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Genetic components of variance and predicted response to selection for fodder yield and its components in a pearl millet (*Pennisetum glaucum* (L.) R. Br.) population

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Abstract

Genetic components of variance were estimated in a pearl millet population in respect of fodder yield and its components following North Carolina Design II. Additive component was predominant for number of leaves per plant, leaf breadth and stem diameter, whereas dominance genetic variance was significant for plant height and ratio of leaf to stem. However, number of tillers per plant, leaf length, dry fodder yield and green fodder yield per plant showed significance for both additive and dominance components. Highest heritability and highest response to selection were observed in number of leaves per plant, whereas green fodder yield per plant and leaf length exhibited the lowest heritability and response to selection, respectively. Most of the fodder attributes including fodder yield (green as well as dry) per plant showed moderate to high response to selection suggesting the scope of achieving considerable genetic gain through selection in fodder yield. To utilise the dominance component of variance of most of the fodder attributes, development of hybrid has been suggested.

Key words : Genetic variance, biparental progenies, North Carolina Design II, fodder, pearl millet

Introduction

The relative importance of genetic components of variance as well as expected response to selection of a trait would be helpful in formulating an effective breeding programme for its genetic improvement. Pearl millet (*Pennisetum glaucum* (L.) R. Br.) is of great importance as a fodder crop also in addition to as grain due to its succulent stem, heavy tillering, leafiness and sufficient green fodder yield. The information on genetic components of variance is available mainly for seed yield and its components of this crop rather than for fodder yield [1-3]. In view of this, an attempt was made to study the genetic components of variance and predicted response to selection for fodder yield and its components following biparental mating in a pearl millet population.

Materials and methods

The experimental material consisted of progenies developed following biparental mating according to North Carolina Design II [4, 5] from a random-mated pearl millet population of UUJ-IV-M variety. One hundred twenty plants were randomly selected from the population and divided into 15 sets each comprising eight plants. In each set four plants designated as 'female' were crossed with each of other remaining four plants designated as 'male' giving rise to 16 full sib progenies. Two hundred forty full sib progenies were, thus, produced wherein each of 15 sets comprised 16 progenies. These 15 sets were grown during *kharif* 1999 in a compact family block design with three replications. The sets were randomised first within replication and then, the progenies were randomised within a set. Each progeny was raised in a single row of 5m long with spacing of 45 cm $\times$ 10 cm and thus, each set was accommodated in 16 rows.

The data on fodder yield and its components were recorded on 10 randomly taken plants in each progeny from each replication. The mean values were subjected to analysis of variance and estimation of additive, dominance components of genetic variance and degree of dominance [4, 5]. Narrow sense heritability and response to selection at 5% selection intensity were also estimated as per standard procedure [6].

Results and discussion

The analysis of variance (Table 1) revealed the significant differences among biparental progenies for all the characters. Partitioning this source of variation into possible different components indicated that mean squares due to male in sets, female in sets and male $\times$ female in sets were also significant for these characters. In other words, not only biparental progenies as a whole, but also half sib progenies (both when 'male' was a common parent and when 'female' was

Table 1. Analysis of variance of biparental progenies for fodder yield and its components in pearl millet

Sources of variation	d.f.	Mean squares								
		Plant height (cm)	Tillers/ plant	Stem diameter (cm)	Leaves/ plant	Leaf length (cm)	Leaf breadth (cm)	Leaf: stem	Dry fodder yield/plant (g)	Green fodder yield/plant (g)
Sets	14	60.4	1.43	0.028	19.04	9.75	0.14	0.04	1432.5	15349.3
Replication in sets	30	86.5	1.74	0.016	14.60	6.20	0.08	0.04	1130.0	19824.8
a) Males(M) in sets	45	595.0**	2.04**	0.051**	116.02**	8.55**	0.23**	0.03**	1319.2*	21458.0**
b) Females(F) in sets	45	385.5**	2.80**	0.061**	94.33**	12.01**	0.44**	0.07**	1750.0**	22943.6**
c) M × F in sets	135	250.0**	0.84**	0.012**	15.94**	3.28**	0.06**	0.03**	1031.3*	16054.0*
Remainder among plots	450	50.0	0.11	0.008	8.84	1.04	0.02	0.01	934.0	14538.3

*, ** Significant at 5% and 1% level of significance, respectively.

a common parent for the progenies) as well as full sib progenies separately showed the significant variation among themselves for different fodder attributes. Theoretically also biparental mating in any population releases the variability resulting in scope for population improvement through half sib or full sib selection.

