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Effect of Boron and Sowing Dates on Growth and Yield of Yellow Mustard (*Sinapis alba*)

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ABSTRACT: A field trial was conducted in *Rabi* 2020 at Crop Research Farm (CRF), Department of Agronomy, SHUATS, Prayagraj (U.P.). The soil of experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%) available Nitrogen (171.48 kg/ha), available Phosphorus (15.2 kg/ha) and available Potassium (232.5 kg/ha). Results that observed that significantly highest plant height (102.5 cm), number of branches (10.3), dry weight (24.90 g), siliquae per plant (143.6), maximum seeds per siliquae (41.4), maximum test weight (3.3 g), seed yield (17.2 q/ha), highest stover yield (58.1 q/ha) were recorded with 2 kg/ha Boron + sowing date October 26. Maximum gross returns (Rs. 103200.00/ha), net returns (Rs. 68241.00 /ha) and benefit: cost ratio (1.95) were obtained highest in the treatment combination of 2 kg/ha Boron + sowing date October 26.

Keywords: Boron, sowing dates, *Sinapis alba*, sandy loam in texture

INTRODUCTION

In India mustard is the second important edible oilseed crop after groundnut. It plays an important role in the oilseed economy of the country. Among the seven edible oilseeds cultivated in India, rapeseed-mustard contributes 28.6% in the total oilseeds production and ranks second after groundnut sharing 27.8% in the India oilseed economy. Brassica play an important role in agriculture as oil seeds, vegetables, forage and fodder, green manure and condiments. In world India ranks 2nd and 3rd for area and production, respectively, with 26.5% and 16.6% of total hecterage and production of Mustard respectively. In India oilseed crop and Rapeseed-Mustard group of species accounts for 14.1 and 3% of gross cropped area, respectively.

Mustard seed contains 30-33 % oil, 17-25% proteins, 8-10% fibers, 6-10% moisture, and 10-12% extractable substances. Demand of edible oil has increased with increasing population and improvement in the living standard of the people, resulting thereby in short supply of edible oils which is being met with imports of edible oil worth 44,000 crores per annum. Major mustard growing states in India are Rajasthan (40.82%), Haryana (13.33%), Madhya Pradesh (11.76%), Uttar Pradesh (11.40%) and West Bengal (8.64%) according to 2018-19 year (Rathi *et al*., 2019).

Boron is one of the micro nutrient required for normal plant growth. The most important function of boron in plants are supposed to be its structural role in cell wall development, cell division, seed development and stimulation or inhibition of specific metabolic pathways for sugar transport and hormone development (Ahmad *et al*., 2009). A part from major plant nutrients, B plays an important role in the production phenology of mustard and this crop responds to applied B (Karthikeyan and Shukla 2008). Thus, B fertilization is necessary for improvement of crop yield as well as nutritional quality. Mustard as a Brassica group generally has a high B requirement (Mengel and Kirkby 1987).

Different sowing dates provide adaptable environmental conditions within the same location for growth and development of crop and yield (Pandey *et al.*, 1981). If the mustard sown late, duration is reduced due to the high temperature during the reproductive phase which results in decline of yield (Kumari & Rao, 2005). Some researchers revealed that the yield of

mustard crop sown at the second fortnight of September was significantly higher than that sown in first fortnight of October.

MATERIALS AND METHODS

This experimental trial was carried out during *kharif* 2020 at Crop Research Farm (CRF), Department of Agronomy, Sam Higginbottom University of Agriculture, Technology & Sciences (SHUATS), Prayagraj (U.P.) located at 25°39′42″ North latitude, 81°67′56″ East longitude and 98 m altitude above the mean sea level. The trial laid out in Randomized Block Design consisting of nine treatments which are T_1: Boron 1 kg/ha + D_1- 11 Nov 2020, T_2: Boron 1 kg/ha + D_2- 18 Nov 2020, T_3: Boron 1 kg/ha + D_3- 25 Nov 2020, T_4: Boron 1.5 kg/ha + D_1- 11 Nov 2020, T_5: Boron 1.5 kg/ha + D_2- 18 Nov 2020, T_6: Boron 1.5 kg/ha + D_3- 25 Nov 2020, T_7: Boron 2 kg/ha + + D_1- 11 Nov 2020, T_8: Boron 2 kg/ha + D_2- 18 Nov 2020, T_9: Boron 2 kg/ha + D_3- 25 Nov 2020 replicated thrice to determine the effect of boron and sowing dates on growth and yield of yellow mustard. Soil of trial plot was sandy loam in texture nearly neutral in soil reaction (pH 7.1), low in organic carbon (0.36%), available Nitrogen (171.48 kg/ha), available Phosphorus (15.2 kg/ha) and available Potassium (232.5 kg/ha). The nutrient sources used in the research plot were urea, DAP and MoP to fulfill the requirements of nitrogen, phosphorous and potassium. The recommended dose of 80 kg N/ha, 40 kg P/ha and 40 kg K/ha and boron was applied according the treatment details. 10 days after sowing gap filling was done and irrigation was given, at 30 DAS, 60 DAS and 80 DAS as per the sowing dates. Between the period of germination to harvest several plant growth parameters were recorded at equal intervals and after harvest several yield parameters were recorded. In growth parameters plant height (cm), plant dry matter accumulation (g) and number of branches/plant were recorded and yield parameters like siliquae /plant, seeds/ siliquae, Test weight (1000 seed weight), seed yield (q/ha) stover yield (q/ha) and harvest index (%) were recorded and statistically analyzed using analysis of variance (ANOVA) as applicable to Randomized Block Design Iraddi, (2008).

