E-ISSN: 2618-0618
P-ISSN: 2618-060X

www.agronomyjournals.com
2024; SP-7(8): 235-238
Received: 18-05-2024
Accepted: 22-06-2024

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Response of sowing dates on seed yield and yield attributing traits of maize (*Zea mays* L.) hybrid seed production

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DOI: https://doi.org/10.33545/2618060X.2024.v7.i8Sd.1277

Abstract
The present investigation was conducted at Agriculture Research Station, Buldhana during 15th July to 15th November, 2022 revealed that sowing of maize hybrid BMH 18-2 (PDKV Aarambha) on 15th October turned out to be the best treatment. Female (V1543) and male (V1551) parents of BMH 18-2 were sown at monthly intervals (from July 15th, 2022 to November 15th 2022) with 6:2 row ratio in RBD with four replications.
Sowing date significantly influenced the flowering behaviour and yield attributing characters in hybrid maize seed production. Sowing of hybrid seed production program in T_4 (October) and T_5 (November) was found optimum and highly remunerative which resulted in high seed yield and yield attributing characters besides good germination and seedling vigour index – I of hybrid seed. The impacts of sowing dates and varieties on maize growth, development and yield parameters are discussed in this article.

Keywords: Maize, hybrid, sowing dates, seed yield

Introduction
Maize (*Zea mays* L.) is one of the most important cereal crop in the world. It belongs to family Gramineae. Maize is called 'queen of cereal' because maize have got very high yield potentiality and wide adaptability under various Agro-climatic condition than any other cereal crop (Singh, 2013) [8]. Maize seed contains 10 percent protein, 4 percent oil and 2-3 percent crude fiber.
India produces about 2 percent of the world`s maize production. Out of which Karnataka is leading producer of maize contributing about 16 percent of total maize production followed by Telangana and Bihar which together contribute about 20 percent of maize production. Maize, an important staple food crop is grown on largest cropped area every year for food and fodder in India. In India, there are 100.83 lakh hectares of maize cultivation, producing 326 lakh tonnes of maize with a yield of about 3232 kg/ha. Maharashtra has 12.08 lakh hectares maize cultivation, producing 36.24 lakh tonnes of maize with a productivity of 3052 kg/ha. (Source: indiastat.com)
One of the most important factors contributing to yield gap is sowing of maize on inappropriate dates. For optimum production seed must be sown on proper time. Considerable reduction in yield can occur if the crop is sown too early or too late (Chaudry, 1994) [1]. Ismail (1996) [4] reported that early sowing of maize lead to an increased maize yield. Shafshak *et al.* (1995) [7] concluded that delay in sowing reduced a wide variety of plant and ear growth parameters and early sowing (1st May) gave the highest yield. The maize inbred response to delay/early planting and mechanism underlying for development of optimum sowing time for maize inbred for quality and quantity hybrid seed production.
Maize demand is continuously increasing due to its major role in ethanol production and government policies regarding to enhance ethanol production. For this it is necessary to increased hybrid seed production programme of maize and this research finding and helpful for seed quality and quantity seed production of maize hybrid seed.

Materials and Methods
The proposed research study was conducted at Agriculture Research Station, Buldhana during July 15th to November 15th, 2022.

The monthly meteorological data pertaining to rainfall, temperature and relative humidity prevailed during crop growth period from July to February 2022 was obtained from the Meteorological Observatory located at Agricultural Research station, Buldhana. Mean meteorological data during crop growth period at fortnightly intervals of each month was presented in Figure 1.

The experiment was carried out in Randomized Block Design with four replications having gross plot size 15 x 5 m^2 (10.2 x 5 m^2). Hybrid maize BMH 18-2 (PDKV Aarambha) were investigated to evaluate the ideal sowing date for realizing maximum seed yield and seed quality. Five sowings were taken up at monthly intervals from July 15th to November 15th. Seeds of female (V1543) and male (V1551) parents were dibbled by hand on 1/3rd of ridge with 1:2 or 1:3 or 1:4 ratio.

