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Research Article

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Boron regulates growth and morpho physical properties of mustard in no-till farming

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ABSTRACT
No-till (NT) or zero tillage (ZT) farming is an emerging cultivation technology which has already been adopted largely for mustard (*Brassica* sp.) production. Foremost problem of NT mustard cultivation is low yield; which is the consequences of inadequate or incomplete vegetative and reproductive growth. Among the many factors which determine growth and morpho-physical features of a plant, fertilizer or nutrient management is of utmost importance. Mass growers only apply major essential plant nutrients without considering the minor crucial elements necessary for soil and plant which leads to a higher yield gap and thereby good modern high yielding varieties fail to deliver potential yield. Taking into account the present study aimed to justify the application of boron (B) and its suitable rate on optimum vegetative growth under NT cultivation in mustard for gaining higher yield. The experiment was laid out in a factorial RCB design during the *rabi* season at BINA Sub-station, Ishurdi, Pabna. Two varieties *viz*. Binasarisha-9 (V_1), BARI Sarisha-17 (V_2) and six B doses *viz*. 0 kg ha^{-1} (B_0), 1 kg ha^{-1} (B_1), 2 kg ha^{-1} (B_2), 3 kg ha^{-1} (B_3), 4 kg ha^{-1} (B_4), 5 kg ha^{-1} (B_5) was used as the treatments. Data on growth (plant height, leaf number, primary and secondary branches) attributes were recorded at 15 days interval starting from 30 DAS (days after seeding) and harvest index (HI) calculated after crop cutting. Findings depicted that, maximum plant height, leaf number, primary and secondary branches were noted with B application between 2 kg ha^{-1} to 3 kg ha^{-1}. HI was significantly highest with treatment combination $V_1 \times B_3$ (42.49%). Contrary, under growth and lowest HI ($V_2 \times B_0$: 29.05%) was spotted with 0 kg ha^{-1} B usage. In general, appropriate growth and satisfactory HI of the mustard varieties were contingent upon 2 kg ha^{-1} to 3 kg ha^{-1} B use.
Keywords: no tillage, zero tillage, boron, morpho-physical, Pabna, Binasarisha-9, BARI Sarisha-17.

INTRODUCTION

Mustard is the major oilseed crops of Bangladesh which bears 78% of the area covering over 62% demand of oil seed production (Mondal et al., 2009). The crop can be cultivated in both irrigated and rainfed conditions. Mustard production requires relatively low temperature thus *rabi* is the only season for its cultivation. This crop needs fairly less moisture (*joe* condition) during the sowing time which is available from the residual soil moisture from the preceding crop (*aman* rice) (Rehman et al., 2013). So, Mustard can be cultivated in zero or no tillage condition. No tillage is one of the best and important resource conservation technologies (Gupta, 2007; Monika et al., 2014) which is resource saving, delivers higher economic production (Hobbs et al., 2002), lessen cost of production (Reifschneider, 2007). This approach not only fosters input use efficiency but also preserves natural resources (Laxmi & Mishra 2007). Considering these benefits farmers are being motivated to cultivate mustard under no tillage to maximize economic profit. Though there are a lot of modern mustard varieties including some local cultivars but the difference in yield is of great concern in no tillage condition. High yielding varieties of mustard released by the national agricultural research institutes have a potential yield of above 1.8 t/ha (Azad et al., 2020; BINA, 2020). In contrast, mustard productivity is more than double in the European countries (4.3 t/ ha in Germany, 3.8 t/ha in France and 3.4 t/ ha in the UK) as compared to Bangladesh (Yadava et al., 2012). Reduced seed yield of mustard ensues mainly due to inadequate fertilizer, crop and water management practices. In Pabna district during 2017-18 total area under rape seed and mustard were 15,714 ha with a production of 14,141 MT whereas in 2019-20 both cultivating area and production was increased to 16,349 ha and 15,131 MT respectively. Mean national seed yield of this crop was about 1.16 t/ha (BBS, 2020).

