Genetic Variability, Correlation Coefficient and Path Analysis of Seed and its Component Traits in Forage Maize (*Zea mays* L.)

Sanjeev K Srivas* and UP Singh
Indian Grassland and Fodder Research Institute, Jhansi-284003

Genetic variability, character association and path analysis for seed yield and its contributing traits were worked out in 100 forage maize accessions along with a control variety, namely, African Tall. These materials were collected from Madhya Pradesh, Rajasthan and Uttar Pradesh. The results indicated that phenotypic coefficients of variation, in general, were relatively higher than the corresponding genotypic coefficient of variation for seed yield and contributing traits. The number of kernels per row, shank diameter, seed yield per plant and cob length showed more variation than the other characters. Heritability in conjunction with genetic advance showed days to maturity, seed yield per plant and plant height to be the most important character for improvement through selection. Seed yield per plant, was found to be significantly and positively associated with test weight, number of kernels per row, kernel width, kernel length, shank diameter and cob length. The path coefficient analysis revealed that characters like test weight, number of kernels per row and shank diameter had positive direct effect on seed yield. From the above findings it may be concluded that an ideal plant type in forage maize for seed yield could be described as one which is characterized by more number of kernels per row, test weight and shank diameter. The selection based on these characters might help in improving seed yield in forage maize both directly and indirectly.

Key Words: Correlation, Forage maize, Germplasm, Path analysis

Introduction

In any crop, germplasm serves as valuable source of base population and provides scope for wide variability. Information on the nature and degree of genetic diversity would help the plant breeder in selecting the right type of parents for breeding programme.

The genetic improvement in forage maize, however could not make head way and the gap still remain to be filled up through development of improved dual purpose variety in this crop. Systematic information on the extent of genetic diversity in existing forage maize germplasm, behaviour of seed yield components and their association with direct and indirect effect is scanty or hardly available. Keeping the above point in view, the present investigation was therefore undertaken with a view to find out the various genetic parameters of variability and to understand the association of various quantitative traits in forage maize.

Materials and Methods

A core collection comprising of one hundred accessions of forage maize (*Zea mays* L.) was made from Madhya Pradesh, Rajasthan and Uttar Pradesh. These accessions were evaluated with control variety of forage maize (African Tall) in a Randomized Block Design with three replications at Central Research Farm, Indian Grassland and Fodder Research Institute, Jhansi. Each accession was evaluated in a plot of two rows of 4 m length at 0.40 m apart. The observations were recorded on 12 metric traits at maturity of the crop. Phenotypic and genotypic coefficient of variation, heritability and genetic advance were computed as per method of Johnson *et al.* (1955). Phenotypic correlation coefficient was calculated (Searle, 1961) and path analysis was done by the procedure given by Dewey and Lu (1959).

Results and Discussion

The analysis of variance revealed significant differences among the accessions. The data on seed yield and its contributing traits, range, mean, phenotypic (PCV) and genotypic (GCV), coefficient of variation, heritability and expected genetic advance are presented in Table 1. Considerable range in variation was observed for all the characters. Phenotypic coefficients of variation values showed relatively high values than corresponding genotypic coefficients of variation for all the traits under study. It indicated the effects of environment in the expression of traits. The PCV, which gives a picture of the extent of phenotypic variability in the population, ranged from 7.31 to 21.79 per cent for various traits. The PCV was moderate for characters like number of kernels per row (21.79%) followed by shank diameter

*Present Address: Government Degree College (GTI Campus), Badaun (UP)

