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# Evaluation of Quantitative Physiological Traits of Some Hybrid Maize

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**Abstract:** The investigation was conducted by laying out in Randomized Block Design with four replications. The objectives of the investigation were to analyse the genetic and physical standard and influence of location on some hybrid maize variety namely Vivek hybrid 5, Vivek hybrid 9, Vivek hybrid 11, Vivek hybrid 15 and Vivek hybrid 23. Analysis revealed that the quantitative characters of the five hybrid maize genotypes were still intact and within the minimum seed standard. It may be used beneficially for the next 2 or 3 generations. Genotype Vivek hybrid 23 was found the highest production potential with null affect by the location. From the investigation it may be suggested that if the conditions are more favourable, the productivity may overcome the check value.

**Key words:** Heritability · Genotypic · Phenotypic · Productivity · Quantitative characters

## INTRODUCTION

Maize is the third most important among the top three cereal crops in the world after rice and wheat. It is one of the most widely adapted crops grown in India. The annual production of maize is 600 million tonnes [1]. Developing countries account for 64% of the world's maize area and 43% of global maize production [2]. In terms of world acreage, India stands fifth, whereas with regard to production, eleventh in position. In India, maize crop occupies 6 million hectare and with the production of 9.75 million tonnes (1992-93) accounting for 6.2 per cent of cereal production. It is expected that by 2020 the worldwide demand for maize will exceed that for wheat and rice. Yield and area of maize production will need to be expanded in order to meet the needs of a growing world population.

Success in any crop improvement or breeding programme depends upon the selection of suitable parents. For effective selection of suitable parents a thorough knowledge of genetic variability, heritability and type of gene action is very essential. In addition, characters upon which selection of parents is to based should be known. The relative higher estimates of genotypic coefficient of variation for straw weight, grain weight, plant height, ear placement, kernel rows per ear and number of grains per row along with high heritability (broad sense) suggests that the selection can be effective for these traits [3]. A number of studies in maize have been conducted to elucidate the nature of association between yield and its components which identify traits like ear length, ear diameter, kernels per row, ears per plant, 100-seed weight and rows per ear as potential selection criteria in breeding programme aiming at higher yield [4, 5]. Keeping in view, the present investigation was undertaken with the objectives: to analyze the genetic and physical standard and to study the influence of locations on physiological traits.

## MATERIALSS AND METHODS

The experimental material constituted a germplasm collection of 5 lines of hybrid maize (*Zea mays*) varieties namely; Vivek hybrid 5 (V5), Vivek hybrid 9 (V9), Vivek hybrid 11 (V11), Vivek hybrid 15 (V15) and Vivek hybrid 23 (V23) which was collected from Vivekananda Parvatiya Krishi Anushandhan Sansthan (VPKAS), Almora, regional research station of Indian Council of Agricultural Research (ICAR). These genotypes exhibited wide spectrum of variation for various agronomic and morphological characters.

***Topography of the experimental site (Field Research Centre, Department of Seed Science and Technology, Chauras HNB Garhwal University)***

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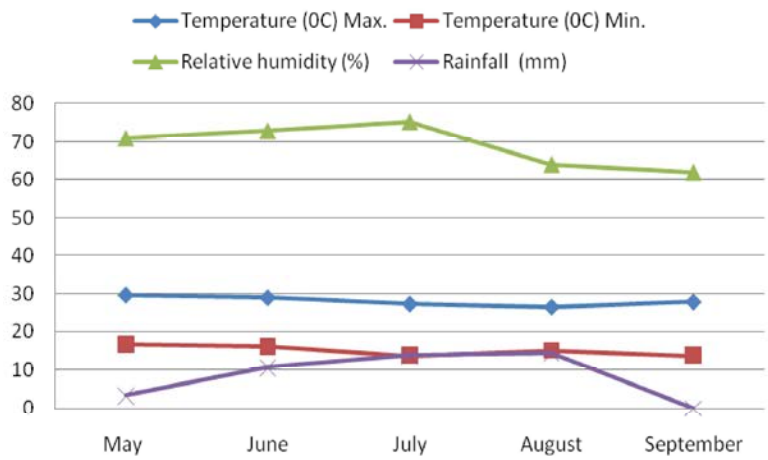


Fig. 1: Monthly meteorological data during the period of investigation, 2009

Srinagar (Garhwal) is situated between the latitude 36°12'24" to 30°13'24" North and longitude 78°41'22" to 78°49'42" east at an elevation of 550 metre above mean sea level (msl). This region has a sub-tropical climate, with both the extremes in the temperature, i.e. winter and summer. In fairly cold winters, the temperature sometimes goes as low as 5 to 9°C in the month of December–January and up to 35-40° in the month of May–June. During winter, occasional dense fog in early morning from December to mid March and during summer, hot scorching winds are common. Nearly 75% of the total rainfall is received during the monsoon (only up to September) with few showers in the winter. The mean minimum and maximum temperatures during this period were 21.8 and 35.6°C, respectively. The soil type of the experimental site was sandy loam, low in organic carbon, nitrogen, phosphorus and in potash. The monthly meteorological data during the period of investigation, 2009 is represented graphically (Figure 1).