Micro nutrient specially boron is a vital element which is critical for development of floral structures, seed formation, development and maintaining quality of seeds (Yadav et al., 2016). Farmers are generally reluctant to use the minor fertilizers in case of no tillage mustard production and they apply the major fertilizers (NPKS) only. Which ultimately leads to lower yield and poor seed quality. Hence, it is of utmost importance to apply the all the available essential nutrients in appropriate portion during the production period (Halder et al., 2007). Past studies have focused mainly on the role of micro nutrients specially boron on the growth and morpho physical characters under tilth condition during the maturity period. But, there's lack of enough information on how different boron doses influences no tillage mustard throughout the production cycle. Therefore, the current investigation aims to unveil the changes in the growth and morpho physical features at different stages of no tillage mustard varieties with relation to different boron doses and to identify the probable rate of boron application for optimizing vegetative growth.

MATERIALS AND METHODS

Experimental area

The research trial was set at Bangladesh Institute of Nulcear Agriculture, Sub-station farm, Ishurdi, Pabna of the Agro Ecological Zone (AEZ) 11 (Shil et al., 2016); which was high Ganges river flood plain. Soil fertility level of this region were low with N, P, K, S and B while CEC is medium. K bearing minerals are moderate to rich but had deficit to moderate Zn levels (FRG, 2012).

Crop and Field Management

This was a *Rabi* season i.e., winter season experiment. Residual soil moisture (after *aman* season) was utilized to sow the mustard seeds. Soil water remains limited in this area as it's the dry season of the year occurring almost no rainfall. Trial plot including land preparation, plot size, seed rate, seeding method was followed as per the procedure described by Chowhan & Islam (2021). Seeds were sown on 18th November 2020 having replication to replication distance 1m and plot to plot distance 50 cm respectively. N, P, K, S and Zn were applied at the rate of 80 Kg/ha, 24 Kg/ha, 60 Kg/ha, 18 Kg/ha and 1.5 Kg/ha respectively following medium soil fertility interpretation level (yield goal: 2.0 ± 0.2 t/ha). Full amount of P, K, S and Zn were applied as basal dose before sowing (Ahmmed et al., 2018). N was applied in two equal doses along with light irrigation after hand thinning (to keep the desired plant population of 70-80/m^2) at 20 DAS (days after seeding) and 35 DAS through broadcasting. The treatments of B (Bingo of Syngenta company) were applied individually in the unit plots as per the experimental design before sowing of seeds. An overview of the weather factors are given in Fig. 1.

Experimental Design

Randomized complete block design (RCBD) with 3 replicates was applied for the experiment setup. Details of the treatments are stated below—

Factor A: Variety (2)-
V_1 = Binasarisha-9, V_2 = BARI Sarisha-17
Factor B: Boron doses (6)-
B_0 = B@ 0 kg/ha, B_1 = B@ 1.0 kg/ha, B_2 = B@ 2.0 kg/ha
B_3 = B@ 3.0 kg/ha, B_4 = B@ 4.0 kg/ha, B_5 = B@ 5.0 kg/ha.

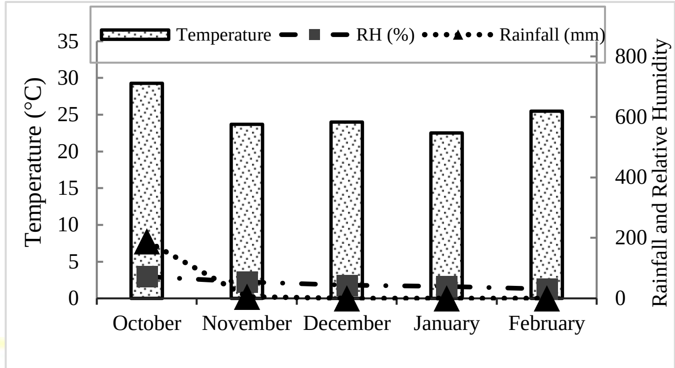


Fig 1. Mean weather data of *Rabi* season (October 2020 to February 2021) at BINA Sub-station, Ishurdi. (Source: PRC, 2021)

