MULTIPLE TRAITS SELECTION IN A MAIZE POPULATION DERIVED FROM MAIZE VARIETY DEHQAN

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ABSTRACT

This experiment was conducted at the Agricultural Research Farm, NWFP Agricultural University, Peshawar to study the effect of multiple traits selection in a population of maize derived from maize variety Dehqan. The experiment was completed in two growing seasons during the years 2001 and 2002, raising one crop per year. In Kharif 2001, variety Dehqan was sown and selection for superior attributes was made on phenotypic basis. The selected (C_1) and original population (C_o) were sown in the next Spring 2002 crop season along with two checks, a maize hybrid, Cargill 919 and an open pollinated maize variety, Sarhad Yellow. The genotypes were evaluated in a randomized complete block design (RCBD) using four replications, with 6 rows plot^{-1}, each 5 m long and 0.75 m apart. Highest number of days to 50% silking were recorded for Cargil 919 (68). Maximum days to 50% tasseling were recorded for Sarhad yellow (61), which were 3.39% more than Dehqan selected population (59). Maximum days to physiological maturity were recorded for Sarhad yellow (116), which were 3.57% more than Dehqan selected population (112). Maximum lodging percentage was observed for Dehqan original population (1.48%) as compared to Dehqan selected population (1.13%). Tallest plants were those of Sarhad yellow (176.75 cm), which were 11.87% taller than those of Dehqan selected population (158 cm). Dehqan original gave maximum ear height (59.5 cm), which was 7.27% more than that of Dehqan selected population (55.5 cm). This study indicated that one cycle of selection considerably helped in accumulating favorable alleles in the selected version of maize variety Dehqan.

Key words: *Zea may* L. multiple traits selection, correlation, index selection

INTRODUCTION

Maize is the third major cereal and staple food after wheat and rice in Pakistan. Besides its consumption as human food, it is also used as fodder for livestock, raw material for industries, bedding for animals and shelter purposes as well. Maize is the most domesticated crop of all field crops. Being a short duration food crop, it has attained priority in the areas of high mountains especially the northern parts of the Frontier Province, where chilling conditions and snow fall limit the growing period of cereals (Saeed and Saleem, 2000).

Most of the agronomic characters in maize show quantitative inheritance. They are controlled by several genes and hence are considerably influenced by the environment. In plant breeding programs multiple traits are often handled together for the improvement of several traits simultaneously. No difficulties arise if the characters are genetically independent, but most of the characters are related to each other and breeders encounter them frequently in one form or another. Correlations between characters are a frequent feature of plant breeding. They may arise from linkage or developmental genetic interactions, with or without a purely phenotypic component. When two desirable characters are correlated, selection will be easy and effective for these characters as they can be improved in the desired direction simultaneously. On the other hand when a desirable character is linked with an undesirable character, then the selection of desirable character becomes complicated and progress through selection will be comparatively slow.

Umakanth *et al.* (2000) reported that in maize grain yield was significantly and positively associated with all characters except days to 50% silking.

Grain yield correlation was the highest for plant height followed by 1000-grain weight and number of kernels ear^{-1}. The highest heritability was recorded for plant and ear height. Hence selection needed to be performed for several characters, with special emphasis on plant and ear height, because of their high heritability and positive correlation with yield. In another study Jadha *et al* (1995) reported that grain yield was positively and significantly correlated with dry matter palnt^{-1}, ear length, number of grains row^{-1}, ear girth, number of grain rows ear^{-1}, plant height and leaf area plant^{-1}.

The objectives of this research were to determine the genetic gain in selected material in comparison with the original (unselected) maize population of variety Dehqan and to synthesize a maize population with superior attributes which could be used as a germplasm source for the extraction of inbred lines in subsequent maize breeding programmes.

MATERIALS AND METHODS

Multiple traits selection in a maize population derived from maize variety Dehqan was carried out at the Agricultural Research Farm NWFP Agricultural University, Peshawar during summer 2001 and spring 2002. The main objective of the study was to observe the effects of multiple traits selection after one cycle of selection in comparison to original (unselected population) $C_{0,}$. Population of variety Dehqan was used as source material for screening and selection purposes. Selection was

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carried out in Kharif crop season 2001 and the selected plants were stored for the next season. Selection was made on the basis of phenotypic superiority. Superior attributes for selection included earlier physiological maturity, reduced plant and ear height, increased ear length and thousand grain weight, free from disease and pests and lodging resistance. A random sample of hundred plants was taken from the field for comparison.

