

STUDIES ON GENETIC PARAMETER FOR YIELD AND YIELD ATTRIBUTING TRAITS ACROSS *KHARIF* AND *RABI* SEASONS IN MAIZE (*ZEA MAYS* L.)

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Received-15.12.2015, Revised-22.12.2015

Abstract: The present investigation was carried out with fifty six genotypes to estimate the heritability, expected genetic advance and coefficient of variation for yield and yield attributing traits. Treatments differences for all characters were highly significant in both the seasons which indicates the presence of inherent genetic differences in our experimental material. The values of phenotypic coefficient of variation (PCV) were higher than genotypic coefficient of variation (GCV) for all characters in both seasons. Sufficient level of heritability ranging from very high to moderate broad sense heritability were recorded for all characters except anthesis-silking interval across both seasons. Genetic advance at 5% selection intensity was higher for grain yield, plant height, ear height and number of kernels/row in both the seasons. In case of genetic advance as per cent of mean was highest for grain yield across both seasons while next lower values fluctuating with seasons. As grain yield having high both types of expected genetic advance coupled with high heritability in both the seasons, indicates the presence of large proportion of additive gene action for deciding this trait.

Keywords: Maize, Heritability, Genetic advance, Coefficient of variation

INTRODUCTION

Over the last decade, maize (*Zea mays* L.) has been emerged as world's leading crop among the cereals with highest production of 991.45 MT (million tonne) and productivity of 5.46 t ha⁻¹ in 2013-14. India contributes about 2.4% of world's maize production from ~ 5.2 % global maize area (USDA, 2015). In India, maize is third important food crop after wheat and rice and its production has been recorded about 24.35 MT from 9.4 Mha (million hectare) area with average productivity of 2.5 t ha⁻¹ in 2013-14 (AICRP on Maize, 2015). The overall productivity of maize in Indian scenario is almost half of the world average but *rabi* maize productivity has been recorded about 4.15 t ha⁻¹ in 2012-13, which is somewhat closure to the world average (DACNET, 2014). Therefore, exploitation of genetic variability specific to environmental conditions is utmost important for enhancing the grain productivity. The knowledge regarding nature and magnitude of genetic variability of our germplasm is essential for accomplishment of effective breeding programme. The genotypic components of variability directly influences the heritability and genetic advance ultimately magnitude of target trait advancement and selection strategies to be adopted by the breeders (Kumar, *et al.* 2015). Therefore, present investigation was undertaken for the estimation of heritability, expected genetic advance and coefficient of variation for yield and yield attributing traits which would be helpful for enhancing the maize grain productivity under respective environmental conditions.

MATERIAL AND METHOD

The present investigation was carried out with fifty six genotypes involving ten parental lines, their forty five F₁s hybrids and one check hybrid over *kharif* 2013 and *rabi* 2013-14 seasons, at N. E. Borlaug Crop Research Center, Pantnagar, Uttarakhand. All genotypes were evaluated in plot size of 6.00 m² with three replications under each environment (season). The data was recorded on different traits like days to 50% tasselling, days to 50% silking, anthesis-silking interval, plant height, ear height, ear length, ear diameter, number of kernel rows/ear, number of kernels/row, 100-kernel weight and grain yield. The appropriate statistical and biometrical analysis were performed for obtaining the genetic parameters namely heritability, expected genetic advance and coefficient of variation (Burton and Devane, 1953 and Allard, 1960).

RESULT AND DISCUSSION

The analysis of variance for all eleven quantitative characters revealed that treatments differences were highly significant in both the seasons indicating the presence of inherent genetic differences in our experimental material (Table 1). This wide spectrum of variability for all characters provides greater opportunity for the isolation of best genotypes to be fitted in breeding programme. Similar finding on presence of significant variability for various characters in the maize genotypes was also reported by many researcher in their study (Kumar *et al.*, 2015 and Has, 2011).

Coefficient of variation: The variability parameters like phenotypic coefficient of variation (PCV) and

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genotypic coefficient of variation (GCV) indicated the presence of considerable variations for all the characters under study in both the environments. The values of PCV were higher than GCV values for all the characters in both seasons (Table 2).

In *kharif* season, PCV was highest for grain yield (35.59) followed by anthesis-silking interval (34.56), number of kernels/row (16.52) and ear length (14.64), while, lowest level of PCV was observed for days to 50% silking (3.00), days to 50% tasselling (3.65) and number of kernel rows/ear (8.15). The GCV was also observed in same pattern as PCV, highest GCV was found for grain yield (29.75) followed by anthesis-silking interval (15.93), number of kernels/row (13.89) and ear length (13.09), while, lowest level of GCV was observed for days to 50% silking (2.30), days to 50% tasselling (3.05) and number of kernel rows/ear (6.23). In *rabi* season, PCV was also highest for grain yield (40.36) followed by anthesis-silking interval (33.41), ear height (29.88) and number of kernels/row (17.48), while, lowest PCV values were of days to 50% silking (2.34), days to 50% tasselling (2.65) and number of kernel rows/ear (9.85). The highest GCV was found for grain yield (37.91) followed by anthesis-silking interval (24.52), ear height (20.53) and number of kernels/row (14.79), while lowest level of GCV was observed for days to 50% silking (2.12), days to 50% tasselling (2.44) and number of kernel rows/ear (7.77).

