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EFFECTS OF SULPHER AND ZINC ON THE YIELD AND YIELD COMPONENTS OF TWO MUSTARD CULTIVARS

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Abstract

A field experiment was conducted at the Agronomy field Laboratory of Bangladesh Agricultural University, Mymensingh, during the Rabi season, November to March to study the effect of sulphur and zinc on the yield and yield contributing characters of two varieties of mustard, namely, Sonali Sarisha and Sampad. Four levels of zinc (0, 2.5, 5 and 7.5 kg ha^{-1}) and sulphur (0, 20, 40 and 60 kg ha^{-1}) were tested. Sulphur had significant effect on yield and all the yield components of mustard. Application of 60 kg S ha^{-1} produced the highest seed yield (0.98 t ha^{-1}) and the lowest one (0.70 t ha^{-1}) was received from the control. Sulphur at the rate of 60 kg ha^{-1} produced highest number of pods per plant, seeds per pod, 1000-seed weight, branches per plant and harvest index. Zinc had significant effect only on plant height and seed yield. The highest seed yield (0.90 t ha^{-1}) was produced by applying 7.5 kg Zn ha^{-1} and the lowest by the control treatment. Sonali Sarisha (SS–75) produced higher 1000-seed weight and higher plant height than Sampad but similar seed yield.

Key words: Mustard, yield and yield contributing characters, zinc and sulphur

Introduction

Bangladesh is not self sufficient in oil seed production. Among the oil seed crops, mustard ranks first in respect of acreage under edible oil seed crops. Mustard and rapes occupy some 78% of the total oil seed production, but the yield (0.95 t ha^{-1}) is very low (BBS, 2012). This may be because of the fact that mustard and rapes have been cultivated to the marginal lands of low productivity (Chowdhury et al., 1992). The indigenous production can cover only 38% of the domestic need and the rest is met from import. *Brassica campestris* and *Brassica juncea* are being cultivated in Bangladesh for oil extraction. Recently, *Brassica napus* (rape) has been introduced but not yet come under commercial scale of edible oil. Oil consumption is very poor in Bangladesh as the production of edible oil is not sufficient. The deficit of edible oil is increasing year after year due to continuous growth of population. Mustard oil plays an important role as a fat substitute in our daily diets as well as in the economy of the nation. It is widely used as cooking ingredient, condiment and medicine. More over mustard oil cake is utilized as cattle feed and manure. So the need for increasing production of mustard as an oil seed crop is very important. It has been estimated that the high yielding varieties (HYV) may first push the yield of mustard. The maximum yield of a HYV crop recorded under ideal condition of cultivation is 2.2 t ha^{-1}. A number of studies on the response of mustard to fertilizers were performed all over the world. Results of such studies indicate that mustard is highly responsive to fertilizers, particularly to suplhur levels. Sulphur fertilizers have been reported to increase the seed yield and oil content of mustard (Viramani and Gulati, 1970; Singh *et al.*, 1970).

A survey on the zinc nutrient status in Bangladesh showed that soils with high p^H and calcareous soils of north western districts and also the soils which have been intensively cultivated with transplanted rice have zinc deficiency problem. About 1.2 million hectares are suspected to be potentially zinc deficient (BRAC, 1982). Hence there is an urgent need to maximize the mustard production in these soils by applying deficient nutrients like zinc.

Some experimental evidences collected from other crops support that sulphur and zinc applications in mustard might have been promising (Khandkar and Negum, 1991). But the results so far obtained from the studies done in Bangladesh using sulphur and zinc fertilizers are inadequate to make any concrete inference on the seed yield and oil content of mustard. Therefore, the present study was undertaken to evaluate the effect of sulphur and zinc on the seed yield, yield contributing characters of mustard.