Table 1. Variability parameters for seed yield and component traits

Character	Range	Mean	PCV (%)	GCV (%)	h^2 (%) (Broad sense)	GA (% of mean)
Days to 50% silking	43.00 – 59.22	47.95	7.31	5.41	54.80	8.26
Plant height (cm)	148.44 – 268.93	190.17	11.78	7.22	37.60	9.12
Number of leaves/plant	9.81 – 17.44	11.95	10.85	7.38	46.30	10.38
Dry fodder yield/plant	41.57 – 170.29	93.46	14.78	11.07	56.10	17.09
Days to maturity	70.00 – 119.33	81.62	8.66	7.75	80.10	14.29
Cob length (cm)	11.87 – 21.34	15.73	14.46	7.81	29.10	8.71
Cob width (cm)	3.06 – 3.90	3.48	8.28	0.98	1.40	0.29
No. of kernel/ row	10.00 – 14.74	12.36	12.51	5.12	16.70	4.29
No. of kernels/ row	19.59 – 40.42	30.62	21.79	12.60	33.40	15.02
Shank diameter (cm)	0.98 – 1.62	1.25	19.15	5.87	9.40	4.00
Kernel length (cm)	0.75 – 1.02	0.86	9.94	4.02	16.40	3.49
Kernel width (cm)	0.74 – 0.99	0.83	10.51	3.43	10.70	2.41
Test weight (g)	14.53 – 25.73	19.93	10.54	6.05	33.00	7.18
Seed yield/plant (g)	126.21 –261.61	184.51	15.19	9.97	43.10	13.48

Residual = 0.2981; r = Phenotypic correlation with seed yield

(19.15 %), seed yield per plant (15.19 %) and cob length (14.46 %). Rest of the characters showed low values of PCV.

Genotypic coefficient of variation, which gives a picture of the extent of genetic variability in the population, ranged from 0.98 to 12.60 per cent. Maximum GCV was found for number of kernels per row and seed yield per plant. Thus, these traits further offered scope for genetic improvement. The remaining traits, however, showed low values of GCV. From the study of PCV and GCV, the number of kernels per row, seed yield per plant and cob length were found to be the most important characters. These results were largely in accordance with those reported by Satyanarayna and Sai Kumar (1995). With the help of genotypic coefficient of variation alone, it is not possible to determine the amount of heritable variation. Heritable variation can be found out with greater degree of accuracy when heritability in conjunction with genetic advance is studied. Hence, both heritability and genetic advance will determine to get a clear picture of the scope of improvement in various characters through selection. Highest values for heritability was found for days to maturity and days to 50% silking while it was moderate to seed yield per plant, plant height, number of kernels per row, test weight and cob length. Rest of the traits were showing low values of heritability. Similarly, highest values for genetic advance were observed for seed yield per plant and plant height while, it was moderate for days to maturity. Remaining characters showed low values of genetic advance. These findings are in conformity with the previous findings of Sviridov (1979), Claudio and Patricio (1988), El-Harary (1989), Arha *et al.* (1990), Pischedd and Magoja (1990), Mani and Bisht (1996) and Tusuz and Balabanli (1997). From the study of heritability and genetic advance, days to maturity, seed yield per plant and plant height to be the most important characters for improvement through selection. Mani and Bisht (1996) reported high heritability along with high genetic advance for days to 50% silking, seed yield and cob length while it was moderate for plant height.

The phenotypic correlation coefficients for 11 metric traits in maize (Table 2) revealed that test weight, number of kernels per row, kernel width, kernel length, shank diameter and cob length, exhibited positive and significant association with the seed yield per plant. Similar results with regard to correlation coefficient of seed yield with test weight, number of kernels per row and cob length have been reported by Singh and Singh (1993), Rahman *et al.* (1995), Wang *et al.* (1997) and Rana *et al.* (2000). Therefore, these characters should be kept in mind while making selection for improvement in seed yield of maize. Among other component traits, test weight had positive and significant correlation with kernel length, days to 50% silking, kernel width, days to maturation, plant height and seed yield per plant. Number of kernels per row showed positive and significant correlation with seed yield and its contributing traits like cob length while kernel width exhibited positive and significant correlation with kernel length, seed yield per plant and cob width. Kernel length had significant positive association with seed yield, test weight, kernel width, cob width, days to maturity, plant height and days to 50% silking. Shank diameter showed positive and

Table 2. Estimates of phenotypic correlation coefficients among various seed yield characters

