The Pharma Innovation Journal 2021; 10(11): 726-729

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 726-729

www.thepharmajournal.com
Received: 17-08-2021
Accepted: 22-09-2021

Behara Tarun Kumar
M.Sc. Scholar, Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Vikram Singh
Associate Professor, Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Shruti Grace George
Ph.D. Scholar, Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Behara Tarun Kumar
M.Sc. Scholar, Department of Agronomy, NAI, SHUATS, Prayagraj, Uttar Pradesh, India

"Efficiency of zinc and sulphur on growth and yield attributes of yellow mustard (*Sinapis alba*)"

Behara Tarun Kumar, Vikram Singh and Shruti Grace George

Abstract
The field experiment was conducted during *rabi* 2020 at Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). To study the "Efficiency of zinc and sulphur on growth and yield attributes of Yellow Mustard (*Sinapis alba*)". There were 9 treatments each replicated thrice. The treatment consists of 3 levels of zinc *viz.* Z_1 (5 kg ha^{-1}), Z_2 (7.5 kg ha^{-1}), Z_3 (10 kg ha^{-1}) and 3 levels of Sulphur *viz.* S_1 (20 kg ha^{-1}), S_2 (25 kg ha^{-1}) and S_3 (30 kg ha^{-1}) as basal application, whose effect was observed on mustard. The experiment was laid out in Randomized Block Design. The results revealed that growth parameters *viz.* plant height (136.02cm) and dry weight (34.37 g/plant) at 100 DAS were recorded superior with the application of Zinc 10 kg/ha + Sulphur 30 kg/ha. Whereas, crop growth rate (29.66 g/m^2/day) at 80-100 DAS were recorded superior with the application of Zinc 10 kg/ha + Sulphur 25 kg/ha. As well as significantly maximum Yield parameters *viz.* number of silique/plant (113), length of silique (5.8cm), number of seeds//silique (32.5), stover yield (5.27 t/ha) and seed yield (1.97 t/ha) were recorded superior with the application of Zinc 10 kg/ha + Sulphur 30 kg/ha.

Keywords: Yellow Mustard, Zinc, Sulphur, Soil application

Introduction
Oilseeds are the major contributors in the agricultural and industrial sector of India and hold its position only next to cereals in terms of area, production and value. Among the rapeseed and mustard group, yellow sarson which belongs to family Brassicaceae is an important crop in terms of its high seed oil and protein content. Over the years, yellow sarson has gained tremendous importance in these areas owing to its high yield potential, seed yield, oil content, protein content and its short period of maturity.

Zinc is an essential micronutrient for plant growth and is absorbed by the plant roots in the form of Zn^{2+}. It is involved in diverse metabolic activities, influences the activities of hydrogenase and carbonic anhydrase, synthesis of cytochrome and the stabilization of ribosomal fractions and auxin metabolism. Principle function of zinc in plants is as a metal activator of enzymes. Zinc entered into the constituents of enzyme system that regulate initial metabolic reactions in the plants body Zinc catalyses the process of oxidation in plant cells and is vital for the transformation of carbohydrates. It regulates the consumption of sugars and increases the source of energy for the seed maturation and production. Production of chlorophyll. Zinc also aids in the formation of auxin and synthesis of protein. Zinc plays vital role in carbohydrate and proteins metabolism as well as it controls the plant growth hormone IAA. It is essential component of dehydrogenase, proteinase and promotes starch formation, seed maturation and production

Due to the intensification of agriculture coupled with the use of high analysis fertilizers widespread deficiency of various secondary or micronutrients has occurred. The deficiencies of sulphur, zinc and boron are common in so many areas. The rapeseed and mustard crop respond greatly to the application of sulphur, moreover, the sulphur requirement is the highest in oilseed crops in comparison with other crops, which is related to the role of this nutrient in oil biosynthesis Ahmad *et al*. (2007) [1]. Most of the oilseeds suffer from sulphur deficiency which results in low yield. Sulphur ranks thirteenth in terms of abundance in the earth's crust and is the fourth most important nutrient after nitrogen, phosphorus and potassium for Indian agriculture. Sulphur is the nutrient which plays a multitudinous role in providing nutrition to oilseed crops, particularly those belonging to cruciferae family. The importance of sulphur is obvious in oilseed production as it is required for the synthesis of sulphur containing amino acids methionine (21%), cysteine (26%) and cysteine (27%), which are essential components of protein and oil as well as for vegetative growth of the plant, it is involved in the formation of chlorophyll. glucoside and glucosinolates (mustard oils), activation of enzymes and sulfhydryl (-SH) linkages that are the source of pungency in oils and increases the root growth and stimulate seed formation.