Application of fertilizers was done @ 120:60:40 kg NPK/ha in the form of Urea, Single Super Phosphate and Murate of Potash. Basal dose of 40 kg N + 60 kg P + 40 kg K are applied. The second dose of 40 kg N at 30 DAS and the third dose of 40 kg N at 60 DAS are applied. Detasseling was done for female (V1543) rows when the tassel was well out of the leaf sheath but before the anthers had shed pollen. Moisture in grain at harvesting should be around 18-20% in female seed. Cob should be dried up to 13-14% moisture content before shelling. Seed should be dried 8-10% moisture before bagging.

Result and Discussion

Response of sowing dates on seed yield and yield attributing traits in hybrid seed production of maize.

1. Yield and yield attributing traits.

1.1. Cob length (cm)

Cob length varied significantly among the treatments. Treatment in T_4 produced long ears (16.38 cm) followed by T_5 (15.78 cm) and were significantly different from other treatments (Figure 2). Crop sown on T_3 produced longer ears (14.73 cm) than T_2 (14.43 cm) and T_1 (14.00 cm). Decrease in cob length was noticed in T_1 (14.00 cm). Decrease in cob length was noticed with the delayed in sowing and was in conformity with the finding by Ibrahim *et al.* (2013) [3].

1.2 Cob diameter (cm)

Cob dimeter varied significantly among the treatments. Treatment in T_4 recorded increased ear diameter (15.50 cm) followed by T_5 (14.48 cm), while decreased ear diameter was observed in T_1 (13.15 cm) and T_2 (13.23 cm) (Figure 2). The significant reduction in ear diameter could be due to the significant increase in the leaf area index of late sown crop at both anthesis and physiological maturity stage which resulted in more light interception and probably higher photosynthesis. Similar result finding by Namakka *et al.* (2008) [5].

1.3 Number of rows cob^{-1}

Number of rows cob^{-1} revealed that, there were significant differences between T_4 and rest of the treatments. Treatment in T_4 (16.78) which was found to be at par with T_5 (16.30), while minimum number of rows cob^{-1} was obtained in T_1 (14.80) followed by T_2 (14.98) and T_3 (15.30) (Figure 2). Higher number of rows cob^{-1} in T_4 could be due to the high pollen viability and moderate temperatures (about 23ºC) during this treatment. This was in accordance with the findings of Harris *et al*. (1984) [2].

1.4 Number of seeds row^{-1}

Number of seeds row^{-1} was significantly influenced by treatments. Crop sown on T_4 was recorded significantly higher number of seed rows^{-1} (26.05) which was found to be at par with T_5 (25.38) and was significantly differ from T_1 (20.65) and T_2 (20.55) (Figure 2). The reason for more seeds row^{-1} could be due to the presence of prolonged reproductive period. This was in accordance with the findings of Harris *et al*. (1984) [2].

1.5 100 seed weight (g)

The results showed that treatments had significantly affected 100 seed weight. Decreasing trend in 100 grain weight was observed in T_1. The average 100 seed weight of 25.80 g was recorded which ranged from 24.25 g to 27.00 g. Crop sown on T_4 registered maximum test weight (27.00 g) which was found to be at par T_5 (26.75 g) while minimum test weight (24.25 g) was recorded in crop sown on T_1 (24.25 g) followed by T_2 (25.50) and T_3 (25.50 g) (Figure 2). Delay in sowing date reduced individual kernel weight. Late sowings decreased the effective rate of grain filling and shortened the effective duration of grain filling compared with timely sowings. These results were in conformity with findings of Rizzardi *et al.* (1994) [6].

1.6 Seed yield plant^{-1}

Significant variance was noticed among the treatments for seed yield plant^{-1}. Higher seed yield plant^{-1} was recorded in T_4 (116.13 g) followed by T_5 (113.18 g) and T_3 (106.98 g), while lower seed yield plant^{-1} was recorded in T_1 (101.13 g) and T_2 (101.80 g) (Figure 3). Maximum seed yield plant^{-1} in T_4 might be due to prolonged growing period leads to more number of seeds row^{-1} and high grain weight with timely planting. Similar result finding by Varma (2013) [9].

