Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(2): 2300-2303
Received: 05-01-2018
Accepted: 06-02-2018

Mahipat Singh Yadav
Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh, India

CS Dhanai
Deptt. Of Forestry, VCSG University, Ranichaury, Uttarakhand, India

Correspondence
Mahipat Singh Yadav
Institute of Agricultural Sciences, Bundelkhand University, Jhansi, Uttar Pradesh, India

Effect of fertilizers on yield and yield attributing characters of mustard (*Brassica Juncea* L. Czern & Coss)

Mahipat Singh Yadav and CS Dhanai

Abstract
An experiment was conducted during rabi season 2016-17 at the research farm of Institute of Agricultural Science, Bundel khand University, Jhansi (U. P.) to find out the effect of different doses of nitrogen and sulphur on seed yield and other characters on 'Varuna' variety of Indian mustard. Different doses, 40, 80 and 120 kg/ha nitrogen and 15, 30, and 45 kg / ha sulphur significantly out yielded the 0 kg/ha nitrogen and sulphur in seed and biological yield. Almost similar results were obtained in case of plant height, branching, siliquae/plant, siliquae length, number of seed/siliquae, harvest index, oil and protein content in seed. The application of 120 kg N/ha and 45 Kg S/ha was the best combination for getting higher seed yield with its better quality.

Keywords: mustard, nitrogen (N), sulphur (S), siliquae

Introduction
Indian mustard (*Brassica juncea* L.) which is locally called as rayi (Lahi), belongs to Cruciferae family and genus *Brassica* [2]. In India, Rapeseed mustard is the major rabi season oilseed crop. It plays a very significant role in agricultural economy of our country and a pensile part of the human diet. The rapeseed mustard occupies about 24.7 per cent of the total oilseeds area and contributes 22.9 per cent to the oilseeds production of the country. Indian mustard (*Brassica juncea* L. Czern & Coss) is most important species grown almost all over India for oil as compared to all other species of family *Brassiceae*. It is generally cultivated on marginal and light texture soils having limited moisture. Amongst the various agronomic factors known to augment crop production, the application of nitrogen and sulphur have an important role in getting high yield of seed and oil in mustard [7]. Keeping in view the above facts the present study was under taken to find out the effect of application of nitrogen and sulphur on seed yield, biological yield and other characters including oil content and its quality in a national variety 'Varuna' of Indian mustard in the agro-climatic conditions of Bundelkhand region of U. P.

Materials and Methods
The field experiment was conducted at the agricultural research farm of the Agricultural Institute of Bundelkhand University, Jhansi during rabi season 2016-17. The fertilizer treatments were comprised four levels of nitrogen viz. 0, 40, 80 and 120 kg/ha and four levels of sulphur viz. 0, 15, 30 and 45 kg / ha and the experimental design used was factorial randomized block with three replication. Urea was the source of nitrogen and the source of sulphur was gypsum while triple superphosphate was used as source of phosphorus. Observations were recorded on plant height, branching, number of siliquae per plant, length of siliquae (cm), number of seeds per siliquae, seed and biological yield (kg/ha), harvest index, oil and protein content. The data was subjected to statistical analysis as per method proposed by [1].

Result and Discussion
For the use of proper quantity of fertilizers is most essential for enhancing yield and quality in various crops. In case of mustard, the nitrogen and sulphur are most important inputs for increasing productivity of this crop. Therefore these two fertilizers were tried to find their role in mustard crop and the results of present study are discussed character wise.

Seed yield
It was observed that there was remarkable increase in seed yield with increase

in the doses of nitrogen and sulphur against control. Highest seed yield was Recorded with the application of 120 kg N and 45 Kg sulphur per hectare followed by application of 80 Kg and 40 kg N/ha and 30 kg and 15 kg sulphur/ha (Table-1). The increase in seed yield under all the three doses of the nitrogen was significantly higher as compared to 0 kg of N/ha. The results are in conformity with the finding [5]. However, application of sulphur showed marginal improvement in seed yield in mustard over control as the differences were non-significant. The highest seed yield of 1869 kg/ha was obtained with the application of 45 kg sulphur per hectare followed by use of 30 kg sulphur per hectare.

