http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan
Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 3 (11): 1870-1872, 2000

Selection of S_1 Maize (*Zea mays* L.) Families to Develop High Green Fodder Yielding Population

Muhammad Ahsan and Syed Sadaqat Mehdi
Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad-38040, Pakistan

Abstract: One hundred S_0 families selected out of 500 families on the basis of fresh shoot weight were further evaluated for green fodder yield under field conditions. The value of genetic coefficients of variation was found to be high (29.97 %) for green fodder yield per plant suggesting greater variability for the said trait. Green fodder yield had positive and significant phenotypic correlated with number of leaves per plant and plant height. High relative expected genetic advance (18.82 %) was found for green fodder yield than other indicated traits. On the basis of genetic coefficient of variation, inter-relationships and relative expected genetic advance (REΔg %), it is concluded that green fodder weight may be used as selection criteria while selecting superior S_1 families of maize. A selection intensity of 20 % from the families revealed an average of 424.2 g compared to 234.6 g green fodder yield. The selected twenty S_1 families (out of one hundred families) were inter-crossed to construct a population.

Key Words: Maize, fodder, heritability, interrelationships, genetic coefficient of variation

Introduction

Maize (*Zea mays* L.) is a dual purpose crop in Pakistan. It is being used as food and as an important kharif fodder grown alone and in mixture in the country. Maize is adaptable to widely varying climatic and soil conditions. In view of its increasing importance, improvement on maize has picked considerable attention in Pakistan and other countries of the world (Hunter, 1980; Han, 1982; Prasad and Singh, 1980; Bhole and Patil, 1983; Russell, 1985; Dai *et al.*, 1990; Hussain and Aziz, 1998; Ahsan, 1999; Mehdi and Ahsan, 1999) It is extensively grown in the irrigated and rainfed areas of Punjab. Buatti, (1988) reported that fodder production is approximately 52-54 percent less than the actual requirement of Pakistan. The staggered planting of maize from February to September helps cope with the fodder scarcity problems faced in May-June and October-November (Nazir, 1994).

Maize provides the cheapest and most valuable fodder for animals, especially the milch cattle. As a cash crop, the farmers around cities, grow it widely for sale as green fodder. Being highly productive and bearing abundant leaf growth, it is typically adapted to soils of high fertility. When used as a grain crop the stalk and leaves of maize are kept as stover. Although significant variation exists for nutritional quality traits of the stover and whole-plant forage in maize (Wolf *et al.*, 1993). However, differences in the rate of dry matter accumulation in different parts of the plant are related to changes in morphological structure. Whereas, peak yield of green herbage occurs at the beginning of milky ripeness (Kirilov and Naidenov, 1990).

The production of maize fodder crop per acre is low in Pakistan as compared to many other countries of the world. This is because, little attention has been paid in the past to the improvement of maize as fodder crop. In spite of the tremendous importance of the fodder crops in the country, there is not even a single variety of maize grown purely for fodder purposes. In order to provide an adequate and regular supply of nutritious fodder, considerable efforts are needed to develop a maize variety for fodder purposes. Therefore this experiment was conducted to evaluate the best one hundred S_1 families for green fodder yield and other plant traits. Based on their performance, the superior families were selected and inter-crossed. The inter-crossed seed was harvested and composited to make a bulk population.

Materials and Methods

This experiment was conducted in the research area of the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad on March 6, 1999. The remnant seed of one hundred S_0 families selected out of five hundred on the basis of their superior performance were raised in a modified randomized complete block design with two replications. One hundred families were assigned to four blocks and each block consisted of twenty-five families. The experimental unit consisted of single row plot of 2.85 m length with row-to-row and plant-to-plant distances of 30 and 15 cm, respectively. Normal cultural practices were applied to the plants throughout their growing period. The experiment was harvested for green fodder yield (g) when the 50 percent of the plants in each row initiate tasseling. Other plant traits, such as leaves per plant and plant height of ten randomly selected plant for each genotype also recorded at the harvest. For each genotype a known sample of green fodder was taken and chopped. The chopped sample was weighed and left to dry to determine the dried fodder weight. Thereafter, completely dried samples were weighed again and dry fodder weight of the samples determined (henceforth called as dry fodder yield).