Characters	Days to maturity	Plant height (cm)	Cob length (cm)	Cob width (cm)	No. of kernel row	No. of kernels/ row	Shank diameter (cm)	Kernel length (cm)	Kernel width (cm)	Test weight (g)	Seed yield/ plant
Days to 50% silking	0.815	0.445**	-0.102	0.050	-0.124	-0.241*	-0.086	0.238*	0.156	0.531**	-0.032
Days to maturity		0.524	-0.062	0.037	-0.089	-0.282**	-0.074	0.302**	0.142	0.503**	-0.022
Plant height			0.054	0.068	-0.124	-0.093	-0.001	0.268**	0.118	0.472**	0.118
Cob length				0.127	-0.003	0.534**	0.336**	0.006	0.090	-0.010	0.222*
Cob width					0.368**	0.055	0.157	0.359**	0.211*	0.145	0.168
No. of kernel rows						0.039	0.090	0.025	-0.370**	-0.201*	-0.052
No. of kernels/ row							0.141	-0.073	-0.096	-0.229*	0.319**
Shank diameter								0.027	0.071	0.052	0.264**
Kernel length									0.509**	0.539**	0.276**
Kernel width										0.513**	0.295**
Test weight											0.410**

*, ** Significant at 5% and 1% level, respectively

significant association with seed yield and its contribution traits like cob length whereas cob length exhibited positive and significant correlation with yield and its related traits such as number of kernels per row and shank diameter.

The path coefficient analysis carried out at phenotypic level (Table 3) including along with important fodder yielding traits like number of leaves per plant and dry fodder yield per plant and some seed yield contributing traits with positive direct effect was shown by test weight (0.5451) and number of kernels per row (0.4553) followed by shank diameter (0.1930). Therefore, these traits can be found rewarding for increasing seed yield. Direct positive contribution of kernels per row has been reported by Singh and Major (1993) and Rana *et al.* (2000) whereas for number of kernels per row and 1000-seed weight by Debnath and Khan (1991). Characters like number of leaves per plant, cob length and dry fodder yield per plant had negative direct effect on seed yield, on the contrary, Rahman *et al*. (1995) revealed that cob length was the main contributor to seed yield.

Further, results indicated that test weight had negative direct effect on yield *via* number of kernels per row and number of leaves per plant, shank diameter showed substantial indirect contribution to yields through number of kernels per row, kernel width showed positive contribution to yield directly and indirectly *via* test weight. Cob length had indirect significant positive effect on yield through test weight. Kernel length had significant direct effect on yield. It also showed considerable positive effects on yield indirectly through test weight.

In the light of above findings, it may be concluded that an ideal plant type in forage maize for seed yield could be described as one having more number of kernels per row, test weight, cob length and shank diameter. The improvement and selection based on these characters might result in increase in seed yield in forage maize.

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Table 3. Path coefficient analysis of various characters contributing to seed yield