Biological yield

The result presented in talbe-1 showed that all the three levels of nitrogen viz. 40, 80 and 120 kg per hectare gave significantly higher biological yield over 0 kgN/ha. It was further clear from the data that 80 kg and 120 kg N/ha produced significantly higher biological yield over 40 kg N/ha. Nevertheless, the differences in the biological yield with the use of 80 kg and 120 kg N/ha were found to be insignificant. The application of sulphur at the rate of 15, 30 and 45 kg per hectare produced significantly higher biological yield as compared to 0 kg/ha sulphur in mustard. The differences in biological yield between 15, 30 and 45 kg sulphur per hectare were significantly higher with each other. But the application of 45 kg sulphur per hectare gave higher biological yield as compared to other two doses of sulphur. These results confirm the findings of (3).

Seed yield per plant (g)

As, for the seed yield per plant, the highest value of 23.8 was obtained at 120 kg N/ha level showing a significant increase with the increasing dose of nitrogenous fertilizer. The various yields attributes like higher seed weight per plant and higher 1000-seed weight showed their additive effect in influencing the seed yield with increasing rates of nitrogen fertilization. Ultimately all these yield attributes had their pronounced effect in significantly increasing the seed yield of mustard at higher rates of nitrogen application upto 120 kg N/ha. These results are in accordance with the early research workers working on rapeseed [8] who also reported increased yield with increased fertilization of nitrogen. Comparing the seed yield per plant under the sulphur rates, data presented in (Table 1) showed that the highest seed yield per plant 19.3g was obtained under 45kg S/ha level. Thus, the seed yield per plant increased significantly with a successive increase in levels of sulphur fertilization, similar to nitrogen. The reason being, seed yield of mustard is chiefly a product of yield attributing characters like seed-weight per plant etc. Consequently, the increase in other yield attributing characters due to sulphur fertilization resulted in increased seed yield per plant of mustard. These results confirm the findings of [2].

1000 Seed weight (g)

Concerning 1000-seed weight under the studied nitrogen and sulphur rates, data of (Table 1) revealed that as nitrogen and sulphur rates increased, 1000-seed weight increased. Application of nitrogen upto 40kg N/ha recorded significantly higher 1000-seed weight than that of 0 kg N/ha, although 1000-seed weight with the application of 40 and 80 kg N/ha remained at par with 120 kg N/ha, the highest (5.0g) being recorded at 120 kg N/ha level. Henceforth, improvement in the growth and yield attributes of Indian mustard due to nitrogen application was quite logical. The results are in conformity with the findings of [7]. As for the sulphur fertilization, the highest 1000-seed weight was recorded 5.1, with the application of 45 kg S/ha which was significantly higher than that of 0 and 15 kg S/ha (4.3 & 4.7 respectively), whereas the difference in 1000-seed weight with 30 and 45 kg S/ha was found to be non-significant. Higher number of primary and secondary branches produced with the increase in sulphur fertilization contributed more to the total seed weight per plant. Accordingly, increase in 1000 seed weight could be ascribed to the overall improvement in plant growth, vigour and production of sufficient photosynthates with sulphur fertilization.

Seed weight per plant (g)

Seed weight per plant of mustard under the four studied nitrogen and sulphur fertilization rates as shown in (Table 1) showed significant increase with the increase in rate of nitrogenous and sulphur fertilizers. The highest seed weight per plant 10.7g was recorded with 120 kg N/ha and lowest 8.4 g in case of 0 kg N/ha level. The increased percent contribution of seed weight per plant with the application of 40, 80 and 120 kg N/ha amounted to 34.00, 67.31 and 109.42 percent over no nitrogen, respectively [6]. While studying the effect of nitrogen in mustard found that that increased levels of nitrogen increased the seed weight per plant. Thus the results are in conformity with the above findings. Whereas crop fertilized with 45 kg S/ha was influenced significantly over control and produced highest seed weight per plant of 10.3g. However, seed weight per plant recorded with the application of 15 and 30 kg S/ha remained at par. This significant influence of different levels of nitrogen fertilization over the lower levels was observed because of prolonged formation of primary and secondary branches and seeds under higher rates of nitrogen. While in case of sulphur, the maximum seed weight per plant at higher levels of sulphur application can be possible, due the fact that sulphur fertilization enhanced the vegetative growth.

