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GENETIC VARIABILITY AND SELECTION PARAMETER FOR GRAIN YIELD AND ITS COMPONENTS IN MAIZE (*ZEA MAYS* L.)

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ABSTRACT

Seventy eight genotypes of maize [12 parents + 66 F_1s (derived from 12 parental diallel cross excluding reciprocals)] were evaluated for eleven attributes namely; days to tasseling, days to silking, days to maturity, plant height (cm) cob height (cm) ear length (cm), ear diameter (cm) number of grain rows per ear, number of grains per row, 1000- kernel weight (g) and grain yield per plant (g). Analysis of variance of means revealed highly significant differences for all the characters among parents and crosses. Phenotypic coefficient of variability (PCV) was higher than corresponding genotypic coefficient of variability (GCV) for all the characters except 1000 - kernel weight. The maximum phenotypic variability was estimated in grain yield per plant (16.16%) followed by rows per ear (11.38%) and 1000 - kernel weight (10.72%) and the least was observed in days to tasseling (3.27%), High broad sense heritability estimates were observed for all the characters (83.50 to 100%) except for cob diameter, ear length and grains per row for which it was moderate (70.30 to 79.10%). An advancement of 27.76g in grain yield per plant was expected from single cycle of selection at k=2.06. Comparatively, the expected gain to the tune of 23.45% was estimated for grain yield per plant followed by 1000 - kernel weight (22.06%), grain rows per ear (21.96%) cob height (16.18%) ear length (12.34%) and grains per row (12.31%). Path analysis revealed that ear diameter, number of rows per ear, days to tasseling and ear length had positive and high direct effect on grain yield per plant. The characters directly related to grain yield viz ear length ear diameter, rows per ear, grains per row and 1000 - kernel weight were significantly and positively correlated hence due emphasis be paid on these characters while making selection for grain yield.

KEYWORDS: maize, genetic variability, selection parameter, heritability, genetic advance, correlation, path analysis.

INTRODUCTION

Maize is an important cereal crop of India having very high yield potential. The yield is a very complex character and depends upon a number of its components. Direct and indirect selection parameters are only effective for any crop improvement programme until sufficient variability for characters are available. In present investigation an attempt was made to collect information on direct and indirect selection parameters for improving yield along with its components.

MATERIAL AND METHODS

Twelve genetically diverse inbred lines / populations of maize namely; D-5, D-7, D-11, D-12, D-13, D-14, D-15, CM 500, TSK-4, TSK-7, TSK-44 and Azad Uttam were crossed in all possible combinations excluding reciprocals to produce F_0 seed during kharif 2018. 66 F_1s + 12 parents were evaluated in a replicated trial with three replications during. Each genotype was sown in two rows 5 m long spaced at 60 cm from row to row and 25 cm from plant to plant during Rabi 2018-19.

The observations were recorded on ten randomly selected plant from each treatments and each replication for days to tasseling, days to silking, days to maturity, plant height (cm), cob height (cm), ear length (cm) ear diameter (cm), number of grain rows per ear, number of grains per row, 1000 grain - weight (g) and grain yield per plant (g).

The data were subjected for various statistical analysis following standard procedures. The coefficients of variations were worked out following **Burton and De vane (1953)**. The heritability in broad sense was calculated as per **Allard (1960)**. The phenotypic and genotypic correlation coefficients according to **Miller *et al.* (1958)** while path analyses for grain yield the dependent character as per **Dewey and Lu (1959)** were estimated.

RESULTS AND DISCUSSION

Analysis of variance of means revealed significant differences for all the characters among parents and crosses. The phenotypic coefficient of variability (PCV) was higher than genotypic coefficient of variability (GCV) for all the characters except 1000-kernel weight which indicates the effects of environments on expression of characters (Table-1). Maximum phenotypic coefficient of variability was estimated for grain yield per plant (16.16%) followed by grain rows per ear (11.38%) and 1000 - kernel weight (10.72%) while it was lowest for days to tasseling. The maximum genotypic coefficient of variability was observed for grain yield per plant (15.95%) followed by grain rows per ear (11.02%) and 1000 - kernel weight (10.72%) while it was lowest for days to tasseling (2.99%) and days to silking (3.71%). These variations indicated that considerable amount of variability was available for these characters which provide ample chance for effective selection. These results are in accordance with earlier reports of **Sandeep *et al.* (2015), Bisen *et al*. (2018), Sampurna *et al*. (2019) and Nusrat *et al*.(2019)**.

