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Variability Estimates for Yield and Yield Components in Maize (*Zea mays* L.)

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ABSTRACT

The present investigation was under taken to study the extent of variability and genetic parameters in 36 maize genotypes for fifteen yield and its component characters during *rabi*, 2010-2011. The magnitude of difference between PCV and GCV was relatively low for all most all the traits, indicating less environmental influence. High (>20 %) GCV and PCV were recorded for anthesis-silking interval, leaf area index, number of branches per tassel and grain yield per plant. Heritability estimates were found to be high (>61 %) for all the characters. High heritability coupled with high genetic advance was observed for anthesis-silking interval, leaf area index, plant height, cob length, tassel length, number of branches per tassel, 100-seed weight and grain yield per plant, implying that most likely the heritability is due to additive gene effects and selection may be effective for these characters.

Key words : Genetic advance,Genetic variability, Heritability, Maize.

Maize (*Zea mays* L.) is a widely grown cereal crop in most parts of the world due to its adaptability and productivity. In India, maize ranks among the top four cereal crops and occupying an area of 7.89 million ha with a production of 15.09 million tonnes and a productivity of 1904 kg ha^{-1}. In Andhra Pradesh, it is grown in an area of 0.85 million hectares with a production of 4.15 million tonnes and a productivity of 4073 kg ha^{-1} (CMIE, 2010). Of late, the maize area in the state as well as in the country is growing enormously to meet the increasing demand of maize as fuel and livestock feed and it has become a challenge to enhance the maize production proportionate to the demand. Hence, the primary objective of most maize breeding programme is to develop promising hybrids in order to speed up economical crop production in maize. To initiate any breeding programme genetic variability is the basic requirement as this provides wider scope for selection. Since, the effectiveness of selection is dependent upon the nature, extent and magnitude of genetic variability present in the material and the extent to which it is heritable, the present study was undertaken to determine the extent of genetic variation, heritability and genetic advance for yield and its component characters.

MATERIAL AND METHODS

The experimental material consisted of eight inbred lines of maize *viz.,* CM 209, CM 132, CM 133, CM 148, CM 149, BML 6, BML 7 and BML 15 and their twenty eight crosses, which were made in a half diallel fashion during *kharif*, 2010. These eight parents and twenty eight F_1 cross combinations were planted in randomized block design (RBD) with three replications during *rabi*, 2010-2011 at Sri Venkateshwara Agricutural College farm, Tirupati. All the 36 genotypes were grown in single row plots of 4 m length and with a row to row and plant to plant distance of 75 cm and 20 cm, respectively. Standard agronomic practices were followed to raise a healthy crop. Data were recorded on five competitive plants from each plot for yield related traits *viz*., leaf area index, plant height, cob length, cob girth, number of kernel rows per ear, number of kernels per row, SPAD (measured using SPAD meter), tassel length, number of branches per tassel, 100-seed weight and grain yield per plant. However, the data for the traits *viz.,* days to 50 per cent tasseling, days to 50 per cent silking, anthesis-silking interval and days to 50 per cent maturity were recorded on per plot basis. The data were subjected to preliminary analysis of variance (Panse and Sukhatme, 1985) and the genotypic (GCV) and phenotypic (PCV) coefficient of variation was calculated by the formulae given by Burton (1952). Heritability in broad sense [$h^2_{(b)}$] was estimated by the formula given by Lush (1940). From the heritability estimates, the genetic advance (GA) was estimated by following the formula given by Johnson *et al.,* (1955).

Table 1. Analysis of variance for yield and yield components in maize.

S.No.	Characters	Source of Variation		
		Replications (df=2)	Genotypes df=35)	Error (df=70)
1	Days to 50 % tasseling	3.01	68.42**	1.65
2	Days to 50% silking	4.39	62.87**	1.73
3	Anthesis-silking interval	1.01	2.88**	0.53
4	Leaf area index	0.34	2.41**	0.25
5	Days to 50% maturity	5.11	75.04**	2.63
6	Plant height (cm)	395.00	1278.67**	67.61
7	No. of kernel rows per ear	1.06	6.99**	0.47
8	No. of kernels per row	21.93	98.04**	8.96
9	Cob length (cm)	2.76	22.77**	1.53
10	Cob girth (cm)	0.55	5.84**	0.39
11	SPAD chlorophyll	24.74	83.41**	9.91
12	Tassel length (cm)	10.45	73.04**	6.62
13	No. of branches per tassel	9.08	40.67**	4.24
14	100 seed weight (g)	5.53	42.53**	2.69
15	Yield per plant (g)	500.31	3884.18**	206.91

** Significant at 1% level

RESULTS AND DISCUSSION

Analysis of variance (Table 1) revealed the presence of sufficient variability in the material for all the traits studied. A wide range of variability was exhibited for all the traits in the present material (Table 2). Grain yield is the most targeted economic trait in any breeding programme and in this study it had recorded appreciable variation (34.02 g to 168.56 g) among the genotypes. Similarly, for the trait days to 50 per cent tasseling, the variation in mean performance ranged between 58.33 days and 77.67 days. A range of 60.67 days to 79.67 days was recorded for days to 50 per cent silking. The mean value for anthesis-silking interval ranged from 1.33 days to 5.30 days, thus showing high variation among the genotypes. The reduced ASI observed in the genotypes is desirable because it has been reported that reduced ASI enhance maize tolerance to stresses during flowering and ensures good grain filling (Edmeades *et al.,* 1993). Leaf area index exhibited significant variation ranging from 1.68 to 5.21. Considerable variation was also noticed among the genotypes for days to 50 per cent maturity which is the baseline for selection of early maturing genotypes and it ranged from 98.67 days to 115 days. Likewise, appreciable variation was manifested for all other traits under study. Nushad Ali *et al.,* (2007) also reported pronounced variation for different morphological traits among maize genotypes. The characters having higher range of variation have better scope of improvement through selection.

