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# Magnitude of Variability for Yield and Yield Associated Traits in Maize Hybrids

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**Abstract:** The study was undertaken to evaluate the maize hybrids for yield and yield associated traits. Results indicated that hybrids were significantly different from one another for all the characters. Among the twelve hybrids, the maximum days to 50 % silking (62.50), days to 50 % pollen shedding (62.50) were recorded in hybrid 3043, while the lowest mid-silking days of 54 and mid-pollen shedding days of 55 were recorded in Pop 9815. The highest values of plant and ear height were recorded in hybrid 3012. On the other hand lowest plant height was recorded in Pop - 9815, lowest ear height was observed in Baber hybrid. Maximum ear length of 20.46 cm was observed in hybrid 3130, while minimum ear length of 16.75 cm was recorded for hybrid Super Early. Maximum kernel rows per ear i.e. 15 rows was obtained for Pop-9815, while minimum (12.30) kernel rows was recorded for hybrid 3062. Maximum 1000-kernels weight of 395.16 g was observed in hybrid Ghauri, while minimum 1000-kernels wt of 261.18 g was recorded for hybrid 3057. Maximum grain yield (9915.66 kg $ha^{-1}$) was obtained from hybrid C-919, while minimum (6845.74 kg $ha^{-1}$) grain yield was recorded for the hybrid 3043. Results suggest that these hybrids, could be used as source of improved germplasm for developing maize genotypes with superior attributes.

**Key words:** Maize hybrids, genetic variability, magnitude of yield associated traits

## Introduction

Maize is the third most important cereal in Pakistan after wheat and rice. It is grown on 961.7 (000) ha with about 64 % under irrigation, the rest is rainfed. Its average production in Pakistan is 1718 kg $ha^{-1}$ with total production of 1652000 tones (Zakir and Abrar, 2000). Due to the many industrial products made from maize crop, maize demand in world as well as in Pakistan is increasing from year to year considerably. The fast growing demand could be met by increasing substantially the yield per unit area and partially by bringing more area under cultivation.

Increased production per unit area is the primary objective in many maize breeding programmes. Of these, grain yield is the most important and complex character with which the maize breeder works. Debnath and Khan (1990) estimated interrelationships for grain yield and eight other agronomic traits in 21 maize genotypes. Grain yield showed positive and significant correlation with days to silking, plant height, ear height, ear diameter and 1000-kernels weight.

Being a quantitatively inherited trait and controlled by numerous genes, it results through the vital processes, such as photosynthesis, transpiration and storage of food materials. Maize displays an orderly sequence of development of yield components, namely: number of ears per plant, number of kernel rows, number of kernel per row and kernel weight (Adams, 1967). Exploitation of heterotic patterns is the key factor in most applied breeding programmes. Breeders can take advantage of knowledge about pedigree origin and relations among inbred lines by evaluating experimental crosses between lines derived from identified the erotic patterns (Eyherabide and Hallaur, 1991). Rozman *et al.* (1996) studied the changes in grain yield, days to silking, grain moisture at harvest, percentage of stalk and root lodged plants and performance index the proportion of changes due to cultural practices and due to breeding.

Maize improvement programmes involve development of new maize varieties with improved yield potential, accompanied with other desirable attributes. This need, screening of available sources of maize germplasm for desirable characteristics.

Therefore the study was undertaken to screen some maize hybrids grown in NWFP for yield and yield components. This could help to identify new sources of improved characteristics for possible incorporation into future maize breeding programmes.

## Materials and Methods

The research work was conducted at NWFP Agricultural University Research Farm, Malakandher, Peshawar during 2001, kharif season. Maize hybrids collected from different sources were used in the investigation. In this study used randomized complete block design and the sub-plot area was 15 $m^2$ having 4 rows each per hybrid with row length of 5 m (Cardoso *et al.*, 2002). Rows were kept 75 cm apart and plant to plant distance was maintained at 25 cm. When plants were 10-15 cm tall, thinning was carried out resulting in a plant population of about 56000 plants per hectare. A basal dose of 120-50 kg NP $ha^{-1}$ fertilizer was applied in the form of DAP and urea. Full dose of phosphorus and half of nitrogen was applied at the time of sowing, while the remaining half of the nitrogen in the form of urea was applied at the time when the crop was at knee high stage. Standard cultural practices were followed from sowing till harvest. Primixtra was used as pre-emergence herbicide just after planting. Furadon granules were applied at sowing time and to the leaf whorl for the control of stem borer immediately after emergence when incidence of borer attack was observed on the crop. The following twelve hybrids developed by different seed companies, NARC Islamabad and CCRI, Pirsabak were used:

| Hybrid | Seed supply sources |
|---|---|
| 3062 | NARC, Islamabad |
| 3043 | Pioneer Hybrid International |
| 3057 | Pioneer Hybrid International |
| 3130 | Pioneer Hybrid International |
| 3012 | Pioneer Hybrid International |
| Super Early | CCRI, Pirsabak, Nowshera |
| Ghauri | CCRI, Pirsabak, Nowshera |
| Baber | CCRI, Pirsabak, Nowshera |
| POP-9815 | CCRI, Pirsabak, Nowshera |
| POP-9864 | NARC, Islamabad |
| C-919 | NARC, Islamabad |
| HBD-3 | NARC, Islamabad |

