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Effect of date of sowing and spacing on growth and seed yield of *kharif* fodder maize (*Zea mays* L.)

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Abstract
The present investigation was conducted during *kharif* season of 2021-2022 at Instructional cum Research Farm, DKS College of Agriculture and Research Station, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh with the objectives to find out the effect of date of sowing and spacing on *kharif* fodder maize. The treatment comprised of three sowing date (D1) 15th July, (D2) 25th July and (D3) 4th August and spacing (S1) 30×10 cm, (S2) 45×10 cm, and (S3) 60×10 cm taken in split plot design with 3 replication. Yield and yield attributing characters like no. of cobs plant-1 and number of seeds cob-1, cob length plant-1 (cm), cob diameter plant-1, number of seeds seed row-1, 100 grain weight (g), grain yield, straw yield and biological yield were recorded significantly maximum under date of sowing 15th July. In case of spacings, all these parameters were significantly maximum in 45×10 cm.

Keywords: Fodder maize, date of sowing, spacing

Introduction
Maize (*Zea mays* L.) is the third most important cereals crop after wheat and rice. It is widely grown around the world in temperate, tropical, and subtropical climates. Protein (10.4 per cent), fat (4.5 per cent), starch (71.8 per cent), vitamins, and minerals like calcium, phosphorus, and sulphur are all present in maize grain in significant amounts. It serves as a source of raw materials for the starch industry and is employed in the creation of a variety of goods (Buriro, 2015) [3].

Maize consumption has increased worldwide during the last decade constituting 40 per cent of the world's major cereals with 70 per cent use as animal feeds in the developed world (Bekele *et al*., 2011) [2]. It is being adopted as raw material to produce biofuel replacing the fossil fuel (Persson *et al*., 2009) [11].

In 2020-21, India's total maize cultivated area will be around 9.72 million hectares, with an annual yield of 28.64 million tonnes. With an average yield of 2945 kg ha^{-1}, the predicted crop productivity is 3.03 tonnes ha-1. Maize is a versatile crop that produces animal feed, poultry feed, and livestock feed in addition to being a staple diet for people.

Roughly 25 developing countries, maize accounts for 5 to 16 per cent of people's daily calories. It is a dual-purpose crop grown for human consumption (25 per cent), poultry feed (49 per cent), livestock feed (12 per cent), corn flakes and popcorn, and other commercial feed materials such as starch, dextrose, maize syrup, and other commercial feed materials (12 per cent), as well as 1 per cent each in drinks and seeds.

The literature on the effect of planting date on maize seed production and quality was limited, and little research has been done, particularly in Chhattisgarh. Many authors have reported on experiments to determine the effect of sowing time on maize, but the results are frequently contradictory. Of all the management aspects (cultivar selection, plant density, amount and timing of fertilisers, etc.) of growing a maize crop, planting date is an important aspect that is probably subject to variation due to differences in weather at planting time between seasons and across climates.

When all other parameters are equal, the sowing date has a considerable impact on maize grain production. Plant spacing is an important agronomic quality because it is thought to affect light interception during photosynthesis, which is the energy-producing medium that uses the plant's green components. Plant spacing determines the maximum number of plants that can be grown on a given unit of land for maximum yield.

Materials and Methods

The field experiment was conducted in the Instructional cum Research farm of DKS College of Agriculture and Research Station, Bhatapara, Chhattisgarh in *kharif* season of 2021- 22 to evaluate date of sowing and spacing in *kharif* fodder maize. The experimental soil was clay loam in texture and slightly alkaline with pH 8.0 and EC 0.20 dS-1. It was low available nitrogen (113.8 kg ha-1), medium available phosphorus (12.72 kg ha-1) and high in available potassium (384 kg-1). The range of mean maximum and minimum temperature 29.6 to 34.2 ºC and 17.1 to 24.7 ºC during the crop growth and development period was respectively. The range of the relative humidity 38.2 per cent - 92.2 per cent, bright sun shine 1.8 to 9.2 hrs day-1, wind speed 2.5 to 8.8 km hr-1 and daily evaporations 12.3 mm day-1 was respectively. The experiment comprised 9 treatments *viz*., main plot: date of sowing D1 (15th July), D2 (25th July) and D3 (4th August) and sub- plot: S1(30×10), S2 (45×10) and S3 (60×10) were replicated thrice in split-plot design. The variety African giant-J 1006 was sown. The gross was 5.4 m × 4 m and net plot size was S1- 4.8 m × 3 m, S2-4.5 m × 3 m and S3- 4.2 m × 3 m, respectively. The entire dose of fertilizer *i.e*., the recommended dose of nitrogen 100 kg ha-1, phosphorus 40 kg ha-1, and potassium 20 kg ha-1 was applied at the time of sowing through urea, DAP and MOP, respectively. Atrazine is applied as pre- emergence. For the encouragement of the growing plants to provide the support, the earthing-up operation follow with hand weeding was performed at 45 DAS. The post sowing irrigations were applied by the sprinkler method after the sowing of seeds for the germination of seeds based on crop water requirement. The crop was harvested on Oct. 12, 2021, Oct. 23, 2021 and Nov. 3, 2021 when more than 80 per cent husk of the cobs turned yellowish-brown and grains became hard. Other practices were in accordance with the recommended package for the region.

