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Heritable Variation and Interrelationship in Fox-tail Millet (*Seteria italica* (L.) P. Beauv.)

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ABSTRACT

Variation, heritability in broad sense, genetic gain, coheritability and inter-relationships among 8 traits of foxtail millet were studied. Substantial genetic variability in the stocks was available for different characters. Heritability of days to heading and maturity, grain weight, plant height and tiller number was found to be high, and those of ear length, ear girth and grain yield had relatively low values. High genetic gains were expected in tiller number, grain yield, 1000 grain weight, days to heading and plant height. The grain values were relatively lower for other traits. The yield had significant positive association with tiller number and ear girth; however it had a negative association with days to heading maturity, plant height and ear length. Heading date had a positive and significant correlation with maturity, plant height, ear length, ear girth and 1000 grain weight; however, they were negatively associated with tiller number. Plant height also had a positive association with ear characters and grain weight. Ear characters were positively associated between themselves and also with 1000 grain weight.

INTRODUCTION

Information on the nature and magnitude of variation in the genetic stocks and association among various economic and morphological characters is a pre-requisite to any programme of breeding for high yields. Further, yield being a complex character, is affected by several factors and even a high genotype x environment interaction may restrict the improvement through selection. Therefore, a fair understanding of the interrelationship among yield and other morphological characters is essential to aim at a rational improvement. The present study was aimed to study the interrelationships, heritabilities and genetic gains expected in different strains of foxtail millet.

MATERIALS AND METHODS

Ninteen promising strains of foxtail millet (*Setaria italica* (L.) P. Beauv.) bred at different research stations in India were tested at Gurdaspur, a submontane zone of Punjab, during Kharif, 1972. Data were recorded on eight characters, *viz.*, days to heading, tiller number, days to maturity, plant height, ear length, ear girth, 1000 grain weight and grain yield.

The material was sown in randomized block design with four replications, maintaining row to row distance of 23 cm. and plant to plant distance of 8 cm. The number of days to heading and maturity were counted from the date of sowing to 50 per cent

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heading and when ears turned pale yellow respectively. The data on tiller number, plant height and grain yield were recorded on an average of 10 randomly selected plants from each replication. Ear characters were based on the main tillers of the selected plants and 1000 grain weight on three composite samples of selected plants in each replication.

The coefficients of variation were estimated according to Burton (1952) and heritability in broad sense by Burton and De Vane (1953). The expected genetic gain was calculated by the formula:

$$G_s = K \times \sigma_p \times H$$

Where G_s is expected genetic advance, K=2.06 at 5 per cent selection intenstiy, σ_p, phenotypic standard deviation and H, heritability in unity.

The correlation coefficients were worked out by the formula:

$$r_{xy} = \frac{\text{Cov. } xy}{\sqrt{(\text{Var. } x)\ (\text{Var. } y)}}$$

The coheritability values for different pairs of characters were calculated by the formula:

$$CH = \frac{\text{Cov. } g_{12}}{\sqrt{P_{11} \times P_{22}}}$$

Where CH is coheritability in unity; Cov. g_{12}, genotypic covariance of two variables and P_{11} and P_{22}, phenotypic variances of both the variables.

RESULTS AND DISCUSSION

The mean values for different characters are presented in Table 1. The differences among the varietal means were large and significant. The range of variation was substantially high for all the characters, particularly more pronounced for plant height, grain yield, days to heading and tiller number (Table 2).

The genetic coefficient of variation ranged from 3.30 g. for 1000 grain weight to 112.56 cm. for plant height. It was substantially high for grain yield, days to heading, tiller number and maturity. It had relatively low value for ear characters and grain weight. Similar results were obtained by Athwal and Singh (1966).

The estimates of heritability were high for days to heading and maturity, 1000 grain weight, plant height and tiller number. It was moderate for ear characters and grain yield. The results are in conformity with those obtained by Athwal and Singh (1966) in *Rangni* and Lal and Singh 1970 in pearl millet.

The highest genetic advance (39.052 per cent of mean) was recorded for tiller number, followed by grain yield (30.166), 1000 grain weight (18.677), days to heading (18.017), plant height (16.342) and ear girth (14.944). Ear length and maturity had low values of genetic advance. High genetic advance for yield and tiller number was indicated by Athwal and Singh (1966).

High values of heritability and genetic advance indicate that the variation is largely conditioned by additive components. Days to heading, tiller number, grain weight and plant height had a high heritability and genetic advance values. Selection for

TABLE 1. Mean values for different traits in fox tail millet

Strains	Days to heading	Tiller number	Days to maturity	Plant height (cm.)	Ear length (cm.)	Ear girth (cm.)	1000 grain weight (g.)	Grain yield (g.)
I. Se 119	56.25	5.35	94.00	144.15	16.50	3.30	3.590	12.98
I. Se 201	49.75	3.55	79.25	164.10	18.20	3.30	3.820	10.08
I. Se 279	52.25	4.40	88.25	156.80	16.85	3.88	3.150	11.93
I. Se 358	59.00	4.90	94.25	140.73	16.70	3.41	3.483	12.00
I. Se 480	52.00	4.85	91.25	148.55	16.60	3.30	3.935	11.25
I. Se 700	57.50	5.20	103.75	141.58	15.20	2.68	3.018	8.10
I. Se 701	55.25	6.53	92.75	137.50	16.10	2.83	3.373	8.88
I. Se 702	53.75	5.50	84.75	138.58	16.43	2.96	3.083	8.38
I. Se 703	56.25	6.43	93.00	135.00	15.33	2.96	3.428	8.73
I. Se 704	50.50	5.55	94.75	142.20	16.33	2.32	3.263	6.78
I. Se 709	55.50	6.38	96.75	136.43	15.93	3.02	3.345	8.33
I. Se 710	50.50	5.20	91.50	141.93	16.05	2.75	3.193	7.90
R. S. 179	57.50	4.68	96.25	141.30	16.18	3.48	4.125	11.20
S. R. 5307	52.00	7.85	93.75	132.95	14.03	2.72	3.228	9.85
S. R. 118	52.75	4.38	96.00	140.08	15.18	2.99	3.528	9.45
MS. 1844.2	40.25	8.90	82.25	97.10	12.78	2.78	3.138	15.80
Co. 3	45.75	7.35	87.75	133.55	15.68	2.50	3.673	13.73
H-1	48.50	4.85	85.50	131.15	14.80	2.91	3.615	7.33
Arjuna	59.75	6.45	98.00	141.40	16.53	3.22	3.903	12.00
Grand Mean	52.89	5.70	91.78	139.13	15.86	3.02	3.468	10.25
C. D. at 5 per cent	1.495	1.078	1.03	9.15	1.35	0.498	0.114	3.33
S. E. (m)	±0.54	±0.388	±0.372	±3.30	±0.488	±0.179	±0.413	±0.130

