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

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Abstract
A field experiment was conducted during *kharif* season of 2020 at experimental field of the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj, (UP) to determine the "Response on growth and yield of Maize (*Zea mays* L.) Hybrids under agro-climatic conditions of Prayagraj, U.P". The soil of 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. Full dose of phosphorus and potassium fertilizers were applied as basal while, half of nitrogen was applied as basal and remaining half was applied 25, 45 days after sowing. Report of study indicate that, among different Hybrids KM-19 produced significantly higher plant height (222.30 cm), number of leaves per plant (11.47), dry weight/plant (77 g), CGR (0.83 g/m^2/day), number of cobs per plant (1.78), number of rows per cob (13.97), number of grains per row (26), seed index (27.33g), Seed yield (7.08 t/ha) and stover yield (21.1t/ha). However, the Hybrid KM-19 also showed significantly minimum number of days to 50% Tasselling (43.40 days), 50% silking (47.07 days), and days to maturity (65.67).

Keywords: Hybrids, yield attributes, growth attributes

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 in 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) [1].

These hybrids have been widely adopted by farmers which resulted in increased maize productivity which was never seen before was observed. This made a very lucrative crop and maize cultivation got extended in some southern areas of India where maize was given less importance. Cultivation during *Rabi* season got picked up. In Uttar Pradesh maize accounts for 7.36 lakh hectare area with the production of 12.86 lakh ton and productivity of 18.47 kg/ha (Department of Agricultural Government of UP 2013) [4].

Many high yielding cultivars developed by public and private sectors are released for commercial cultivation under different agro ecological zones. Public sector varieties mainly focused on more risk zones where as private sector focus on low-risk zones of maize crop as their main objectives are higher productivity potential and proper seed marketing. Due to this private sector maize varieties are dominating in certain states of India where maize is mainly cultivated for commercial purposes such as feed and other industrial purposes. General resistance to diseases, lodging tolerance, grain color, high shelling recovery, good storage life, and higher grain yield are some of the preferred attributes of popular or good varieties. Several promising varieties from the public sector have not reached the farmer's field due to the non-availability of proper seeds. There is a ravenous increase of area under private sectors mostly under perfect agronomic conditions. On the other bright side, private sector maize hybrids have successfully diffused to farmer's field owning to strong marketing initiatives.

Public sector varieties got to be brought under an efficient seed production system along-side an efficient transfer of hybrid maize cultivation technology to spice up the maize yield levels and production in India. (Dahmardeh M. 2010) [3]. Hybrid seeds 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 along with public sector research institutions which helps in improving seed production and marketing of public-bred hybrids. (Babu *et al.* 2019) [2].

Private sector companies tend to market only F_1 hybrids of maize without any proper testing. Due to this, farmers don't have any other option except to pay more prices for hybrid seeds. Sometimes farmers got deceived by the supply of false and unsuited seeds. Based on local data available and experimental trails the specific hybrid selection and recommendations can be done.

Material and Method

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 25.57º N latitude, 87.19º E longitude and at 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 carried out 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 35.73ºC, 26.25ºC, 84.75%, 50.03% and 6.08 mm respectively. Maize was sown at a spacing of 60 cm × 20 cm using seed rate of 20 kg/ha which were supplied by UPCAR. The field was uniformly irrigated before four day 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 full dose of K_2O (60 kg/ha) were 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. (F-value) at 5% level (Gomez and Gomez, 1984) [6]. 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), Days to 50% tasseling (No.), Days to 50% silking (No.), Plant dry weight (g/plant), Crop Growth Rate (g/m^2/day), Relative Growth Rate (g/g/day) varied due to different Maize Hybrid are presented in Table 1. The maize hybrid KM-19 resulted in higher Plant height (222.3 cm), Plant dry weight (77.0 g/plant), Crop Growth Rate (0.83 g/m^2/day) and least Days to 50% tasseling (43.40), Days to 50% silking (47.07) and Relative Growth Rate (0.0013 g/g/day). KM-19 had recorded highest plant dry weight which was found on for with none and for days to 50% tasseling KM-11 (46.60), KM-13 (45.30), KM-14 (45.63), KM-16 (46.30), KM-18 (46.87), KM-20 (46.43), KM-21 (45.20) were found statistically at par with KM-19 which had recorded least number of days to 50% tasseling.

The differential growth with respect to 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) [8].

