The Pharma Innovation Journal 2021; 10(11): 450-453

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(11): 450-453

www.thepharmajournal.com
Received: 07-08-2021
Accepted: 14-09-2021

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Study on nitrogen and sulphur on growth and yield of yellow mustard (*Synapis alba*)

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Abstract

The field experiment was conducted during *rabi* 2020 at Central Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P.). To study the “Study on Nitrogen and Sulphur on Growth and Yield of Yellow Mustard (*Synapis alba*)”. There were 9 treatments each replicated thrice. The treatment consists of 3 levels of nitrogen *viz.* N_1 (60 kg ha^{-1}), N_2 (70 kg ha^{-1}), N_3 (80 kg ha^{-1}) and 3 levels of Sulphur *viz.* S_1 (20 kg ha^{-1}), S_2 (30 kg ha^{-1}) and S_3 (40 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 (147.37cm) at 100 DAS, dry weight (32.89 g/plant) and crop growth rate (7.82 g/m^2/day) at 80-100 DAS were recorded superior with the application of Nitrogen 80 kg/ha + Sulphur 30 kg/ha. As well as significantly maximum Yield parameters *viz.* number of silique/plant (143.07), length of silique (7.08 cm), number of seeds//silique (36.20), test weight (3.00 g), stover yield (4.02 t/ha) and seed yield (1.78 t/ha) were recorded superior with the application of Nitrogen 80 kg/ha + Sulphur 30 kg/ha.

Keywords: Yellow mustard, nitrogen, 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.

Nitrogen, and sulphur play important role in increasing the yield and quality of mustard. Nitrogen is known to activate most of metabolic activities and transformation of energy. Nitrogen is considered a major element required for high yield of most of the crop. Nitrogen is the key element in mustard production. It is structural components of protein molecules, amino acids, chlorophyll and other constituents. Its adequate supply promoted higher photosynthetic activity and vigorous vegetative growth. A higher nitrogen supply favors the conversion of carbohydrate into protein.

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) [2]. 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 crucifereae 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, glucosides 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 Nitrogen 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 and sulphur. The half dose of nitrogen and full dose of phosphorous, potassium 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 nitrogen and sulphur at different stages.

(Table No.1) revealed that yellow mustard crop fertilized with Nitrogen 80 kg/ha + Sulphur 30 kg/ha significantly resulted maximum plant height (147.37cm). However, Nitrogen 60 kg/ha + Sulphur 20 kg/ha (144.46cm), Nitrogen 60 kg/ha + Sulphur 30 kg/ha (433.71 cm), Nitrogen 80 kg/ha + Sulphur 40 kg/ha (135.38), Nitrogen 70 kg/ha + Sulphur 40 kg/ha (136.47 cm) and Nitrogen 80 kg/ha + Sulphur 20 kg/ha (134.93 cm) at 100 days after sowings are statistically at par with Nitrogen 80 kg/ha + Sulphur 30 kg/ha. Nitrogen is the chief constituent of the lipids and nucleo-proteins, an abundance in the meristematic region might have helped in cell division and multiplication and also concerned with physiological growth Singh *et al.* (2003) [14]. The application of sulphur enhance root growth, cell multiplication, elongation and cell expression in the plant body Kumar and Yadav (2007).

The analysed data presented in (Table No.1) shown significant variation among all other treatments. At 100 DAS significantly maximum plant dry weight (32.89g) were recorded in Nitrogen 80 kg/ha + Sulphur 30 kg/ha. However, Nitrogen 70 kg/ha + Sulphur 30 kg/ha (27.79 g), Nitrogen 80 kg/ha + Sulphur 20 kg/ha (30.44 g) and Nitrogen 80 kg/ha + Sulphur 40 kg/ha (32.11 g) were statistically at par with the application of Nitrogen 80 kg/ha + Sulphur 30 kg/ha. Increase in the production of dry matter is the outcome of growth, the photosynthetic activity of the plants and their capacity to utilise available nutrients along with moisture, and it is dependent between photosynthesis and respiration balance. Nitrogen improves better chlorophyll synthesis which increase the effective area of photosynthesis and resulting in higher dry matter Singh *et al.* (2014) [13]. 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 Meheriya and Khangarot (2000) [7]. The results were in conformity with those of Singh and Kumar. (2014) [13].