In the Spring season 2002, the selected samples were grown along with original unselected population and two checks i.e. a maize hybrid, Cargil 919 and an open pollinated maize variety, Sarhad yellow. The experiment was laid down in Randomized Complete Block Design (RCBD) having four replications. Irrigations were provided on weekly basis or as required during the entire crop season. A basal dose of fertilizer of 120 kg nitrogen and 50 kg of phosphorus was applied in the form of urea and DAP. Full dose of phosphorus and half dose of nitrogen was applied at the time of sowing. The remaining half dose of nitrogen fertilizer was side dressed when plants were 10-15 cm tall. Diazinon 10 G was used in shoots after 25 days of sowing followed by spot application thereafter, whenever required for the control of maize stem borer. Each replication comprised 24 rows, having six rows of each entry. Row length was 5 m. which were spaced at 75 cm and the plants were having a space of 25 cm resulting in a population of about 50,000 plants ha^{-1}. Standard cultural practices were applied from sowing till harvest. Data were recorded on the following parameters using either standing crop or the harvested material.

Days to 50% Silking
For recording days to 50% silking, the number of days were calculated from date of sowing to the date when 50% plants in the six row plot produced silks.

Days to 50% Tasseling (Anthesis)
Days were counted when 50% plant in the six row plot shed pollen.

Days to Physiological Maturity
The number of days required to reach maximum dry matter accumulation or physiological maturity was recorded by observing black layer formation on the middle of kernels on randomly taken ears from eight plants $plot^{-1}$.

Plant Height
Plant height was recorded from the soil surface to the base of the tassel of selected plants at physiological maturity. Eight plants were taken randomly from each plot for the measurement of plant height character and then average was calculated.

Ear Height
At maturity, notes were recorded as measurement in cm from the soil surface to the node bearing the upper most ear. Average was calculated for the selected eight plants.

Lodging Percentage
Lodging percentage was calculated from the number of plants $plot^{-1}$, exhibiting lower stalk breakage or leaning more than 45^{o} from the lowest internode.

RESULTS AND DISCUSSION
One cycle of multiple traits selection was completed in this study. Data on maturity and morphological parameters including days required to 50% silking, days to 50% tasseling, plant and ear height, days to physiological maturity and lodging percentage were recorded at appropriate time. The data analyzed statistically is discussed in the following paragraphs.

Days to 50% Silking
Data on days to 50% silking is given in Table I. Analysis of variance (ANOVA) showed that Dehqan original C_0 (unselected population) and Dehqan selected C_1 were significantly different from each other at 0.05 level of probability. Dehqan selected population needed 65 days for 50% silking. Dehqan original, Sarhad yellow and Cargil 919 showed no significant difference and were in the same category by needing maximum number of 67 days to 50% silking. The non-manifestation of any significant differences among the maize populations could be due to their somewhat similar maturity range. As maize breeders in Pakistan practice selection for early silking therefore, the range for days to silking in the locally developed maize population is getting narrower. The result is that most of the locally developed maize varieties need some what similar number of days to 50% silking. Non significant difference among maize populations for number of days to 50% silking was also reported by Khan *et al*. (2000) who studied correlation among yield and yield components in maize crosses and concluded that grain yield was positively correlated with all yield components except days to 50% silking. Pandey *et al.* (1991) while studying the performance of open pollinated maize cultivars observed -2.6% superiority of the selected cycle over the original cycle for days to 50% silking among 40 experimental cultivars.

Days to 50% Tasseling
For days to 50% tasseling no significant difference was observed among the four populations at 0.05

level of significance, however, Dehqan selected (C_1) took lesser days than Dehqan original (C_0). Dehqan selected took 59 days for tasseling while Dehqan original, Sarhad yellow and Cargil 919 took 60, 61 and 60 days, respectively (Table 1). In maize breeding tassel size is of great importance and larger tassel is favoured for long plants whereas smaller tassel size is desirable for smaller stature plants. The non significant differences for days to tasseling in this study could be attributed to selection of uniform maturity plants. Our results for days to 50% tasseling are in agreement with those of Farias *et al*. (2001) in divergently selected maize population for genotypic and phenotypic correlations between tassel size and ear height.

