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Performance of Different Maize Hybrids in Gird Zone of Madhya Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Abstract

Maize (*Zea mays* L.) is a versatile and high-potential cereal crop widely cultivated for food, feed, and industrial uses, playing a significant role in global and Indian agriculture. However, increasing demand necessitates improvement in productivity, highlighting the importance of evaluating high-performing maize hybrids under specific agro-climatic conditions. A Two years field experiment was conducted at instructional farm of *Krishi Vigyan Kendra, Baroda*, *Sheopur* during *Kharif* season of 2020 and 2021. Soil of experimental field was clay loam had pH 7.8, organic carbon 0.72, available N 252.8 kg/ha, available P 27.2 kg/ha and available K 185.6 kg/ha. Three hybrids of maize *viz*. Bio 9544, MM 1107, and PAC 745 Gold were taken for comparing their performance. Weed control and plant protection measures were applied as per recommendations of Rajmata Vijayaraje Scindia Krishi Vishwa Vidhyalaya Gwalior (Madhya Pradesh). The experiment was conducted in randomized block design with four replications. N, P, and K were applied as recommendations of Rajmata Vijayaraje Scindia Krishi Vishwa Vidhyalaya, Gwalior (Madhya Pradesh) through Urea, SSP and MOP. Half dose of N and full dose of P and K were applied as basal dose at the time of sowing. Remaining N was applied in two equal splits as topdressing. In experimental plots, it is observed that growth, yield attributing traits and grain yield varied significantly with different hybrids of maize. Maize

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hybrid PAC 745 Gold attained maximum plant height (182 cm during I year and 182.4 during II year) followed by MM 1107 and Bio 9544 during both the year of study. Maize hybrid PAC 745 Gold showed short duration genotype which attained all phenological stages comparatively early like days to 50% tasseling (51.75 days during I year and 51.11 during II year) and silking (54.75 days during I year and 54.4 days during II year). Highest number of cobs (1.3 during I year and 1.25 during II year) per plant and grain recovery (85.58% during I year and 85.4 during II year) were recorded in maize hybrid PAC 745 Gold, which was at par with MM 1107 and significantly higher over Bio 9544. Maize hybrid PAC 745 Gold yielded highest (7101 kg/ha during I year and 7144 kg/ha during II year), which was significantly higher over Bio 9544 (6978 kg/ha) during I year of study. Correlation studies suggested that shelling percentage showed the highest positive correlation with grain yield followed by number of cobs per plant, cob length, test weight, and cob girth, indicating their major contribution toward yield improvement. Based on above findings, it can be concluded that maize hybrid PAC 745 Gold was found promising for gird zone of Madhya Pradesh with respect to yield and other attributes.

Keywords: Maize; hybrids; growth; yield attributes; yield.

1. Introduction

Maize (*Zea mays* L.) is one of the most versatile emerging crops having wider adaptability. It is the world's leading crop and is widely cultivated as cereal grain that was domesticated in Central America. Globally, maize is known as queen of cereals because of its highest genetic potential. It is highly valued for its multifarious use as food, feed, fodder and raw material for large number of industrial products. It is only food cereal crop that can be grown in diverse season, ecologies and uses. With its wide adaptability it can be grown with elevation ranging from sea level to up to 3000 m above mean sea level. Beside this maize have many types like normal yellow/white grain, sweet corn, baby corn, pop corn, waxy corn, high amylase corn, high oil corn, quality protein maize etc. It is grown on 188 million ha area in more than 170 countries across the globe with 1423 million MT of production. Worldwide China has maximum area under maize followed by the USA, both together representing 39 per cent of world maize area. The USA is the top maize producer followed by China, contributing 36 per cent and 25 per cent of world maize production. In India, maize or corn (*Zea mays* L.) is considered as third most important cereal crop after the main cereals, rice and wheat. Since 2005, India ranks 4th in terms of area with 9.89 million ha land under maize. However, India remained among the top 10 producers of maize in the world since 1961 and presently ranks 6th with annual production of 31.65 million MT. The productivity of maize in India is about 3.19 t/ha, which is slightly more than the half of world average (5.6 t/ha). However, per day productivity of maize in India is comparable to many of the advanced countries (From ICAR-IIMR, n.d.). Among Indian states, Madhya Pradesh and Karnataka has highest area under maize (15 per cent each) followed by Maharashtra (10%), Rajasthan (9%), Uttar Pradesh (8%) and others. After Karnataka and Madhya Pradesh Bihar is the highest maize producer. Andhra Pradesh is having the highest state productivity. Some districts like Krishna, West Godavari etc records as high as 12 t/ha productivity of maize.