Results and Discussion

Number of cobs plant-1

Significant differences were recorded in the effect of date of sowing on number of cobs plant-1 (Table 1). The highest number of cobs plant-1 (1.92) was recorded at D1 while the lowest (1.37) at D3 (Table 1). Results of the study conform to the findings of Shete *et al.* (2020) [14]. Spacing has no significant effect on number of cobs plant-1.

Cob length plant (cm)

The effect of date of sowing on cob length was significant with a general trend of decrease in the cob length is due to delayed in the date of sowing. Maximum cob length (13.30) was recorded at D1 (Table 1). Similar result was found by Namakka *et al.* (2008) [10] and Prasad *et al.* (2017) [12]. Spacing of S2 resulted insignificantly higher cob length (13.30). Similar result was reported by Fanadzo (2010) [5].

Cob diameter plant-1

According to the result, date of sowing showed significant differences on cob diameter. Date of sowing of D1 resulted in significantly higher (5.95) and lowest in D3 (5.68). Similar result was found by Namakka *et al.* (2008) [10]. Spacing has no significant effect on cob diameter plant-1 (Table).

Number of seeds cob-1

The effect of date of sowing on number of seeds cob was significant with a general trend of decrease in the number of seeds cob is due to increase in the date of sowing. Maximum number of seeds cob was obtained in D1 (334.5). Similar, results have been reported by Khan *et al.* (2002) [7] that delay in maize sowing time, there is a significant drop in the number of grains per cob and other yield contributing features. Similarly, spacing also had significant effect on number of seeds cob-1. Spacing S2 resulted in significantly higher (326.7). Similar, result was found by Hayat *et al*. (2018) [6] that the row spacing of 45 cm and 60 cm had significantly greater number of grains per cob, 227.80 and 222.33 respectively, than the number of grains (206.53) produced by the treatment having 30 cm apart rows (Table 1).

Number of seeds seed row-1

Date of sowing had a significant effect on number of seeds seed row-1. The highest on number of seeds seed row- (36.38) was recorded at D1 while the lowest (28.03) at D3. Similar, results have been reported by Khan *et al.* (2002) [7]. Spacing S2 (34.55) had recorded significant higher number of seeds seed row-1 (Table1). Similar result was found by Manan *et al.* (2016) [9].

Yield

Significant differences were recorded due to the date of sowing on the grain yield. The highest grain yield (2858) and straw yield (6618 kg ha-1) as well as the biological yield (9468 kg ha-1) was recorded at D1 compared to the D3, which was found to be inferior in terms of yield (Table 2). The possible reason of higher values of grain yield and straw yield under D1 may be due to early sowing as compared to D2 and D3 which favour the yield and growth of fodder maize. Similar result was found by Bahadur *et al.* (2015) [1] and Cantarero (2000) [4] they reported that delaying sowing dates reduced maize grain yield and early sowing in yielded the maximum yield. Spacing S2 produced highest grain yield (2814 kg ha-1) and straw yield (6408 kg ha-1) as well as the biological yield (9222 kg ha-1). Similar, result was found by Kunjir *et al*. (2007) [8] and Hayat *et al.* (2018) [6].

Table 1: Yield attributes of *kharif* fodder maize as influenced by different date of sowing and spacing

Treatment	Number of cobs plant-1	Cob length plant-1 (cm)	Cob diameter plant-1	Number of seeds cob-1	Number of seeds seed-1 row	100 grains weight
D1- 15th July	1.92	13.30	5.95	334.5	36.38	26
D2- 25th July	1.64	12.61	5.92	321.5	34.29	25.88
D3-4thAugust	1.37	12.12	5.68	256.9	28.03	25
S.Em±	0.09	0.15	0.04	6.90	0.65	1.29
CD (P=0.05)	0.38	0.60	0.18	27.84	2.62	NS
Spacing						
S1- 30×10 cm	1.46	12.36	5.80	285.1	30.85	24.44

S2- 45×10 cm	1.82	13.03	5.92	326.7	34.55	26.77
S3- 60×10 cm	1.66	12.63	5.83	302.1	33.31	25.66
S.Em±	0.10	0.11	0.03	4.18	0.54	0.61
CD (P=0.05)	NS	0.34	NS	13.03	1.70	NS

Table 2: Yield of *kharif* fodder maize as influenced by different date of sowing and spacing

Treatment	Grain yield (kg ha-1)	Straw yield (kg ha-1)	Biological yield (kg ha-1)	Harvest index (per cent)
Date of sowing				
D1- 15th July	2858	6610	9468	30.17
D2- 25th July	2754	6208	8962	30.76
D3- 4th August	2591	5739	8330	31.06
S.Em±	48.22	9.105	54.49	0.37
CD (P=0.05)	194.43	36.70	219.71	NS
Spacing				
S1- 30×10 cm	2672	5994	8666	30.83
S2- 45×10 cm	2814	6408	9222	30.54
S3- 60×10 cm	2716	6155	8871	30.62
S.Em±	27.44	16.00	31.96	0.22
CD (P=0.05)	85.50	49.85	99.59	NS

Conclusions

Yield and yield attributing characters like no. of cobs plant-1 and number of seeds cob-1, cob length plant (cm), cob diameter plant-1, number of seeds seed row, 100 grain weight (g), grain yield, straw yield and biological yield were recorded significantly maximum under date of sowing 15 July. In case of spacings, all these parameters were significantly maximum in 45×10 cm. On the basis of above study, it could be concluded that sowing of *kharif* fodder maize on 15th July at 45×10 cm spacing produced maximum growth and yield.

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