Materials and Methods

The experiment was conducted at the Field Laboratory of the Bangladesh Agricultural University, Mymensingh, during November to March. SS-75 (Sonali Sarisha) and Sampad were used in the experiment. Before sowing seeds, germination test was carried out in the laboratory and percentage of germination was found to be over 90% for both the varieties. The experiment was laid out in a Randomized Complete Block Design with three replications. The size of unit plot was 7.2m x 1.4m. The replications were separated from one another by

one meter wide levee. Allocation of all treatments for two varieties was made at random in each block.

There were 16 fertilizer treatments in the experiment for each variety. The rate of N, P and K were 120, 60 and 40 kg ha^{-1}, respectively. There were four rates of S (0, 20, 40 and 60 kg S ha^{-1}) and Zn (0, 2.5, 5.0 and 7.5kg Zn ha^{-1}) and the combinations of sulphur (S) and zinc (Zn) were, $T_1 - S_0Zn_o$, $T_2 - S_{20}Zn_o$, $T_3 - S_{40}Zn_o$, $T_4 - S_{60}Zn_o$, $T_5 - S_0Zn_{2.5}$, $T_6 - S_{20}Zn_{2.5}$, $T_7 - S_{40}Zn_{2.5}$, $T_8 - S_{60}Zn_{2.5}$, $T_9 - S_oZn_5$, $T_{10} - S_{20}Zn_5$, $T_{11} - S_{40}Zn_5$, $T_{12} - S_{60}Zn_5$, $T_{13} - S_0Zn_{2.5}$, $T_{14} - S_{20}Zn_{7.5}$, $T_{15} - S_{40}Zn_{7.5}$, $T_{16} - S_{60}Zn_{7.5}$.

The land was first ploughed with a tractor drawn disc plough and then land was prepared with a 2 wheel tractor plough. Three composite soil samples were collected from plough depth of 0-15cm and laboratory analysis was done. Half of the total dose of urea, full dose of potassium, phophorus, gypsum and zinc oxide were applied during the final land preparation. The rest half of urea was top dressed after 35days of sowing. The N, P, K, S and Zn were supplied from urea, triple super phophate (TSP), muriate of potash (MP), gypsum and zinc oxide containing 46, 48, 60, 18 and 80.2% N, $\%P_2O5$, $\%K_2O_2$, %S and %Zn, respectively. The seeds at the rate of 10 kg ha^{-1} were sown. The seeds were sown on 26th November and intercultural operations like weeding, thinning, irrigation and insecticide application were done as and when necessary. The seeds were weighed and moisture in the seeds was adjusted at 10%. The dried seeds and straw were weighed as per plot which was subsequently converted to yield t ha^{-1}. Ten sample plants per plot were selected at random for measuring yield components.

Results and Discussion

Effects of Sulphur

Crop response to sulphur fertilizer for yield and yield parameters have been presented in Table 1. The rate of sulphur had significantly influenced the plant height of mustard. The differences between successive treatments were also significant. Sulphur gave significantly the highest plant height (112 cm) when applied at the rate of 20kg S ha^{-1} and the control treatment produced the lowest one (103 cm). Sulphur rates of 40 and 60 kg ha^{-1} gave lower plant height than 20kg S ha^{-1}, but was significantly higher than the control treatment. Sulphur fertilizer had significant ($P \leq 0.05$) effect on pod number per plant. Sulphur at the rate of 60kg ha^{-1} produced the highest number of pod per plant and minimum number of pods was produced by the control treatment. Increasing rates of sulphur increased pod number per plant and successive treatment differences were also significant. This finding is supported by Rathore and Manohar (1989), who obtained significantly the highest number of pods per plant by applying sulphur rates up to 160kg S ha^{-1}. Koti *et al.* (1989) also obtained similar results. Different rates of sulphur produced similar trends in case of seed per pod. Highest rate of sulphur (60kg S ha^{-1}) produced maximum number of seeds per pod and control treatment gave the lowest one. The findings of Chowdhury *et al.* (1991) were agreement with the view that sulphur at the rate of 50kg S ha^{-1} increased seeds per siliqua.

