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National Academy of Agricultural Science (NAAS) Rating : 3. 03

Genetic Variability and Heritability Studies in the Maize Genotypes

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Abstract: *An experiment was conducted at Field Experimentation Centre of Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad to determine the various parameters of genetic variability, broad sense heritability and genetic advance estimates in newly developed 10 maize genotypes. Analysis of variance revealed highly significant differences for all the characters indicated the presence of substantial amount of genetic variability among the maize germplasm. Highest grain yield per plant was observed in genotype UMH-5 (59.66g). The difference between Genotypic Coefficient of Variation (GCV) and Phenotypic Coefficient of Variation (PCV) was high which depicted the influence of environment in the expression of most of the characters. Moderate estimates of heritability and genetic advance were recorded for most of the characters studied. High to moderate heritability with moderate estimates of genetic advance recorded for biological yield, grain yield per plant, plant height and ear height where careful selection may lead towards improvement for these traits. Hence, provides better opportunities for selecting plant material for these traits in maize.*

Keywords: *Maize, Genetic variability, Heritability, Genetic advance*

INTRODUCTION

Maize (Zea mays L.) belongs to the family graminae (2n=2x=20) and is an important staple food of many countries, particularly in the tropics and subtropics. It is third most important cereal food crop of the world after Rice and Wheat. This cereal is referred to as a 'Miracle crop' and 'Queen of the Cereals' due to its high productivity potential compared to other Poaceae family members. The development of new varieties mainly depends on the magnitude of genetic variability in the base material for the desired character. Genetic variability is of greatest interest to the plant breeder as it plays a vital role in framing successful breeding programme. The knowledge of genetic variability, heritability, genetic advance and relationship between yield and its contributing characters in a given crop species is of paramount importance for the success of any plant breeding programme.

The need to increase food production is one of the major world problems. Where physical areas under cultivation cannot be increased, the only way is to increase the productivity per unit time. This can be achieving by growing high yielding maize hybrids. With the advancement in Maize breeding, the farmers have become increasingly aware about the importance of the hybrid seed. To enhance the yield productivity, genetic parameters like variability heritability studies between yield and yield components are pre requisite to plan a meaningful breeding programme to develop high yielding inbreeds and hybrids (Reddy *et al.*, (2013). The magnitude of genetic variability and heritability 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 germplasm consisted of 10 maize hybrids UMH-1, UMH-2, UMH-3, UMH-4, UMH-5, UMH-6, UMH-7, UMH-8, K-25 (Check 1) and GA-85(Check 2) Obtained from the Utter Pradesh Council for Agricultural Research. The genotypes were tested in random block design with three replications at SHIATS. Each genotype was grown in a six row of 6

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m length, spaced 60 cm apart with a 20 cm distance between plants within the row. The standard package of agronomical practices, were followed to raise a healthy experimental maize crop. The five randomly selected plants were tagged in advance at every location and all subsequent observations were recorded on them in each replication of all entry. Following parameters viz., 50% tasseling, days to 50% silking, anthesis silking interval, plant height, cob height, cobs per plant, cob length, cob girth, grain rows per cob, days to maturity, seed index and grain Yield/plant were used under this investigation. The genetic parameters *viz*., genotypic and phenotypic coefficients of variation, broad sense heritability and genetic advance as per cent of mean was calculated as per standard procedures.

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 (1967). Heritability in broad sense. was calculated by the formula given by Burton and Devane (1953). The estimates of genetic advance were obtained by the formula given by Johnson *et al.,* (1955).

RESULTS AND DISCUSSION

Analysis of variance revealed significant differences for all the 12 quantitative traits studied which is presented in Table 1. The estimate of variance (genotype and phenotype), coefficient of variation, for all the twelve characters studied have been explained here as under the following:

Variability plays an important role in crop breeding. An insight into the magnitude of variability present in crop species is of utmost important as it provides the basis for selection. A perusal of variability parameters revealed that wide range of genotypic variance was observed for plant height (92.30) followed by cob height (47.52), grain yield per plant (94.09) whereas the rest of the characters showed low estimates of genotypic variance which indicates the influence of environment for expression of most of the characters in present investigation. Similar results on the influence of environment on the expression of grain yield and its components in maize was reported by Rajesh *et al.* (2013).