Harvest index

The data given in Talbe-1 revealed that all the three levels of nitrogen gave significantly higher harvest index as compared to zero level of nitrogen. The use of 120 kg N/ha gave significantly higher harvest index over other two doses i. e. 40 and 80 kg N/ha. The difference in the harvest index between 40 kg and 80 kg N ha was non-significant. The value of harvest index in zero kilogram of sulphur was at per with the harvest index values of all the other three levels of sulphur. However, application of 15 kg sulphur/ha gave significantly higher harvest index in comparison to application of 30 and 45 kg sulphur per hectare.

Oil and protein content

The oil and protein content are most important quality traits in mustard. It was interesting to note from the data given in Talbe-1 that both oil and protein content increased successively upto application of 120 kg N/ha. The differences in the mean values of both the quality traits with the use of various levels of nitrogen application were significantly higher in comparison to zero kilogram of nitrogen. The use of 80 and 120 kg N/ha and 45 kg/ha of sulphur gave significantly higher improvement in the oil content as compared to their all other doses. However, the differences in the oil content under 80 and 120 kg N/ha were non-significant. It was interesting to note from the data in Table-1

that the application of 80 and 120 Kg N/ha also improved the protein content by a significant margin as compared to other levels of nitrogen. However, the application of sulphur did not show significant improvement in protein content of mustard seed.

Table 1: Effect of nitrogen and sulphur on seed and biological yield, harvest index and some quality traits in mustard.

Treatment	Seed yield (Kg/ha)	Biological yield (kg/ha)	Seed yield per plant (g)	1000-seed weight (g)	Seed weight per plant (g)	Harvest index	Oil content (%)	Protein content (%)
Nitrogen level (kg/ha)								
0	1194	5887	11.4	4.0	8.4	20.7	37.5	16.6
40	1733	7781	15.2	4.9	8.9	22.0	39.4	19.6
80	1945	8767	19.0	4.9	10.5	21.9	39.9	21.1
120	2104	8967	23.8	5.0	10.7	23.4	41.4	22.5
S Em ±	35	15	0.4	0.2	0.1	0.6	0.8	0.5
CD at 5%	71	320	0.8	0.4	0.2	1.2	1.7	1.0
Sulphur level (kg/ha)								
0	1618	7206	15.4	4.3	9.7	22.3	36.5	19.5
15	1697	7347	17.0	4.7	9.6	23.4	38.5	19.9
30	1793	8163	17.6	4.9	9.9	21.6	40.2	20.2
45	1869	8724	19.3	5.1	10.3	21.3	43.0	20.2
S Em ±	35	156	0.4	0.2	0.1	0.6	0.8	0.5
CD at 5%	320	71	0.8	0.4	0.2	1.2	1.7	NS

Plant height

Fertilization of mustard plant with nitrogen and sulpur (Table-2) reveals an effect up to a greater extent with the increase in the rate of doses. After 60 days of sowing the plant height increased significantly upto 120 kg N/ha level, showing the maximum height of 91cm, whereas in case of sulphur application, the plant attained the maximum height of 87.8 cm at a sulphur level of 45 kg/ha, after 60 days of sowing. At the harvesting stage, the maximum plant height was recorded 194.1cm at 120 kg of nitrogen supply thus showing clear cut effect of increasing nitrogen level on plant growth. These findings are in consonance with the reports of [5]. While in case of sulphur, maximum plant height recorded with the application of 45 kg/ha was 183.39cm, which differed significantly from the plant height recorded at 0 & 15 kg/ha sulphur doses (177.9 & 178.0cm) respectively. Consequently, the main effect of nitrogen on plant height during the observation recorded after 60days of sowing & at harvesting stage were found significant while for sulphur application, plant height at harvest with 45 kg/ha was found significant & the plant height after 60 days of sowing was found non-significant. The increase in plant height may be attributed mainly due to the fact that sulphur application improved the nutritional environment & hence could result in more nutrient uptake. These findings are comparable with [3] who stated that plant height, number of branches increased significantly with the increasing levels of sulphur fertilizers.