The large difference between the values of PCV and GCV of characters like grain yield and anthesis-silking under each season, indicated that environmental factors significantly influenced the expression of these traits while other remaining traits were having the lower difference between of PCV and GCV, indicating the less influence of environment in expression of these traits.

Knowledge of nature and magnitude of genetic variability present in the population is of immense value for planning efficient breeding programme to improve the yield potential of genotypes. The extent of variability as measured by PCV and GCV provides information regarding the relative amount of variation in different characters. The characters namely anthesis-silking interval and grain yield had higher PCV and GCV, while, days to 50% tasselling and days to 50% silking had lower PCV and GCV irrespective of environmental condition. Other remaining characters were having the fluctuating PCV and GCV values across the environments. Therefore, characters namely days to 50% tasselling and days to 50% silking, anthesis-silking interval and grain yield might be considered as having the same exploitable genetic variability for crop improvement across both seasons. The present findings are in accordance with earlier findings reported by Abiramiet al. (2005), Bhoite and Sonone (2007), Bello et al. (2012) and Kumar et al. (2015).

Heritability: The estimates of broad sense heritability (h^2) were high for days to 50% tasselling, (69.68%), days to 50% silking(58.80%), plant height(60.68%), ear length(79.91%), number of kernel rows/ear(58.33%), number of kernels/row(70.76%), 100- kernel weight(67.95%) and grain yield(69.87%) in *kharif* season. Whereas, moderate level of heritability was recorded for ear diameter(47.40%) and low level of heritability was observed for anthesis-silking interval(21.25%) in this environment. In *rabi* season, very high estimates of broad sense heritability were observed for the characters namely days to 50% tasselling(84.72%), days to 50% silking(81.72%), ear length(79.50%), ear diameter(76.83%), number of kernels/rows(71.55%) and grain yield(88.24%). While high level of broad sense heritability were observed for remaining traits namely anthesis-silking interval(53.86%), plant height(70.67%), ear height(58.32%) and number of kernel rows/ear(62.26%) in this environment. Overall heritability of all studied characters were higher in *rabi* season than *kharif* season, therefore, more exploitable variation of genotypes are present in *rabi* season(Table 2).

The estimate of broad sense heritability is the proportion of total genetic variance involving both additive and non-additive types to total phenotypic variance. Most of the traits included in the present investigation were having sufficient level of heritability ranging from very high to moderate broad sense heritability across both seasons with minor fluctuation. However, the level anthesis-silking interval heritability was significantly changed with seasons as indicated by low heritability in *kharif* season and moderate heritability in *rabi* season due to seasonal effect. This indicated that all characters except anthesis-silking interval are less influenced by the environmental conditions and selection for such characters on the basis of phenotype will be effective. Similar findings of heritability for grain yield and other characters have also been reported by Abiramiet al. (2005), Bhoite and Sonone (2007), Awasthiet al. (2009), Shanthiet al. (2011), Badawy (2012) and Kumar et al. (2015).

Genetic advance: The estimate of genetic advance at 5% selection intensity was highest for grain yield (23.66) followed by plant height (21.86) ear height (12.39) and number of kernels/row (7.81) in *kharif* season. Whereas, lowest genetic advance at 5% selection intensity was observed for ear diameter (0.39) followed by anthesis-silking interval (0.40) and number of kernel rows/ear (1.30) in this environment. In *rabi* season, genetic advance at 5% selection intensity was also highest for grain yield (40.38) followed by plant height (33.42) ear height (19.63) and number of kernels/row (7.38). Whereas, lowest genetic advance at 5% selection intensity was observed for ear diameter (0.70) followed by

anthesis- silking interval (1.38) and number of kernel rows/ear (1.66) in this environment(Table 2). For comparison among the characters, genetic advance at 5% selection intensity was transformed into genetic advance as per cent of mean. In *kharif* season, genetic advance as percent of mean was also highest for grain yield(51.23) ear length (24.11) and number of kernels/row(24.08). In *rabi* season, highest genetic advance as percent of grain yield (73.36) followed by anthesis- silking interval (37.07) and ear height (32.30), as presented in Table 2. Expected genetic advance for particular trait indicates the expected genetic progress under one cycle of selection. All the characters had higher genetic advance at 5% selection intensity and genetic advance as percent of mean in *rabi* season than *kharif* season because of higher magnitude of heritability for all the characters in *rabi* season compare to *kharif* season. This indicate that genetic advance at 5%