Materials and Methods

The experiment was conducted during *Rabi* season 2020, at the Crop Research farm, Department of Agronomy, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (7.3), available N (230 kg/ha), available P (32.10 kg/ha), available K (346 kg/ha). The treatment consists of levels of zinc and sulphur. There were 9 treatments each replicated thrice. The experiment was laid out in Randomised Block Design. The crop was sown on 27 November 2020 at a spacing of 30cm*10 cm. The recommended dose of 80 kg N, 40 kg P, 40 kg K per ha was applied according to treatment details through urea, DAP, MOP along with micro nutrients like zinc and sulphur. The half dose of nitrogen and full dose of phosphorous, potassium along with zinc and sulphur were applied as basal. The split dose of nitrogen applied at 50 days after sowing. Five random plants were selected from each plot to record observations on plant growth attributes. Similarly, five random plant samples were collected from each plot at the time of harvest for recording observations on plant growth and yield attributes. Experimental data collected was subjected to statistical analysis by adopting Fishers method of Analysis of Variance (ANOVA) as outlined by Gomez and Gomez (2010). Critical Difference (CD) value were calculated whenever the 'F' test was found significant at 5% level.

Results and Discussion

The growth parameters like plant height, dry weight and crop growth rate was significantly affected by application of zinc and sulphur at different stages.

The analysed data presented in (Table No.1) revealed that yellow mustard crop fertilized with Zinc 10 kg/ha + Sulphur 30 kg/ha significantly resulted maximum plant height (136.02cm). However, Zinc 10 kg/ha + Sulphur 25 kg/ha (132cm) and Zinc 10 kg/ha + Sulphur 20 kg/ha (131.18cm) at 100 days after sowings are statistically at par with Zinc 10 kg/ha + Sulphur 30 kg/ha. The application of sulphur enhance the nutritional environment for plant growth at active vegetative stages as a result of improvement in root growth, cell multiplication, elongation and cell expression in the plant body. The increase in plant height due to adequate availability of zinc might be attributed to profuse root system which increases the plant growth by the enhancement in cell division because it influenced the formation of several growth hormones like indole acetic acid (IAA) in plants Kumar and Yadav (2007) [5].

The analysed data presented in (Table No.1) shown significant variation among all other treatments. At 100 DAS significantly maximum plant dry weight (34.37g) were recorded in Zinc 10 kg/ha + Sulphur 30 kg/ha. However, Zinc 10 kg/ha + Sulphur 25 kg/ha (32.76g), Zinc 10 kg/ha + Sulphur 20 kg/ha (31.83g) and Zinc 7.5 kg/ha + Sulphur 25 kg/ha (30.30g) were statistically at par with the application of Zinc 10 kg/ha + Sulphur 30 kg/ha. Sulphur application increases the dry matter production might be because of higher rate in protein synthesis and enhanced photosynthetic activity of the plant with increased chlorophyll synthesis due to fertilization with sulphur. The results were in conformity with those of Singh *et al*. (2015).

The analysed data presented in (Table No.1) shown significant variation among all other treatments. At 80 to 100 DAS significantly maximum Crop growth rate (g/m^2/day) (29.66 g/m^2/day) were recorded in Zinc 10 kg/ha + Sulphur 25 kg/ha. However, Zinc 10 kg/ha + Sulphur 30 kg/ha (27.47 g/m^2/day), Zinc 7.5 kg/ha + Sulphur 25 kg/ha (27.93 g/m^2/day), Zinc 7.5 kg/ha + Sulphur 30 kg/ha (25.30 g/m^2/day), and Zinc 10 kg/ha + Sulphur 20 kg/ha (28.09 g/m^2/day) were statistically at par with Zinc 10 kg/ha + Sulphur 25 kg/ha. Chakraborty and Das (2000) [2] the sulphur and zinc application made higher nutrients available to plants resulted in to more shoot biomass accumulation and crop growth rate which might have resulted higher photosynthetic activity at higher fertility levels. These results are also in close conformity with the results of Chakraborty and Das (2000) [2].

The Yield and Yield parameters like number of silique per plant, length of silique, number of seeds per silique, Stover yield and grain yield were significantly affected by application of zinc and sulphur at harvest.

The analysed data presented in (Table No.2) represents that significantly superior Number of silique per Plant (113) was recorded in Zinc 10 kg/ha + Sulphur 30 kg/ha. However, Zinc 10 kg/ha + Sulphur 25 kg/ha (109.5) was statistically at par with Zinc 10 kg/ha + Sulphur 30 kg/ha. Nadian *et al*. (2010) [6] Sulphur enhance the primary and secondary branches which are silique bearing organs as flowers are borne at the terminals of the branches. Therefore with increased number of branches, there was increase in the number of silique per plant. Yadav *et al*. (2007) [12] Zinc have the role in photosynthesis and nitrogen metabolism and it helps in regulating the auxin concentration in plant. It promotes flower setting and help in proper development of fruits. It also helps in carbohydrates transformation and sulphur metabolism.