Data Collection and Analysis

Randomly ten plants were selected from each plot and data were collected on plant height (cm), number of leaves per plant, number of primary, secondary branches per plant and harvest index. All the above attributes were recorded at 30 DAS, 45 DAS, 60 DAS, 75 DAS and during harvest. Harvest index was calculated as per formula described by Chowhan *et al* (2018). Gathered data were statistically separately analyzed with ANOVA (analysis of variance) technique through Statistix 10 software (Statistix, 2021). Significance of mean difference was compared by LSD (least significant difference) test (Russell, 1986; Gomez & Gomez, 1984) at 5% or 10% level of probability.

RESULTS AND DISCUSSION

Plant height

At different date after sowing (DAS) and harvest the plant height was non-significantly influenced by the variety. At 45 DAS, 60 DAS, 75 DAS DAS and during harvest Binasarisha-9 showed higher the plant height than BARI sarisha-17 (Fig. 2). At 30 DAS, 45 DAS and 60 DAS the plant height was non-significantly affected by the different boron doses but at 75 DAS and harvest the plant height was significantly influenced by different boron doses. At 30 DAS, 45 DAS and 60 DAS the highest plant height was observed in the treatment B_4 (4.0 kg B ha^{-1}) and the lowest plant height per plant was found with no boron application (B_0). But, at 75 DAS and upon harvest the tallest plant height was observed in the treatment B_3 (3.0 kg B ha^{-1}) and the shortest was found with the control treatment B_0 (0.0 kg B ha^{-1}).

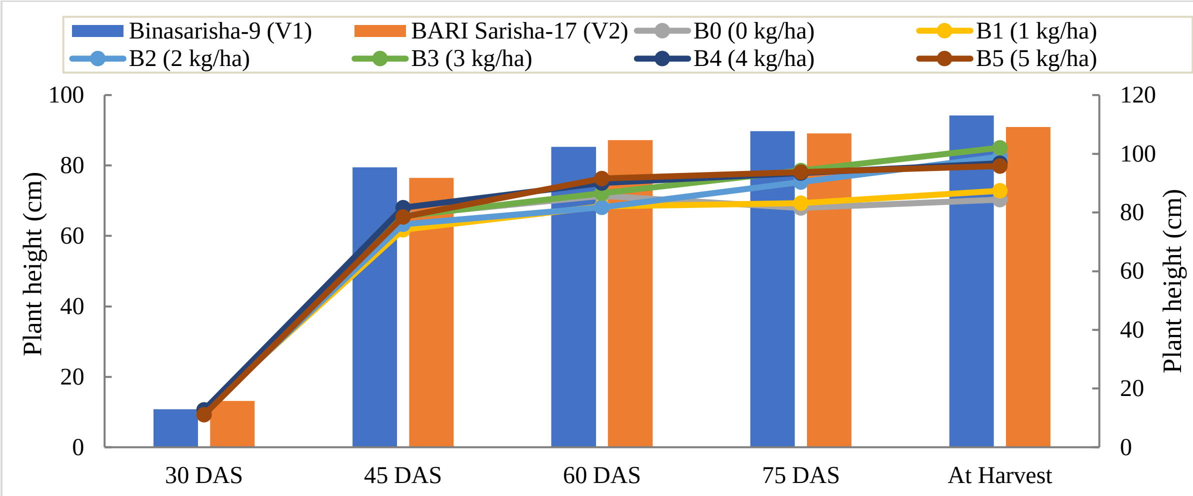


Fig 2. Influence of variety and Boron doses on plant height at different days after sowing.

