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Evaluation of growth, yield and economics of maize (*Zea mays* L.) hybrids under agro climatic conditions of Prayagraj U.P.

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Abstract
A field experiment entitled "Evaluation of growth, yield, and economics of maize (*Zea mays* L.) Hybrids under agro- climatic conditions of Prayagraj, U.P" trial was carried out during the *Kharif* season 2020 at the experimental plot of Crop Research Farm, which was located near the department of Agronomy, SHUATS, Prayagraj, (U.P). The Soil of the experimental site was sandy loam in texture, nearly neutral in soil reaction. The experiment consists of different Hybrids *Viz*., KM-1, KM-2, KM-3, KM-4, KM-5, KM-6, KM-7, KM-8, KM-9 and KM-10. It was carried out through a statistical design of Randomized Block Design (RBD) with three replications. A Full dose of phosphorus and potassium fertilizers were applied, half of the nitrogen was applied as basal and the remaining half was applied 45 days after sowing. Report of the study indicates among different Hybrids KM-8 produced significantly higher plant height (207.50 cm), number of leaves/plant (11.80), and dry weight/plant (75.20 g). Hybrid KM-8 also fetched the highest gross returns (1, 95,015.00 INR/ha), net returns (1,44,855.00 INR/ha), and benefit-cost ratio (2:88) when compared to other Hybrids. Due to genetic variation among the hybrids different challenges were experienced during the research. They had germinated and matured differently. Also, disease and pest attacks were quite varied in hybrids.

Keywords: Hybrids, yield, growth, economics, genetic variation

Introduction
Maize (*Zea mays* L.) is one of the most important food grains, industrial and versatile emerging crops having wider adaptability under varied agro-climatic conditions. Globally, maize is known as “queen of cereals” because it has the highest genetic yield potential among the cereals in the world both as food for man and feed for animals. Maize is the third most important food grain in India after wheat (*Triticum aestivum* L.) and rice (*Oryza sativa* L.). The rapid climate changes are imperative to evaluate and find ways that suite to maize-specific varieties either hybrids or varieties with appropriate sowing dates to avoid the critical growth stages from the stresses due to climate condition. Sowing at proper time and selection of good verity are the most important factor cropping system. Its grain has high nutritive value containing 66.2% starch, 11.1% protein, 7.12% oil and 1.5% minerals. Moreover, it contains 90 mg carotene, 1.8 mg niacin, 0.8 mg thiamin and 0.1 mg riboflavin per 100 g grains (Hasan *et al.* 2018). In general local varieties of Uttar Pradesh failed to give higher yields in comparison with hybrids. Thus there is a great need for replacing local varieties with hybrids of different groups. Hybrid maize cultivars possessed a prominent role in enhancing the production and quality of maize which is used for feed, fiber and aesthetic value. These not only helped with their direct contribution but also created a way for adoption of other components of production. These single cross hybrids possess certain advantages like increased grain yield potential, abiotic and biotic stress tolerance, early maturity etc. These advantages had led to cross many barriers faced by farmers in past.
Adoption of modern and various varieties of maize, characterized by higher genetic potential, and adoptability to various climatic changes with a view of enhancing yield level of maize. There is no specific kind of organized system or well-structured system for documenting the proper crop varieties and their area coverage in India. Various attempts are done to fulfil such knowledge gaps by documenting the major maize varieties and estimating the adoption rates of certain genotypes to different agro- climatic zones.

Methods and Results

The seeds of different maize hybrids were being evaluated during the *Kharif* season of 2020 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Science, Prayagraj, UP. The Crop Research Farm is situated at 25.57º N latitude, 87.19º E longitude and an altitude of 98m above mean sea level. The experiment consists of different Hybrids *Viz.*, KM-1, KM-2, KM-3, KM-4, KM-5, KM-6, KM-7, KM- 8, KM-9 and KM-10. The experiment was conducted in a statistical design of Randomized Block Design (RBD) with three replications. During the growing season, the mean weekly maximum and minimum temperature, relative humidity, and rainfall were 35.73ºC, 26.25ºC, 84.75%, 50.03%, and 6.08 mm respectively. The spacing of the Maize sown was 60 cm × 20 cm using a seed rate of 20 kg/ha. The seeds were provided by UPCAR. The RDF i.e., Nitrogen (120 kg/ha) was applied through urea and DAP in two equal splits, first as basal and remaining dose at 45 DAS (days after sowing), full dose P2O5 (80 kg/ha) whereas the full dose of K2O (60 kg/ha) was applied in the form of DAP and MOP and ZnSO4 (25 kg/ha). A uniform irrigation was incorporated to the soil four days before sowing and further irrigations were given based on treatment and requirement. Observations on growth parameters, yield attributes and yield of maize hybrids, was recorded and their significance was tested by the variance ratio.

Composite soil samples are collected before the layout of the experiment to determine the initial soil properties. The soil samples are collected from 0-15 cm depth and were dried under shade, powdered with wooden pestle and mortar, passed through a 2 mm sieve and were analysed for organic carbon by rapid titration method by Nelson (1975) [4]. Available nitrogen was estimated by alkaline permanganate method by Subbiah and Asija (1956), available phosphorus by Olsen's method, available potassium was determined by using the flame photometer normal ammonium acetate solution and estimating by using flame photometer (ELICO Model) as outlined by Jackson (1973) [2] and available ZnSO4 was estimated by Atomic Absorption Spectrophotometer method.