The analysed data presented in (Table No.2) Significantly maximum Length of silique (5.8 cm) were recorded in Zinc 10 kg/ha + Sulphur 30 kg/ha over all rest of the treatments respectively. Adequate supply of nutrients facilitated better growth and development of crop plant, enhanced nutrient uptake which resulted significant increase in length of silique. Similar results have also been reported by Sharma (2008) [8].

The analysed data presented in (Table No.2) Significantly maximum Number of seeds per silique (32.5) were recorded in Zinc 10 kg/ha + Sulphur 30 kg/ha. However, Zinc 10 kg/ha + Sulphur 25 kg/ha (30.5) was statistically at par with Zinc 10 kg/ha + Sulphur 30 kg/ha. Verma *et al*. (2012) [11] the increase in yield attributes might be due to that application of Sulphur where they improved over all nutritional environments of the rhizosphere as well as in the plant system, which in turn enhanced the plant metabolism and photosynthetic activity. This resulted in to better growth and development of plants and ultimately reflected in better yield traits. These results are also in close conformity with the results of Kumar and Yadav, (2007) [5].

The analysed data presented in (Table 2) Stover yield (5.27 t/ha) data showing that significant variation among all the treatments. The highest Stover yield was recorded significantly in Zinc 10 kg/ha + Sulphur 30 kg/ha. However, Zinc 7.5 kg/ha + Sulphur 30 kg/ha (4.83 t/ha), Zinc 10 kg/ha + Sulphur 20 kg/ha (4.83 t/ha) and Zinc 10 kg/ha + Sulphur 25 kg/ha (5.10 t/ha) were statistically at par with Zinc 10 kg/ha + Sulphur 30 kg/ha. Singh *et al*. (2010) [10] Sulphur is being an essential constituent of several biological active

compounds like amino acids (Cystine, cysteine and methionine), vitamins (Thiamine and Biotin) lipoic acid, acetyl Co-A, Ferrodoxin and glutathione-S play multiple roles in the plant metabolism. Zinc engages in activation of a number of enzymes participating in dark reaction of photosynthesis via improvement in chlorophyll content of leaves. Hussain *et al*. (2008) [4]. These results are also in close conformity with the results of Singh and Mukherjee (2004) [9].
The analysed data presented in (Table 2) represented the highest seed yield (1.97 t/ha) was recorded significantly superior in Zinc 10 kg/ha + Sulphur 30 kg/ha. However, Zinc 7.5 kg/ha + Sulphur 20 kg/ha (1.67 t/ha), Zinc 7.5 kg/ha + Sulphur 30 kg/ha (1.67 t/ha), Zinc 10 kg/ha + Sulphur 20 kg/ha (1.87 t/ha) and Zinc 10 kg/ha + Sulphur 25 kg/ha (1.93 t/ha) were statistically at par with Zinc 10 kg/ha + Sulphur 30 kg/ha. Sharma *et al*. (2009) [7] Sulphur and boron application might be attributed to sum total effect of increased growth and yield attributing characters. Due to increased supply of sulphur and boron results in better translocation of photosynthates to seeds and thus increased to value of harvest index. Chandra *et al*. (2009) [3] zinc results in better translocation of photosynthesis from source to sink results in enhanced yield parameters and yield. These results are also in close conformity with the results of Chakraborty and Das (2000) [2].

Table 1: Effect of zinc and sulphur on growth attributes of Yellow mustard

S. No.	Treatments	Plant Height (cm) (100 DAS)	Dry weight/plant (g) (100 DAS)	Crop growth rate (g/m^2/day) (80-100 DAS)
1.	Zinc 5 kg/ha + Sulphur 20 kg/ha	125.14	21.60	18.61
2.	Zinc 5 kg/ha + Sulphur 25 kg/ha	127.73	25.60	21.48
3.	Zinc 5 kg/ha + Sulphur 30 kg/ha	130.13	25.87	21.82
4.	Zinc 7.5 kg/ha + Sulphur 20 kg/ha	129.15	27.00	23.6
5.	Zinc 7.5 kg/ha + Sulphur 25 kg/ha	128.18	30.30	27.93
6.	Zinc 7.5 kg/ha + Sulphur 30 kg/ha	130.52	29.57	25.30
7.	Zinc 10 kg/ha + Sulphur 20 kg/ha	131.18	31.83	28.06
8.	Zinc 10 kg/ha + Sulphur 25 kg/ha	132	32.76	29.66
9.	Zinc 10 kg/ha + Sulphur 30 kg/ha	136.02	34.37	27.47
	F-test	S	S	S
	SEm±	1.7	1.55	1.66
	CD (0.05)	5.20	4.64	4.98