The interaction effect of variety and different doses of boron on plant height was found non-significant at 30 DAS, 45 DAS and 60 DAS (Table 1). But significant variation was seen 75 DAS and at harvest. Treatment combination $V_1 \times B_3$ (Binasarisha-9 with 3.0 Kg Boron ha^{-1}) had longest height and identical shortest plant height was observed with $V_1 \times T_1$ (Binasarisha-9 with no Boron application) and $V_2 \times B_0$ (BARI Sarisha-17 with no Boron application).

Table 1. Interaction effect of variety and Boron doses plant height.

Treatments	Plant height at 30 DAS	45 DAS	60 DAS	75 DAS	At Harvest
$V_1 \times B_0$	10.56	79.67	85.22	81.50 c	87.78 d
$V_1 \times B_1$	10.88	78.44	81.33	82.78 bc	84.22 cd
$V_1 \times B_2$	10.44	79.11	77.77	88.55 abc	99.33 ab
$V_1 \times B_3$	9.99	75.78	85.99	96.61 a	103.78 a
$V_1 \times B_4$	12.77	82.66	90.11	94.89 ab	103.11 a
$V_1 \times B_5$	10.33	81.11	91.55	94.16 abc	96.78 ab
$V_2 \times B_0$	11.77	78.33	81.11	83.55 c	87.00 d
$V_2 \times B_1$	14.55	69.89	82.77	83.61 bc	84.45 cd
$V_2 \times B_2$	13.55	72.88	85.66	92.15 abc	98.64 ab
$V_2 \times B_3$	14.44	81.55	86.99	93.66 abc	100.33 ab
$V_2 \times B_4$	12.66	80.55	89.99	90.22 abc	90.43 bc
$V_2 \times B_5$	11.77	75.89	91.66	93.28 abc	94.89 abc
$LSD_{0.05}$	7.34	16.45	19.44	12.82	11.50
Level of significance	NS	NS	NS	*	*
SEm±	3.54	7.93	9.37	6.18	5.55
CV	36.1%	12.5%	13.3%	8.47%	7.34%

Figures in a column having different letter(s) differ significantly at 5% level of probability as per LSD, NS- Non significant, SEm- Standard Error mean, CV- Coefficient of Variation, DAS- Days After Sowing.

Plant height remained statistically steady with varietal effect throughout the crop duration. In addition, Boron doses and interaction effect from 30 DAS to 60 DAS was also non-significant. But remarkable changes were noted at 75 DAS and upon harvest. Boron doses B_3, B_4 and B_5 produced identical and most plant height. In the combined effect it was seen that, Binasarisha-9 with 3.0 Kg ha^{-1} Boron application gave utmost plant height at 75 DAS and during maturity. But over, low or no dose of Boron effected the mustard varieties. Variation in different sowing days was dependent on varietal response to Boron and also on appropriate Boron dose. Hussain *et al.* (2008) reported variations in plant height with different Boron doses. Hossain *et al.* (2011) noticed an increase in plant height up to a certain dose of Boron then it gradually declined. Similar results were also found from the present experiment.

Number of leaves per plant

At different dates of sowing (DAS) and at harvest the number of leaves per plant was significantly influenced by the variety except 30 DAS (Figure 3). Mean leaf numbers of BARI sarisha-17 remained at peak till harvest whereas for Binasarisha-9 off-peak leaf numbers were noticed until it reached to harvest. On the other hand, there was no effect of Boron doses between 30 DAS to 75 DAS; but at harvest maximum number of leaves per plant was obtained by treatment B_3 (3.0 Kg B ha^{-1}) and the minimum and statistically identical number was seen with treatments B_0 (0.0 Kg B ha^{-1}) and B_4 (4.0 Kg B ha^{-1}).