Characters	Days to 50% silking	No. of leaves/ plant	Dry fodder yield/ plant	Days to maturity	Cob length	Cob width	No. of kernels/ row	Shank diameter	Kernel length	Kernel width	Test weight	r
Days to 50% silking	-0.0637	-0.0462	-0.0382	0.0526	-0.0132	0.0112	0.0276	0.0092	0.0078	0.0058	0.2672	0.216*
No. of leaves/ plant	-0.0326	–0.1011	-0.0237	-0.0216	-0.0047	0.0044	-0.0346	0.0073	0.0002	0.0094	0.3167	0.174
Dry fodder yield/ plant	-0.0422	-0.0635	-0.0377	-0.0118	-0.0155	0.0045	0.0027	0.0135	0.0002	0.0121	0.3336	0.250*
Days to maturity	-0.0168	-0.0562	-0.0127	-0.0264	-0.0118	0.0067	0.0073	0.0162	0.0012	0.0138	0.0682	0.267*
Cob length	-0.0230	-0.0060	-0.0074	0.0016	**-0.0791**	0.0056	0.2431	0.0649	0.0000	0.0064	-0.0055	0.222*
Cob width	-0.0078	-0.0102	-0.0039	-0.0226	-0.0100	**0.0438**	0.0250	0.0303	0.0003	0.0137	0.0790	0.168
No. of kernels/ row	-0.0248	0.0077	-0.0002	0.0178	-0.0422	0.0024	**0.4553**	0.0272	-0.0001	-0.0062	-0.1248	0.319**
Shank diameter	-.0.0094	-0.0038	-0.0026	0.0286	-0.0266	0.0069	0.0642	**0.1930**	0.0000	0.0046	0.0283	0.264**
Kernel length	-0.0198	-0.0270	-0.0119	-0.0073	-0.0005	0.0157	-0.0332	0.0052	**0.0008**	0.0331	0.2938	0.276**
Kernel width	-0.0056	-0.0146	-0.0070	-0.0112	-0.0078	0.0092	-0.0437	0.0137	0.0004	**0.0651**	0.2796	0.295**
Test weight	-0.0168	-0.0587	-0.0231	-0.0084	0.0008	0.0063	-0.1043	0.0100	0.0004	0.0334	**0.5451**	0.410**

References

Arha MD, RP Sarda and KN Agrawal (1990) Studies on maize gene pools. II Heritability and expected genetic advance. *Acta Agronomica Hungarica* **39:** 121-125.

Claudio Jobet F and Barriga B Patricio (1988) Genetic variance of yield and other quantitative characters in a population of maize I. Estimation of the component of variance and heritability. *Crop Sci.* **28:** 257-263.

Debnath SC and MF Khan (1991) Genotypic variation, covariation and path coefficient analysis in maize. *Pak. J. Scientific Industrial Res.* **3:** 391-394.

Dewey DR and KH Lu (1959) A correlation and path coefficient analysis of component of crested wheat grass production. *Agron. J*. **51:** 515-518.

El- Harary AA (1989) Genetic studies in a synthetic variety of maize. *Egyptian J. Agron.* **12:** 57-64.

Johnson HW, HF Robinson and RE Comstock (1955) Estimates of genetic and environmental variability in soybean. *Agron. J.* **47:** 314-318.

Mani VP and GS Bisht (1996) Genetic variability in local maize (*Zea mays*) germplasm of Uttar Pradesh hill. *J. Hill Res.* **9:** 131-134.

Pischedda G and JL Magoja (1990) More about maize introgressed with diploperennial teosinte germplasm. *Maize Genetics Cooperation Newsl.* **64:** 74.

Rahman MM, MR Ali, MS Islam, MK Sultan and B Mitra (1995) Correlation and path coefficient studies in maize (*Zea mays* L.) composites. *Bangladesh J. Scientific Industrial Res.* **30:** 87-92.

Rana MK, SK Bhalla and V Kapoor (2000) Interrelationship and path coefficients analysis in maize (*Zea mays*). *Indian J. Plant Genet. Resour.* **13:** 226-229.

Satyanarayna E and R Sai Kumar (1995) Genetic variability and *per se* performance of non- conventional hybrids in maize. *Mysore J. Agric.. Sci.* **29:** 213-218.

Searle SR (1961) Phenotypic, genotypic and environmental correlation. *Biometrics* **57:** 474-480.

Singh Gyanendra and Major Singh (1993) Correlation and path analysis in maize under mid-hills of Sikkim. *Crop Improv.* **20:** 222-225.

Sviridov AV (1979) Heritability of quantitative characters in maize under irrigation. *Pshenitsy* **3:** 15.

Tusuz MA and AC Balabanli (1997) Heritability of main characters affecting maize varieties and determination of relationship among these characters. *Anadola* **7:** 123-134.

Wang Guirong, Zhang Deshui, Cui Decai and Yin Cheng (1997) Genetic analysis of various yield component of maize hybrids. *J. Shandong Agric. Univ*. **28:** 33-36.