RESULTS AND DISCUSSION

A. Effect on growth of yellow mustard

The statistical data regarding growth parameters is presented in Table 1.

Plant height (cm). Significantly highest plant height (102.5 cm) was observed in the treatment with Boron at 2 kg/ha+ October 26 (D_1) sowing date which was significantly higher over rest of the treatments except treatment with 1.5 kg/ha Boron + October 26 (D_1) sowing date and treatment with Boron at 1.5 kg/ha+ October 26 (D_1) sowing date which were statistically on par with the 2 kg/ha Boron + October 26 (D_1) sowing date. The probable reason for significant variation in the plant height is due to the abundant availability of bright sunlight and high temperature in the early sowing helped the plant to grow efficiently and in time availability of the needed nutrients to the plant at the important growth stages Singh *et al.*, (2001).

Table 1: Effect of Boron and sowing dates on growth parameters of yellow mustard.

Sr.No.	Treatments	Plant height (cm)	No. of branches/plant	Plant dry weight (g)
1.	Boron-1 kg/ha + D_1-26-October-2020	100.5	9.0	23.44
2.	Boron-1 kg/ha + D_2-5-November-2020	99.8	8.5	23.05
3.	Boron-1 kg/ha + D_3-15-November-2020	99.5	8.3	22.66
4.	Boron-1.5kg/ha + D_1-26-October-2020	101.5	9.7	24.08
5.	Boron-1.5 kg/ha + D_2-5-November-2020	100.8	9.2	23.65
6.	Boron-1.5 kg/ha + D_3-15-November-2020	100.1	8.9	23.20
7.	Boron-2 kg/ha + D_1-26-October-2020	102.5	10.3	24.90
8.	Boron-2 kg/ha + D_2-5-November-2020	101.9	9.9	24.27
9.	Boron-2 kg/ha + D_3-15-November-2020	101.3	9.6	23.93
	SEm(±)	0.30	0.20	0.37
	CD (5%)	0.91	0.61	1.27

Number of Branches per plant. Significantly highest no. of branches per plant (10.3) was observed in the treatment with 2 kg/ha Boron + October 26 (D_1) sowing date which was significantly higher over rest of the treatments except treatment with 1.5 kg/ha Boron + October 26 (D_1) sowing date and treatment with Boron at 1.5 kg/ha+ October 26 (D_1) sowing date and treatment with Boron 2 kg/ha+ November 15 (D_3) sowing date which were statistically on par with the Boron 2 kg/ha+ October 26 (D_1) sowing date. The better levels of boron recognized to best results because boron might attributed to the favorable influence of them on plant metabolism and biological process activity and their stimulating effect on photosynthetic pigments and enzyme activity which in turn encouraged vegetative growth. The results were found similar with Ravichandra *et al.*, (2015).

Plant dry weight (g). Significantly highest Plant dry weight (g) was observed in the treatment with Boron at 2 kg/ha+ October 26 (D_1) sowing date (24.90 g) which was significantly higher over rest of the treatments except treatment with Boron at 1.5 kg/ha+ October 26

(D_1) sowing date and treatment with 1.5 kg/ha Boron + October 26 (D_1) sowing date and treatment with Boron at 2 kg/ha+ November 15 (D_3) sowing date which were statistically on par with the Boron at 2 kg/ha+ October 26 (D_1) sowing date. The application of boron generally influences cell division and nitrogen absorbtion from soil might enhanced plant growth reflects in terms of plant dry weight. The findings were in harmony with Mamatha *et al.* (2016). The early sowing might helped the higher biomass accumulation because of higher exposure to the sunlight and heat of November 11th sowing compared to other sowings, similar results were observed.

B. Effect on yield attributes and yield of yellow mustard

The statistical data representing yield and yield attributes is presented in Table 2.