1.7 Cob yield plant^{-1} (g)

Significant differences were observed in cob yield plant^{-1} among all the treatments. Higher cob yield plant^{-1} was recorded in T_4 (147.30 g) followed by T_5 (144.90 g), while minimum cob yield plant^{-1} was recorded in T_1 (131.45 g), T_2 (133.8 g) and T_3 (136.95 g) (Figure 3). The difference in cob yield due to sowing dates was a consequence of differences in the rate of dry matter accumulation *i.e.*, percentage of partitioning of dry matter into the reproductive parts at the time of seed filling stage.

1.8 Shelling (%)

Significant variation was found among the treatments for shelling percent. Higher shelling percent was recorded in T_4 (78.86%) which was found to be at par with T_5 (78.61%) and T_3 (78.08%), while lower shelling percent was recorded in T_2 (76.08%) and T_1 (76.93%) (Figure 3). In general, difference in temperatures prevailed in T_1 (27.1ºC) and T_4 (23.3 ºC) aggravated the ill effects of soil temperatures causing desiccation of pollen grains and there by adversely affecting fertilization leading to less number of effective seeds.

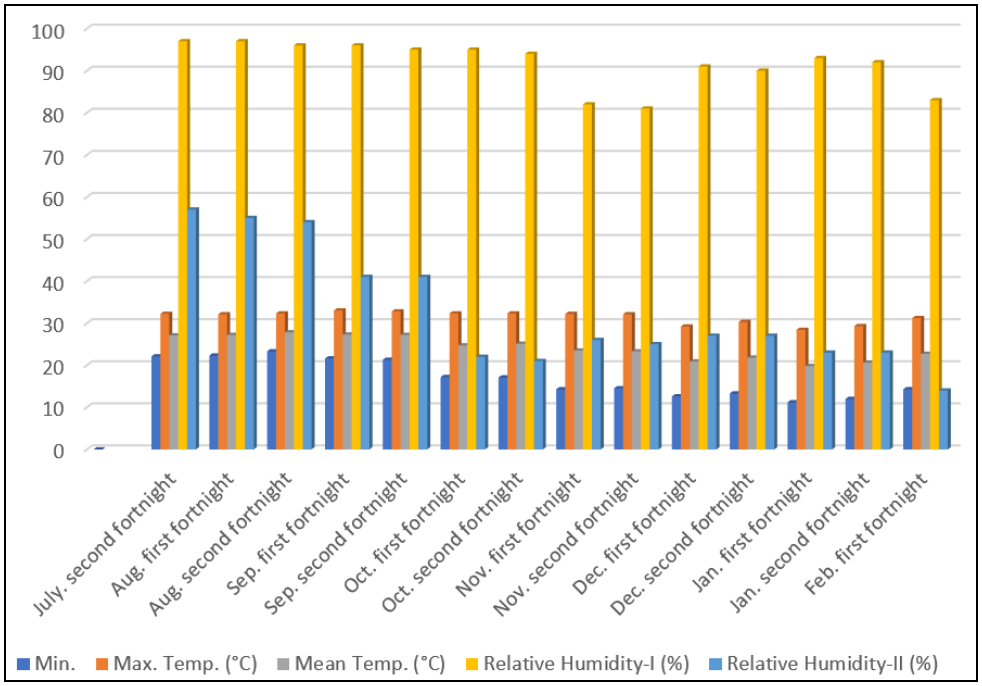

Fig 1: Fortnightly distribution of minimum, maximum and mean temperatures (°C), rainfall (mm) and relative humidity (%) during crop growth period from July to February 2022-23.