Table 2: Effect of zinc and sulphur on Yield and Yield attributes of Yellow mustard

S. No.	Treatments	Number of Silique/plant	Length of silique (cm)	Number of seeds /silique	Stover yield (t/ha)	Seed yield (t/ha)
1.	Zinc 5 kg/ha + Sulphur 20 kg/ha	79	4.5	23.5	4.03	1.47
2.	Zinc 5 kg/ha + Sulphur 25 kg/ha	85.5	4.6	23.0	4.18	1.50
3.	Zinc 5 kg/ha + Sulphur 30 kg/ha	88.5	4.8	25.3	4.26	1.54
4.	Zinc 7.5 kg/ha + Sulphur 20 kg/ha	90	4.9	25.5	4.05	1.67
5.	Zinc 7.5 kg/ha + Sulphur 25 kg/ha	97	4.9	25.2	4.65	1.57
6.	Zinc 7.5 kg/ha + Sulphur 30 kg/ha	96	4.8	24.9	4.83	1.67
7.	Zinc 10 kg/ha + Sulphur 20 kg/ha	103.5	5.3	28.5	4.83	1.87
8.	Zinc 10 kg/ha + Sulphur 25 kg/ha	109.5	5.3	30.5	5.10	1.93
9.	Zinc 10 kg/ha + Sulphur 30 kg/ha	113	5.8	32.5	5.27	1.97
	F-test	S	S	S	S	S
	SEm±	1.6	0.126	1.30	0.123	0.11
	CD (0.05)	4.82	0.37	3.89	0.370	0.34

Conclusion
Based on the findings of experimentation in one season in a year, it is concluded that application of Zinc 10 kg/ha as well as Sulphur 30 kg/ha was found more helpful for attaining better yields in mustard under Eastern U.P. climatic condition.

Acknowledgement
I express gratitude to my advisor Dr. Vikram Singh for constant support and guidance. I am indebted to Prof. (Dr.) Joy Dawson and all the faculty members of SHUATS for inspiration.

References
1. Ahmad AI, Khan NA, Anjum YP, Abrol, Iqbal M. Role of sulphate transporter systems in Sulphur efficiency of mustard genotypes. Journal of Plant Science 2005;169(5):842-846.
2. Chakraborty AK, Das DK. Interaction between Boron and Sulphur on different quality parameters of rape (*Brassica campastris*). Journal of Research on Crops 2000;1:326-329.
3. Chandra D, Khandelwal RB. Effect of zinc and phosphorus on yield, nutrient uptake and oil content of mustard grown on the gypsum treated sodic soil. Journal of Indian Society of Soil Science 2009;57(1):194-197.
4. Hussain MJ, Sarker MMR, Sarker MH, Ali M, Salim MMR. Effect of different levels of boron on the yield and yield attributes of mustard in surma-kushiara flood plain soil (AEZ 20). Journal of Soil and Nature 2008;2:6-9.
5. Kumar H, Yadav DS. Effect of phosphorus and sulphur levels on growth, yield and quality of Indian mustard cultivars. Indian Journal of Agronomy 2007;52:154-157.
6. Nadian H, Alami SK, Gharineh MH, Siadat A, Najarzadegan R. Effect of boron and sulphur application on yield and yield components of (*Brassica napus* L.) in calcarious soil. World Applied Science Journal 2010;10:1242-1246.
7. Sharma A, Sharma P, Brar MS, Dhillon NS. Comparative

response to Sulphur application in raya (*Brassica juncea*) and Wheat (*Triticum aestivum*) grown on light textured alluvial soils. Journal of the Indian Society of Soil Science 2009;57(1):62-65.

8. Sharma YK. Effect of phosphorus and sulphur on yield and uptake of nutrient by mustard. Annuals of Plant Soil Research 2008;10(2):195-196.
9. Singh RK, Mukharjee D. Effect of Sulphur fertilization in sustaining mustard productivity in nice mustard cropping system. Haryana Journal of Agronomy 2004;20(1/2):7-9.
10. Singh Y, Singh T, Singh UN, Rajput PK. Effect of nutrient management on yield, quality and economics of irrigated Indian mustard (*Brassica juncea*). Indian Journal of Agricultural Sciences 2010;80:691-694.
11. Verma CK, Prasad K, Yadav DD. Studies on response of sulphur, zinc and boron levels on yield, economics and nutrients uptake of mustard [*Brassica juncea* (L.) Czern and Coss.]. Crop Research 2012;44:75-78.
12. Yadav RB, Singh RV, Singh HR, Yadav HS. Effect of different levels of zinc and sulphur on Indian mustard (*Brassica junceae* L). Journal of Crop Research 2007;33(1):74-76.