Growth, Yield and Economics of Maize (*Zea mays* L.) Hybrids Under Agro-Climatic Conditions of Prayagraj, Uttar Pradesh, India

ABSTRACT

A field experiment was conducted during *kharif* season of 2021 at experimental field of the Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, and Uttar Pradesh, India to determine the Growth and Yield of Maize (*Zea mays* L.) Hybrids Under Agro-Climatic Conditions of Prayagraj, Uttar Pradesh, India. The experiment was done on 15 Maize Hybrids. It was carried out through a statistical design of Randomized Block Design (RBD) with three replications. The soil of the experimental plot was sandy loam in texture and contain ph 7.8, organic carbon (0.35%), available nitrogen (243kg/ha), available phosphorus (20.10kg/ha) and available potassium (105 kg/ha). Report of study indicate that, among different Hybrids UM-14 produced significantly higher plant height (218.48 cm), number of leaves per plant (13.07), dry weight/plant (166.11 g), cob length (17.12 cm), number of cobs per plant (2.07), number of rows per cob (15.60), number of grains per row (31.10), Seed yield (7.99 t/ha), stover yield (18.95 t/ha) and harvest index (29.67%). Hybrid UM-14 also fetched highest gross returns (Rs.2,00,631/ha), net returns (Rs.1,43,736/ha) and benefit cost ratio (2.53) when compared to other Hybrids in both growth and yield attributes.

***Key words*:** *Hybrids, Yield Attributes, Growth Attributes, Economics*.

1. INTRODUCTION

Maize (*Zea mays* L.) is the world's leading crop and is widely cultivated as cereal grain that was domesticated in Central America. It is considered as one of the most important food grains 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. Nutrient composition of maize includes crude protein 7.6%, crude fiber 2.3%, crude fat 3.6%, starch 63.8%, Total sugar 1.7%, Gross energy 3840kcal/kg. **(Kumar *et al.* 2012).** In India maize is cultivated over an area of 8.49 million hectares with the production of 21.28 million tones and productivity of 2057 kg/ha. With maize world's average yield production of 27.8 q/ha, considering Uttar Pradesh has reported 8.33% of the total maize areaand 9.65% of total maize production in the country. From maize starch, many bi- products like corn syrups and also alcoholic beverages include beer, whiskey, etc. In India, about 28% of maize produced is used for food purposes, about 11% as livestock feed, 48%for poultry feed, 12% in the milling industry, and 1% for seeds purpose. (**Iken *et al*. 2001**). Major prominence on maize improvement was started from the year 2000 where there is a development of Single Cross Hybrids (SCHs). The cultivation of high yielding, stress resistant/tolerant single cross hybrids offers viable, sustainable and profitable option for Indian farmers. The impact of single cross hybrid in India by hardly covering 20% area under single cross hybrids the crop growth rate with respect to area, production and productivity of maize has increased**. (Dass *et al.* 2009).** Focusing on requirements of farmer, higher grain yield and disease resistant hybrids need to be produced. Also, their evaluation and performance under different agro climatic conditions need to be carefully estimated. This can help farmers in choosing great performing varieties. **(Dass *et al.* 2009).**

2. MATERIALS AND METHODS

This experiment was carried out during *Kharif* 2021 at Crop Research Farm, Department of Agronomy, NAI, SHUATS, Prayagraj, (U.P) which is located at 25.28^{o}N latitude, 81.54^{o}E longitude and 98 m altitude above the mean sea level on sandy loam soil having basic ph (7.8), organic carbon (0.35%), available nitrogen (243kg/ha), available phosphorus (20.10kg/ha), available potassium (105 kg/ha) and EC (0.296ds/m). The climate is characterised by The climate of this region is typically sub-tropical and semi-arid with monsoon commencing by the third week of June and withdrawing by end of October with mean temperature of 43^{o}c. The experiment was laid out in Randomized Block Design (RBD), where 15 hybrids are replicated thrice. Sowing of maize hybrid seeds at spacing of 60x20 cms

were done. The crop was fertilized with recommended dose of NPK 120:60:40 kg/ha was applied. 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. Similarly, $ZnSO_4$ was applied as basal dose at the rate of 25 kg/ha for correction of zinc and Sulphur deficiency. Irrigation was done at critical stages i.e. vegetative stage, tasseling stage, cob filling and maturity stage. However other normal cultural practices were weeding and spraying of insecticide was done timely. One quadrate was harvested in every plot for the determination of results and data was subjected to statistical analysis separately by using analysis of variance technique. The difference among hybrid means was compared by using least significant difference test at 5% probability levels.