Heritability in broad sense includes both additive and epistatic genetic effects; it is realized only when accompanied with genetic advance. It is also assumed that heritability estimates along with GCV would give the real picture of the extent of genetic advance for better selection.

High heritability estimates were observed for all the characters (83.50 to 100%) except ear diameter, ear length and grains per row for which it was moderate (70.30 to 79.10%). These results are in accordance with earlier reports of **Jaiswal *et al*. (2019), Sampurna *et al*. (2019) and Nusrat *et al*.(2019)**.

The genetic advances conform to the heritability estimates. An advancement of 27.76 in grain yield per plant was expected from single cycle of selection at p = 0.05, since the heritability for 1000 - kernel weight was 100%, therefore, the genetic advance is expected to the mean of selected sample mean. Similarly an advancement of 19.08 cm in plant height and 12.26 cm in cob height were expected per cycle of selection. However it was numerically low for ear diameter (0.21 cm) and ear length (1.88cm) per cycle of selection.

Comparatively the expected gain to the tune of 23.45 per cent was estimated for grain yield per plant followed by 1000 kernel weight (22.08%), rows per ear (21.96%), cob height (16.18%), ear length (12.94%) and grains per row (12.31%).

High heritability with high genetic advance for plant height, cob height, 1000 - kernel weight and grain yield per plant revealed the significant role of additive gene action. Additive gene action for yield attributes was also observed by **Sandeep *et al*. (2015)** and **Poudel *et al*. (2016)** in maize.

The grain yield per plant showed positive and significant genotypic and phenotypic associations with ear length, ear diameter, number of rows per ear, number of grains per row and 1000- kernel weight while days to tasseling had negatively significant association with grain yield per plant at genotypic level only. These findings are in agreement with earlier reports of **Kumar *et al*. (2017), Saripalli *et al*. (2018), Michael *et al*. (2019) and David *et al.* (2020)**.

Among characters themselves, days to tasseling and days to silking showed negatively significant correlations with ear length and ear diameter but positive and significant with cob height. Plant height had positive and significant association of ear length with ear diameter and number of grains / row and ear diameter with grains per row and 1000- kernel weight might considerable as these were positively associated with yield characters **Michael *et al.* (2019) and David *et al.* (2020)** also reported similar association between various characters.

The path analysis which is simple regression coefficient which split the correlation values of the selected character into direct and indirect effect as mentioned in table-3. The selection based on phenotypic path is misleading as it includes environmental components also hence, here only genotypic path of action is considered. The genotypic path revealed highest positive direct effect of ear diameter on grain yield (0.668) followed by number of grain rows per ear (0.250), days to tasseling (0.173) and ear length (0.162). The maximum indirect effect of ear diameter *via* number of grains per row and 1000-grain weight may also be considerable for better selection indirectly. The results of **Kumar *et al.* (2014), Kinfe *et al*. (2015) and Kumar *et al*. (2017)** are in close agreement with these results.

On the basis of above experiment it is concluded that due emphasis be paid on ear length, ear diameter, grain rows per ear, grains per row and 1000-kernel weight while making selection for improving grain yield.

Table 1: Mean and genetic parameters for grain yield and its components in maize.

