Research Article

Effects of Sowing Dates on Yield Attributes and Yield in Maize (*Zea mays* L.) Hybrids Sown In *Kharif* Season in Haryana

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Abstract

A field experiment was conducted during *Kharif* 2012 to study the effect of different dates on yield attributes and yield of different maize (*Zea mays* L.) hybrids. The experiment consists of four dates of sowing (15th June, 25th June, 5th July and 15th July) in main plot and five maize (*Zea mays* L.) hybrids of different maturity groups namely, HQPM-1 (long), HM-4 (medium), HM-5 (long), HM-6 (early) and HM-7 (extra early) in sub plot was replicated thrice in split plot design. The 10 days advance, normal and 10 days delayed sowing from normal sowing date being at par recorded significantly higher cob length, cob girth, 100 grain weight, shelling per cent and grain yield/ha as compared to delayed sowing by 20 days from normal sowing date. Highest cob length was recorded in HM-4 (15.6 cm) followed by HQPM-1 (14.2 cm), HM-6 (13.4 cm), HM-7 (12.9 cm) and lowest in HM-5 (12.1 cm). Highest shelling per cent was recorded in HQPM-1 (67.8 %) followed by HM-6 (65.1 %), HM-4 (63.6 %), HM-7 (62.3 %) and lowest in case of HM-5 (58.5 %). Hybrid HM-5 recorded highest cob girth (4.3 cm), 100-grain weight (27.0 g), grain yield (7.64 t/ha) and highest nitrogen, phosphorus and potassium uptake in grains and straw.

Keywords: Maize Hybrids, cob girth, cob length, dates of sowing, grain yield, nutrient uptake, shelling per cent

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Introduction

Maize is the third most important food grain in India after wheat and rice. In India, during 2014-15 maize was grown over an area of 9.18 million ha with production and productivity of 24.17 million tonnes and 2632 kg/ha, respectively. Maize was grown in Haryana during *Kharif* 2014 over an area of 8,000 ha with productivity of 2250 kg/ha [1]. However its area fluctuates year after year. The main reasons for fluctuation in acreage and production of this crop during *kharif* season are: deficit or excess moisture, prevailing high temperatures, cloudiness which favors incidence of insect pests, weeds and diseases and restricts sunshine hours for photosynthesis, rainfall which washes off the pollens and leaches the fertilizers nutrients. The productivity level of maize can be increased further due to the availability of single cross hybrids of different maturity durations which are best suited to different climatic conditions and soil types.

Two important components of maize cropping systems are plant variety and planting date. Proper selection of these components can help in improving maize yields. Maize grain yield potential has dramatically increased during the last 50 years especially in the temperate regions of the world [2, 3]. This yield enhancement can be attributed largely to the release of genetically superior hybrids, reduction of row spacing, higher plant densities, increased use of chemical fertilizers, improved cultural practices and better weed and pest controls [4, 5]. Planting date is one of the most important aspects of management in agricultural system, which can affect yield through influencing emergence date, plant density, normal growth, pollination and maturity date [6].

The importance of sowing time has been widely investigated in many countries and the conclusion has always been that a higher yield can be obtained if sowing is done on the date which is the possibly earliest for a specific country. Delaying planting date ends in decreased in maize grain yields [7]. This happens due to higher temperature at nights and the increased respiration of plants, which causes consumption of carbohydrate supplies and a much less conveyance of carbohydrate to grains. Determination of the best planting date for different environments is important in realizing the maximum yield potential of crops.

Today, the challenge for maize growers is to find the narrow window between planting too early and planting too late. Farmers who plant maize early are concerned about high temperature and early plant growth. On the other hand, farmers who plant late are concerned about different maturity hybrids, and how the late planting will affect the final

grain yield and grain moisture. It is generally suggested that farmers should plant the crop on more than one planting date in order to safeguard against unpredicted seasons.

Keeping in view the prevailing rainfall and climatic aberrations and availability of high yield potential hybrids, a field experiment was conducted to study Performance of maize (*Zea mays* L.) hybrids under different sowing dates in *kharif* season.

Materials and methods

Location of Experiment and Soil type

The field experiment was conducted during 2012-13 at Regional Research Station , Karnal, CCSHAU, Haryana, situated in semi -arid, sub-tropics at 29°43'N latitude and 76°58'E longitude at an altitude of 245 meters above the mean sea level. The soil of experimental field was sandy loam in texture, slightly alkaline in reaction, low in organic carbon and available nitrogen, medium in available phosphorus and potassium.