Yield attributes and yield

Yield attributes such as Cobs per plant (No.), Cob length (cm), Grain row/cob (No.), Number of grain/row (No.), Seed index (g) varied due to different Maize Hybrids are presented in Table 2. The Hybrid KM-19 was recorded with higher yield attributes *viz.* Cobs per plant (No.) (1.78), Cob length (14.87 cm), Grain row/cob (No.) (13.97), Number of grain/row (No.) (26.00), Seed index (27.33 g). KM-19 was recorded with Medium Seed Size and Yellow Seed Colour. For number of cobs/plant KM-12 (1.22), KM-13 (1.55), KM-17 (1.66) and KM-21 (1.55) were found at par with KM-19. For cob length KM-13 (13.9 cm) and KM-17 (13.5 cm) were found on for with KM-19. Where, number of grains/row KM-13 (25.20), KM-14 (25.40) and KM-21 (24.40) were found on for with KM-19. In case of seed index KM-11 (26.00 g), KM-13 (26.00 g), KM-16 (25.33 g) and KM-20 (25.33 g) were found at with KM-19.

Different genetic makeup has resulted in increases yield attributes like Cobs per plant, Number of grains per row etc. which ultimately resulted in increase in seed yield (Kumar and Kandel 2020) [7]. KM-19 was also recorded with highest seed yield (7.08 t/ha), Stover yield (21.1), and Biological yield (28.16 t/ha). For seed yield KM-11 (7.02 t/ha), KM-13 (6.68 t/ha) and KM-17 (6.86 t/ha) were found on for with KM-19. Where, stover yield KM-11 (20.80 t/ha), KM-13 (20.00 t/ha) and KM-17 (20.70 t/ha) were found at par with KM-19. In case of biological yield KM-11 (27.86 t/ha), KM-13 (26.63 t/ha) and KM-17 (27.56 t/ha) were found on for with KM-19.

Table 1: Evaluation of growth parameters of maize hybrids under agro-climatic conditions of Prayagraj. U.P.

Hybrids	Growth attributes					
	Plant height (cm) at harvest	Dry weight/plant (g) at harvest	Crop growth rate (g/m^2/day) (60-80 DAS)	Relative growth rate (g/g/day) (60-80 DAS)	Days to 50% tasseling	Days to 50% silking
KM-11	219.43	71.33	0.74	0.0013	46.60	49.97
KM-12	190.50	56.60	0.39	0.0008	43.97	47.30
KM-13	207.20	71.30	0.68	0.0012	45.30	49.07
KM-14	189.90	60.00	0.21	0.0004	45.63	49.20
KM-15	188.20	59.00	0.33	0.0007	44.53	48.40
KM-16	201.10	58.90	0.38	0.0008	46.30	49.77
KM-17	206.50	71.33	0.40	0.0007	44.97	47.87
KM-18	188.40	58.20	0.50	0.0010	46.87	48.63
KM-19	222.30	77.00	0.83	0.0013	43.40	47.07
KM-20	198.40	62.33	0.42	0.0008	46.43	50.3

KM-21	193.10	61.87	0.36	0.0007	45.20	48.63
S.Em(+)	7.79	1.44	0.15	0.0002	0.54	0.71
CD (P= 0.05)	-	4.27	-	-	1.61	-

Table 2: Evaluation of yield attributes and yield of maize hybrids under agro-climatic conditions of Prayagraj, U.P.

Hybrids	Yield attributes and yield							
	Number of cobs/plant (No.)	Cob length (cm)	Number of rows/cob (No.)	Number of grains/row (No.)	Seed index (g)	Seed yield (t/ha)	Stover yield (t/ha)	Biological yield (t/ha)
KM-11	1.22	12.13	13.5	23.77	26.00	7.02	20.80	27.86
KM-12	1.44	10.73	12.4	24.30	25.00	6.15	18.50	24.65
KM-13	1.55	13.9	12.83	25.20	26.00	6.68	20.00	26.63
KM-14	1.33	10.2	12.4	25.40	23.67	6.28	18.90	25.15
KM-15	1.22	12.83	12.4	22.77	24.67	6.16	18.50	24.61
KM-16	1.11	12.97	11.97	23.53	25.33	5.88	17.60	23.52
KM-17	1.66	13.5	12.5	24.20	23.67	6.86	20.70	27.56
KM-18	1.33	12.97	13.27	25.10	24.00	6.43	19.40	25.84
KM-19	1.78	14.87	13.97	26.00	27.33	7.08	21.10	28.16
KM-20	1.22	11.57	11.63	24.30	25.33	6.19	18.60	24.83
KM-21	1.55	12.23	11.87	24.40	24.67	6.12	18.50	24.66
S.Em(±)	0.13	0.52	0.48	0.56	0.7	0.19	0.52	0.69
CD (P= 0.05)	0.38	1.54	-	1.66	2.07	0.57	1.55	2.05

Conclusion

Among all hybrids, KM-19 was found to be best by obtaining highest growth and yield attributes and yield. It was found more productive, when compared to others under agro climatic conditions of Prayagraj, U.P. A good maize hybrid will result in better yield to farmers which differs with different agro-climatic conditions of India.

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