



Original Research Article

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Response of Sowing Methods and Different Levels of Sulphur and Boron on Growth and Yield of Yellow Sarson (*Brassica campestris* L.)

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ABSTRACT

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A field experiment was carried out during the winter season of 2013-14 at the Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, SHUATS, Allahabad (U.P.) entitled "Response of sowing methods and different levels of sulphur and boron on growth and yield of yellow sarson (*Brassica campestris* L.)." The experiment was laid out in Randomized Block Design with twelve treatments and replicated thrice. The plot consisted of three levels of sulphur (15, 30 and 45 kg ha⁻¹), two levels of boron (1 and 2 kg ha⁻¹) with two sowing methods (line sowing and broadcasting) along with NPK each at 80:40:40 kg ha⁻¹ respectively, the results revealed that the maximum plant height (101.28 cm), plant dry weight (19.62 g), maximum no. of branches (9.93), test weight (3.18 g), seed yield (1.74 t ha⁻¹), oil yield (755 kg ha⁻¹) and harvest index (41.90%) recorded in the treatment (T₅) sulphur 30 kg ha⁻¹ and boron 2 kg ha⁻¹ with line sowing. However, maximum oil content (44.21%) recorded in the treatment T₆ – sulphur 45 kg ha⁻¹ + boron 2 kg ha⁻¹ with line sowing. The highest benefit cost ratio (1.82) was obtained in treatment (T₇) Sulphur 15 kg ha⁻¹ and boron 1 kg ha⁻¹ with broadcasting.

Introduction

Yellow sarson (*Brassica campestris* L.) is important oilseed crop of family *cruciferae* and occupies a prominent place among oilseed crops being next to groundnut in important. The present area, production and yield of nine oilseeds in India is around 26.48 million hectares, 30.94 million tonnes and 1168 kg per hectare respectively, and rapeseed mustard sown area in India is 6.36 million hectare which has a production of 8.03 million

tonnes.(Directorate of Economics and Statistics, Department of Agriculture and Cooperation, 2012-13). The average productivity of rapeseed-mustard in India is only 1145kg ha⁻¹, which needs to be enhanced upto 2562 kg ha⁻¹ by 2030 for ensuring edible oil self-reliance (DRMR, 2011). Rapeseed and mustard crops are of particular significance of Rajasthan and Uttar Pradesh, which shares about 80% of area and production of entire country. The oil content of the yellow sarson seeds ranges from 35-48 % (By NIIR Board)

and 37-42 % protein in cake (Nagaraj, 1995). It is well known that sulphur is only next to nitrogen in the nutrition of *Brassica* crops. Sulphur promotes oil synthesis, besides being an important constituent of seed protein, amino acid, enzymes, glucosinolate and chlorophyll (Holmes, 1980). In terms of agronomic efficiency, each kilogram of S increases the yield of mustard by 7.7 kg (Katyal *et al.*, 1997). Rapeseed-mustard crops are particularly sensitive to sulphur deficiency mainly due to the fact that S plays an important role in the chemical composition of seed and increases the percentage of oil content of seed (Khan *et al.*, 2002). Recent advances in B research have greatly improved an understanding for B uptake and transport processes (Brown *et al.*, 2002; Frommer and Von Wieren, 2002; Takano *et al.*, 2002), and roles of B in cell wall formation (Matoh, 1997; O, Neill *et al.*, 2004), cellular membrane functions (Goldbach *et al.*, 2001), and anti-oxidative defense systems (Cakmak and Romheld, 1997). Reproductive growth, especially flowering, fruit and seed set is more sensitive to boron (B) deficiency than vegetative growth (Dear and Lipsett, 1987, Noppakoonwong *et al.*, 1997). Thus, B fertilization is necessary for improvement of crop yield as well as nutritional quality. Mustard as a *Brassica* crop is very responsive to B application (Mengel and Kirkby, 1987).