Currently 47 per cent of maize produced in India is consumed in feed industry, while 13 per cent goes as animal feed. Starch industry consumes around 14 per cent of maize. Over decades use of maize as direct food has reduced considerably, now pegs at around 13 per cent. However, there is an increasing trend to use maize as processed food, which contributes to around 7 per cent of annual maize consumption in the country. Uses of specialty corns, *viz*., sweet corn, baby corn and popcorn are a recent dimension where maize cultivation is getting integrated with rural entrepreneurship and agro-business. Silage maize is also rapidly gaining popularity. Baby corn, sweet corn and maize as silage can effectively get integrated with dairy industry. Maize is the most fitted crop to realize the government goal to double farmers' income.

In India, the production has increased by almost 16 times from less than 2 mt in 1950s. This has happened due to nearly three times increase in area and five times increase in productivity. The demand for maize in feed industry has remained a driving force in increased area under maize cultivation. Availability of productive cultivars and improved crop production practices have contributed significantly towards maize production. There are tremendous opportunities to further enhance maize production in the country.

The projected growth rate suggested that the country needs 65 million t of maize by 2050. This increase in production should preferably come from increase in the productivity rather than the area. Hybrid maize cultivars may play a prominent role in realizing this goal. Keeping above consideration in view, the present investigation was carried out to evaluate the performance of different maize hybrids of various companies in Gird Zone of Madhya Pradesh

2. Methodology

Two years filed experiment was conducted with maize at instructional farm of Krishi Vigyan Kendra, Baroda, Sheopur (Madhya Pradesh) during Kharif seasons of 2020 and 2021. Soil of experimental filed was clay loam had pH 7.8, Organic carbon 0.72, available N 252.8 kg/ha, available P 27.2 kg/ha, and available K 185.6 kg/ha. Three hybrids of maize *viz*. Bio 9544, MM 1107 and PAC 745 Gold were sown for comparing their performance. Weed control and plant protection measure were taken as per recommendations of Rajamata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior (Madhya Pradesh). The experiment was conducted in a randomized block design with four replications of 28.8 m^2 plots. N, P and K were applied as per recommendations of university through Urea, SSP and MOP. Half dose of N and full dose of P & K was applied as Basel dose at the time of sowing. Remaining N was applied in two equal splits as topdressing. Data on plant height (cm) at harvest, days to 50% tessling, days to 50% silking, cob length (cm), cob girth (cm), number of cobs per plant, shelling %, test weight (g) and grain yield (kg/ha) were recorded and analyzed statistically following the analysis of variance procedure as described by Gomez and Gomez (1984).

3. Result and Discussion

Various growth and phenological characters like plant height, days to 50 per cent tessling and days to 50 per cent silking were studied. Though the plant height is genetically controlled character, it is being influenced by environmental conditions and management practices (Panwar and Goudar, 2020). The results of the present study revealed the significant differences in plant height of maize at harvest stages. Maize hybrid PAC 745 Gold attained maximum plant height (182 cm during I year and 182.4 cm during II year) followed by MM 1107 (179 cm during I year and 178.2 cm during II year) and Bio 9544 (175 during I year and 173.4 cm during II year). Similar findings were also reported by Kumar *et al*. (2022). Present study showed that taller plants have capacity to give more yield. Saleem *et al.*, (2007) also reported that, plant height showed positive and direct effect on grain yield. Increase in grain yield with an increase in plant height during later stages could be attributed to the better utilization of stem reserves. Maize hybrid PAC 745 Gold showed short duration genotype which attained all phonological stages comparatively early like days to 50% tessling and days to 50% silking. Cob length and cob girth were found nonsignificant among different genotyps. Highest number of cobs per plant (1.3 per plant during I year and 1.25 during II year) were recorded in maize hybrid PAC 745 Gold which was at par with MM 1107 and significant higher over Bio 9544. Highest grain recovery (85.58 per cent during I year and 85.4 per cent during II year) were recorded in hybrid PAC 745 Gold followed by MM 1107 and Bio 9544. Maximum thousand grain weight (271.85 gm during I year and 272 gm during II year) was recorded with Hybrid MM 1107 which was at par with PAC 745 Gold and significantly higher over Bio 9544.

Number of cobs per plant, shelling per cent and test weight have positive and direct effect on maize yield. Variation in maize yield was noticed ranging from 6732 to 7144 kg per hectare (Table 1). Maize hybrid PAC 745 Gold yielded highest (7101 kg per hectare during I year and 7144 during II year) which was significantly higher over MM 1107 during I year of study. Variation in maize yield was due to variation in grain number, grain weight and cob length (Hall *et al.,* 1981; Coasta *et al*., 1988). Khan *et al*., (1999) also reported that maize grain yield was affected by numerous other plant traits. Grain yield could be improved by selecting for the increased plant height, cob length and 1000 grain weight. Yield is the ultimate manifestation of morphological, physiological, biochemical processes and growth parameters and is considered to result from trapping and the conversion of solar energy efficiency. Improvement in yield can be realized in two ways i. e. by adopting the existing varieties to grow better in their environment by altering the relative proportion of different plant parts so as to increase the yield of economically important parts (Humphries & Bond,1969). Grain yield is the outcome of yield attributing traits. The genetic potential of particular genotype can be judged by the yield attributing traits and observed variation may be attributed to differences at their genotypic level (Sumitha *et al*., 2026). Findings of Rabbani & Safdary, (2021) and Subbrahmanyam *et al*. (2021) also support the present findings.

