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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 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-11, KM-12, KM-13, KM-14, KM-15, KM-16, KM-17, KM-18, KM-19, KM-20, and KM-21. 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 as basal while, half of the nitrogen was applied as basal and the remaining half was applied 25, 45 days after sowing. Report of the study indicates among different Hybrids KM-19 produced significantly higher plant height (213.50 cm), number of leaves/plant (11.87), and dry weight/plant (75 g). Hybrid KM-19 also fetched the highest gross returns (1, 83,614.17 INR/ha), net returns (1, 33,454.17 INR/ha), and benefit-cost ratio (2.66) when compared to other Hybrids. The challenges experienced during the research were mostly due to genetic variation in hybrids. They had germinated and matured differently. Also, disease and pest attacks were quite varied in hybrids.

Keywords: Hybrids, Yield, Growth, Economics, Genetic variation, Pest, Disease.

INTRODUCTION

Maize (*Zea mays*) is considered as one of the most important food grain in India after the main cereals rice and wheat. India ranks fifth within the area and third in production and productivity over other cereal crops and members of the Gramineae family. It is the third most important crop in Uttar Pradesh and is also regarded as the 'Queen of Cereals'. It has great potential to meet the food demands of living beings which collectively include both humans and animals. Nutrient composition of maize includes crude protein 7.6%, crude fibre 2.3%, crude fat 3.6%, starch 63.8%, Total sugar 1.7%, Gross energy 3840 kcal/kg. (Afzal *et al.*, 2017)

Moreover, local varieties of Uttar Pradesh failed to give higher yields in comparison with hybrids. Consequently, there was 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 help with their direct contribution but also created a way for the 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 the cross many barriers faced by farmers in past (Zhang *et al.*, 2014).

Uttar Pradesh Council of Agricultural Research (2015) evaluated the performance of genotypes belongs to different companies among them P-3401 variety of pioneer seeds company recorded germination percentage (83.91%), days to maturity (88.87), days to 50% tasselling (53.79), days to 50% silking (56.11), plant height (213.51 cm), 100-grain weight (24.20 g), grain yield (48.53 q/ha) compared to other varieties of maize.

Afzal *et al.*, (2017) observed the performance of different maize genotypes under agroclimatic conditions of Haripur, the PS-1 had recorded the maximum plant height (212.1 cm), ear height (88.7 cm), a higher number of rows/ear (15.6), grain yield (5495 kg/ha) and maximum thousand-grain weight (330 g) respectively.

Rajeswari *et al.*, (2018) observed three different maize hybrids as influenced by different dates of sowing, most of the plant parameters number of cobs/m^2 (7.4), number of rows/cob (20.8), number of seeds/row (11.7), 100-grain weight (26.4 g), cob length (13.2 cm), grain yield (3006.6 kg/ha) are recorded significantly higher by maize hybrid Pinnacle. While CP818 recorded maximum cob yield (4486.2 kg/ha), and stover yield (4947.5 kg/ha) respectively.

Sharma *et al.*, (2018) stated among three hybrids (LG 32.01, LG 34.04, BL 4121)- BL 4121 hybrid had recorded maximum biological yield (468.3 q/ha), dry

matter yield (169.2 q/ha), days to 50% tasselling (65.4), days to 50% silking (76.4) and cob length (21 cm) where maximum plant height (178.9 cm) was recorded by LG32.01 maize hybrid.

Babu *et al.*, (2019) reported that PMH-3 maize cultivar recorded the highest plant height (243 cm), cobs per plant (1.3), cob length (18.7 cm), grains per cob (14.7), grains per row (17.2), biological yield (14.07 t/ha) and protein content (10.1%) among all the cultivars produced under an organic produced system in the north-western plain region of Uttar Pradesh.

Rachana *et al.*, (2019) reported the performance of various hybrid Rice cultivars, the following parameters are significantly found higher in different hybrids which include plant height (115.14 cm), number of the tiller (381/m^2), panicle length (30.7 cm), number of filled grains/panicle (307.66) and grain yield (13.96 t/ha) in KR-38, number of tiller/hill (14.3) in KR-24 when compared to remaining hybrids.

Chaudhary *et al*., (2020) observed various cultivars of maize for forage yield among which African Tall had recorded significantly higher Plant height (265.13 cm) also Green fodder yield (35.19 t/ha), PMC-6 had recorded maximum stem girth (16.58 cm), Number of leaves /plant (13.87 cm), and Dry matter yield (8.91 t/ha) when compared to other cultivars.

Anil and Sreedhar (2020) conducted a study about pre-released rice genotypes among which RNR 15048 had produced significantly higher plant height (125 cm), KNM 1638 ha recorded maximum number of Tillers (367/m^2), dry matter production (1302 g/m^2), number of Panicles (338/m^2), number of filled grains/panicle (245), grain yield (7144 kg/ha) and straw yield (7739 kg/ha) when compared to remaining hybrids.

Kumar and Kandel (2020) reported that P3396 maize hybrid had shown maximum ear weight (75 g), test weight (468 g), and grain yield (11.18 t/ha) while other hybrids performed better in parameters like Shrestha plant height (218 cm), RML-96 ear height (104 cm), Ganga Kaveri-number of kernel/row (32) and Rajkumar- the number of kernel row/ear (14.7) respectively.

Lucian and Maria (2020) evaluated the performance of maize genotypes in which the hybrid Turda (5432 kg/ha), where Olt hybrid had recorded maximum plant height (264 cm), 1000 grain weight (306 g) and F423 had recorded maximum ear height (113.5 cm) respectively.

Shah *et al*. (2020) revealed that the maize hybrid Gorilla had shown significantly higher plant height (171.0 cm), cob diameter (41.1 mm), grain yield (1550 kg/ha) while Granon hybrid had recorded maximum cob length (17.75 cm) when compared to other hybrids.