Experimental details

The experiment consisted of four dates of sowing (15^{th} June -10 days before normal date of sowing**,** 25^{th} June -Normal date of sowing, 5^{th} July -10 days after normal date of sowing and 15^{th} July -20 days after normal date of sowing) in main plot and five hybrids of different maturity groups [HQPM-1 Late maturity, HM-5 (Late maturity), HM-4 (Medium maturity), HM-6 (Early maturity), HM-7 (Extra early maturity)] in sub plots. All the cultural practices were followed from sowing till harvesting as per the recommended package and practices of CCS HAU, Hisar.

Where, Seed rate = 20 kg/ha, row-row spacing = 75 cm, plant-plant spacing = 20 cm, number of rows/plot = 6, number of replications = three, design = split plot design, gross plot size = 4.5 m x 6.0 m = 27 m^2, net plot size = 3.0 m x 5.0 m = 15 m^2 and total number of plots = 60.

NPK uptake (kg/ha) in grains and straw at harvest

Uptake in straw of each nutrient NPK (kg/ha) was worked out by multiplying the dry matter yield (kg/ha) with their respective NPK contents and uptake in grains of each nutrient NPK (kg/ha) was worked out by multiplying the grain yield (kg/ha) with their respective NPK content. So first NPK uptake (kg/ha) in grains and straw at harvest was measured and then NPK uptake (kg/ha) in grains and straw at harvest was worked out.

NPK content (%) in grains and straw at harvest

Oven dried sample weighed 0.2 g for grain and 0.5 g for straw was digested in diacid mixture of H_2SO_4 and $HClO_4$ in the ratio of 9:1 for NPK estimation. After digestion, a known volume was made with distilled water and filtered through Whatman's filter paper No. 42. Nitrogen content in digested plant material was determined by Nessler reagent method [8]. Phosphorus and potassium content were determined by Vanadomolybdo phosphoric acid yellow color method [9] and flame photometric method [10], respectively.

Statistical analysis

All the experimental data were statistically analyzed by the method of analysis of variance (ANOVA) as described by Panse and Sukhatme [11]. The significance of treatment effects was tested with the help of 'F' (variance ratio) test. Appropriate standard errors along with critical differences (CD at 5%) were recorded for differentiating the treatment effects.

Result and Discussion

Effect on yield and yield attributes

Sowing dates and hybrids tested did not show significant difference in terms of number of cobs/ha at harvest (**Table 1**). However, cob length, cob girth, test weight, shelling per cent and grain yield/ha differed significantly due to sowing dates and hybrids. Normal date of sowing and 10 days advance and 10 days delayed from normal date of sowing being at par recorded significantly higher cob length, cob girth, test weight, shelling per cent and grain yield/ha as compared to last sowing date i.e. 20 days after normal sowing time (Table 1).

Highest cob length was recorded in HM-4 (15.6 cm) followed by HQPM-1 (14.2cm), HM-6 (13.4cm), HM-7 (12.9cm) and lowest in HM-5 (12.1cm). Hybrids HM-6 and HM-7 were found at par with each other. HM-5 (4.3cm)

recorded significantly highest cob girth among all the hybrids. HM-6 (3.7cm) recorded significantly higher cob girth compared to HQPM-1 (3.5cm), HM-4 (3.6cm) and HM-7 (3.5cm), the later three being at par with each other.

Table 1 Effect of dates of sowing and maize hybrids on number of cobs/ha, cob length, cob girth, test weight, shelling % and grain yield/ha

Treatments	Number of cobs/ha (000/ha)	Cob length (cm)	Cob girth (cm)	Test weight (g-100 grain)	Shelling (%)	Grain yield (q/ha)
Dates of sowing						
15th June	59.9	14.0	3.8	25.7	66.9	64.5
25th June	60.1	13.9	3.8	25.4	66.4	63.5
5th July	59.7	13.8	3.7	24.9	65.7	61.7
15th July	59.7	12.7	3.5	22.2	54.8	48.7
SEm±	0.1	0.2	0.04	0.4	0.9	1.3
CD(p=0.05)	NS	0.7	0.12	1.2	3.0	4.3
Hybrids						
HQPM-1	60.2	14.2	3.5	24.9	67.8	63.8
HM-4	59.6	15.6	3.6	24.2	63.6	55.0
HM-5	59.6	12.1	4.3	27.0	58.5	76.3
HM-6	59.9	13.4	3.7	23.7	65.1	52.5
HM-7	60.0	12.9	3.5	23.0	62.3	50.7
SEm±	0.2	0.2	0.04	0.3	1.2	1.1
CD(p=0.05)	NS	0.5	0.12	1.0	3.5	3.2

Among hybrids, HM-5 (27.0 g) recorded significantly highest test weight. Hybrids HQPM-1 (24.9 g), HM-4 (24.2 g) and HM-6 (23.7) being at par recorded significantly higher test weight as compared to HM-7 (23.0 g).