Branching

It is revealed from (Table-2) that different nitrogen levels had highly significant effect on the number of branches per plant (primary, secondary and total). The highest number of primary branches was recorded 9.2 at 120 kg N/ha supply. With the application of different levels of nitrogen, similar trend of significant increase was observed for number of secondary branches per plant, their number varying from 7.9 to 18.9 with highest in case of 120 kg N/ha. Again the highest numbers of total branches (27.5) were recorded at 120 kg N/ha level which were significantly higher than that of lower levels of nitrogen as well as over control. This could be on account of vigorous vegetative growth due to greater cell division & more meristematic activity increasing supply of photospothates for the formation of branches. It is well known that nitrogen being the constituent of amino acids, proteins, chrolophyll & protoplast would directly influence the growth & attributing characteristic through better utilization of photosynthesis. These results are in agreement with those obtained by [4]. However in case of sulphur the highest number of primary branches was found 7.9 at 45 kg/ha level while lowest value of 6.3 in case of control. Different levels of sulphur fertilization also influenced the number of secondary branches per plant significantly with the highest value of 15.5 in case of application of 45 kg/ha as compared to lowest value of 13.1 obtained with control. Total number of branches per plant significantly increased with the increment of sulphur fertilization up to 45 kg/ha in comparison to lower levels of sulphur. These results are quite in line with the early research work done by [4] who has reported that the increasing level of sulphur increased plant height, number of primary branches, yield straw and leaf area index, relative growth rate and net assimilation rate at all the stages of crop growth.

Siliquae per plant

The results presented in Table-2 indicated that all the three levels of nitrogen i. e. 40, 80 and 120 kg/ha gave significantly higher number of siliquae per plant in comparison to 0 kg/ha nitrogen. The differences in the number of siliquae per plant with the doses of 40, 80 and 120 kg nitrogen/ha were also significant. The highest number of siliquae per plant was recorded in 120 kg N/ha followed by 80 and 40 Kg N per hectare. These findings are in consonance to result reported by [2]. In case of saulphur application, 45 kg/ha dose of sulphur produced highest number of siliquae followed by 30 kg and 15 kg of sulphur/per hectare. The differences in the number of siliquae per plant among all the doses of sulphur including control (0 kg S/ha) were significant. The successive increase in the number of siliquaes per plant under varied doses of nitrogen and sulphur may be due to availability of more nutrients for proper growth of plants at different stages of mustard crop. These findings are in full agreement to the results reported earlier by [8].

Siliquae length (cm)

It is revealed from the data given in talbe-2 that different levels of nitrogen had considerable effect on length of siliquae. The highest length of siliquae (5.1 cm) was recorded

in 120 N/ha which was significantly higher than the length of siliquae in other levels of nitrogen including 0 Kg N/hectare. This could be due to the availability of more nutrients for proper development of vegetative parts of plant including siliquae under higher dose of nitrogen. These results are in full agreement with those observed by [4]. However, in case of both 30 and 45 kg levels of sulphur, 4.8 cm length of siliquae was recorded which was significantly higher than the siliquae length observed in 0 and 15 kg doses of sulphur per hectare. These findings are in full agreement to those reported by [6] who observed that the increasing level of sulphur not only increased the siliquae length but also gave higher yield of straw, more leaf area index, high growth rate and higher net assimilation rate at all the stages of crop growth.

Number of seeds per siliquae

Number of seeds per siliquae recorded in mustard in four levels of nitrogen and sulphur application is given in Table-2 which revealed that there were significant differences in the mean values of seeds per siliqaue under four doses of nitrogenous and sulphur fertilizers. The highest number of seeds per siliquae (10.7) was recorded in 120 kg N/ha and lowest (8.4) in case of zero kilogram nitrogen per hectare. It was evident that increase in the number of seeds per siliqaue with the application of 40, 80 and 120 kg N/ha was successive and it amounted to 34.00, 67.31 and 109.42 percent higher over zero kilogram of nitrogen per hectare, respectively. Similar result were reported by [8] who found that use of higher dose of nitrogen in mustard crop increased the number of siliqaue per plant. In case of application of sulphur at the rate of 45 kg/ha, it was observed that this dose was significantly better over control as well as other two doses (15 and 30 kg/ha) of sulphur in increasing the number of seed per siliquae in mustard. But the application of sulphur at the rates of 15 and 30 kg/ha was at par to each other in producing the number of seeds per siliquae.