The data evaluated for various characteristics were subjected to statistical analysis by adopting the tactic of study of variance (ANOVA) as described by Gomez and Gomez (1984) [1]. The significance of comparison was tested. The significant difference values were computed for a 5 percent probability of error. Wherever the variance ratio (F value) was found significant, critical difference (CD) values were computed for the comparison among the treatment means. Relative economics was calculated as per the prevailing market prices of the inputs and produced during *Kharif* season.

Result and Discussion Growth parameter

Growth parameters of maize hybrid *viz.*, Plant height (cm), Number of leaves/plant and Plant dry weight (g/plant), varied due to different Maize Hybrids are presented in Table 1. The maize hybrid KM-8 resulted in higher plant height (207.50 cm) where hybrids KM-1 (207.10 cm), KM- 9 (202.60 cm), KM-10 (201.50 cm) and KM-3 (195.30 cm) were found statistically at par with KM-8. For Leaves per plant (No.) KM-8 (11.80) recorded the highest no. of plant leaves where KM-1 (11.50), KM-3 (11.0), KM-4 (10.50), KM-7 (10.50), KM-9 (11.70) and KM-10 (11.20) were found to be statistically at par with KM-8. KM-8 recorded highest plant dry weight (75.20g/plant) where hybrids KM-1(75.10g), KM-2 (73.60g), KM-3 (74.20g), KM-9 (73.80g) and KM-10 (74.0g) were found statistically at par with KM-8.

The differential growth concerning plant height, leaves per plant, plant dry weight among the varieties may be attributed to differences in genetic characterization of the individual varieties, including rapid growth rates, tallness, or shortness of species. (Pal *et al.* 2012) [5]. Different genetic makeup has resulted in increases yield attributes like Cobs per plant, Number of grains per row, etc. which ultimately resulted in an increased in seed yield (Kumar and Kandel 2020) [3].

KM-8 had recorded with highest seed yield (7.69 t/ha), Stover yield (21.10t/ha), and Biological yield (28.79 t/ha). KM-5 had recorded least seed yield (6.30 t/ha), stover yield (16.67 t/ha), and biological yield (22.97 t/ha) (Singh *et al.* 2021) [6].

Economics

The prices of both the seed yield and stover yield was calculated as (18.5 INR/kg) and (2.5INR/kg) respectively as per the MSP 2020-21 of maize. The total cost of cultivation calculated was 50160 INR/ha. The highest gross returns (195015.00 INR), net returns (144855.00 INR), and B: C ratio (2.88) were observed by KM-8, as it had recorded the highest grain yield (7.69 t/ha) and stover yield (21.10 t/ha). The lowest gross returns (158225.00 INR), net returns (108065.00 INR) and B: C ratio (2.15) were recorded by KM-5, as it had recorded the lowest seed yield (6.30 t/ha) and stover yield (16.67 t/ha) (Table 2.). The differences observed among the gross returns and net returns by the varieties were mainly due to their variability in their growth and yield performances.

Table 1: Evaluation of Growth parameters of Maize hybrids under agro climatic conditions of Prayagraj, U.P.

Hybrids	At 60 DAS		
	Plant Height (cm)	Number of Leaves (No.)	Dry weight/plant (g)
KM-1	210.3	11.80	69.57
KM-2	188.0	10.40	55.67
KM-3	206.4	11.33	69.67
KM-4	187.2	10.23	59.50
KM-5	187.8	10.60	58.20
KM-6	191.7	10.33	58.00
KM-7	208.1	11.27	70.37
KM-8	186.2	9.53	57.00
KM-9	213.5	11.87	75.00
KM-10	195.0	10.53	61.33
SEm(±)	6.15	0.41	1.45
CD (P= 0.05)	18.14	1.22	4.29

Table 2: Economics of maize hybrids under agro climatic conditions of Prayagraj, U.P.

Hybrids	Cost of Cultivation (INR/ha)	Gross return (INR/ha)	Net Return (INR/ha)	B:C
KM-1	50160.00	1,91,045.00	1,40,885.00	2.80
KM-2	50160.00	1,62,945.00	1,12,785.00	2.24
KM-3	50160.00	1,73,920.00	1,23,760.00	2.46
KM-4	50160.00	1,69,110.00	1,18,950.00	2.37
KM-5	50160.00	1,58,225.00	1,08,065.00	2.15
KM-6	50160.00	1,62,140.00	1,11,980.00	2.23
KM-7	50160.00	1,67,675.00	1,17,515.00	2.34
KM-8	50160.00	1,95,015.00	1,44,855.00	2.88
KM-9	50160.00	1,84,210.00	1,34,050.00	2.67
KM-10	50160.00	1,78,120.00	1,27,960.00	2.55

Conclusion

From the above findings it was concluded that among all hybrids, KM-8 was found to be best by obtaining highest growth and yield and found economically feasible with higher Benefit-Cost ratio. It was found better yielding compared to other hybrids under agro climatic conditions of Prayagraj, U.P. However, these hybrids need to be testes under other agro-climatic conditions of Uttar Pradesh to select the best hybrid under the agro-climatic conditions of Uttar Pradesh. KM-8 was found to be the best under Prayagraj's climatic conditions.

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