In the present study, the estimates of genotypic and phenotypic coefficients of variability indicated that the values of phenotypic coefficient of variation (PCV) were little higher than genotypic coefficient of variation (GCV). However, the magnitude of difference between PCV and GCV values for most of the traits was low, which indicated that these characters were less influenced by the environment (Table 2). The perusal of results revealed that grain yield per plant, anthesis-silking interval, leaf area index and number of branches per tassel exhibited higher estimates of GCV and PCV, therefore, simple selection can be advocated for further improvement of these characters. Similarly, Abirami *et al.,* (2005) also reported high PCV and GCV values for grain yield per plant and other yield related traits.

Though GCV and PCV gives an estimate of magnitude of variability existing in the genotypes, it is not possible to assess the portion of variation that is heritable. Heritable variation can be predicted through studies on heritability. High heritability values were recorded for all the fifteen characters

Table 2. Estimates of variability and genetic parameters for 15 characters in maize.

S.No.	Characters	Mean	Range	Variance		Coefficient of variation (%)		Heritability in broad sense (h^2_b) %	Genetic Advance (GA) %	Genetic advance as % of mean GAM
				Genotypic (Vg)	Phenotypic (Vp)	Genotypic (GCV)	Phenotypic (PCV)			
1	Days to 50 % tasseling	65.80	58.33 – 77.67	22.26	23.91	7.17	7.43	93.00	9.38	14.25
2	Days to 50% silking	68.77	60.67 – 79.67	20.38	22.11	6.56	6.84	92.00	8.93	12.98
3	Anthesis-silking interval	2.97	1.33 – 5.33	0.78	1.32	29.78	38.61	64.00	1.41	47.31
4	Leaf area index	3.64	1.68 – 5.21	0.72	0.97	23.30	27.02	74.00	1.51	41.40
5	Days to 50% maturity	107.31	98.67 – 115.00	24.13	26.77	4.58	4.82	90.00	9.61	8.95
6	Plant height (cm)	165.78	104 – 211.3	403.69	471.30	12.12	13.10	86.00	38.31	23.11
7	No. of kernel rows per ear	14.45	11.47 – 17.87	2.17	2.64	10.19	11.25	82.00	2.75	19.03
8	No. of kernels per row	30.78	18.1 – 39.40	29.69	38.65	17.70	20.20	77.00	9.84	31.96
9	Cob length (cm)	17.67	11.13 – 21.07	7.08	8.61	15.06	16.61	82.00	4.97	28.13
10	Cob girth (cm)	14.95	11.33 – 17.07	1.82	2.21	9.02	9.93	82.00	2.52	16.87
11	SPAD chlorophyll	47.53	32.37 – 54.86	24.50	34.41	10.41	12.34	71.00	8.60	18.10
12	Tassel length (cm)	33.21	23.33 – 44.07	22.14	28.76	14.17	16.15	77.00	8.51	25.61
13	No. of branches per tassel	16.67	7.67 – 24.67	12.14	16.38	20.91	24.28	74.00	6.18	37.09
14	100 seed weight (g)	29.23	19.66 – 37.33	13.28	15.97	12.47	13.67	83.00	6.84	23.42
15	Yield per plant (g)	114.79	34.02 – 168.60	1225.76	1432.67	30.50	32.97	86.00	66.71	58.12

studied. High heritability coupled with high genetic advance as per cent of mean was recorded for anthesis-silking interval, leaf area index, plant height, cob length, tassel length, number of branches per tassel, 100-seed weight and grain yield per plant, emphasizing that the additive genetic variation was the major component of genetic variation in the inheritance of these traits. Similarly, Alake *et al.,* (2008) also reported high heritability coupled with high genetic advance estimates for grain yield per plant and cob length, Ali *et al.,* (2010) for leaf area index, plant height, and Suresh (2004) for 100-seed weight. The traits *viz.*, days to 50 per cent tasseling, days to 50 per cent silking, number of kernel rows per ear, cob girth and SPAD cholorophyll exhibited high heritability with moderate genetic advance, indicating the importance of both additive and non-additive gene effects for these traits. However, the trait days to 50 per cent maturity had high heritability coupled with low genetic advance, implying that this trait was controlled by non-additive (dominance) gene effects. Hence, simple selection may not be effective to improve this trait.

By and large the present study concludes that in the present material there is a substantial variability, which could be used to develop suitable maize hybrids and improved inbreds. Based on the estimates of genetic parameters, the traits *viz*., anthesis-silking interval, leaf area index, plant height, cob length, tassel length, number of branches per tassel, 100-seed weight and grain yield per plant which exhibited high heritability coupled with high genetic advance could be exploited for the improvement in these characters through simple selection procedures.

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