As my research work is completely under the Uttar Pradesh Council of Agricultural Project. The hybrids used are selected by them. Whether the hybrids belong to private or public, they need to be tested in several locations for their official launch in the market. Being hybrids, they have produced maximum height and reduced stalk strength which made them susceptible to heavy rains or strong winds. Also, with unevenness in their heights, the hybrids with maximum height observed more sunlight and they shade the next plot hybrids which lead to poor development. They mostly produced single cob per plant, which was found similar to non-hybrids.

MATERIAL AND METHODS

The experiment was conducted during the *Kharif* season of 2020 at the Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Science (SHUATS), Prayagraj, (Allahabad) (UP). The Crop Research Farm is situated at 25.57^o N latitude, 87.19^o E longitude and an altitude of 98m above mean sea level. The experiment consists of different Hybrids *Viz.*, KM-11, KM-12, KM-13, KM-14, KM-15, KM-16, KM-17, KM-18, KM-19, KM-20, and KM-21. It was administered through 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 35.73^{o}C, 26.25^{o}C, 84.75 %, 50.03 %, and 6.08 mm respectively. Maize was sown at a spacing of 60 cm × 20 cm using a seed rate of 20 kg/ha which was supplied by UPCAR. The field was uniformly irrigated before four days of sowing and further irrigated based on treatment. 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 P_2O_5 (80 kg/ha) whereas the full dose of K_2O (60 kg/ha) was applied through DAP and MOP and $ZnSO_4$ (25 kg/ha). 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 analyzed for organic carbon by rapid titration method by Nelson (1975). 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) and available $ZnSO_4$ was estimated by Atomic Absorption Spectrophotometer method.

The data recorded for various characteristics were subjected to statistical analysis by adopting the tactic of study of variance (ANOVA) as described by Gomez and Gomez (1984). 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.

Hybrid seeds are produced by public sectors and their marketing is done by some public sector organizations where demand is not fulfilled. Due to this motive, they build a partnership among small and medium private seed companies alongside with the public sector research institutions which helps in improving seed production and marketing of public-bred hybrids. (Babu *et al.,* 2019).

Due to research carried out in the Prayagraj condition, it is hard to conclude their performance based on a single climatic condition. Some hybrids may perform well in certain climatic conditions and some in others. It is hard to state their performance based on a single location. Where, the drawbacks of the previous study were selected hybrids samples may not have performed well in selected agroclimatic conditions, lacks more previous work for reliability, and also insufficient investment during research work. This evaluation will help to carry out research in other agro climatic conditions.

RESULT AND DISCUSSION

A. 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-19 resulted in higher Plant height (213.5 cm), Number of leaves/plant (11.87), and Plant dry weight (75.0 g/plant. Where, plant height recorded by KM-11 (210.30 cm), KM-13 (206.40 cm), KM-17 (208.10 cm), and also number of leaves/plant by KM-11 (11.80), KM-13 (11.33), KM-17 (11.27) were found at par with KM-19. 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 and Bhatnagar, 2012). 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).

B. Economics

The price of both seed and stover is considered as (18.5 INR/kg) and (2.5 INR/kg). The total cost of cultivation was estimated as 60160 INR/ha. The highest gross returns (183614.17 INR), net returns (133454.17 INR), and B: C ratio (2.66) were recorded by KM-19, as it had reported the highest grain yield and stover yield. The lowest gross returns (152880.00 INR), net returns (102720.00 INR) and B: C ratio (2.05) were reported by KM-16, as it had reported the lowest seed yield and stover yield (Table 2). The differences among net returns and gross returns were mainly due to their variability in yield performance.

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-11	210.3	11.80	69.57
KM-12	188.0	10.40	55.67
KM-13	206.4	11.33	69.67
KM-14	187.2	10.23	59.50
KM-15	187.8	10.60	58.20
KM-16	191.7	10.33	58.00
KM-17	208.1	11.27	70.37
KM-18	186.2	9.53	57.00
KM-19	213.5	11.87	75.00
KM-20	195.0	10.53	61.33
KM-21	188.2	10.60	61.00
SEm(±)	6.15	0.41	1.45
CD (P= 0.05)	18.14	1.22	4.29

Table 2: Evaluation of 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-11	50160.00	182014.17	131854.17	2.63
KM-12	50160.00	159971.67	109811.67	2.19
KM-13	50160.00	173516.67	123356.67	2.46
KM-14	50160.00	163355.00	113195.00	2.26
KM-15	50160.00	160085.00	109925.00	2.19
KM-16	50160.00	152880.00	102720.00	2.05
KM-17	50160.00	178721.67	128561.67	2.56
KM-18	50160.00	167488.33	117328.33	2.34
KM-19	50160.00	183614.17	133454.17	2.66
KM-20	50160.00	161168.33	111008.33	2.21
KM-21	50160.00	159623.33	109463.33	2.18

CONCLUSION

Among all hybrids, KM-19 was found to be the best by obtaining the highest growth and yield and also a better B: C ratio. It was found more productive, when compared to others under agroclimatic conditions of Prayagraj, U.P. The public sector hybrids need to be tested in different agro-climatic conditions as they possess genetic variation, to find out best-performing hybrids for their release in the market. KM-19 was found best in Prayagraj condition compared to others.

FUTURE SCOPE

Based on research work done, it can be used as reliable work for further reference. The hybrids need to be tested in other agro climatic conditions for finding out best- performing hybrid under different conditions.

Conflict of Interest. None of the authors of this paper features a financial or personal relation with people or organizations that would inappropriately influence or bias the content of the paper. We assure you that the content of the paper is never been published.

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