Character	Mean	PCV %	GCV %	Heritability (B.S.) %	Genetic advance at (K=2.06)	Genetic advance in % over mean
Days to tasseling	52.48	3.27	2.99	83.50	2.95	5.62
Days to silking	56.74	3.99	3.71	86.10	4.02	7.08
Days to maturity	85.36	3.67	3.62	97.00	6.27	7.34
Plant Height (cm)	199.60	4.87	4.76	95.20	19.08	9.56
Cob length (cm)	75.76	8.45	8.25	92.90	12.26	16.18
Ear Length (cm)	15.23	7.62	6.75	78.50	1.88	12.34

Ear diameter (cm)	3.98	3.67	3.08	70.30	0.21	5.28
No. of rows/ear	14.25	11.38	11.02	93.80	3.13	21.96
No. of grains/row	28.02	7.56	6.73	79.10	3.45	12.31
1000 kernel weight (g)	257.39	10.72	10.72	100.00	56.85	22.08
Grain yield plant (g)	85.54	16.16	15.95	97.50	27.76	32.45

* Significant at P = 0.05 ** Significant at P = 0.01

Table 2: Genotypic and Phenotypic correlation coefficient for yield characters for parents + F_1s derived from 12 parental diallel cross in maize.

Character	1	2	3	4	5	6	7	8	9	10	11
Days to tasseling	rp rg ►	0.908*	0.073	0.027	0.214**	-0.232**	-0.260**	-0.089	-0.287**	-0.036	-0.183**
Days to silking	0.879**		0.030	0.044	0.187*	-0.178*	-0.082	-0.040	-0.241**	0.004	-0.167
Days to maturity	0.069	0.026		-0.125	-0.140	-0.233**	0.082	0.035	-0.128	-0.010	0.050
Plant Height (cm)	0.022	0.036	-0.113		0.670**	0.100	0.193*	-0.122	0.281**	-0.017	0.111
Cob length (cm)	0.191*	0.159	-0.124	0.639**		0.016	-0.040	-0.076	0.050	-0.109	-0.034
Ear Length (cm)	-0.183	0.160	-0.192*	0.091	0.029		0.239**	-0.096	0.358**	0.132	0.257**
Ear diameter (cm)	-0.199**	-0.185*	0.067	0.157*	-0.019	0.198**		0.030	0.553	0.326**	0.669**
No. of rows/ear	-0.072	-0.028	0.040	-0.106	-0.068	-0.068	0.050		-0.013	0.026	0.245**
No. of grains/row	-0.242**	-0.202**	-0.104	0.240**	0.044	0.0342**	0.453**	0.004		0.150	0.327**
1000 kernel weight (g)	-0.33	0.004	-0.010	-0.017	-0.105	0.119	0.273**	0.025	0.135		0.261**
Grain yield plant (g)	-0.163	-0.156	0.048	0.104	-0.25	0.234**	0.582**	0.241**	0.306**	0.258**	

* Significant at p = 0.05 ** Significant at p = 0.01

Table 3: Genotypic path of action of various characters on grain yield in maize.

Character	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**rg with grain yield / plant**
Days to tasseling	**0.173**	-0.149	0.000	0.001	-0.002	-0.002	-0.174	-0.022	0.029	-0.001	-0.183*
Days to silking	0.157	**-0.164**	0.000	0.002	-0.002	-0.029	-0.146	-0.010	0.025	0.000	0.167
Days to maturity	0.013	-0.005	**-0.007**	-0.005	0.002	-0.038	0.055	0.009	0.013	0.000	0.050
Plant Height (cm)	0.005	-0.007	-0.001	**0.036**	-0.007	0.016	0.129	-0.030	-0.029	-0.001	0.111
Cob height (cm)	0.037	-0.031	-0.001	0.024	**-0.011**	0.003	-0.26	-0.019	-0.005	-0.004	-0.034
Ear Length (cm)	-0.040	0.029	-0.002	0.004	0.000	**0.162**	0.160	-0.024	-0.036	0.005	0.257*
Ear diameter (cm)	-0.045	0.036	0.001	0.007	0.000	0.030	**0.668**	0.008	-0.056	0.012	0.669**
No. of rows/ear	-0.015	0.007	0.000	-0.004	0.001	-0.015	0.020	**0.250**	0.001	0.001	0.245**
No. of grains/row	-0.050	0.039	-0.001	0.010	-0.001	0.058	0.370	-0.003	**-0.102**	0.006	0.327**
1000 kernel weight (g)	-0.06	-0.001	0.000	-0.001	0.001	0.021	0.218	0.006	-0.015	**0.037**	0.261**

Residual effect = 0.473 rg= genotypic correlation *Significant at p = 0.05 **Significant at p = 0.01

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