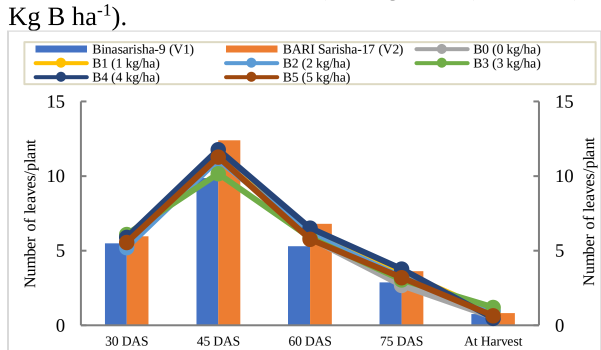


Figure 3. Influence of variety and Boron doses on number of leaves per plant days after sowing.

Collective effect of variety and Boron doses were not significant at 30 DAS (Table 2). But, from 45 DAS to harvest a significant difference was noticed. At 45 DAS, 60 DAS and 75 DAS, the greatest number of leaves per plant was produced by treatment combination $V_2 \times B_4$ (BARI Sarisha-17 with 4.0 Kg Boron ha^{-1}). Contrary, the least was found with $V_1 \times B_0$ (Binasarisha-9 and with no or 0.0 Kg Boron ha^{-1}) at 45 DAS, 60 DAS, 75 DAS and at harvest. Binasarisha-9 and BARI Sarisha-17 with 3.0 Kg Boron ha^{-1} ($V_1 \times B_3$ and $V_2 \times B_3$) was found to have statistically alike and utmost leaf numbers in the harvesting stage.

Table 2. Combined effect of variety and Boron doses on number of leaves per plant.

Treatments	Number of leaves per plant at 30 DAS	45 DAS	60 DAS	75 DAS	At Harvest
$V_1 \times B_0$	5.22	8.66 e	4.81 b	2.23 b	0.35 h
$V_1 \times B_1$	5.55	12.11 a-d	5.82 ab	3.77 ab	0.90 cd
$V_1 \times B_2$	5.33	8.89 de	5.14 ab	3.14 ab	1.05 b
$V_1 \times B_3$	5.55	9.78 c-e	5.66 ab	2.74 b	1.25 a
$V_1 \times B_4$	5.44	9.99 c-e	5.37 ab	2.65 b	0.50 fg
$V_1 \times B_5$	5.88	9.78 c-e	4.95 b	2.66 b	0.45 g
$V_2 \times B_0$	5.99	12.78 a-c	6.86 ab	3.15 ab	0.58 ef
$V_2 \times B_1$	6.44	10.22 b-e	6.50 ab	3.35 ab	0.84 d
$V_2 \times B_2$	5.11	13.33 ab	7.12 ab	3.29 ab	0.94 c
$V_2 \times B_3$	6.66	11.66 a-e	6.07 ab	3.33 ab	1.17 a
$V_2 \times B_4$	6.33	13.55 a	7.64 a	4.89 a	0.61 e
$V_2 \times B_5$	5.22	12.77 a-c	6.59 ab	3.74 ab	0.82 d
$LSD_{0.05}$	1.76	3.28	2.58	1.80	0.09
Level of significance	NS	*	*	*	*
SEm±	0.84	1.58	1.25	0.87	0.05
CV	18.1%	17.4%	25.2%	32.7%	7.08%

Figures in a column having different letter(s) differ significantly at 5% level of probability as per LSD, NS- Non significant, SEm- Standard Error mean, CV- Coefficient of Variation, DAS- Days After Sowing.

Deviations in leaf number at different DAS among the varieties was may be due to varietal characters. Whereas, Boron doses had no effect on number of leaves from 30 DAS to 75 DAS. But at harvest, highest number was noted with Binasarisha-9 with 3.0 Kg ha^{-1} Boron usage; contrary, control treatment had the least value. Collective effect indicated that application of Boron at 4.0 Kg ha^{-1} with BARI Sarisha-17 produced highest leaves between 45 DAS to 75 DAS. But, at harvest, application of 3.0 Kg ha^{-1} Boron gave most number of leaves per plant. Leaf number might be related to balanced fertilization. It was observed that, in both varieties using Boron at the rate of 3.0 Kg ha^{-1} gave best result. It implies that this dose may be the optimum for necessary vegetative growth.