The analysed data presented in (Table No.1) shown significant variation among all other treatments with respect to crop growth rate. At 80 to 100 DAS significantly maximum Crop growth rate (g/m^2/day) (7.82 g/m^2/day) were recorded in Nitrogen 80 kg/ha + Sulphur 30 kg/ha. However, Nitrogen 70 kg/ha + Sulphur 40 kg/ha (6.09 g/m^2/day), Nitrogen 70 kg/ha + Sulphur 20 kg/ha (6.32 g/m^2/day), Nitrogen 70 kg/ha + Sulphur 30 kg/ha (6.52 g/m^2/day), Nitrogen 80 kg/ha + Sulphur 20 kg/ha (6.93 g/m^2/day) and Nitrogen 80 kg/ha + Sulphur 40 kg/ha (7.39 g/m^2/day) were statistically at par with Nitrogen 80 kg/ha + Sulphur 30 kg/ha. Nitrogen 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 Ghanbahadur *et al.* (2006) [3]. These results were also been reported by Kumar and Kumar, 2008 [5].

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 nitrogen and sulphur at harvest.

(Table No.2) represents that significantly superior Number of silique per Plant (143.07) was recorded in Nitrogen 80 kg/ha + Sulphur 30 kg/ha over all rest of the treatments respectively. However, Nitrogen 80 kg/ha + Sulphur 40 kg/ha (124.93) was statistically at par with Nitrogen 80 kg/ha + Sulphur 30 kg/ha. Nitrogen application appeared quite logical and well known that nitrogen being the constituent of amino acids, proteins, chlorophyll and protoplast would directly influence the growth and yield attributing characteristics Mukesh (2017) [8]. Sulphur enhanced primary and secondary branches which are siliqua 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 siliqua per plant. Similar finding was also reported by Rao *et al.* (2013) [9], Singh and Kumar, (2014) [13].

(Table No.2) Significantly maximum Length of silique (7.08 cm) were recorded in Nitrogen 80 kg/ha + Sulphur 30 kg/ha over all rest of the treatments respectively. However, Nitrogen 80 kg/ha + Sulphur 40 kg/ha (6.83 cm) was statistically at par with Nitrogen 80 kg/ha + Sulphur 30 kg/ha. Adequate supply of nitrogen 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) [11].

(Table No.2) Significantly maximum Number of seeds per silique (36.20) were recorded in Nitrogen 80 kg/ha + Sulphur 30 kg/ha over all rest of the treatments respectively. Achin *et al.* (2016) [1] Nitrogen is being the constituent of protein and protoplasm would naturally increase seed yield of Brassica principally through formation of greater potential sites for pod formation as a result of enhanced growth, branching and also decreased abscission rate of flowers. The increase in yield attributes might be due to that application of S 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. Similar results were also reported Reager *et al.* (2006) [10].

(Table 2) Stover yield (4.02 t/ha) data showing that significant variation among all the treatments. The highest Stover yield was recorded significantly in Nitrogen 80 kg/ha + Sulphur 30 kg/ha. However, Nitrogen 70 kg/ha + Sulphur 40 kg/ha (3.02 t/ha), Nitrogen 70 kg/ha + Sulphur 30 kg/ha (3.30 t/ha), Nitrogen 80 kg/ha + Sulphur 20 kg/ha (3.52 t/ha) and Nitrogen 80 kg/ha + Sulphur 40 kg/ha (3.88 t/ha) was statistically at par with Nitrogen 80 kg/ha + Sulphur 30 kg/ha. Nitrogen being the constituent of amino acids, proteins and protoplast, directly influences plant growth and development through better utilization of photosynthates up to a certain level depending on the genetic potential of the crop and soil Nitrogen availability Kaur and Sidhu (2004) [4].