Days to Physiological Maturity

The data for days to physiological maturity presented in Table 1 showed no significant difference between Dehqan Original and Dehqan Selected at 0.05 level of significance, however, Dehqan selected population matured three days earlier than the unselected population i.e. Dehqan Original. The highest mean days to physiological maturity were recorded for open pollinated maize variety Sarhad yellow (116 days) followed by Dehqan Original (115 days) and Cargil 919 (114 days). Minimum days to physiological maturity were recorded for Dehqan Selected C_1 (112.5). Physiological maturity mean accumulation of dry matter in grain and early maturing varieties are required in NWFP for adjustment in multiple cropping systems. Eltahhir *et al*. (2003) reported similar results who conducted phenotypic mass selection in two maize populations to study broad sense heritability for days to maturity. In the present study the difference between highest and lowest data was 3.11%. Kumar and Kumar (1997) on the other hand revealed significant correlation between days to maturity and grain yield in their study on eight yield related traits in five maize lines.

Plant Height

Plant and ear height are important morphological parameters in maize breeding. Maize breeders are interested in short stature plants because of their lodging resistance and higher response to fertilizer application. Analysis of variance showed no significant difference among the four maize populations used in this study for the two parameters i.e. plant and ear height. Data given in Table I indicates that Sarhad yellow gave maximum plant height of 176.75 cm followed by Dehqan original (162.5 cm) and Cargil 919 (160.5 cm). Minimum plant height was observed for Dehqan selected population (158 cm). Selected plants were 4.5 cm (2.85%) shorter than the original plants. Statistical analysis of variance showed that although there was no significant difference among the four populations, however, selected plants were 4.5 cm (2.85%) shorter than the original. The difference between highest and lowest value was 6.17%. It was observed that short stature plants were resistant to lodging and resulted in high grain yield. Kumar and Kumar (1997) while conducting experiment on five maize lines reported that plant height was positively correlated with grain yield. On the contrary Tiwari and Verma (1999) concluded that short statured plants will give low grain yield because they will take less number of days for physiological maturity and hence will have lower accumulation of dry matter in kernels.

Ear Height

Proper position of ear on the maize stalk is important for improving lodging resistance in maize and hence maize breeders are interested in low ear height. Analysis of variance at 0.05 level of probability showed no significant difference among the four maize populations for ear height. Minimum ear height was exhibited by Cargil 919 (51.25 cm) followed by Dehqan selected (55.5 cm) and Sarhad yellow (58.5 cm) as given in Table I. Maximum ear height was observed for Dehqan Original (59.5 cm). Decrease in ear height for Dehqan selected was 7.21% as compared to Dehqan original (unselected population). During the present study, it was observed that ear height was positively correlated with lodging percentage and physiological maturity. Selected plants matured earlier than the unselected plants. The higher the ear placement is, the late it will be in maturity. Rahman *et al*. (1995) reported that ear height, plant height and 1000 grain weight were the main contributors to maize grain yield. Altinbas (2003) observed in maize genotypes that additive gene effects were more important than non-additive gene effects for ear height.

Lodging Percentage

The data for lodging percentage at 0.05 level of probability showed significant differences among Dehqan Original, Dehqan selected, Sarhad yellow and the hybrid Cargil 919 as given in Table I. Maximum lodging percentage was recorded for Dehqan original (1.48%) followed by Sarhad yellow (1.43%) and Cargil 919 (1.38%). Minimum lodging percentage was recorded for Dehqan selected population (1.13%). Selection for stalk strength is the main point of interest in developing lodging resistance. In this experiment plants with robust stalk and low ear height were selected to control lodging. Improvement in lodging percentage for Dehqan selected was 3.16% as

compared to Dehqan original (unselected population). Increase in lodging resistance could be attributed to selection for robust stalk and low ear height. Flint et al. (2003) revealed that maize plants with lower ear placement had stronger stalks and were therefore less vulnerable to lodging.

The present study indicated that one cycle of S1 line recurrent selection helped in accumulating favorable alleles for the desired attributes in the selected version of maize variety Dehqan. Further selection is needed to enhance the frequency of these favorable alleles in subsequent generations.

Table I. ***Mean values for maturity and morphological parameters of four maize populations tested at Agricultural Research Farm during 2002***

Genotype/Population	Days to 50% Silk	Days to 50% Tassel	Days to Maturity	Ear Height (cm)	Plant Height (cm)	Lodging %
Dehqan Original (C_0)	67.50a	60.25a	115.25a	59.50a	162.50 a	1.48a
Dehqan Selected (C_1)	65.25b	59.25a	112.50a	55.5a	158.00 a	1.13b
Sarhad Yellow (Check 1)	67.50a	61.00a	116.25a	58.50a	176.75 a	1.43a
Cargil 919 (Check 2)	67.75a	60.50a	114.25a	51.25a	160.50 a	1.38ab
LSD Value (0.05)	1.77	2.07	4.53	14.21	20.31	0.26

Means in the same column followed by different letters differ significantly using LSD at p=0.05 level.

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