Data were analyzed for the analysis of variance technique (Steel and Torrie, 1980). The data collected for each seedling trait was also analyzed to estimate components of genetic, phenotypic and environmental variances (Robinson *et al.*, 1951). Thereafter phenotypic (r_P) and genetic (r_G) correlation coefficients (Kown and Torrie, 1964), and estimates of broad sense heritability were also obtained to determine the superior progenies by using 20% selection intensity. Mean and genetic coefficients of variation (GCV%) were also calculated for each seedling trait. Genetic advance (Δg) was also calculated as:

Genetic advance $(\Delta g) = i.\ h^2.\ \sigma p$
(where $i = 1.40$)

Relative expected genetic advance $(RE\Delta g\ \%) = \Delta g \times 100\ /\ \text{mean}$

Results and Discussion

Mean squares from analysis of variance revealed significant ($p<0.01$) differences among S_1 families for number of leaves per plant and plant height (cm) (Table 1). However, the

Table 1: Mean squares from the analysis of variance for indicated plant traits among S_1 maize families evaluated for fodder purposes

Source	df	Green fodder yield plant^{-1}(g)	Dry fodder yield (g)	Plant height (cm)	Leaves plant^{-1}
Blocks	3	113796.0**	383.1^{NS}	286.0^{NS}	2.42^{NS}
Replications /blocks	4	61450.3*	250.2^{NS}	384.3**	0.57^{NS}
Families / blocks	96	24580.3^{NS}	334.0^{NS}	505.6**	2.77**
Error	96	19634.7	293.7	218.9	1.11

NS = non-significant, *, ** Significant at 5 and 1 percent levels of probability, respectively.

Table 2: Mean, genetic coefficients of variation (GCV %) of some indicated traits among 100 S_1 maize families evaluated for fodder purposes

Trait	Mean	σ^2g	σ^2e	GCV (%)
Green fodder yield plant^{-1} (g)	234.61	4945.59	19634.71	29.97
Dry fodder yield (g)	143.88	40.28	293.72	4.41
Plant height (cm)	10.55	1.66	1.11	12.21
Leaves plant^{-1}	143.57	286.70	218.86	11.79

Where: σ^2g = component of genetic variance, σe^2= components of environmental variance.

Table 3: Phenotypic (r_P) and genetic correlation coefficients (r_G in parenthesis) among some indicated traits of S_1 maize families evaluated for fodder purposes

Trait	Green fodder yield	Dry fodder yield	Plant height
Dry fodder yield	0.008^{NS}		
	(-0.350)		
Plant height	0.413**	0.463**	
	(0.721)	(0.683)	
Leaves plant^{-1}	0.405**	0.327**	0.662**
	(0.497)	(0.236)	(0.552)

NS = Non-significant, ** = Significant at 0.01 probability level.

Table 4: Broad-sense heritability (h^2 %) estimates and relative expected genetic advance (REΔg %) for some indicated traits among S_1 maize families evaluated for fodder purposes

Trait	h^2 %	Δg	REΔg (%)
Green fodder yield plant^{-1} (g)	20.12	44.1621	18.82
dry fodder yield (g)	12.06	3.0856	2.14
Plant height (cm)	56.71	17.8518	12.43
Leaves plant^{-1}	59.93	1.3964	13.24

Table 5: Mean of indicated plant traits of the best twenty selected out of one hundred S_1 maize families on the basis of green fodder yield under field conditions