The estimate of additive and dominance genetic variance for fodder yield and its components (Table 2) revealed that additive genetic variance was relatively more important for number of leaves per plant, leaf breadth and stem diameter as these traits showed high significance only in additive variance with degree of dominance less than 0.5.

Only dominance genetic variance was predominant for plant height and ratio of leaf to stem. The estimate of degree of dominance indicated the presence of over-dominance and thus, dominance gene effect predominantly influenced the inheritance of these two fodder yield components. Both additive and dominance genetic variance were significant for number of tillers per plant, leaf length, dry fodder yield per plant and green fodder yield per plant.

The narrow sense heritability was highest for number of leaves per plant and lowest for green fodder yield per plant (Table 2). However, dry fodder yield per plant, ratio of leaf to stem and plant height exhibited low heritability estimate, whereas high heritability estimate was observed for stem diameter and leaf breadth. High heritable characters such as number of leaves per plant, stem diameter and leaf breadth could be improved effectively through phenotypic (mass) selection, whereas for low heritable characters progeny testing is required. As green fodder yield showed the lowest heritability and moreover, most of the contributing components were also low heritable, selection based on progeny testing through either half sib or full sib progeny should be practised for genetic improvement of fodder yield in pearl millet.

Response to selection expressed in percentage of mean at 5% selection intensity was predicted (Table 2). Number of leaves per plant was the highest in expecting genetic gain as a result of selection from the population as it showed the highest response to selection, whereas the lowest estimate of response to selection was observed for leaf length. Though leaf

Table 2. Estimate of genetic variance (additive, dominance), degree of dominance, narrow sense heritability and response to selection for fodder yield and its components in pearl millet

Characters	Genetic variance		Degree of dominance	Heritability (%) (narrow sense)	Response to selection (% of mean)
	Additive	Dominance			
Plant height	80.140	266.080**	1.82	20.21	4.87
Tillers/plant	0.520*	0.970**	1.37	32.90	7.40
Stem diameter	0.014**	0.003	0.47	53.70	11.57
Leaves/plant	38.440**	8.260	0.46	62.51	19.33
Leaf length	2.420*	2.990*	1.11	37.60	3.27
Leaf breadth	0.090*	0.020	0.44	55.62	15.51
Leaf:stem	0.007	0.026**	1.92	16.67	16.49
Dry fodder yield/plant	167.760*	129.780*	0.88	13.72	10.90
Green fodder yield/plant	2048.940*	2020.900*	0.99	11.02	10.08

*, ** :Significant at 5% and 1% level of significance, respectively

length showed higher estimate of heritability as compared to dry fodder yield per plant, green fodder yield per plant, ratio of leaf to stem and plant height, its predicted response to selection was least because its additive genetic variance as percentage of mean was comparatively less. Likewise, ratio of leaf to stem, being lower heritable trait in comparison to stem diameter and number of tillers per plant had higher response to selection than these two traits because of its more additive variance (as percentage of mean).

Plant height and number of tillers per plant had low estimate of response to selection. On the other hand, the remaining traits including dry fodder as well as green fodder yield per plant showed moderate to high response to selection suggesting the scope of achieving genetic gain for fodder yield through selection.

As only additive genetic variance was significantly prevalent for three important fodder yield components namely number of leaves per plant, stem diameter and leaf breadth and furthermore, number of tillers per plant, leaf length, dry fodder yield and green fodder yield per plant showed considerable amount of additive (along with dominance) variance, breeding synthetic or composite variety for fodder pearl millet would be appropriate which will utilise heterosis due to additive gene effect. But development of hybrid would be the best, as it will utilise dominance variance and 'over-dominance' effect of most of the fodder attributes.

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