Among hybrids, highest shelling per cent was recorded in HQPM-1 (67.8 %) followed by HM-6 (65.1 %), HM-4 (63.6 %), HM-7 (62.3 %) and lowest in case of HM-5 (58.5 %). Hybrids HM-4, HM-6 and HM-7 were found at par with each other in term of shelling per cent at harvest.

Among hybrids, HM-5 (76.3 q/ha) recorded significantly highest grain yield/ha. Hybrids HM-4 (55.0 q/ha) and HM-6 (52.5 q/ha) being at par recorded significantly lower grain yield/ha as compared to hybrid HQPM-1 (63.8 q/ha). The hybrids HM-6 (52.5 q/ha) and HM-7 (50.7 q/ha) were found at par with each other in terms of grain yield/ha. Hybrid HM-5 produced 17.5, 37.8, 44.9 and 50.1 % higher grain yield over hybrids HQPM-1, HM-4, HM-6 and HM-7, respectively.

Table 2 Effect of dates of sowing and maize hybrids on NPK uptake (kg/ha) in grains and straw

Treatments	Grains			Straw		
	N (kg/ha)	P (kg/ha)	K (kg/ha)	N (kg/ha)	P (kg/ha)	K (kg/ha)
Dates of sowing						
15th June	84.7	25.6	27.2	55.2	11.4	79.1
25th June	83.4	25.2	26.8	54.1	11.1	77.7
5th July	81.2	24.5	26.1	53.3	11.0	76.5
15th July	64.3	19.3	20.6	46.5	9..6	67.1
SEm±	1.7	0.5	0.3	0.7	0.1	1.0
CD (P=0.05)	5.8	1.7	1.1	2.3	0.4	3.1
Hybrids						
HQPM-1	82.0	24.8	26.3	58.2	12.0	84.0
HM-4	73.2	22.1	23.5	49.3	10.3	71.3
HM-5	100.3	30.3	32.1	66.3	13.6	94.6
HM-6	68.7	20.7	22.1	44.3	9.1	63.3
HM-7	67.8	20.5	21.8	43.4	8.9	62.3
SEm±	1.5	0.4	0.5	1.0	0.2	1.5
CD (P=0.05)	4.4	1.3	1.5	3.0	0.6	4.3

Effect on NPK uptake (kg/ha) in grains and straw

The perusal of data presented in **Table 2** indicated that dates of sowing and hybrids tested differed significantly for nutrient uptake in grains. The 10 days advance; normal and 10 days delayed sowing from normal sowing date being at par recorded significantly higher nitrogen, phosphorus and potassium uptake in grains and straw over delayed sowings by 20 days from normal sowing. Lowest nitrogen, phosphorus and potassium uptake in grains and straw was recorded in last sowing date.

Hybrids differed significantly for nitrogen, phosphorus and potassium uptake in grain and straw. Among hybrids, HM-5 recorded highest nitrogen, phosphorus and potassium uptake in grains and straw. HQPM-1 recorded significantly higher nitrogen, phosphorus and potassium uptake in grains and straw as compared to HM-4. Hybrids HM-7 and HM-6 were found at par for nitrogen, phosphorus and potassium uptake in grains and straw. HM-6 and HM-4 were found at par with each other for phosphorus and potassium contents in grains and straw. Hybrid HM-5 had highest nitrogen, phosphorus and potassium uptake in grains and straw followed by HQPM-1, HM-4, HM-6 and lowest in case of HM-7.

Conclusion

Based on one year experiment it is concluded that optimum dates of sowing of maize in Haryana was June 15 to July 5 as it utilized prevailing weather condition especially temperature for *kharif* season. If there is any deviation from normal onset of monsoon, sowing by 10 days advance and 10 days delayed from normal date has no adverse effect on grain yield. Among hybrids HM-7 (extra early), HM-6 (early), HM-4 (medium) and HQPM-1 and HM-5 (long duration) can be grown successfully from June 15 to July 5. HM-5 was found best yielder and among all the hybrids under all the dates of sowing.

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