Table 2: Effect of nitrogen and sulphur on plant height, branching and some traits in mustard.

Treatment	Plant height		Primary Branches	Secondary Branches	Total braches	Siliquae/plant	Siluquae length (cm)	Number of seed/siliquae
	60 Days	At harvest						
Nitrogen level (kg/ha)								
0	73.7	166.0	5.0	7.9	13.1	258.6	4.0	8.4
40	84.6	177.5	6.7	12.7	19.3	322.9	4.6	8.9
80	89.9	183.0	7.8	17.0	24.6	403.3	4.8	10.5
120	91.0	194.1	9.2	18.9	27.5	485.4	5.1	10.7
S Em ±	2.7	1.8	0.2	0.4	0.4	6.3	0.1	0.1
CD at 5%	5.4	3.7	0.4	0.8	0.8	12.7	0.2	0.2
Sulphur level (kg/ha)								
0	82.1	177.9	6.3	13.1	19.5	309.4	4.4	9.7
15	84.1	178.0	7.0	13.6	20.5	364.0	4.5	9.6
30	85.2	181.3	7.3	14.5	21.4	375.7	4.8	9.9
45	87.8	183.3	7.9	15.5	22.9	421.0	4.8	10.3
S Em ±	2.7	1.8	0.2	0.4	0.4	6.3	0.1	0.1
CD at 5%	NS	3.7	0.4	0.8	0.8	12.7	0.2	0.2

Conclusion

The results pertaining to the traits under investigation exhibit a profound influence of nitrogen and sulphur application in mustard crop. So it can be concluded from a perusal of the results that the treatment of sulphur application at 45 kg S/ha made in conjunction with 120 kg N/ha, are best than all other treatments for achieving the highest traits of expression of growth, seed productivity and seed quality parameters, thus promising to boost the productivity of Indian mustard under agro-ecological conditions of Bundelkhand region (U. P.)

References

1. Cochran WG, Cox GM. Experimental Design. Wiley Intl. Pub., New York, 1959.
2. El Kholy MH, MEl Zeky, Saleh SZ, Metwaly SG. Physical and chemical studies on some rapeseed varieties under different levels of nitrogen fertilization. Proceeding of the 12th International Rapeseed Congress 26-30 March, Sustainable Development in Cruciferous Oilseed crop Production, Wuhan, China. 2007; 3:217-222.
3. Fathy S, El-Nakhlawy, Ahmed A, Bakhashwain. Performance of Canola (*Brassica napas* L.) Seed yield, Yield Components and Seed Quality under the Effect of Four Genotypes and Nitrogen Fertlizer Rates, JKAU: Met, Enz, & Arid Land Agric. Sci. 2009; 20(2):33-47.
4. Issa Piri, Mohsen Moussavi Nik, Abolfazl Tavassoli, Fatemeh Rastegaripour. Effect of irrigation interval and sulphur fertilizer on growth analysis and yield of Brassica juncea. African Journal of Microbiology Research. 2011; 5(22):3640-3646.
5. Seyedeh Neda Mozaffari, Babak Delkhos, Amirhossein Shirani Rad. Effect of nitrogen and potassium levels on yield and some of the agronomical characteristics in Mustard (*Brassica juncea*). Indian Journal of Science and Technology. 2012; 5(2):2051-2054.
6. SF El-Habbasha, Abd El-Salam MS. Response of two canola varieties (*Brassica Napus* L.) to Nitrogen Fertilizer Level and Zinc Foliar Application. International Journal of Academic Research. 2010; 2(2):60-66.
7. Singh Amar, Meena NL. Effect of nitrogen and sulphur on growth, yield attributes and seed yield of mustard (*Brassica Juncea* L.) in eastern plains of Rajasthan. Indian J Agron. 2004; 49(3):186-188.
8. Yasari E, Patwardhan AM. Physiological analysis of the growth and development of canola (*Brassica napus* L.) Asian Journal of Plant Sciences. 2006; 5(5):745-752.