Data were taken on the following parameters on the central two rows at appropriate time for each parameter. Days to 50% silking, days to 50 % pollen shedding, plant height, ear height, ear length, kernel rows/ear, 1000 Kernels weight, grain yield/hectare at 15% moisture. The data thus obtained were statistically analyzed to detect if significant differences among the different hybrids exist for various parameters. LSD test was applied to determine significant means separation.

## Results and Discussion

**Days to 50 % silking:** Most of the crop rotations cut short maize growing season and this necessitates early maturing varieties of maize for Peshawar region. Days to 50 % silking were mostly used as basis for determining the maturity range of a maize variety. The

analysis of variance showed significant differences at 0.05 level of probability for days to 50 % silking among all hybrids (Table 1). The highest mean for days to mid-silking was obtained for hybrid 3043 (62.50) followed by hybrid HBD-3 (61.50). The lowest mid-silking days of 54.00 were recorded for Pop-9815. The estimated co-efficient of variation (C.V) for mid-silking days of hybrids was 2.25 %. Similar results were also been reported by Cha *et al.* (1995) who reported a wide range for days to silking in a group of maize hybrids.

**Days to 50 % pollen shedding:** Mid-pollen shedding is an important character which if synchronizes with anthesis shows the adoptability of the germplasm to the prevailing environmental conditions. Results obtained during the study indicated that highly significant differences for mid-pollen shedding among the maize hybrids (Table 1). Hybrid 3043 was having maximum days (62.50) for mid pollen shedding. Pop 9815 was comparatively earlier and took the lowest number of days (55) to mid-pollen shedding. The estimated co-efficient of variation (C.V) for days to mid-pollen shedding was 1.69 %. Traits such as male and female flowering dates and anthesis-silking interval are considerably influenced by moisture and temperature stress. Their relationships to yield and potential are used as selection criteria in breeding maize for drought tolerance can be considerably helpful (Guei and Wassom, 1992).

Table 1: Mean values for yield associated traits of 12 maize hybrids

| Hybrids | Days to 50% silking | Days to 50% pollen shedding | Plant height (cm) | Ear height (cm) |
|---|---|---|---|---|
| 3062 | 60.00b | 60.25bc | 181.95ab | 81.27ab |
| 3043 | 62.50a | 62.50a | 172.45bcd | 79.55b |
| 3057 | 60.25b | 60.25bc | 172.35bcd | 80.05b |
| 3130 | 58.00c | 57.50d | 182.90ab | 64.90d |
| 3012 | 60.75ab | 61.00b | 190.85a | 89.15a |
| Super Early | 55.75de | 56.50d | 169.35cd | 66.35d |
| Ghauri | 57.50cd | 57.75d | 182.50ab | 65.95d |
| Baber | 57.00cd | 57.00d | 156.80ef | 63.55d |
| Pop-9815 | 54.00e | 55.00e | 151.55f | 67.10cd |
| Pop-9864 | 60.00b | 59.50c | 167.35cde | 67.70cd |
| C-919 | 61.00ab | 61.00b | 163.60 def | 75.70bc |
| HBD-3 | 61.50ab | 61.00b | 177.65bc | 77.75b |
| Means | 59.04 | 59.10 | 172.44 | 73.25 |
| LSD(0.05) | 1. 91 | 1.43 | 12.26 | 8.93 |
| C.V | 2.25 | 1.69 | 4.94 | 8.47 |

Means followed by different letters differ significantly at P< 0.05

**Plant height:** Plant height has great influence to withstand the undesirable effects of winds particularly lodging in maize crop. The various hybrids used in this study indicated significant differences for plant height (Table 1). Maximum plant height of 190.85 cm was observed in hybrid 3012, followed by 182.90 cm in hybrid 3130. On the other hand minimum plant height of 151.55 cm was recorded for the Pop-9815. The estimated co-efficient of variation (C.V) for plant height was 4.94 %. Hassan (2000) noted significant results for plant height in a group of hybrids. Similar results were also reported by Burgos *et al.* (1989) who concluded that increased fertilizer doses did not alter the plant height suggesting that it could be purely genetically controlled.

**Ear height:** Lower ear placement on the stalk is desirable because it is less susceptible to lodging as strong winds at or near maturity can cause severe lodging and substantial yield loss to the farmer. Generally, selection studies have not been made directly for shorter plants, but instead most studies have been for lower ear placement on the stalk. The highest mean ear height of 89.15 cm was observed for hybrid 3012 followed by hybrid 3062 with ear height of 81.27 cm (Table 1). The lowest ear height of 63.55 cm was recorded for hybrid Baber. The estimated co-efficient of variation was 8.47 %. In path analysis study, Parh *et al.* (1986) concluded that ear height and 1000-grains weight directly influenced yield, where as days to maturity and height influenced yield mainly through ear height.