Materials and Methods

The experiment was carried out during *rabi* season 2013-14 at Crop Research Farm, Department of Agronomy, Allahabad School of Agriculture, Sam Higginbottom University of Agriculture, Technology and Sciences, Allahabad (U.P.). Which is located at 25° 24' 42" N latitude, 81° 50' 56" E longitude and 98 m altitude above the mean sea level. The soil was sandy loam, pH of soil was 7.4 with 0.39% organic C, having available N, P, K (185.5, 36 and 98 kg ha⁻¹ respectively). The

experiment was laid out in randomized block design (factorial) with three replications, having three factors are sowing methods (line sowing and broadcasting), sulphur levels (15, 30 and 45 kg ha⁻¹) and boron levels (1 and 2 kg ha⁻¹). Half dose of nitrogen (40 kg ha⁻¹) and full dose of phosphorus and potash each 40 kg ha⁻¹ was applied basal and remaining half dose of nitrogen (40 kg ha⁻¹) was applied after the first irrigation. There were total 12 treatment combinations in all. The net subplot size was 3 m x 3m. All other agronomic practices i.e. thinning, hoeing, eradication of weeds and irrigation was kept same for all treatments. Yellow sarson variety 'PeelaSona' was sown. The line sowing was done at a spacing of 30 × 10 cm. B: C ratio considering the prevailing market price of produce and cost of cultivation. Where, T1 (S 15 kg ha⁻¹ + B 1 kg ha⁻¹ (line sowing)), T2 (S 30 kg ha⁻¹ + B 1 kg ha⁻¹ (line sowing)), T3 (S 45 kg ha⁻¹ + B 1 kg ha⁻¹ (line sowing)), T4 (S 15 kg ha⁻¹ + B2 kg ha⁻¹ (line sowing)), T5 (S 30 kg ha⁻¹ + B2 kg ha⁻¹ (line sowing)), T6 (S 45 kg ha⁻¹ + B2 kg ha⁻¹ (line sowing)), T7 (S 15 kg ha⁻¹ + B1 kg ha⁻¹ (Broadcasting)), T8 (S 30 kg ha⁻¹ + B1 kg ha⁻¹ (Broadcasting)), T9 (S 45 kg ha⁻¹ + B1 kg ha⁻¹ (Broadcasting)), T10 (S 15 kg ha⁻¹ + B2 kg ha⁻¹ (Broadcasting)), T11 (S 30 kg ha⁻¹ + B2 kg ha⁻¹ (Broadcasting)), T12 (S 45 kg ha⁻¹ + B2 kg ha⁻¹ (Broadcasting)).

Results and Discussion

Growth characters

Growth characters are tabulated in table 1. Growth parameters of yellow sarson, viz. plant height, branches plant⁻¹, dry matter accumulation (DMA), crop growth rate (CGR) and relative growth rate (RGR) were influenced by different sowing methods, sulphur and boron levels. The maximum plant height (101.28 cm) was recorded in the treatment T₅-Line sowing +30 kg sulphur + 2 kg boron ha⁻¹, which was significantly

superior to all other treatments. The maximum dry weight (19.62g) plant⁻¹ and number of branches (9.93) plant⁻¹ were recorded in the treatment T₅ -Line sowing+30 kg sulphur and 2 kg boron ha⁻¹ as compared to all other treatments. However, the plant height, dry matter accumulation and branches plant⁻¹ were found non-significant. The results are in agreement with those of Sharma *et al.*, (2008) who reported that higher dry matter accumulation and plant height were also recorded higher under the border method. Budzynski, and Jankowski, (2001) also reported that the application of supplementing NPK with sulphur (30 kg ha⁻¹) or Mg had no effect on the stand architecture and morphological features of white mustard (*Sinapsis alba*). Sharma *et al.*, (2008) who reported that higher dry matter accumulation was recorded at application of 15 kg S and 80 kg N ha⁻¹. Hossain *et al.*, (2011) who observed that the optimum rate of B was found to be 1 kg ha⁻¹ and between 1 and 2 kg ha⁻¹ boron was no significant difference. Kumar *et al.*, (2012) found that the increasing levels of sulphur and phosphorus enhanced the growth, plant height and yield attributes showed maximum increase at 30 kg S ha⁻¹ and 45 kg P₂O₅ha⁻¹, respectively.