(Table 2) represented the highest seed yield (1.78 t/ha) was recorded significantly superior in Nitrogen 80 kg/ha + Sulphur 30 kg/ha. However, Nitrogen 70 kg/ha + Sulphur 40 kg/ha (1.38 t/ha), Nitrogen 70 kg/ha + Sulphur 30 kg/ha (1.39 t/ha), Nitrogen 80 kg/ha + Sulphur 20 kg/ha (1.50 t/ha) and Nitrogen 80 kg/ha + Sulphur 40 kg/ha (1.66 t/ha) over rest all other treatments. The increase in yield of mustard due to nitrogen application may be because of the fact that nitrogen played an important role in synthesis of chlorophyll and amino acids, which constitute building of protein blocks. Nitrogen influenced the seed yield through a source-sink relationship and in addition to higher production of photosynthates it leads to increased translocation to reproductive parts. Nitrogen being a most important plant nutrient needed for growth and development of plant and is known to increase the yield of Brassica species Singh *et al.* (2002) [12]. Sulphur application might be attributed to sum total effect of increased growth and yield attributing characters due to sulphur application. Due to increased supply of sulphur and better translocation of photosynthates to seeds and thus increased to value of harvest index. Similar finding was also reported by Rao *et al.* (2013) [9].

Table 1: Effect of Nitrogen 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.	Nitrogen 60 kg/ha + Sulphur20 kg/ha	144.46	20.89	4.95
2.	Nitrogen 60 kg/ha + Sulphur 30 kg/ha	133.71	22.78	5.27
3.	Nitrogen 60 kg/ha + Sulphur 40 kg/ha	125.27	21.11	4.62
4.	Nitrogen 70 kg/ha + Sulphur 20 kg/ha	117.36	25.11	6.32
5.	Nitrogen 70 kg/ha + Sulphur 30 kg/ha	127.94	27.78	6.52
6.	Nitrogen 70 kg/ha + Sulphur 40 kg/ha	136.47	26.78	6.09
7.	Nitrogen 80 kg/ha + Sulphur 20 kg/ha	134.93	30.44	6.93
8.	Nitrogen 80 kg/ha + Sulphur 30 kg/ha	147.37	32.89	7.82
9.	Nitrogen 80 kg/ha + Sulphur 40 kg/ha	135.38	32.11	7.39
	F-test	S	S	S
	SEm±	4.58	1.828	0.641
	CD (0.05)	13.75	5.480	1.922

Table 2: Effect of Nitrogen 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.	Nitrogen 60 kg/ha + Sulphur20 kg/ha	94.53	6.31	26.60	2.59	1.11
2.	Nitrogen 60 kg/ha + Sulphur 30 kg/ha	99.40	6.37	26.87	2.95	1.18
3.	Nitrogen 60 kg/ha + Sulphur 40 kg/ha	96.13	6.35	26.80	2.87	1.12
4.	Nitrogen 70 kg/ha + Sulphur 20 kg/ha	100.00	6.51	27.27	2.95	1.22
5.	Nitrogen 70 kg/ha + Sulphur 30 kg/ha	104.20	6.56	28.07	3.30	1.39
6.	Nitrogen 70 kg/ha + Sulphur 40 kg/ha	104.00	6.53	27.53	3.02	1.38
7.	Nitrogen 80 kg/ha + Sulphur 20 kg/ha	117.60	6.57	28.47	3.52	1.50
8.	Nitrogen 80 kg/ha + Sulphur 30 kg/ha	143.07	7.08	36.20	4.02	1.78
9.	Nitrogen 80 kg/ha + Sulphur 40 kg/ha	124.93	6.83	29.20	3.88	1.66
	F-test	S	S	S	S	S
	SEm±	8.40	0.151	1.30	0.201	0.148
	CD (0.05)	25.19	0.45	3.91	0.60	0.44

Conclusion

Based on the findings of experimentation in one season in a year, it is concluded that application of Nitrogen 80 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.

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