Number of Siliquae/plant. Significantly higher Siliquae/plant (143.6) was recorded in treatment with Boron at 2 kg/ha+ October 26 (D_1) sowing date. Whereas, treatment with Boron 1.5 kg/ha+ October 26 (D_1) sowing date is statistically at par with sowing date of Boron 2 kg/ha+ October 26 (D_1) sowing date. Higher temperatures accelerated flowering which was observed in early sown crop, while the flowering occurred later in late sowings were more sensitive to the lower temperatures. The findings were in accordance with Lallu *et al*., (2010). Significantly higher Seeds per Siliquae (41.4) recorded in treatment with Boron at 2 kg/ha+ October 26 (D_1) sowing date. However, treatment with sowing date of October 26 (D_1) + Boron 1.5 kg/ha and treatment with Boron 1.5 kg/ha+ October 26 (D_1) sowing date is statistically on par with Boron 2 kg/ha+ October 26 (D_1) sowing date. The application of boron to yellow mustard generally improves fruit growth by synthesizing tryptophan and auxin. The enhancement effect on seeds per silique attributed to the favorable influence of boron application to crops on nutrient metabolism, biological activity and growth parameters which in turn influenced higher enzyme activity which in turn encouraged more seeds/siliqua and silique/plant Yadav *et al.,* (2016). Significantly higher test weight (3.3 g) was recorded with treatment with Boron at 2 kg/ha+ October 26 (D_1) sowing date. However, treatment with Boron at 1.5 kg/ha+ sowing date of October 26 (D_1) and treatment with Boron 1.5 kg/ha+ October 26 (D_1) sowing date is statistically on par with Boron 2 kg/ha+ October 26 (D_1) sowing date.

Significantly higher Seed yield (17.2 q/ha) was recorded with treatment with Boron at 2 kg/ha+ October 26 (D_1) sowing date. Whereas, treatment with Boron 1.5 kg/ha+ sowing date of October 26 (D_1) and treatment with Boron 1.5 kg/ha+ October 26 (D_1) sowing date is statistically at par with Boron 2 kg/ha+ October 26 (D_1) sowing date. Boron plays the vital role in increasing because it takes place in many physiological process of plant such as chlorophyll formation, stomatal regulation, starch utilization which enhanced seed yield, Mallik and Raj (2015). Early sowing resulted in the early flowering which helps in early siliqua development and increase in reproductive phase and finally the seed yield, thus the November 10 sowing obtained the higher yield attributes and yield, Kumari and Singh, (2012**)** obtained the similar results in the early sown crop. Significantly higher Stover yield (58.1 q/ha) was recorded with treatment with Boron on 2 kg/ha+ October 26 (D_1) sowing date. Whereas, treatment 8 with Boron 1.5 kg/ha+ October 26 (D_1) sowing date is statistically on par with Boron 2 kg/ha+ October 26 (D_1) sowing date. November 11th sowing helped the plants to encounter higher amount of sunlight and heat which resulted in the higher bio mass accumulation, higher plant height and number of branches. This ultimately resulted in higher stover yield Patel *et al.,* (2017). The non-significant results were obtained in case of harvest index the highest (24.1 %) and lowest (22.3%) were recorded with November 05 (D_2) + Boron 1.5 kg/ha and with Boron 2 kg/ha+ sowing date of November 15 (D_3) respectively.

Table 2: Effect of Boron and sowing dates on yield attributes and yield of yellow mustard.

Sr.No.	Treatments	No. of Siliquae per plant	No. of seeds per Siliquae	Test weight (g)	Seed yield (q/ha)	Stover yield (q/ha)	Harvest index (%)
1.	Boron-1kg/ha + D_1-26-October-2020	138.8	39.5	2.9	15.2	50.7	23.1
2.	Boron-1kg/ha + D_2-5-November-2020	134.4	38.7	2.9	14.5	45.9	24.1
3.	Boron-1kg/ha + D_3-15-November-2020	132.9	38.3	2.9	14.0	44.7	23.9
4.	Boron-1.5kg/ha + D_1-26-October-2020	142.9	40.5	3.2	16.3	56.1	22.4
5.	Boron-1.5kg/ha + D_2-5-November-2020	140.9	39.8	3.0	15.7	53.6	22.7
6.	Boron-1.5kg/ha + D_3-15-November-2020	136.6	39.2	2.9	14.9	49.3	23.3
7.	Boron-2kg/ha + D_1-26-October-2020	144.1	41.4	3.3	17.2	58.1	22.8
8.	Boron-2kg/ha + D_2-5-November-2020	143.6	40.8	3.2	16.8	57.3	22.7
9.	Boron-2kg/ha + D_3-15-November-2020	141.7	40.0	3.1	15.8	55.2	22.3
	F test	S	S	S	S	S	NS
	SEm(±)	0.44	0.34	0.03	0.29	0.87	0.54
	CD (5%)	0.54	1.03	0.10	0.86	2.60	-

CONCLUSION

Based on the findings of the investigation it may be concluded that Boron at 2 kg/ha+ October 26 (D_1) performed exceptionally in all growth and yield parameters and in obtaining maximum seed yield of yellow mustard. Hence, Boron at 2 kg/ha+ October 26 (D_1) is beneficial under eastern Uttar Pradesh Conditions.

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Conflict of Interest. None.

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