TABLE 2. Range, coefficients of phenotypic and genotypic variance, heritability and genetic advance for 8 characters in fox tail millet

Characters	Range	Coefficient of phenotipic variance	Coefficient of genotypic variance	Heritability (%)	Genetic advance (% of mean)
Days to heading	40-60	44.82	42.62	95.08	18.017
Tiller number	3.4–9.6	38.84	28.22	72.67	39.0523
Days to maturity	79–105	21.98	21.37	97.25	9.776
Plant height (cm)	82.5–171.9	143.91	112.56	78.21	16.342
Ear length (cm)	11.9–20.8	13.09	7.08	54.12	10.107
Ear girth (cm)	2.03–4.46	7.84	3.56	45.44	14.944
1000 grain weight (g)	2.990–4.200	3.22	3.03	93.90	18.677
Grain yield (g)	5.6–19.9	91.59	44.76	48.86	30.166

the high values of these parameters can materially contribute towards grain production. Ear length and ear girth had a relatively low heritability and the coefficients of genotypic variance, offered resistance to improvement.

Phenotypic and genotypic coefficients of correlation are presented in Table 3. Grain yield had a positive and significant correlation with tiller number and ear girth at both the genotypic and the phenotypic levels,

TABLE 3. Phenotypic and genotypic coefficients of correlation for different characters in fox tail millet

Characters	Days to heading	Tiller number	Days to maturity	Plant height	Ear length	Ear girth	1000 grain weight
Tiller number	−0.185 (−0.356)**						
Days to maturity	+0.965** (+0.960)**	−0.115 (−0.003)					
Plant height	+0.414** (+0.517)**	−0.695** (−0.826)**	+0.141 (+0.149)				
Ear length	+0.275* (+0.552)**	−0.479** (−0.852)**	−0.047 (−0.049)	+0.708** +0.983**			
Ear girth	+0.319* (+0.438)**	−0.254 (−0.667)**	−0.303* (−0.020)	+0.286* (+0.587)**	+0.330* (+0.589)**		
1000 grain weight	+0.179 (+0.265)*	−0.223 (−0.264)*	+0.078 (+0.081)	+0.249 (+0.306)*	+0.400** (+0.628)**	+0.276* (+0.442)**	
Grain yield	−0.196 (−0.325*	+0.475** (+0.310)*	−0.249 (−0.397)**	−0.270* (−0.374)**	−0.036 (−0.239)	+0.346** (+0.335)**	+0.137 (+0.218)

Genotypic coefficients of correlation in paranthesis

* Significant at 5% level of probability

** Significant at 1% level of probability.

but was negatively associated with plant height. Days to heading and maturity reflected a negative association with yield. Samathuvam (1951) also observed a positive correlation between tiller number and yield in finger millet.

The association of days to heading with maturity, plant height, ear length and ear girth, that of plant height with ear length and ear girth, that of ear length with ear girth and grain weight, and that of ear girth with grain weight were positive and significant at both the genotypic and the phenotypic levels. Tiller number had significant negative association with plant height and ear length at both genotypic and phenotypic levels, but was negatively correlated with ear girth and grain weight genetically. Phenotypically, ear girth also had a significant negative association with days to maturity. Genotypically, grain weight had a significant positive correlation with days to heading and plant height. It is encouraging to note that selection for high tillering and heavy girth along with sizeable earliness and dwarfism can materially help in yield improvement.

TABLE 4. Coheritability values for different characters in fox tail millet

Characters	Days to heading	Tiller number	Days to maturity	Plant height	Ear length	Ear girth	1000 grain weight
Tiller number	−0.296						
Days to maturity	+0.923	−0.003					
Plant height cm)	+0.445	−0.623	+0.130				
Ear length (cm)	+0.396	−0.534	−0.035	+0.639			
Ear girth (cm)	+0.288	−0.384	−0.014	+0.349	+0.292		
1000 grain-weight (g)	+0.251	−0.218	+0.078	+0.262	+0.448	+0.288	
Grain yield (g)	−0.221	+0.184	−0.274	−0.232	−0.123	+0.158	+0.148

The coheritability estimates of days to heading with plant height, ear length, ear girth and grain weight, days to maturity with grain weight, plant height with ear characters and grain weight, ear length with ear girth and grain weight, ear girth with yield and grain weight and grain weight with grain yield were found to be isodirectional while in all the other traits there was an opposite relationship.

Parallel heritability of the traits and significant positive associations at genotypic and phenotypic levels, could help the breeder to find relative weights on different traits for yield improvement.

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