selection intensity as well as genetic advance as percent of mean for all the characters were more responsive in *rabi* season than *kharif* season. High genetic advance along with high heritability arises due to additive type of gene action, while, high heritability estimates with low genetic advance indicates that heritability of these characters is due to non-additive gene effects, viz., dominance, over dominance and epistasis gene action. High expected genetic advance at 5% selection intensity and as per cent of mean coupled with high heritability for most important economic trait i.e. grain yield indicated that genotypic variation present in the genetic material studied might be due to additive genetic variance in both the seasons. These obtained results are in accordance to similar findings with some deviations of Mahmood *et al.* (2004), Singhalet *et al.* (2006), Nagabhusan *et al.* (2011), Badawy (2012) and Bekele and Rao (2014).

Table 1. Analysis of variance for important characters in maize across *kharif* and *rabi* seasons

Source of variation	df	Env	Days to 50% tasselling	Days to 50% silking	Anthesis-silking interval	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of kernel rows / ear	No. of kernels /row	100-kernel weight (g)	Grain yield (Q/ha)
Replication	2	<i>Kharif</i>	3.26	6.47	0.54	122.67	67.78	2.49	0.14	0.63	51.58	5.10	234.54
		<i>Rabi</i>	4.19	2.04	0.21	241.56	604.76	3.41	0.11	0.60	22.42	9.33	819.77
Treatment	55	<i>Kharif</i>	8.15**	5.53**	1.20**	676.60**	249.18**	12.34**	0.32**	2.52**	69.27**	19.37**	647.73**
		<i>Rabi</i>	26.86**	21.82**	3.23**	1271.98**	578.15**	11.51**	0.50**	3.77**	60.93**	22.59**	1364.64**
Error	110	<i>Kharif</i>	1.03	1.05	0.66	120.17	52.92	0.95	0.09	0.49	8.39	2.63	81.42**
		<i>Rabi</i>	1.52	1.51	0.72	154.62	111.22	0.91	0.05	0.63	7.13	2.30	58.06

*, ** Significant at 5% and 1% probability levels, respective

Table 2. Heritability, genetic advance, genotypic and phenotypic coefficient of variation for important characters in maize across *kharif* and *rabi* seasons

Genetic Parameters	Seasons	Days to 50% tasselling	Days to 50% silking	Anthesis-silking interval	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of kernel rows / ear	No. of kernels /row	100 kernels weight (g)	Grain yield (Q/ha)
Heritability	<i>Kharif</i>	69.68	58.80	21.25	60.68	55.28	79.91	47.40	58.33	70.76	67.95	69.87
	<i>Rabi</i>	84.72	81.72	53.86	70.67	58.32	79.50	76.83	62.26	71.55	74.62	88.24
Genetic advance	<i>Kharif</i>	2.65	1.93	0.40	21.86	12.39	3.59	0.39	1.30	7.81	4.01	23.66
	<i>Rabi</i>	5.51	4.85	1.38	33.42	19.63	3.45	0.70	1.66	7.38	4.63	40.38
Genetic advance as per cent of mean	<i>Kharif</i>	5.24	3.63	15.13	11.61	13.33	24.11	10.11	9.80	24.08	16.93	51.23
	<i>Rabi</i>	4.62	3.94	37.07	25.30	32.30	23.76	18.93	12.63	25.77	18.95	73.36
PCV	<i>Kharif</i>	3.65	3.00	34.56	9.29	11.70	14.64	10.35	8.15	16.52	12.10	35.59
	<i>Rabi</i>	2.65	2.34	33.41	17.38	26.88	14.51	11.96	9.85	17.48	12.33	40.36
GCV	<i>Kharif</i>	3.05	2.30	15.93	7.23	8.70	13.09	7.13	6.23	13.89	9.97	29.75
	<i>Rabi</i>	2.44	2.12	24.52	14.61	20.53	12.94	10.49	7.77	14.79	10.65	37.91

PCV- Phenotypic coefficient of variation, GCV- Genotypic coefficient of variation

CONCLUSION

In present study, our genetic material had high amount of genotypic and phenotypic coefficient of variation for all characters in both the seasons which can be exploited in crop improvement programme. All the characters except anthesis-silking interval were having sufficient level of heritability

ranging from very high to moderate broad sense heritability across both seasons with minor fluctuation. Therefore, selection for such characters on the basis of phenotype only will be effective for development of cultivars. Genetic advance as 5% selection intensity and as per cent of mean were higher for grain yield, plant height and ear height were higher in magnitude across both seasons. High

both types of expected genetic advance coupled with high heritability for grain yield in both the seasons indicating the presence of additive genetic variance, which can be effectively exploited in crop improvement programme.

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