Hassan and Malhi (2011) reported that a combination of 60 kg K + 30 kg S ha⁻¹ would accelerate phonological development and improve seed quality of rape and mustard. Khan *et al.*, (2008) investigated the efficiency of GA₃ at 0 or 10⁻⁵ with different S levels (0, 25, 50 and 75 kg ha⁻¹). The maximum S use efficiency was recorded with 25 kg S ha⁻¹. The maximum crop growth rate(4.69 gm⁻²day⁻¹) and relative growth rate (0.28 gg⁻¹day⁻¹) recorded in the treatment T₃-Line sowing+ sulphur 45kg + boron 1 kg ha⁻¹.The results are in agreement with those of Lal and Singh (2012) reported that application of sulphur and boron levels enhanced significantly all the growth parameters at higher doses *i.e.* 50 kg S

ha⁻¹ and 1.5 kg B ha⁻¹, respectively. Application of various nutrients increased the dry matter accumulation of the crop plant and hence, other growth indices like CGR, RGR and NAR values were recorded highest at the initial growth stages and declined thereafter. The results are in also agreement with those of Verma *et al.*, (2009) reported that agronomic efficiency and apparent recovery was maximum at 60 kg N ha⁻¹ and 15 kg S ha⁻¹ and it declined with further increases in the levels of N and S. optimum economic dose of N 39.5-46.3 kg ha⁻¹ and 24.5 kg S ha⁻¹.

Yield characters

Yield is tabulated in table 2. Results revealed that the seed yield, stover yield, oil content, oil yield, harvest index and test weight of yellow sarson increased non-significantly due to sowing methods, sulphur and boron levels. However, harvest index was significantly increased due to sowing methods, sulphur and boron levels. The maximum seed yield (1.74tha⁻¹), oil yield (755 kg ha⁻¹), harvest index (41.90%) and test weight (3.18g) were recorded in the treatment T₅-Line sowing + sulphur 30 kg + boron 2 kg ha⁻¹. While, minimum seed yield (1.53 tha⁻¹) was found in the treatment T₈ –Broadcasting + sulphur 30 kg ha⁻¹+boron 1 kg ha⁻¹. The highest stover yield (2.70 t ha⁻¹) was recorded in the treatment T₇ –Broadcasting + sulphur 15 kg+boron 1 kg ha⁻¹. However, it was also found non-significant. The maximum oil content (44.21%) was recorded in the treatment T₆–Line sowing + sulphur 45 kg ha⁻¹ + boron 2 kg ha⁻¹.Dry matter production and its transformation into economic yield is the ultimate outcome of various physiological, biochemicals, phenological and morphological events occurring in the plant system. Seed yield of a variety is the result of interplay of its genetic makeup and environmental factors in which plant grow.

Table.1 Response of sowing methods and different levels of sulphur and boron on growth characters of yellow sarson

Treatment	Plant height (cm)	Plant dry weight (g)	No. of branches plant ⁻¹	CGR (gm ⁻² day ⁻¹)	RGR (gg ⁻¹ day ⁻¹)
T ₁	97.45	18.93	9.20	3.15	0.18
T ₂	98.88	17.85	9.40	3.79	0.21
T ₃	98.06	19.08	9.46	4.69	0.28
T ₄	97.80	18.22	9.33	3.19	0.18
T ₅	101.28	19.62	9.93	1.77	0.09
T ₆	100.76	17.64	9.80	0.52	0.18
T ₇	100.25	19.41	9.26	2.17	0.11
T ₈	98.11	17.93	9.26	2.87	0.17
T ₉	98.62	17.57	9.40	0.60	0.03
T ₁₀	100.34	18.29	9.00	2.49	0.13
T ₁₁	99.16	18.35	9.06	2.30	0.16
T ₁₂	97.10	17.01	9.00	1.56	0.09
SEm±	2.92	1.22	0.51	1.33	0.10
CD (P = 0.05)	-	-	-	-	-