Number of primary and secondary branches per plant

From 45 DAS to maturity BARI sarisha-17 kept maximum and Binasarisha-9 retained minimum number of primary branches per plant (Table 3). With Boron dose effect, treatment B_2 (2.0 Kg Boron ha^{-1}) demonstrated abundant number of primary branches; conversely scarce primary branches were spotted with treatment B_0 (0.0 Kg ha^{-1} or no application of Boron). Combined effects denoted that, combination $V_2 \times B_2$ (BARI sarisha-17 with 2.0 Kg Boron ha^{-1}) retained highest number of primary branches per plant throughout the growing period including upon maturity. But a diversification was seen in case of the lowest numbers for 45 DAS and 60 DAS. At 75 DAS and harvesting phase $V_1 \times B_0$ (Binasarisha-9 with no Boron application) beared lowest numbers of primary branches.

Table 3. Effect of variety, Boron doses and their interaction on number of primary branches.

Treatments	Number of primary branches per plant at 45 DAS	60 DAS	75 DAS	At Harvest
Variety				
Binasarisha-9 (V_1)	1.35 b	1.76 b	2.24 b	2.61 b
BARI Sarisha-17 (V_2)	1.60 a	2.08 a	2.50 a	2.82 a
$LSD_{0.05}$	0.08	0.09	0.08	0.10
Level of significance	*	*	*	*
SEm±	0.04	0.05	0.04	0.05
Boron doses				
B_0 (0 kg/ha)	1.13 d	1.49 c	1.69 e	1.93 e
B_1 (1 kg/ha)	1.49 bc	1.91 b	2.31 c	2.55 c
B_2 (2 kg/ha)	2.01 a	2.56 a	3.40 a	4.09 a
B_3 (3 kg/ha)	1.43 c	2.06 b	2.60 b	2.99 b
B_4 (4 kg/ha)	1.19 d	1.54 c	1.96 d	2.15 d
B_5 (5 kg/ha)	1.61 b	1.95 b	2.26 c	2.61 c
$LSD_{0.05}$	0.15	0.17	0.15	0.18
Level of significance	*	*	*	*
SEm±	0.074	0.08	0.07	0.08
Variety × Boron doses				
$V_1 \times B_0$	1.09 d	1.60 fgh	1.61 h	1.93 h
$V_1 \times B_1$	1.85 b	2.22 c	2.45 d	2.55 de
$V_1 \times B_2$	1.22 cd	1.90 de	2.89 b	3.78 b
$V_1 \times B_3$	1.41 c	1.63 fg	2.52 cd	2.97 c
$V_1 \times B_4$	1.16 d	1.42 gh	1.88 fg	2.03 gh
$V_1 \times B_5$	1.39 c	1.79 ef	2.09 ef	2.43 ef
$V_2 \times B_0$	0.84 e	1.38 h	1.77 gh	1.94 h
$V_2 \times B_1$	1.12 d	1.60 fgh	2.17 e	2.56 de
$V_2 \times B_2$	2.80 a	3.22 a	3.92 a	4.41 a
$V_2 \times B_3$	1.77 b	2.50 b	2.69 bc	3.02 c
$V_2 \times B_4$	1.22 cd	1.67 ef	2.04 ef	2.27 fg
$V_2 \times B_5$	1.84 b	2.11 cd	2.43 d	2.78 cd
$LSD_{0.05}$	0.22	0.24	0.22	0.26
Level of significance	*	*	*	*
SEm±	0.11	0.11	0.10	0.12
CV	8.70%	7.26%	5.40%	5.58%

Figures in a column having different letter(s) differ significantly at 5% level of probability as per LSD, NS- Non significant, SEm- Standard Error mean, CV- Coefficient of Variation, DAS- Days After Sowing

Table 4. Influence of variety, Boron doses and their interaction on number of secondary branches.