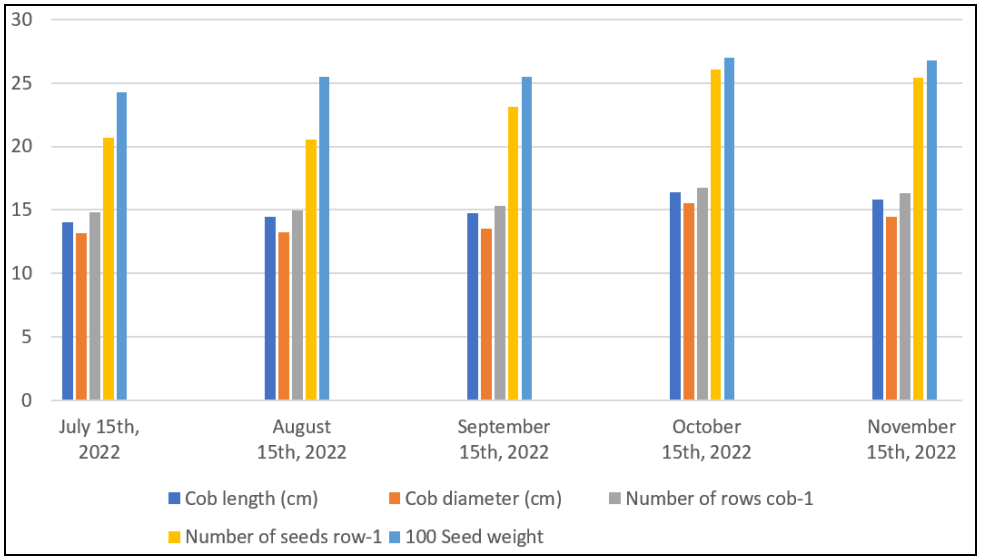

Fig 2: Response of sowing dates on yield attributing characters of seed parent of maize hybrid, BMH 18-2 (PDKV Aarambha)

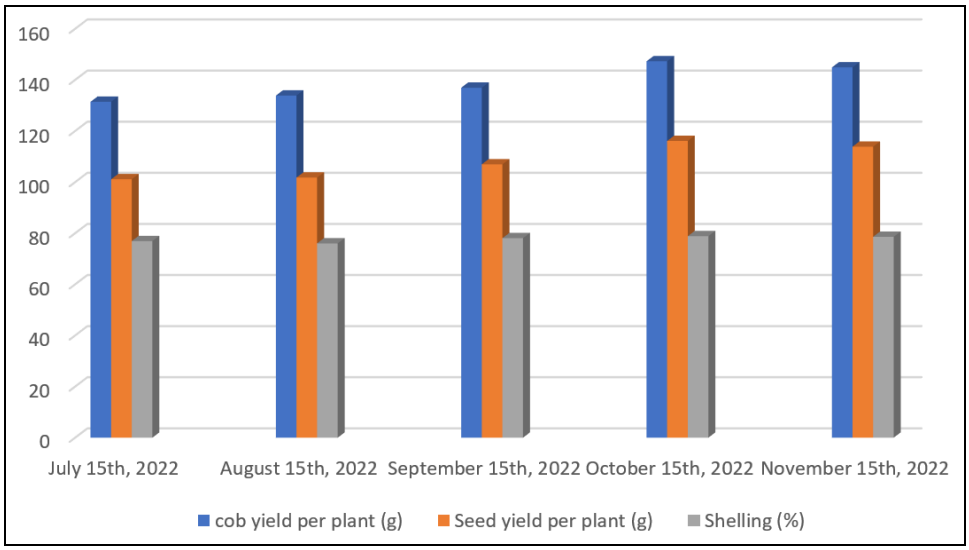

Fig 3: Response of sowing dates on yield attributing characters of seed parent of maize hybrid, BMH 18-2 (PDKV Aarambha)

Conclusion

- Sowing date significantly influenced the flowering behaviour, yield attributing characters and seed quality parameters in hybrid maize seed production.
- Sowing of hybrid seed production program in T_4 (October) and T_5 (November) was found optimum and highly remunerative which resulted in high seed yield and yield attributing characters besides good germination and seedling vigour index – I of hybrid seed.

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