Table.2 Response of sowing methods and different levels of sulphur and boron on yield, oil content, harvest index, test weight and B: C ratio of yellow sarson

Treatment	Seed yield (tha ⁻¹)	Stover yield (tha ⁻¹)	Oil yield (kg ha ⁻¹)	Oil content (%)	Harvest index (%)	Test weight (g)	B:C ratio
T ₁	1.59	2.50	681.63	42.87	37.66	2.98	1.80
T ₂	1.67	2.45	721.60	43.21	39.80	2.90	1.74
T ₃	1.63	2.33	711.33	43.64	39.95	2.95	1.58
T ₄	1.64	2.49	706.67	43.09	38.97	2.86	1.73
T ₅	1.74	2.26	755.50	43.42	41.90	3.18	1.68
T ₆	1.65	2.29	729.46	44.21	40.98	3.10	1.50
T ₇	1.60	2.70	658.56	41.16	36.77	2.70	1.82
T ₈	1.53	2.67	642.60	42.00	36.43	2.75	1.61
T ₉	1.64	2.64	691.91	42.19	37.88	2.76	1.60
T ₁₀	1.57	2.68	649.66	41.38	36.94	2.72	1.67
T ₁₁	1.62	2.63	689.14	42.54	37.53	2.80	1.59
T ₁₂	1.60	2.63	683.04	42.69	37.68	2.84	1.47
SEm±	1.88	0.26	0.42	1.11	0.01	0.24	-
CD (P = 0.05)	-	-	-	-	0.03	-	-

These results and probable reasons for such results are in conformity with the findings of Sarkees, (2013) reported that crop grown with drill-row sowing method showed significantly highest seed yield as compare to broadcasting. Kumar *et al.*, (2002) also reported that the application of 25 kg S ha⁻¹ significantly increased the yield attributes (siliqua plant⁻¹, seeds siliqua⁻¹ and 1000 seed weight). Rashid *et al.*, (2012) reported that yield and yield contributing characters increased significantly with the increased rate of boron application up to 1.5 kg B ha⁻¹. Tomar *et al.*, (2007) also reported that sulphur application up to 30 kg ha⁻¹ significantly improved the yield attributes, seed yield, stover yield, oil yield and oil content. Dabhi *et al.*, (2010) also showed that the maximum growth, yield attributes and uptake of S under, 40 kg S ha⁻¹ ultimately result in the highest seed yield of mustard. Verma *et al.*, (2012) observed the effect of S (0, 20, 40 and 60 kg S ha⁻¹), Zinc (0, 5 and 10 kg Zn ha⁻¹) and B (0, 0.5 and 1.0 kg B ha⁻¹) levels on quality, economics and uptake of nutrients in mustard.

Result revealed that application of 60 kg S ha⁻¹ and 1.0 kg B ha⁻¹ significantly increased seed yield, economics and oil yield over the control. Among treatment combinations of yellow sarson under sowing methods, sulphur and boron levels, the highest B: C ratio (1.82) was obtained in treatments T₇-broadcasting+15 kg sulphur and 1 kg boron ha⁻¹. The results and probable reasons for such results are in conformity with the findings of Sahu *et al.*, (2004) reported the highest net monetary returns and benefit: cost ratio were obtained with 75 kg P and 40 kg S ha⁻¹.

Application of Sulphur at 30 kg ha⁻¹ and Boron at 2 kg ha⁻¹ along with recommended dose of nutrients (N at 80, P₂O₅ at 40 and K₂O at 40 kg ha⁻¹) with line sowing recorded highest growth and yield. Since the data is based on the study concluded in one season,

the experiment may be repeated to confirm the findings.

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