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Genetic variance and heritability of some ear traits in prolific maize (Zea *mays* L)

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ABSTRACT

Full-sib and half-sib families of one generation advanced population of a cross between N3 x J1 were developed in the population using NCD1 and were evaluated at experimental fields of Vivekananda Parvatiya Krishi Anusandhan Sansthan, Almora (1250 m amsl) using normal and high plant densities. The results revealed that additive composite were significant for ears per plant (Prolificacy), ear diameter, and kernel rows per ear, 100 kernel weight, ear grain weight and total grain yield. Heritability and expected genetic gains were highest for ear grain weight followed by total grain yield and ears per plant. The results also revealed 2 to 4 time's superior effect of a cycle of full-sib selection over mass selection.

Key Words: *Genetic Variance, Heritability, Maize, Mass selection, Prolificacy*

INTRODUCTION

Among the grain yield components in maize, prolificacy (ears per plant) has been widely recognized as most important character, due to relatively high positive correlation with grain yield (Goodman 1966, Burn and Dudley 1989, Burk and Magoja 1990). Prolificacy is also desirable to increase grain production at high densities, particularly under high soil fertility and moisture (Collins *et al* 1965, Russell 1968). Leng (1964), Lindsey *et al* (1962) reported partial dominance, with prevalence of additive genetic variance for prolificacy. Effects of complete dominance and over-dominance have also been reported (Laible and Dirk 1968). A high heritability of the character has been reported by several workers including Leng (1954) and Laible and Dirk (1968). The studies conducted to estimate the effects of plant densities on genetic components in prolific or semi-prolific types, however, in most of the cases are based on relatively lower densities (Subandi and Compton, 1974, Sorrels *et al* 1979) than the recommended level (60,000-65, 000 plants/ha) in our country. Therefore, the present study in North Carolina Design I (NCD I) has been undertaken to estimate genetic component of variance in a prolific base population at normal and high plant densities.

MATERIALS AND METHODS

Reported material comprised 192 full-sib and half sib families developed using NCD1 in a broad base one generation advance population of a cross between N3 (A highly prolific collection from North-east Himalyas) and composite J1.

RESULTS AND DISCUSSION

In the present study, negative and non-significant estimates of dominance variance indicated that there was no overestimation of dominance variance and hence multiple allelism can be assumed to be absent. Estimates of genetics variance (Table 1) indicate prevalent role of additive component in case of

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prolificacy and other traits, except ear length in normal and high plant densities. Magnitude-wise also the additive component was larger in high density (E_2) than in normal (E_1) for all the traits. Preponderance of additive components revealed that both environments (E_1 and E_2) were suitable for selection? However, E_2 appeared to be more favourable. Shahi and Singh (1988) have also suggested more importance of additive variance under high plant population. Significant additive variance has also been reported by Robinson *et al* (1949) for prolificacy and grain yield; Khehra *et al* (1985) for grain yield, ear length and kernel rows per ear; Shahi and Singh (1985) for grain yield, ear length, ear diameter, kernel rows per year and 100 kernel weight; Ochieng and Compton (1994) for ears per plant. In the present investigation, dominance variance was found to be negative for ears per plant, and ear diameter in E_2 and for 100 kernel weight in both environments. As the variance by definition can not be negative, therefore, true value for this estimate may be either zero or of small positive value. These negative estimates might have resulted due to sampling error or lack of random mating in making half-sib groups. In the present investigation, dominance variance was found to be negative for ears per plant, ear diameter in E_2 and for 100 kernel weight in both E_1 and E_2. The magnitude of dominance variance for the remaining traits was quite low itself and also lowers than the corresponding additive component. Under high plant population, the estimates of dominance variance

Table 1 Genetic variance for ear characters in maize.

Character	Variance component			
	6^2A		6^2D	
	E_1	E_2	E_1	E_2
No. of ears	0.05* + 0.02	0.07* + 0.03	0.05 + 0.10	$ $
Ear length	0.29 + 0.61	0.50 + 0.52	0.10 + 1.59	2.14 + 1.67
Ear diameter	0.55* + 0.22	0.90* + 0.35	0.24 + 0.29	$ $
Ear Kernel row	1.33* + 0.61	1.76** + 0.66	0.88 + 0.89	0.10 + 0.88
Ear 100-kernel wt.	3.69** + 1.34	9.01** + 2.55	$ $	$ $
Ear grain wt.	118.20** + 45.40	140.70* + 50.78	3.88 + 49.92	5.54 + 64.85
Total grain yield	229.56* + 111.22	90.36 + 48.32	78.60 + 172.03	1.96 + 81.70

*, **Significant at 5% and 1% level of probability, $ Not reported due to negative variance.

Table 2 Mean heritability and expected genetic grains for ear characters in maize.

Characters	Mean	Heritability	Expected grains (% of mean)		Superiority
			Full-sib selection	Mass selection	
J of Biotech & Crop Sci (2012) 1(1): 42-45		38.05	13.42	4.40	3.05
		$	$	$	$
Ear length (cm)	E 15.55	10.97	4.92	1.14	4.32
	E 14.71	14.36	2.75	0.80	3.44
Ear diameter (cm)	E 10.93	55.94	7.10	2.52	2.80
	E 10.79	$	$	$	$
Ear Kernel row	E 13.20	60.38	8.29	2.69	3.08
	E 13.37	70.68	10.94	3.69	2.89
Ear 100-kernel weight	E 16.48	$	$	$	$
(cm)	E 16.25	$	$	$	$
Ear grain wt. (gm)	E 67.15	65.56	17.35	5.62	3.08
	E 58.54	75.34	23.37	8.26	2.82
Total grain yield (gm)	E 88.45	47.92	15.52	4.59	3.38
	E 70.08	49.53	11.40	3.10	3.67

$ Not estimated due to negative variance.

were higher than the corresponding estimates under normal plant populations for ear length and ear grain weight, however, kernel rows per ear and total grain yield showed comparatively more dominance variance under normal plant populations. The results, therefore, indicated that dominance variance had no role in the inheritance of all the traits at both density level.

Heritability in narrow sense (Table 2) for prolificacy and other traits resulted from very low for ear length to considerably high for ear grain weight with slightly higher estimates in E_2 than E_1. First ear grain weight recorded substantially higher score of heritability than the total grain yield and prolificacy at both densities. Expected gains through full-sib and mass selection were highest for first ear grain weight in E_1 and E_2. Prolificacy and total grian yield showed substantial expected improvement throught full-sib and mass selection at both the densities. Magnitude of gain was higher in E_2 for ear kernel rows, ear grain weight; however, ear length and total grain yield recorded comparatively high expected gain in E_1 than E_2. Full-sib selection surpassed mass selection by 2 to 4 times in expected gains per cycle of selection (Table 2).

The results of the present investigation therefore, indicated that high plant density is more desirable for expression of additive variance than normal plant densities, and substantial improvement can be made for all the traits except ear length and total grain yield. Mass selection or recurrent selection scheme of population improvement capitalizing on additive genetic variance and use of high plant density environment may be more fruitful for a realistic improvement in prolific materials.

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