**Observations:** Five competitive plants were randomly selected for observations from each plot and recorded on the following quantitative characters; (a) average yield (unit in kilogram per hectare, based on plant populations by assuming 65,000 plants per hectare) (b) kernel rows per ear (c) plant height (measured in centimetre from ground level up to flag leaf at the peak flowering stage) (d) ear height (measured in centimetre from ground level before harvesting) (e) ear length (measured in centimetre after harvesting and removing husk) (f) ear girth (measured in centimetre after harvesting and removing husk).

The analysis of variance (ANOVA) was worked out to test the CD as per methodology [6]. The test of significance was compared at 5% level. The genotypic variance, phenotypic variance, heritability estimates in broad-sense and error variance of mean were estimated [7].

## RESULTS AND DISCUSION

**Seed Yield:** The average seed yield per hectare was non significant (Table 1). Genotypes V 23 and V 15 observed the higher productivity than the check value whereas the productivity of V 5 (4137.2 kg/ha) was below the check productivity. But the rest two genotypes showed the null affect of location to the genotypes with respect to seed productivity. The maximum average productivity by V 23 indicated that this genotype has the potential to produce higher if the condition is favourable. So for optimum productivity, optimum plant population is a pre-requisite to realize the potential of a maize variety. Since, maize is widely spaced crop and unlike the other cereals such as wheat, barley and rice, does not posses the tillers, it cannot compensate for left over spaces. In Table 2, the genotypic variance ($\sigma^2_g$ = 34969271.16) was found less than the phenotypic variance ($\sigma^2_p$=38376125.16). The heritability in broad sense ($h^2_{BS}$=91%) was observed high showing that selection can safely be exercised. The reduction in final yield in some genotypes was may be due to decline in emergence as reported by Roberts [8]. The heritability in broad sense ($h^2_{BS}$=91%) that is proportion of genetic component to phenotypic variance, was observed high showing that selection can safely be exercised [3, 9].

Table 1: Average seed yield, kernel rows per ear, plant height, ear height,ear length and ear girth of the five hybrid maize genotypes

| | Average yield (kg/ha) | | kernel rows/ear | | Plant height (cm) | | Ear height (cm) | | Ear length (cm) | | Ear girth (cm) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Genotype | Check | Recorded | Check | Recorded | Check | Recorded | Check | Recorded | Check | Recorded | Check | Recorded |
| V 5 | 4500-5000 | 4137.2 | 14-16 | 13.2 | 220-225 | 154.5 | 110-112 | 57.62 | 21-22 | 14.00 | 19-20 | 14.0 |
| V 9 | 5000-5500 | 5003.3 | 16-18 | 14.7 | 215-220 | 152.8 | 107-110 | 57.87 | 20-22 | 16.00 | 18-19 | 16.0 |
| V 11 | 4000-4200 | 4247.5 | 14-16 | 13.7 | 200-205 | 137.1 | 98-109 | 43.25 | 18-19 | 14.87 | 13-14 | 14.5 |
| V 15 | 5000-5500 | 5612.7 | 14-16 | 14.7 | 200-205 | 136.2 | 100-105 | 41.62 | 17-18 | 15.37 | 14-15 | 14.8 |
| V 23 | 5500-6000 | 7182.5 | 14-16 | 13.5 | 206-220 | 152.6 | 100-105 | 49.00 | 16-18 | 19.75 | 15-16 | 16.0 |
| | Sem ± | 1493.46 | | 0.634 | | 5.696 | | 5.462 | | 0.991 | | 0.432 |
| CD at 5% level | | 1421.96 | | 1.366 | | 6.507 | | 4.930 | | 1.907 | | 0.839 |

Table 2: Estimates of variances and heritability with respect to seed yield per hectare, kernel rows per ear, plant height, ear height, ear length and ear girth of the hybrid maize varieties

| Variances and heritability | Average yield (kg/ha) | Kernel rows/ear | Plant height (cm) | Ear height (cm) | Ear length (cm) | Ear girth (cm) |
|---|---|---|---|---|---|---|
| Genotypic variance ($\sigma^2_g$) | 34969271.16 | 244.88 | 26955.55 | 3157.55 | 323.15 | 284.49 |
| Phenotypic variance ($\sigma^2_p$) | 38376125.16 | 246.48 | 27026.91 | 3198.51 | 326.26 | 285.09 |
| Heritability in broad sense ($h^2_{BS}$) | 0.91 (i.e., 91%) | 0.99 (i.e., 99%) | 0.99 (i.e., 99%) | 0.98 (i.e., 98%) | 0.99 (i.e., 99%) | 0.99 (i.e., 99%) |
| Error variance ($\sigma^2_e$) | 3406854 | 1.6 | 71.356 | 40.96 | 3.11 | 0.604 |

Low size of error variance ($\sigma^2_e$=3406854) in the result shows the non-genetic or environmental component. It is, therefore, suggested that this trait was found almost unchanged which can be used extensively in commercial crop production and selection for further crop improvement.