**Ear length:** Maximum mean ear length of 20.46 cm was observed in hybrid 3130 followed by 19.62 cm for hybrid Ghauri (Table 2). The minimum ear length of 16.75 cm was recorded for hybrid Super Early. The estimated co-efficient of variation (C.V.) was 5.20 %. Manivannan (1998) stated that ear girth, Kernel rows, kernel per row and ear length had significant and positive correlations with seed yield. Results of this study are also supported by those of Firoza *et al.* (1999).

Table 2: Mean values for yield and yield associated characters of 12 maize hybrids

| Hybrids | Ear length (cm) | Kernel rows/ear | 1000-Kernels wt. (g) | Grain yield kg ha$^{-1}$ |
|---|---|---|---|---|
| 3062 | 18.22cde | 12.30e | 385.68ab | 9731.31a |
| 3043 | 16.96ef | 12.65de | 349.28abc | 6845.74d |
| 3057 | 17.49cdef | 13.30bcde | 261.18e | 7324.02cd |
| 3130 | 20.46a | 12.90cde | 335.41bcd | 8079.02abcd |
| 3012 | 18.74bc | 14.00abc | 305.48cde | 8806.21abc |
| Super Early | 16.75f | 13.40bcde | 303.65cde | 7194.80cd |
| Ghauri | 19.62ab | 12.80cde | 395.16a | 9292.32ab |
| Baber | 17.15def | 13.65bcd | 304.29cde | 7508.00bcd |
| Pop-9815 | 18.76bc | 15.00a | 323.81cd | 8277.18abcd |
| Pop-9864 | 17.57cdef | 14.50ab | 324.85cd | 8736.61abc |
| C-919 | 18.41bcd | 14.40ab | 286.76de | 9915.66a |
| HBD-3 | 17.49cdef | 13.30bcde | 323.62cd | 8407.28abcd |
| Means | 18.13 | 13.51 | 324.93 | 8343.10 |
| LSD(0.05) | 1.36 | 1.26 | 50.59 | 1875.00 |
| C.V | 5.20 | 6.51 | 10.82 | 15.62 |

Means followed by different letters are significantly different at P< 0.05

**Kernel rows/ear:** Kernel rows/ear shows the number of grain per cob, which is directly correlated with grain yield potential of a genotype. The highest mean kernel rows per ear i.e. 15 rows was obtained from Pop-9815 followed by Pop- 9864, having kernel rows of 14.50 respectively (Table 2). The lowest kernel rows of 12.30 were recorded for the hybrid 3062. The estimated co-efficient of variation was 6.51 %. High and positive direct effects were observed for kernel rows and 1000-kernels weight. Considerable indirect effects for most of the yield contributing characters through kernel rows were observed. Hence, ear girth and kernel rows should be given more importance in selection for yield improvement in maize (Manivannan, 1998).

**1000-kernels weight:** Significant difference was found among all hybrids for 1000 kernel weight. Maximum mean 1000 kernels weight of 395.16 g was observed in hybrid (Table 2). Ghauri followed by 385.68 g for hybrid 3062. The minimum 1000-kernels weight of 261.18 g was recorded for the hybrid 3057. The estimated co-efficient of variation was 10.82 %. Wang *et al.* (1997) suggested that hybrid yield can be increased further by improving the relationship between 1000-grains weight and kernel rows per ear. These observations are fully supported by Alam *et al.* (1993).

**Grain yield ha$^{-1}$:** Hybrid C-919 out yielded all other hybrids by producing 9915.66 kg ha$^{-1}$ as against the lowest per hectare grain yield of 6845.74 kg ha$^{-1}$ produced by the hybrid 3043. The estimated co-efficient of variation (C.V) for grain yield was 15.62 %. Grain yield is a product of a number of subfractions called yield associated traits and the subfractions are the number of reproductive plants per unit area, maturity of plant, the number of kernel per reproductive unit and average weight per unit. Debnath and Khan (1990) concluded that yield components were positively correlated with days to silking, plant height, ear height, number of kernel per row and 1000-grains weight and strong positive direct contribution to grain yield. The greatest per hectare grain yield of hybrid C-919 might be attributed to its genetic make-up. The findings of this study are in agreement with those of

Sotchenko (2000) who observed a positive correlation between increased grain moisture content and increased grain yield.

This study revealed that elite hybrids derived from different sources can be successfully used in NWFP for getting higher grain yield. The various hybrids showed a wide range in physiological parameter and yield components. This suggests that hybrid, could also be used as source of improved germplasm for incorporation into other maize genotypes.

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