Treatments	Number of secondary branches per plant at			
Variety	45 DAS	60 DAS	75 DAS	At Harvest
Binasarisha-9 (V_1)	0.43 b	0.74 b	0.99	1.29
BARI Sarisha-17 (V_2)	0.52 a	0.79 a	0.97	1.26
$LSD_{0.05}$	0.06	0.04	0.06	0.06
Level of significance	*	*	NS	NS
SEm±	0.03	0.02	0.03	0.03
Boron doses				
B_0 (0 kg/ha)	0.31 c	0.71 c	0.91 c	1.05 d
B_1 (1 kg/ha)	0.52 ab	0.73 c	0.95 bc	1.29 c
B_2 (2 kg/ha)	0.45 b	0.83 a	1.20 a	1.74 a
B_3 (3 kg/ha)	0.46 b	0.79 ab	1.04 b	1.58 b
B_4 (4 kg/ha)	0.53 ab	0.76 bc	0.90 c	1.02 d
B_5 (5 kg/ha)	0.58 a	0.76 bc	0.89 c	0.97 d
$LSD_{0.05}$	0.10	0.07	0.11	0.10
Level of significance	*	*	*	*
SEm±	0.05	0.03	0.05	0.05
Variety × Boron doses				
$V_1 \times B_o$	0.28 gh	0.73 cd	0.89 b	1.04 de
$V_1 \times B_1$	0.38 efg	0.60 e	0.94 b	1.17 d
$V_1 \times B_2$	0.23 h	0.71 cd	1.13 a	1.83 a
$V_1 \times B_3$	0.50 cde	0.87 ab	1.18 a	1.68 b
$V_1 \times B_4$	0.56 abc	0.73 cd	0.87 b	1.02 e
$V_1 \times B_5$	0.65 ab	0.80 bc	0.95 b	1.01 e
$V_2 \times B_0$	0.33 fgh	0.69 d	0.94 b	1.06 de
$V_2 \times B_1$	0.67 a	0.86 ab	0.96 b	1.41 c
$V_2 \times B_2$	0.66 a	0.95 a	1.27 a	1.65 b
$V_2 \times B_3$	0.42 def	0.72 cd	0.90 b	1.48 c
$V_2 \times B_4$	0.51 cde	0.79 bcd	0.94 b	1.02 e
$V_2 \times B_5$	0.52 bcd	0.71 cd	0.84 b	0.92 e
$LSD_{0.05}$	0.14	0.09	0.15	0.14
Level of significance	*	*	*	*
SEm±	0.07	0.04	0.07	0.07
CV	16.98%	7.20%	9.20%	6.58%

Figures in a column having different letter(s) differ significantly at 5% level of probability as per LSD, NS- Non significant, SEm- Standard Error mean, CV- Coefficient of Variation, DAS- Days After Sowing.

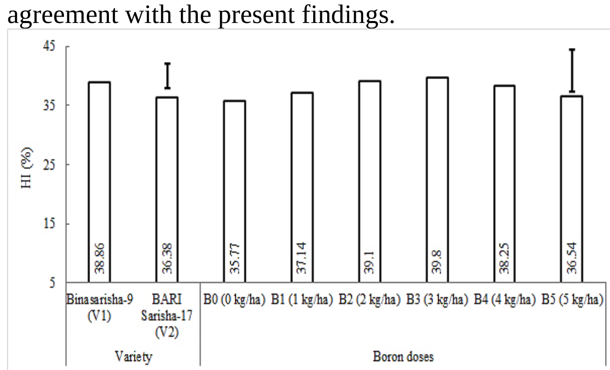
From 45 DAS to 60 DAS significant deviation in secondary number of branches per plant was noticed (Table 4). But 75 DAS and during harvest it was non-significant. As like primary branches BARI Sarisha-17 retained most and Binasarisha-9 retained least secondary branches. Significantly lowest number secondary branches were noted with treatment B_0 (no Boron application) during the whole growth and maturity period (45 DAS to harvest). But profuse number of secondary branches were identified in the treatment B_2 (2.0 kg Boron ha^{-1}) from 60 DAS to maturity.