Sulphur rates significantly influenced 1000-seed weight and the results were also similar to seeds per pod. Applying sulphur at the rate of 60kg ha^{-1} increased 1000-seed weight up to 3.12 g. Increasing rates of sulphur increased 1000-seed weight gradually and successive differences of treatments were also significant. The result is in conformity with that of Rahtore and Manohar (1989), who observed that sulphur at the rate of 80 kg S ha^{-1} increased 1000-seed weight. The treatment of sulphur at the rate of 60 kg S ha^{-1} showed the highest harvest index, which was statistically superior to the other treatments and the control treatment produced the lowest one (Table 1). The differences between successive treatments were not statistically different. The result accords to that of Chaudhry *et al.* (1991). Branches per plant also visualized the similar tendency as pod number per plant, seeds per pod and 1000-seed. Sulphur at the rate of 60 kg S ha^{-1} produced maximum number of branches per plant, whereas control treatment produced the lowest one. The similar finding has been reported by Rathore and Manohar (1989).

Table 1. Effect of sulphur on the yield and yield contributing characters of mustard

Doses of sulphur (kg ha^{-1})	Plant height (cm)	Pod no./ plant	Seeds/ pod	1000 seed weight (g)	Harvest index (%)	Branch/ plant	Seed yield (t ha^{-1})
S_0	103d	79.5d	20.53d	2.39d	22.08c	60.60d	o.70d
S_{20}	129a	96.1c	23.93c	2.60c	23.17bc	7.16c	0.82c
S_{40}	109b	111.9b	28.30b	2.96b	24.08ab	7.79b	0.91b
S_{60}	108c	129.0a	30.84a	3.13a	25.08a	8.17a	0.98a
LSD(0.01)	0.49	3.59	1.99	0.03	1.31	0.12	0.03
SE(±)	0.24	1.75	0.99	0.02	0.66	0.06	0.01
CV(%)	0.78	5.81	13.33	1.82	9.63	2.76	4.89

In a column, figure with common letter(s) do not differ significantly

The trend of seed yield per hectare due to application of different rates of sulphur was very much similar to the patterns responded by the yield components. The rate of 60 kg sulphur per hectare produced the highest seed yield (0.98 t ha^{-1}) and the lowest seed yield (0.70 t ha^{-1}) was found when applied no sulphur. Seed yield decreased with the decreasing rates of sulphur fertilizer. Khandker and Negum (1991) obtained nearly similar result in that they received 60 kg sulphur per hectare producing the highest yield.

Effect of zinc

Effect of zinc on the yield and yield components of mustard have been presented in Table 2. From the Table, it would be seen that the application of zinc fertilizer significantly increased plant height. The highest plant height (111 cm) was recorded when zinc was applied at the rate of 5kg Zn ha^{-1}. The rates of 2.5 and 7.5kg Zn ha^{-1} gave significantly shorter plants over control and the effects of these two rates on plant height were identical. The control treatment gave the following plant height (110 cm). It is observed that application of zinc fertilizer at the rate of 5 kg Zn ha^{-1} produced the highest number of pods per plant and the lowest number of pods per plant was produced by the control treatment. The yield increase was not significant. The rates of 2.5 kg and 7.5 kg zinc per hectare produced higher number of pods over control. Haque and Rahman (1980) stated that zinc did not affect significantly the number of pods per plant.

Table 2 shows that zinc fertilizer had insignificant effect on seed number per pod. Zinc at the rate of 2.5 kg Zn ha^{-1} gave the highest number of seeds per pod over 5 and 7.5 kg Zn ha^{-1} and the lowest number of seeds per pod were given by the control one. The rate of Zinc fertilizer significantly influenced 1000-seed weight. Zinc at the rate of 7.5kg Zn ha^{-1} produced the highest 1000-seed weight and the control treatment produced the lowest one. Increasing rates of zinc fertilizer increased 1000-seed weight gradually. Zinc fertilizer had no significant effect on harvest index. The harvest index ranged from 23.25 to 23.75, with the application of zinc fertilizers. However, Rathore *et al.* (1989) noted that zinc application increased the harvest index. The treatments of zinc fertilizer had some trend in improvement of branches per plant, but differences were not statistically significant. Zinc fertilizer at the rate of 2.5 and 5 kg Zn ha^{-1} produced more branches per plant compared to the control. The tendency of seed yield per hectare showed similar effect like plant height and 1000 seed weight and that the effect was statistically significant. Zinc at the rate of 7.5 kg Zn ha^{-1} gave the highest seed yield (0.94 t ha^{-1}) and seed yield decreased with the decreasing application of zinc fertilizer. Seed yield obtained 0.79 t ha^{-1}, when no zinc was applied in the plot. Zinc at the rate of 2.5 and 5 kg Zn ha^{-1} produced better yields than in the control one. Metal *et al.* (1975) supported this result and reported that $ZnSO_4$ at the rate of 7 kg per hectare increased grain yield of rice.