Table 1
Analysis of variance for 12 quantitative characters in Maize genotypes

S.No.	*Characters*	*Mean Sum of Squares*		
		Replications (df=2)	*Treatments (df=9)*	*Error (df=18)*
1	Days to 50% tasseling	1.10	5.31*	2.18
2	Days to 50% silking	0.05	7.39**	1.81
3	Anthesis silking interval	0.55	0.99**	0.21
4	Plant height	180.81	361.59**	84.68
5	Cob height	29.76	159.27**	16.69
6	Number of cobs per plant	0.096	0.089*	0.03
7	Cob length	1.00	4.80*	1.41
8	Cob girth	0.96	1.22*	0.34
9	Grain rows per cob	0.10	1.47*	0.55
10	Seed index	29.19	68.08*	22.37
11	Days to maturity	2.13	18.44*	6.46
12	Grain yield per plant	2.41	290.88**	8.60

* Significant at 5% level of significance
** Significant at 1% level of significance

Genotypic and phenotypic coefficient of variation

In the present investigation the values of phenotypic coefficient of variation (PCV) were higher than that of genotypic coefficient of variation (GCV) for all the characters. The phenotypic coefficient of variation was estimated to be high for anthesis silking interval (29.15) followed by grain yield per plant (24.42), seed index(17.75) and number of cobs per plant(17.35) whereas it was low for days to 50 percent tasseling (3.39), days to 50 percent silking (3.46), days to maturity (3.60), cob girth (5.75), grain rows per cob (6.72), plant height (7.71), cob length (9.37) and cob height (11.92). Genotypic coefficient of variation (GCV) also showed a similar trends in all the traits studied and was observed to be moderate to low for days to 50%tasseling (1.93), followed by days to maturity (2.22), days to 50% silking (2.46), cob girth(3.88). Similar results were also reported by Saikia *et al.,*(2000) and Abirani *et al.,* (2005) for anthesis silking interval, seed index and grain yield per plant in maize. On an average the moderate PCV and GCV were recorded for anthesis silking, cob per plant and grain yield per plant which suggested sufficient variability (table2) The above findings are accordance with the findings of Murugan *et al.,* (2010) and Nagabhushan *et al.,* (2011)**.** Indicating that, the selection based on these traits would facilitate, the successful isolation of desirable genotypes easily.

Heritability and Genetic advance

The proportion of this genotypic variability, which is transmitted from parents to the progeny, is reflected through heritability. Burton (1952) suggested that genetic variation along with heritability will give better idea about expected efficiency of selection. Thus, a character possessing high GCV along with high heritability will be valuable in a selection programme. In the present study, heritability was high (>60 percent) for grain yield per plant (91.60%) and cob height (74%), moderate (>30 to 60%) for anthesis silking interval (54%), plant height (52%) (Fig. 1). Higher values for heritability indicate that it may be due to higher contribution of genotypic components. Zahid Mahmood *et al.* (2004) reported moderate heritability for plant height. Whereas, Jawaharlal and Anshuman (2011) observed low heritability for days to silking and seed index.

Heritability alone could not provide sufficient indication about the amount of genetic improvement that would results from selection of the individual genotype hence knowledge about genetic advance coupled with heritability is more useful. However, in present investigation moderate heritability coupled with low genetic advance for the characters like, grain yield per plant (91.6 & 19.12), and days to maturity (38.2 & 2.54) was observed. On the other hand high heritability coupled with high genetic advance for grain yield per plant (91.6&24.51), cob height (74.00 & 15.65), and plant height (52.22 & 18.31).

Table 2
Estimation of genetic parameters for 12 characters in Maize

S. No.	*Character*	V_G	V_P	*GCV%*	*PCV%*	*h^2 (Broad Sense) %*	*GA*	*GA as percent of mean*
1	Days to 50 % tasseling	1.04	3.22	1.93	3.39	0.32	1.19	2.26
2	Days to 50% silking	1.85	3.67	2.46	3.46	0.50	1.99	3.61
3	Anthesis silking interval	0.26	0.47	21.55	29.15	0.54	0.77	32.82
4	Plant height	92.30	176.99	5.57	7.71	0.52	14.29	8.29
5	Cob height	47.52	64.22	10.26	11.92	0.74	12.21	18.18
6	Cob per plant	0.02	0.05	10.96	17.35	0.39	0.18	14.27
7	Cob length	0.68	2.10	5.33	9.37	0.32	0.96	6.26
8	Cob girth	0.29	0.63	3.88	5.75	0.45	0.75	5.42
9	Grain rows per cob	0.30	0.86	4.01	6.72	0.35	0.68	4.94
10	Days to maturity	3.99	10.45	2.22	3.60	0.38	2.54	2.83
11	Seed index	15.23	37.61	11.29	17.75	0.40	5.11	14.81
12	Grain yield per plant	94.09	102.69	23.38	24.42	0.91	19.12	46.10

