami S, Vanniarajan C, Armugachamy S. Genetic variability Studies in maize *Zea mays* L. germplasm. Plant Archieves. 2005; 5(1):105-108.
7. Chen ling, Cuishaoping, Chen L, Cui AP, Sun YB. Analysis of the gene effect on ear characters in maize. Acta Agricultural Bareli Sinica. 1996; 11(2):28-32.
8. Satyanarayana E, Sai Kumar R. Genetic variability and *per se* performance of non Conventional hybrids in maize. Mysore Journal of Agricultural Sciences. 1995; 29(3):213-218.
9. Ojo DK, Omikunle OA, Oduwaye OA, Ajala MO, Ogunbayo SA. Heritability,character correlation and path coefficient analysis among six inbred-lines of maize *Zea mays* L. World Journal of Agricultural Sciences. 2006; 2(3):352-358.
10. Thanga Hemavathy A, Balaji K, Ibrahim SM, Anand G, Deepa Sankar. Genetic variability and correlation studies in Maize *Zea mays* L. Agriculture Science Digest. 2008; 28(2):112-114.
11. Burton GW, Devane EH. Estimating heritability in tall fascue *Restuca arundican* from replicated clonal material. Agronomy Journal. 1953; 45(1):478-481.
12. Johnson HW, Robinson HF, Comstock RE. Estimates of genetic and environmental variability in soybean. Agronomy Journal. 1955; 47:314-318.
13. Panse, Sukhatme PV. Satistical methods for agricultural workers (IInd ed.), ICAR Publications, New Delhi, 1967.