Studies on heritability and genetic advance estimates in Maize genotypes

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ABSTRACT

The present experiment was conducted at department of genetics and plant breeding, Allahabad school of agriculture, Sam Higginbottom institute of agriculture technology and sciences, deemed university. The mean sum of squares due to genotypes showed significant differences for all the characters except for number of cobs per plant. Broad-sense heritability, coefficients of variability and genetic advance values were computed on 14 characters. High to moderate estimates of GCV and PCV were recorded for anthesis silking interval, grain yield per plant, ear height, harvest index, number of grains row per cob, number of grains per row and 100 seed weight suggesting sufficient variability thus offers scope for genetic improvement through selection. High estimates of heritability were observed for plant height, ear height and ear girth. 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.

Key words: Broad-sense heritability, genetic advance, genetic improvement, maize.

INTRODUCTION

India's maize production had declined to 16.8 million tonnes in the 2009-10 and the production of maize go up by 19 percent to touch 20 million tonnes in 2010-11 crop year on higher acreage and improved yield (Anonymous, 2009). However, productivity of maize has been continuously rising during last few years in India. Maize possesses a wide range of adaptation and is grown extensively in the temperate, sub-tropical and tropical zones in India. About 26% of the world's total cultivable land falls in arid and semi-arid areas (Paylore and Greenwell, 1979) and about 40 million hectares are planted annually in Asia. The existence of variability is essential for resistance to biotic and abiotic factors as well as for wide adaptability in the genotypes. Selection is effective when there is genetic variability among the individuals in a population. Hence, insight into the magnitude of genetic variability present in a population is of paramount importance to a plant breeder for stating a judicious breeding programme. Knowledge of heritability and genetic advance of the character indicate the scope for the improvement through selection. Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection then heritability estimates alone (Johnson *et al.,* 1955). Hence, the present studies were undertaken at Allahabad centre which falls under subtropical climate to estimate the genetic component of variance for grain yield and its related traits to compute broad sense heritability, genetic advance in maize.

MATERIALS AND METHODS

The present experiment was conducted in the field experimentation centre of the Department of genetics and plant breeding, Allahabad school of agriculture, sam Higginbottom institute of agriculture technology and sciences. The present study was carried out with 20 genotypes including 3 checks. These genotypes were procured from National Bureau of Plant Genetic Resources, New Delhi. The gross field area of 288 m^2 was divided into 3 sub plots.

These sub plots were used to replicate the treatments thrice. Each sub plot was divided into thirty units of equal dimension and all the genotypes were grown in these units at a spacing of 60x20 cm. Observations for 14 traits were recorded in 10 randomly selected competitive plants for each treatment in each replication except for days to 50 percent tasselling, days to 50 percent silking, where the observations were recorded on plot basis. Five plants were selected randomly and dugged out along with the root system. The roots were washed thoroughly to remove soil particles. The plant separated into leaves, branches, flower, stem and root. 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

Variability plays an important role in crop breeding. An insight in to the magnitude of variability present in crop species is of utmost importance as it provides the basis of selection. The mean sum of squares due to genotypes showed significant differences for all the characters except for number of cobs per plant (Table1). This indicates the presence of substantial genetic variability among the genotypes. Similar results were reported by Saikia and Sharma (2000) for different maize characters i.e. plant height, ear height and grain yield per palnt.

Table 1: Analysis of variance for different quantitative characters in Maize.

	Parameters	Mean Sum of Squares		
		Replications (df = 1)	Treatments (df = 19)	Error (df = 19)
1	Days to 50% tasseling	0.90	14.03**	0.84
2	Days to 50% silking	1.60	16.10**	1.07
3	Anthesis silking interval	0.10	1.08*	0.25
4	Plant height	0.13	399.7**	1.65
5	Ear height	1.10	232.72 **	0.95
6	Number of cobs /plant	0.22	0.10	0.07
7	Ear girth	2.02	0.84*	0.26
8	Ear length	0.63	3.11**	0.83
9	100 Grain weight	0.15	32.20**	0.68
10	Number of grain rows /cob	0.01	2.83*	0.91
11	Number of grains / row	2.16	12.74**	1.43
12	Grain yield /plant	3.91	986.18**	1.14
13	Biological yield	0.62	5596.41**	37.46
14	Harvest index	0.12	16.82**	0.05