Varietal performances

Performances of the tested varieties for yield and yield parameters have been presented in Table 3. The varieties 'Sampad' and 'Sonali Sarisha (SS-75)' had statistically significant effect on plant height, pods per plant, 1000-seed weight and branches per plant.

Table 2. Effect of zinc on the yield and yield contributing characters of mustard

Doses of zinc (kg ha^{-1})	Plant height (cm)	Pod no./ plant	Seeds/ pod	1000 seed weight (g)	Harvest index (%)	Branch/ plant	Seed yield (t ha^{-1})
Zn_0	110b	103	24.92	2.62d	23.25	7.38	0.79d
$Zn_{2.5}$	108c	103	26.60	2.69c	23.66	7.45	0.83c
Zn_5	111a	106	26.45	2.86b	23.75	7.45	0.88b
$Zn_{7.5}$	104d	105	25.63	2.92a	23.75	7.44	0.90a
LSD (0.01)	0.49	NS	NS	0.03	NS	NS	0.03
SE(±)	0.24	1.75	0.99	0.02	0.66	0.06	0.01
CV(%)	0.78	5.81	13.33	1.82	9.63	2.76	4.89

In a column, figure with common letter(s) do not differ significantly, NS= Not significant

Table 3. Yield and yield contributing characters of mustard varieties

Varieties	Plant hieght (cm)	Pod no./ plant	Seeds/ pod	1000 seed weight (g)	Harvest index (%)	Branch/ plant	Seed yield (t ha^{-1})
Sampad (V_1)	100b	115.47a	26.21a	2.67b	23.90a	7.68a	0.86
Sonali Sarisha (SS-75)(V_2)	116a	92.82b	25.59a	2.87a	23.31a	7.19b	0.85
LSD(0.01)	0.34	2.47	NS	0.02	NS	0.8	NS
SE(±)	0.2	1.24	0.70	0.02	0.46	0.04	0.02
CV (%)	0.8	5.81	13.33	1.82	9.63	2.76	4.89

In a column, figure with common letter(s) do not differ significantly, NS= Not significant

The variety Sonali Sarisha (SS-75) showed significantly higher plant height (116 cm) compared to Sampad (100 cm) but Sonali Sarisha produced significantly less number of pods per plant compared to the variety Sampad. Sampad yielded higher amount of seeds per pod than Sonali Sarisha (SS-75), but the increased of seeds per pod was not significant. The variety Sampad also produced significantly lower 1000-seed weight but higher number of branches per plant than the variety Sonali Sarisha (SS-75). On the other hand, the harvest index and seed yield (t ha^{-1}) were found higher in the variety Sampad, but the differences were not significant. Sawarker *et al.* (1987) noted that *Brassica juncea* cv. varuna produced better seed yield (1.82 t ha^{-1}) than cv. Rw 351 (1.77 t ha^{-1}).

Conclusion

Sulphur fertilizer had significant effect on yield and all the yield components of mustard. Sulphur at the rate of 60kg S ha^{-1} produced the highest seed 0.98 t ha^{-1}. Zinc at the rate of 7.5 kg ha^{-1} produced the highest seed yield and seed yield decreased with the decreasing rates of zinc fertilizer.

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