3. RESULTS AND DISCUSSIONS

3.1 GROWTH ATTRIBUTES

Growth parameters in maize hybrids were measured in terms of plant height(cms), no. of leaves, plant dry weight(gms) at harvesting stage were shown in table 1. During research trial, significantly highest plant height was found in hybrid UM-14(218.48 cm). However, hybrid UM-12(211.83cm) was found statistically at par with UM-14. Plant height was significantly affected by maize hybrids. There is a considerable varietal variation in this characteristics, when the height of final plant is strongly influenced by environmental conditions during stem elongation as shown by **Sener *et al.* (2004)**. At harvest, significantly highest number of leaves/plant (No.) was recorded by UM-14(13.07) however hybrids UM-9(11.93), UM-12(12.53) and UM-13(12.47) were found statistically at par with UM-14 hybrid. The differences observed in the number of leaves of maize may be attributed to differences in growth characters which are being influenced by genetic make-up of the plants as shown in **Gollar *et al.* (1996).** Significantly highest plant dry weight was recorded by UM-14(166.11g). However, hybrid UM-12(159.51 g) was found statistically at par with UM-14. The accumulation of dry matter is a good index, to express the photosynthetic efficiency of the plants, noticeably higher total dry matter including leaves, cob and stem was recorded with different hybrids which could be due to higher plant height as shown in **Singh *et al.* (2014)**.

Table 1: Evaluation of Growth attributes of Maize Hybrids Under Agro-climatic Conditions of Prayagraj U.P

HYBRIDS	PLANT HEIGHT(cms)	NO. OF LEAVES	PLANT DRY WEIGHT(g)
UM-1	203.48	11.53	141.44
UM-2	192.32	11.60	149.88
UM-3	196.23	11.40	142.17
UM-4	188.08	10.53	143.83
UM-5	195.85	10.53	144.88
UM-6	194.51	10.60	133.10
UM-7	182.26	11.13	146.17
UM-8	202.26	10.47	151.67
UM-9	204.23	11.93	146.09

UM-10	193.13	11.13	148.03
UM-11	187.68	11.60	143.50
UM-12	211.83	12.53	159.51
UM-13	196.74	12.47	148.43
UM-14	218.48	13.07	166.11
UM-15	199.89	11.53	139.16
F TEST	**S**	**S**	**S**
SEm(+)	**4.51**	**0.49**	**2.96**
CD(P=0.05)	**13.13**	**1.45**	**8.63**

3.2 YIELD ATTRIBUTES

The observations regarding yield attributes viz., number of cobs/plant, cob length(cm), number of rows/cob, number of grains/row and seed index(g) were shown in table 2. Significantly highest number of cobs/plant was recorded by hybrid UM-14(2.07). However, the hybrids UM-8(1.73), UM-9(1.73) and UM-12(1.80) were found statistically at par with UM-14. significantly highest cob length (17.12 cm) was recorded by UM-14 however, hybrids UM-1(16.23cm) and UM-12(16.57cm) were found statistically at par with UM-14. The probable reason could be that at favourable environment optimum utilization of solar light, higher assimilated production and its conversion to starches resulted higher cob length as reported by **Ahmad *et al.* (2018).** The number of rows per cob (15.60) was recorded significantly higher in UM-14. However, hybrids UM-10(14.38) and UM-12(15.31) were found statistically at par with UM-14. The number of grains per row (31.10) was recorded significantly higher in UM-14. However, the minimum number of grains per row was recorded in UM-6(24.13). An increase in the number of grains per row might be due to the lower competition for nutrients that allowing the plants to accumulate more biomass with a higher capacity to convert more photosynthesis into sink resulting in more grains per row as reported by **Adhikari *et al.* (2021).** The maximum test weight (32.00 g) was recorded by UM-14 and the minimum test weight (26.00 g) was recorded by UM-6.

Table 2: **Evaluation of Yield attributes of Maize Hybrids Under Agro-climatic Conditions of Prayagraj U.P**

Hybrids	No. of cobs/plant	Cob length(cm)	No. of rows/cob	No.of grains/row	Seed index(g)
UM-1	1.60	16.23	13.40	28.53	27.67
UM-2	1.60	15.39	13.29	29.60	27.33
UM-3	1.60	15.33	13.93	28.60	27.67
UM-4	1.60	15.47	13.07	27.47	27.00
UM-5	1.47	15.26	13.60	28.03	26.33
UM-6	1.13	13.71	12.85	24.13	26.00

UM-7	1.60	14.75	13.12	25.03	31.00
UM-8	1.73	15.30	13.20	26.80	28.00
UM-9	1.73	15.37	13.47	27.33	28.00
UM-10	1.40	14.79	14.38	26.33	30.00
UM-11	1.47	14.31	13.09	28.40	26.33
UM-12	1.80	16.57	15.31	29.73	31.33
UM-13	1.40	15.34	14.13	28.73	28.67
UM-14	2.07	17.12	15.60	31.10	32.00
UM-15	1.60	14.18	14.04	25.33	27.67
F TEST	**S**	**S**	**S**	**S**	**NS**
SEm(+)	**0.13**	**0.56**	**0.42**	**1.31**	**1.81**
CD(5%)	**0.40**	**1.63**	**1.24**	**3.83**	**-**