Where, * and ** significant at 5% and 1% level of significance respectively

Presence of genetic variability in the breeding materials is essential for a successful plant breading programme. Wide range of genotypic variability was high for biological yield (2779.47) followed by grain yield per plant (492.52), ear height (115.88) and plant height (199.03). Moderate estimates of genotypic variability were recorded for 100 grain weight, whereas low estimates of genetic variability were observed for harvest index (8.39), days to 50 per cent silking (7.52), days to 50 % tasseling (6.59) (Table 2). High estimates of genotypic variability and phenotypic variability were recorded for plant height, grain yield per plant and ear height and biological yield, there by indicating presence of sufficient inherent genetic variability over which selection can be more effective. Similar findings in maize were also reported by Mahto *et al.,* (2002) for plant, grain yield per plant and ear height. Rather *et al.,* (2003) observed high genetic variability in maize for yield per plant and ear height.

Table 2. Estimation of genetic parameters for different quantitative characters in Maize

Characters	$\sigma^2 g$	$\sigma^2 p$	Coefficient of variation GCV (%)	PCV (%)	h^2 (bs) (%)	GA as (%) GA 5%	GA 1%	GA as percent of mean 5%	1%
Days to 50% tasseling	6.59	7.44	2.41	2.56	88.6	4.98	6.38	4.67	5.99
Days to 50% silking	7.52	8.59	2.50	2.68	87.5	5.28	6.77	4.82	6.18
Anthesis silking interval	0.41	0.67	22.16	28.25	61.6	1.04	1.33	35.83	45.91
Plant height	199.03	200.69	5.69	5.71	99.2	28.94	37.09	11.67	14.96
Ear height	115.88	116.84	9.27	9.31	99.2	22.09	28.30	19.02	24.37
Number of cobs /plant	0.01	0.09	7.13	18.40	15.0	0.09	0.12	5.70	7.30
Ear girth	0.29	0.55	4.27	5.90	52.3	0.80	1.03	6.36	8.15
Ear length	1.14	1.97	5.73	7.54	57.7	1.67	2.14	8.96	11.48
100 Grain weight	15.76	16.44	11.69	11.94	95.8	8.00	10.26	23.57	30.21
Number of grain rows /cob	0.96	1.87	7.21	10.05	51.4	1.45	1.86	10.65	13.65
Number of grains / row	5.65	7.09	7.40	8.29	79.7	4.37	5.60	13.61	17.44
Grain yield /plant	492.52	493.67	14.83	14.85	99.8	45.66	58.52	30.22	39.11
Biological yield	2779.47	2816.94	7.61	7.66	98.7	107.88	138.25	15.57	19.95
Harvest index	8.39	8.44	13.39	13.43	99.4	5.95	7.62	27.51	35.25

Where, $\sigma^2 g$= Genotypic variance, $\sigma^2 p$ = Phenotypic variance, GCV=Genotypic coefficient of variation, PCV= Phenotypic coefficient of variation, h2 (bs)= Heritability broad sense, GA= Genetic advance.

In the present investigation the phenotypic coefficient of variation was estimated to be high for anthesis silking interval (28.25) followed by number of cobs per plant (18.40) and grain yield per plant (14.85). Genotypic coefficient of variance showed a similar trend in all the traits studied and was observed to be high for anthesis silking interval (22.16) and for grain yield per plant (14.83). On an average high to moderate phenotypic coefficient of variation and genotypic coefficient were recorded for anthesis silking interval, grain yield per plant, ear height, harvest index and 100 grain weight suggesting sufficient variability and thus offers scope for genetic improvement through selection for the traits. Singh *et al.,* (2003) and Abirami *et al.,* (2005) reported high PCV and GCV values for grain yield per plant and ear height in maize. Moderate PCV values of ear girth, ear length, 100 grain weight and number of grain rows per cob were reported by Singh *et al.,* (2003).The estimates of genotypic coefficient of variation (GCV) reflect the total amount of genotypic variability which is transmitted from parents to the progeny is reflected by heritability. In the present investigation the heritability estimates were found to be high for grain yield per plant (99.8 %), harvest index (99.4 %), plant height (99.2 %), ear height (99.2 %), biological yield (98.7 %), 100 grain weight (95.8 %), days to 50 per cent tasseling (88.6 %), days to 50 per cent silking (87.5 %) and moderate for anthesis silking interval (61.6 %), ear girth (52.3 %) and number of grain rows per cob (51.4 %).Whereas low estimates of heritability was recorded for number of cobs per plant (15.0 %). In the present study, the estimates of heritability in board sense were computed, which include both additive and non additive gene effects. High value of heritability in broad sense indicates that the character is least influenced by environmental effects. Similar results have been reported by Chen *et al.,* (1996) for grain yield per plant and harvest index. Moderate for anthesis silking interval, ear girth and number of grain rows per cob was reported by Satyanorayana and Kumar (1995).