S_1 families	Green fodder yield plant^{-1} (g)	Dry fodder yield (g)	Plant height (cm)	Number of leaves plant^{-1}
1	390.0	161.6	159.9	10.8
2	363.4	143.6	145.1	12.4
3	421.7	166.9	147.8	10.8
4	363.4	153.8	148.2	11.9
5	367.5	166.0	148.1	13.2
6	425.0	142.9	199.9	12.4
7	555.9	145.5	134.4	10.7
8	384.2	126.4	154.9	11.4
9	501.2	123.9	148.9	9.6
10	413.6	137.8	147.6	10.3
11	373.8	146.8	142.2	12.4
12	431.7	134.9	168.7	12.3
13	400.0	151.4	130.5	10.8
14	464.2	150.1	152.9	12.1
15	373.3	170.5	166.4	11.9
16	374.9	161.5	166.2	9.2
17	580.3	129.3	161.6	11.4
18	402.4	153.8	143.3	11.5
19	528.5	119.9	160.3	12.8
20	369.0	134.3	148.6	12.3
Mean	424.2	146.1	153.8	11.5

differences among S_1 families for green fodder yield per plant (g) and dry fodder yield (g) were non-significant. Ayub *et al.* (1999) reported non-significant differences for plant height, stem diameter, leaf area plant^{-1}, green fodder yield, extractable fat percentage, crude protein, crude fibre percentage and total ash percentage in two maize varieties. However they reported that dry matter yield was significantly more in Akbar (7.18t ha^{-1}) than Neelum (6.09t ha^{-1}). Kim *et al.* (1992) also reported significant differences among the maize cultivars for dry matter yield .

Mean and genetic coefficients of variation (GCV %) for plant traits recorded from one hundred S_1 families are given in Table 2. The genetic coefficients of variation magnitudes were found lower for dry fodder yield (GCV = 4.41%). However, moderate genetic coefficients of variation were found for leaves per plant and plant height (12.21 and 11.79 %, respectively). However, the genetic coefficient of variation for green fodder yield per plant was found to be higher (29.97 %). Similar to these finding, Mehdi and Ahsan (1999) reported high magnitudes of coefficient of variation (GCV%) for green fodder yield (GCV= 18.34 %) than dry fodder yield (GCV= 11.96 %), leaves plant^{-1} (GCV= 8.95 %)and plant height (GCV= 10.96 %). This indicated that variability in green fodder yield is useful in selecting superior families for further inter-crossing. This inter-crossing will help to accumulate the gene(s) flow of superior families in a newly improved maize population for fodder purposes. Ayub *et al.* (1998) reported significant differences among maize cultivars for plant height, fresh fodder yield and some other agronomic traits. These results indicate that there was more variability among S_1 lines for green fodder yield per plant. Therefore, green fodder weight per plant variability may be more useful in selecting the superior families for further inter-crossing.

Green fodder yield had positive and highly significant ($P<0.01$) phenotypic correlation with number of leaves per plant and plant height. However, there was no significant phenotypic correlation found between dry fodder yield and green fodder yield per plant. There were positive, highly significant phenotypic correlation coefficients found among dry fodder yield, leaves per plant and plant height (Table 3). Ahsan, (1999) reported a significant and positive linear correlation coefficient between plant height and leaves plant^{-1}. There were positive and significant inter-relationships among green fodder yield, leaves per plant and plant height (Mehdi and Ahsan, 1999). Although, they reported that dry matter yield was not significantly correlated with green fodder yield. Highly significant relationship between dry matter yield and plant height in maize was reported by Rehman *et al.* (1992). It is, therefore, concluded from the results that green fodder yield can be used as selection criteria while selecting superior S_1 families in maize. Broad-sense heritability estimates (Table 4) were found lower for dry fodder yield (12.06) and green fodder yield per plant (20.12 %) as compared to leaves per plant and plant height (h^2_{BS} = 59.93 and 56.71%, respectively). Whereas, the magnitude of relative expected genetic advance (REΔg %) was higher for green fodder yield per plant (18.82 %) as compared to dry fodder yield, leaves per plant and plant height (REΔg % = 2.14, 13.24 and 12.43 respectively).