Vg = Genotype variance
Vp = Phenotypic variance
GCV = Genotypic coefficient of variation
PCV = Phenotypic coefficient of variation
h^2(bs)% = Heritability (broad sense)
GA = Genetic advance
GA% = Genetic advance as percent of mean

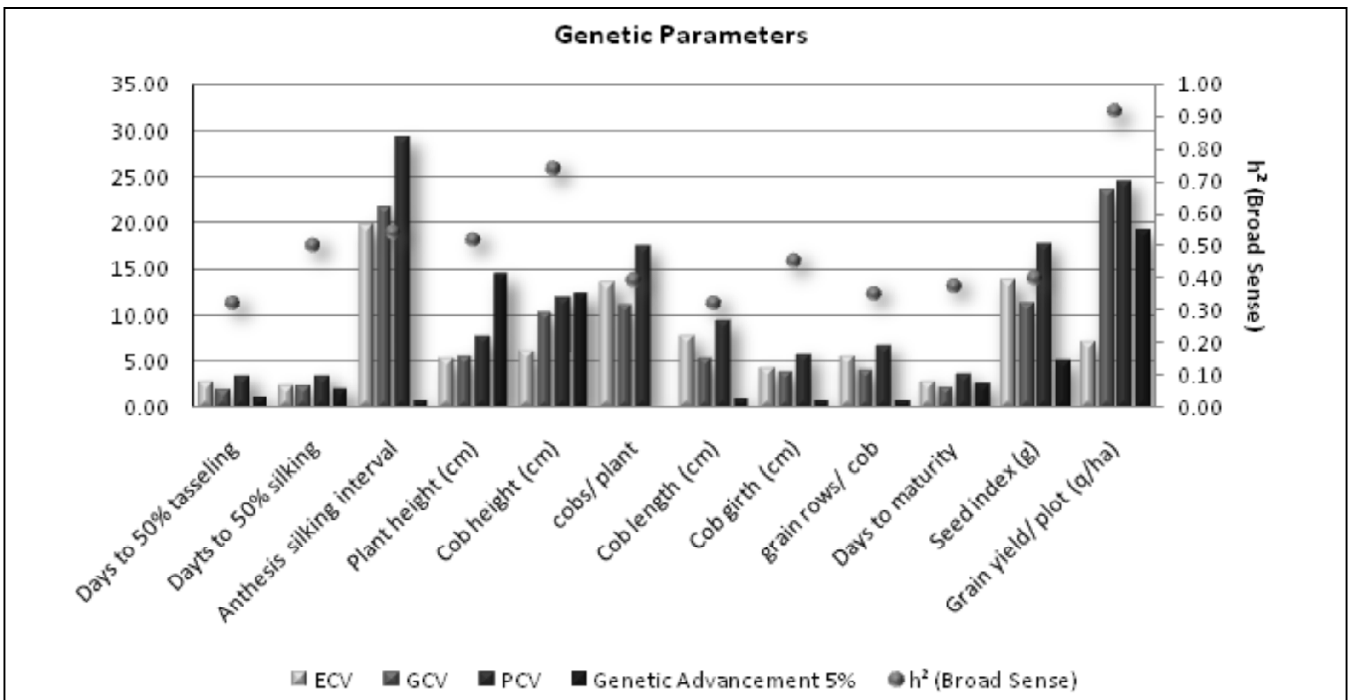

Figure 1: Histogram depicting genotypic, phenotypic coefficient of variation and heritability (broad sense) 12 characters in maize

CONCLUSION

The good amount of variability was present in the experimental material and ample scope for selection of promising lines was present in gene pool for yield and quality improvement. Grain yield/plant, anthesis silking interval and seed index showed high GCV combined with high heritability indicating improvement of these traits through simple *per se* selection and using them in hybrid breeding programme. The high genetic variance was recorded in all the traits except for cob per plant and anthesis silking interval. Hence, provides better opportunities for selecting plant material for these traits in maize.

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