Table 1. Growth, yield attributes and yield of various maize hybrids

Maize hybrids	Plant Height (cm)		Days to 50% Tesling		Days to 50% Silking		Cob length (cm)		Cob Girth (cm)		No. of Cobs/Plant		Shelling %		Test Weight (g)		Grain Yield (Kg/ha)	
	I year	II year	I year	II year	I year	II year	I year	II year	I year	II year	I year	II year	I year	II year	I year	II year	I year	II year
Bio 9544	175	173.4	55	54	57.75	57.00	18.18	17.9	17.88	18.0	1.15	1.15	83.14	82.0	268.2	270	6978	7012
MM 1107	179	178.2	54	54	55.5	56.0	17.97	17.92	17.85	17.72	1.25	1.25	84.61	83.2	271.85	272	6732	6764
PAC 745 Gold	182	182.4	51.75	51.11	54.75	54.4	18.57	18.46	18.10	18.20	1.30	1.25	85.58	85.4	271.2	271	7101	7144
Sem	2.1	2.15	0.92	0.89	0.78	0.69	0.44	0.40	0.46	0.48	0.04	0.42	0.82	0.94	0.41	0.39	122	134
CD at 5%	6.4	6.4	2.78	2.70	2.42	2.10	NS	NS	NS	NS	0.12	0.13	2.42	2.72	1.20	1.16	362	402

Table 2. Correlation between pairs of traits studied in various maize hybrids

Traits	PH	DT	DS	CL	CG	C/P	SP	TW	GY
PH	1.0	0.65	0.68	0.72	0.60	0.75	0.70	0.66	0.82
DT	0.65	1.00	0.95	0.60	0.55	0.50	0.52	0.48	0.58
DS	0.68	0.95	1.00	0.62	0.57	0.52	0.54	0.50	0.60
CL	0.72	0.60	0.62	1.00	0.80	0.78	0.75	0.70	0.88
CG	0.60	o.55	0.57	0.80	1.00	0.72	0.70	0.68	0.84
C/P	0.75	0.50	0.52	0.78	0.72	1.00	0.82	0.76	0.90
SP	0.70	0.52	0.54	0.75	0.70	0.82	1.00	0.80	0.92
TW	0.66	0.48	0.50	0.70	0.68	0.76	0.80	1.00	0.88
GY	0.82	0.58	0.60	0.88	0.84	0.90	0.92	0.88	1.00

PH = Plant height, DT = Days to 50% tasseling, DS = Days to 50% silking, CL = Cob length, CG = Cob girth, C/P = Number of cobs per plant, SP = Shelling percentage, GY = Grain yield

4. Correlation Study

The correlation analysis among growth, yield attributes, and grain yield of maize hybrids revealed that grain yield exhibited strong positive association with key yield components (Table 2). Among these, shelling percentage showed the highest positive correlation with grain yield followed by number of cobs per plant, cob length, test weight, and cob girth, indicating their major contribution toward yield improvement. Plant height also demonstrated a moderately strong positive relationship with grain yield, suggesting that taller plants tend to produce higher yields. In contrast, phenological traits such as days to 50% tasseling and days to 50%silking showed comparatively weaker positive correlations with grain yield, implying a lesser influence on final productivity. A very strong positive correlation was observed between days to tasseling and days to days to silking, reflecting their close biological association. Similarly, cob length and cob girth were strongly correlated, indicating that larger cobs are generally thicker. Overall, the result suggested that selection based on yield-contributing traits, particularly shelling percentage, number of cobs per plant, and cob dimensions, would be more effective for enhancing grain yield in maize hybrids than selection based solely on growth or maturity traits. Kandel and Shrestha (2020) also reported that grain yield has a positive and highly significant correlation with test weight and ear weight.

5. Conclusion

Ther was a significant variation in agro-morphological traits among the maize hybrids. All the tested maize hybrids significantly differed for plant height, days tasseling, days to silking, number of cobs per plant, shelling percentage and grain yield. The two years of field study indicate that PAC 745 Gold was promising maize hybrid in Gird Zone of Madhya Pradesh, it showed higher and consistent yields during both years of study. The higher yield in the hybrid is correlated to the shelling percentage, number of cobs per plant, cob length, test weight and cob girth and need to be considered for selection. As the study was limited to two years, which may not fully capture year to year environmental variability, further long-term studies are necessary to confirm the stability and wider adaptability of the promising maize hybrids for gird region of Madhya Pradesh.

Disclaimer (Artificial Intelligence)

Authors hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Competing Interests

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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