On the basis of GCV, inter-relationships and relative genetic advance (REΔg %), it is suggested form the results that green fodder yield may be used as indicator to select superior S_1 families of maize. Therefore, 20 best families were selected out of 100 S_1 families on the basis of green fodder yield evaluated in this experiment. The mean performance of the 20 selected S_1 families is given in Table 5. Upon selection of 20 superior families (20 % selection intensity) the green fodder yield improved from 234.61 g per plant (Table 2) to 424.2 g per plant (Table 5). Likewise, other plant traits i.e., plant height, number of leaves per plant and dry fodder yield also improved.

References

Ahsan, M., 1999. Performance of six maize (*Zea mays* L.) inbred lines and their all possible as well as reciprocal cross combinations. Pak. J. Biol. Sci., 1: 222-224.

Ayub, M., R. Ahmad, A. Tanveer and I. Ahmad, 1998. Fodder yield and quality of four cultivars of maize (*Zea mays* L.) under different methods of sowing. Pak. J. Biol. Sci., 1: 232-234.

Ayub, M., R. Mahmood, A. Tanveer and M.S. Sharar, 1999. Effect of seeding density on the fodder yield and quality of two maize varieties. Pak. J. Biol. Sci., 2: 664-666.

Bhatti, M.B., 1988. National perspective for fodder crops in Pakistan, NARC, Islamabad, pp: 1-2.

Bhole, G.R. and R.C. Patil, 1983. Genotypic and phenotypic correlations in maize. Jr. Muhurashtra Agric. Uni., 9: 251-251.

Dai, J.Y., Gu. Wl, X.Y. Shen, B. Bheng, H. Qi and S.F. Cai, 1990. Effect of drought on the development and yield of maize at different growth stages. J. Shen. Agri. Uni., 21: 181-185.

Han, G.C., 1982. Correlations between maize photosynthetic traits and yield in maize and an analysis of genetic effects. Acta Agron. Sinica., 8: 237-244.

Hunter, R.B., 1980. Increased leaf area (source) and yield of maize in short season areas. Crop Sci., 20: 571-574.

Hussain, M.R. and K. Aziz, 1998. Study of combining ability in maize line × tester hybridization. Pak. J. Biol. Sci., 1: 196-198.

Kim, B.H., Y.H. Moon and J.N. Shin, 1992. A comparison of productivity of various silage maize cultivars. J. Korean Soci. Grassland Sci., 12: 185-192.

Kirilov, A. and T. Naidenov, 1990. Composition, yield, intake and digestibility of green maize. 2. Intake, digestibility and performance. Zhivotnov dni Nauki, 27: 59-61.

Kwon, S.H. and J.H. Torrie, 1964. Heritability and inter relationship among traits of soybean populations. Crop Sci., 4:196-198.

Mehdi, S.S. and M. Ahsan, 1999. Evaluation of S_1 maize (*Zea mays* L.) families for green fodder yield. Pak. J. Biol. Sci., 2: 1069-1070.

Nazir, S., 1994. Fodder crops In: Crop Production, pp. 391-417. National Book Foundation, Islamabad.

Prasad, S.K. and T.P. Singh, 1980. A comparison of different methods for determining the stability of maize varieties. Indian J. Agric. Sci., 50: 731-733.

Rehman, N., A.R. Chaudhry and M. Hussain, 1992. Heterosis and inter-relationship estimates in maize hybrids for fodder yield and quality. J. Agric. Res., 30: 41-51.

Robinson, H.F., R.E. Comstock and P.H. Harvey, 1951. Genotypic and phenotypic correlations in corn and their implications in selection. Agron. J., 43: 282-287.

Russell, W.A., 1985. Evaluation for plant, ear and grain traits of maize cultivars respecting seven years of breeding. Maydica, 30: 85-96.

Steel, R.G.D. and J.H. Torrie, 1980. Principles and Procedures of Statistics: a biometrical approach. McGraw Hill Book Co., New York, USA.

Wolf, D.P., J.G. Coora, K.A. Abrecht, D.J. Undersander and P.R.Carter, 1993. Forage quality of maize genotypes selected from extreme fibre concentrations. Crop Sci., 33: 1353- 1359.