3.3 YIELD

Yield parameters were measured in terms of seed yield(t/ha), stover yield(t/ha), biological yield(t/ha) and harvest index (%) were shown in table 3. Significantly highest seed yield (7.99 t/ha) was recorded by UM-14. However, UM-12(7.63 t/ha) was found statistically at par with UM-14. Hybrids react differently for grain yield due to their genetic makeup and potential expressed in terms of difference in cob/plant, number of grains/cob as shown in **Jan *et al.* (2018).** An increase in grain yield might be due to the lower competition for nutrients which leads to more canopy of plant contributing higher photosynthetic activity to accumulate more biomass with the bold grain as reported by **Adhikari *et al.* (2021).** Significantly highest Stover yield (18.95t/ha) was recorded by UM-14. However, UM-3 (17.61t/ha) and UM-12(18.24t/ha) were found statistically at par with UM-14. The higher stover yield could be due to its higher height and leaf area which created a better chance to utilize more nutrients and more photosynthetic activity, which ultimately resulted in higher biomass production as reported in **Zamir *et al.* (2011).** The significantly higher biological yield (26.94 t/ha) was recorded by UM-14. However, UM-12(25.87t/ha) was found statistically at par with UM-14. The significantly highest harvest index (29.67 %) was recorded by UM-14. However, UM-12(29.50%), UM-9(27.87%) and UM-8(28.62%) were found statistically at par with UM-14. Harvest index indicates the physiological efficiency of a plant for changing the total dry matter into economic yield. Higher harvest index was observed due to increment in grain yield & stover yield and similar findings were found in **Ali *et al.* (2020).**

Table 3. Evaluation of Yield of maize hybrids under agro climatic conditions of Prayagraj, U.P

Hybrids	Seed yield(t/ha)	Stover yield(t/ha)	Biological yield(t/ha)	Harvest index(%)
UM-1	5.96	17.30	23.27	25.58
UM-2	6.12	17.05	23.17	26.47
UM-3	6.32	17.61	23.92	26.42

UM-4	6.07	16.69	22.77	26.73
UM-5	6.08	17.37	23.45	25.91
UM-6	5.53	15.79	21.32	25.98
UM-7	5.93	16.89	22.82	25.97
UM-8	6.38	15.89	22.27	28.62
UM-9	6.42	16.64	23.07	27.87
UM-10	6.02	17.24	23.27	25.89
UM-11	5.89	16.86	22.75	25.98
UM-12	7.63	18.24	25.87	29.50
UM-13	6.14	17.37	23.51	26.12
UM-14	7.99	18.95	26.94	29.67
UM-15	5.96	17.26	23.22	25.71
F TEST	**S**	**S**	**S**	**S**
SEm(+)	**0.25**	**0.51**	**0.61**	**0.91**
CD(5%)	**0.73**	**1.51**	**1.80**	**2.67**

3.4 Economics

The highest gross returns (INR200631.00), net returns (INR143736.00), and B:C ratio (2.53) was recorded by UM-14, as it had reported highest grain yield and stover yield.

The lowest gross returns (INR146075.00), net returns (INR89180.00) and B:C ratio (1.57) was reported by UM-6, as it had reported lowest seed yield and stover yield. The differences among net returns and gross returns were mainly due to their variability in yield performance.

Table 4: Economics of maize hybrids under agro climatic conditions of Prayagraj, U.P

HYBRIDS	COST OF CULTIVATON (INR/ha)	GROSS RETURNS (INR/ha)	NET RETURNS (INR/ha)	B:C
T1	56895	158233	101338	1.78
T2	56895	160541	103646	1.82
T3	56895	165660	108765	1.91
T4	56895	158612	101717	1.79
T5	56895	160533	103638	1.82

T6	56895	146075	89180	1.57
T7	56895	156503	99608	1.75
T8	56895	162231	105336	1.85
T9	56895	165053	108158	1.90
T10	56895	159193	102298	1.80
T11	56895	155687	98792	1.74
T12	56895	191991	135096	2.37
T13	56895	161770	104875	1.84
T14	56895	200631	143736	2.53
T15	56895	158116	101221	1.78

CONCLUSION

From the above findings it was concluded that among all hybrids, UM-14 was found to be best by obtaining highest growth, yield attributes and yield. It was found more productive, when compared to others under agro climatic conditions of Prayagraj, U.P.

FUTURE SCOPE

As there was less research happened in the field, further research should be done to obtain proper results and help farmers to choose better performing hybrid. Since the findings are based on the research done in one season, further trails are needed to confirm the results of this experiment.

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