**Kernel Rows per Ear:** The study revealed that average kernel rows per ear were non significant (Table 1). It was observed that the kernel rows per ear was found reduction in number under field experimentation except the genotype V 15 which it's check value was 14-16 kernel rows/ear and recorded number was 14.7 kernel rows/ear. The genotypic variance ($\sigma^2_g$= 244.88) was found less than the phenotypic variance ($\sigma^2_p$= 246.48). The heritability in broad sense ($h^2_{BS}$ = 99%) was observed very high showing that selection can safely be exercised and trait are remained unchanged. The low size of error variance ($\sigma^2_e$ = 1.6) shows the slight changed in trait is due to environmental factors. The recorded increase in the average seed yield per hectare might be due to the parameter high number of kernels per row and these traits may be useful in selection and seed production. Relative higher estimates of genotypic coefficient of variation for kernel rows per ear along with high heritability (broad sense) can select the traits effectively [3]. Similar suggestions were also given by [4, 5]. Study also revealed that these components (kernel rows per ear and kernels per row) traits had played a vital role in enhancement of seed yield and maximum emphasis should be given to these traits during selection.

**Plant Height:** The study also apparently illustrated that the average plant height was significant (Table 1). The maximum average plant height was found in genotype V 5 (154.5 cm) followed by V 9 (152.8 cm), while the minimum was in V 15 (136.2 cm). The average plant height of the entire genotypes was observed below the check height. In Table 2, genotypic variance ($\sigma^2_g$= 26955.55) and phenotypic variance ($\sigma^2_p$ = 27026.91) was found with slight difference which indicated the high heritability ($h^2_{BS}$ = 99%) that is the trait of plant height remained unchanged. The low size of error variance ($\sigma^2_e$= 71.356) shows the slight changed in trait is due to environmental factors. Similar results were also observed by Najeeb *et al* [3]. They suggested that the selection may be effective for this trait if such observations were found. In the present investigation the proportion of reduction in the average plant height to each genotype was found corresponding to the check height, which shows there is affect of location, that may be due to low mean sea level (msl).

**Ear Height:** The average ear height was found highly significant due to both genotypes and replications sources (Table 1). The average ear height was observed reduction in height by about 50% from the check ear height under field experimentation. The fall in the recorded ear height is directly related to the fall in the average plant height. The genotypic variance ($\sigma^2_g$ = 3157.55) and phenotypic variance ($\sigma^2_p$= 3198.51) (Table 2) indicated the heritability ($h^2_{BS}$ = 98%) that is the trait of ear height has been changed to some extent. The moderate size of error

variance ($\sigma^2_e$= 40.96) shows the slight changed in trait due to environmental factors which may possibly be, due to the low altitude from sea level.

**Ear Length:** The recorded data revealed that the average ear length was highly significant (Table 1). The maximum average ear length was found in V 23 (19.75 cm), which was above the check ear length whereas the average ear length of the rest four genotypes was found below the check length showing the significant affect of location to the genotypes. In Table 2, the slight difference of genotypic variance ($\sigma^2_g$= 323.15) and phenotypic variance ($\sigma^2_p$ = 326.26) indicated the high heritability ($h^2_{BS}$ = 99%) that is the trait of ear length remain unchanged. The low size of error variance ($\sigma^2_e$ = 3.11) was due to environmental factors. Several researchers, Mohan *et al* [4] and Tollenaar *et al* [5] emphasized this trait as potential selection criteria in breeding programme for higher yield.

**Ear Girth:** The average ear girth of the five maize genotypes was found significant (Table 1). Observations showed that the average ear girth was found decrease in ear girth under two genotypes V 5 and V 9 while genotypes V 11, V 15 and V 23 was found within the check ear girth. The maximum average ear length and ear girth of the genotype V 23 has direct effect to the recorded increase in the average seed yield per hectare as ear length has direct relationship to the number of kernels per row. The genotypic variance ($\sigma^2_g$= 284.49) and phenotypic variance ($\sigma^2_p$ = 285.09) in Table 2, indicated the high heritability ($h^2_{BS}$ = 99%). The low size of error variance ($\sigma^2_e$= 0.604) was due to environmental factors. Number of studies in maize was conducted to elucidate the nature of association between yield and its components like ear length, ear diameter, kernels/row, ears/plant, 100-seed weight and rows/ear as potential selection criteria in breeding programme aiming at higher yield [4, 5].

## CONCLUSION

The genetic and physical standard of the five hybrid maize genotypes were almost intact indicated that there is a good scope for selection to develop better genotype or for commercial seed production. The least affects of location on the physiological traits was found, it rather significantly improved when the environmental condition is more favourable.

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