The interaction effect of variety and different doses of boron were significant at different sowing intervals (DAS) and at harvest. Highest secondary branches were observed with combination $V_2 \times B_2$ (BARI Sarisha-17 and 2.0 kg B ha^{-1}) at 45 DAS, 60 DAS and 75 DAS. Whereas, at maturity Binasarisha-9 with 2.0 kg B ha^{-1} ($V_1 \times B_2$) showed the highest number of secondary branches per plant.

Both primary and secondary number of branches per plant was most with application of 2.0 Kg Boron ha^{-1}. It reveals that Boron dose at this level was the peak to gain the maximum efficiency of the plant branching characters. Kumararaja *et al.* (2015) mentioned statistically identical rise in the number of primary and secondary branches in mustard up to 16 Kg ha^{-1} through Borax application.

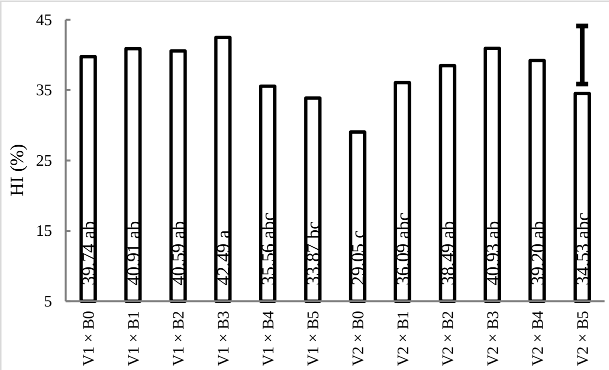
Harvest index

Non-significant effect of variety and boron doses were noted on harvest index of mustards (Fig.4,5). Yet Binasarisha-9 and application boron at the rate of 3 Kg ha^{-1} seemed to have top HI. However, interaction effect was significant and the highest HI was seen with Binasarisha-9 by applying of 3 Kg B ha^{-1} ($V_1 \times B_3$). Inversely, the lowest was noticed by treatment $V_2 \times B_0$ (BARI Sarisha-17 with no or 0.0 Kg B ha^{-1} application). Binasarisha-9 showed more HI than BARI Sarisha-17 may be due to varietal capability for utilization of more resource and nutrients. Whereas, peak HI was found with application of 3 Kg B ha^{-1}. It was break-even point of boron optimization later doses thus gave lower HIs. In the interaction effect no boron application resulted least HI and the most was observed by Binasarisha-9 with usage of 3 Kg B ha^{-1}. 3 Kg ha^{-1} application of boron resulted most HI in all cases. So, this dose of boron might be accurate in terms of no tillage HI maximization. Sharma *et al.* (2020) reported maximum harvest index (%) of mustard with application of 3 Kg B ha^{-1} combined with full recommended fertilizer doses which are in agreement with the present findings.



Vertical bars represent $LSD_{0.05}$ (NS)

Fig 4. Influence of variety and boron doses on harvest index (HI).



Vertical bar represents $LSD_{0.10}$ (values having different letter(s) differ significantly)

Fig 5. Harvest index of mustard with interaction effect.

CONCLUSION

Growth, phenology and ontogeny of the mustard varieties showed clear distinction of various boron doses. Boron played a key role to makeup the vegetative growth of the plants. From the acquired results we can recommend that, application of 2.0 Kg ha^{-1} to 3.0 Kg ha^{-1} boron might be suitable for optimizing growth and morpho physical properties of modern mustard varieties under no or zero tillage. As this trial covered a specific site; it's outcome may not be the same for all AEZs or locations.

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