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. Character exhibiting high heritability may not necessarily give high genetic advance. Johanson *et al.,* (1955) showed high heritability should be accompanied by high genetic advance to arrive at more reliable conclusion. In the present investigation high to moderate heritability with moderate estimates of genetic advance were observed for biological yield (138.25), grain yield per plant (58.52), plant height (37.09) and ear height (28.30).

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. In the investigation moderate estimates of heritability along with moderate to low estimates of genetic advance were observed for 100 grain weight, number of grains per row, harvest index days to 50 per cent silking, days to 50 per cent tasseling which results in intermediate expression for both additive and dominance gene effect. On the other hand character like anthesis silking intervel, number of cobs per plant, ear girt, ear length, number of grain rows per cob and number of cobs per plant exhibited moderate to low heritability along with low GCV and genetic advance indicating limited scope for improvement of these traits through selection. Similar findings were reported by Satyanarayana *et al.,* (2003) for plant height, grain yield per plant in maize.

Hence in conclusion high estimates of genotypic and phenotypic coefficient of variation were observed for grain yield per plant, ear height, harvest index, 100 grain weight and number of grains per cob suggesting sufficient variability and thus offers scope for genetic improvement through selection. In the present investigation 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.

LITERATURE CITED

Anonymous, 2009. Annual Progress Report, Directorate of Maize Research, New Delhi.

Abirami S, Vanniarajan C, and Armugachamy S, 2005. Genetic variability Studies in maize (*Zea mays* L.) germplasm. *Plant Archieves*., **5**(1): 105-108.

Burton GW, and Devane EH, 1953. Estimating heritability in tall fascue (Restuca arundican) from replicated clonal material. *Agron. J.,* **45**(1):478-481.

Chen ling, Cuishaoping, Chen L, Cui AP and Sun YB, 1996. Analysis of the gene effect on ear characters in maize. *Acta Agric. Bareli Sinica*, **11**(2):28-32

Johnson HW; Robinson HF, and Comstock RE, 1955. Estimates of genetic and environmental variability in soybean. *Agron. J.,* **47**: 314-318.

Mahto RN, Ganguli DK, and Yadava MS, 2002. Evaluation of inbred lines and their F1 crosses of maize. *J. Res., Birsa Agric. Univ.,* **14** (1): 45-49.

Panse and Sukhatme PV, 1967. *Satistical methods for agricultural workers* (II^{nd} ed.), ICAR Pub., New Delhi.

Paylore P and Greenwell JR 1979. Fools run in pinpointing the arid zones. *J. Arid Environ.,* **10**: 17–8

Rather AG, Bhatt MA and Zargar MA, 2003. Genetic variation in maize (*Zea mays* L.) population in high altitude temperate conditions in Kashmir. *Indian J. Agric. Sci.,* **79**(3): 179-180.

Saikia RB, and Sharma G, 2000. Variability studies in some exotic maize genotypes. *Indian J. Hill Farming*. **13** (1/2): 106-107.

Satyanarayana E and Sai Kumar R, 1995. Genetic variability and *Per se* performance of non conventional hybrids in maize. *Mysore J. Agric. Sci*. **29**(3): 213213:218.

Satyanarayana E, Shanthi P and Kumar RS, 2003. Genetic variability studies for morphological quantitative parameters in sweet corn. *J. Maharashtra Agric. Univ.,* **28**(1): 41-44.

Singh P, Dass S, Kumar Y and Dutt JY, 2003. Variability studies for grain yield and component traits in maize (*Zea mays* L.). *Annals Agri. Bio Res.*, **8**(1): 29-31.

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