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Ashwini A Ingle
M.Sc. Scholar, Department of Agronomy, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

Pratiksha J Karpe
M.Sc. Scholar, Department of Agronomy, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

Poonam Gunjal
M.Sc. Scholar, Department of Agronomy, R.C.S.M. College of Agriculture, Kolhapur, MPKV, Rahuri, Maharashtra, India

Corresponding Author:
Ashwini A Ingle
M.Sc. Scholar, Department of Agronomy, College of Agriculture, Latur, VNMKV, Parbhani, Maharashtra, India

Influence of phosphorus and Sulphur on seed and oil yield and economics of mustard (*Brassica juncea* L.)

Ashwini A Ingle, Pratiksha J Karpe and Poonam Gunjal

Abstract
An agronomic investigation entitled as "Effect of phosphorus and sulphur on growth yield and quality of Indian mustard (*Brassica juncea* L.) was conducted at Experimental Farm, Agronomy Section, College of Agriculture, Latur, during *Rabi* 2020-21. The objective of present study was to study the effect of phosphorus and sulphur levels on growth, yield and quality of mustard and to study the economics of mustard cultivation. The soil of experimental plot was clayey in texture, slightly alkaline in reaction, low in available nitrogen, medium in available phosphorous, very high in available potassium and low in available sulphur. The experiment was laid out in Factorial Randomized Block Design (FRBD) with nine treatment combinations, consisting of two factors i.e. different phosphorus levels and sulphur levels, which includes three levels each of different phosphorus levels and sulphur levels application. The different fertilizer levels were 25 kg P ha^{-1} (P_1), 37.5 kg P ha^{-1} (P_2) and 50 kg P ha^{-1} (P_3) whereas, sulphur levels were 15 kg S ha^{-1} (S_1), 30 kg S ha^{-1} (S_2) and 45 kg S ha^{-1} (S_3). The gross plot size of each experimental unit was 5.4 m × 4.5 mand net plot size was 4.5 m × 3.9 m. Sowing was done on 09th November, 2020 by dibbling method at spacing 45 cm x 15 cm. The crop was harvested on 22rd February, 2021. The result of the experiment revealed that higher seed yield (1897 kg ha^{-1}), oil yield (779.92 kg ha^{-1}), GMR (Rs.75880 ha^{-1}), NMR (Rs. 39549 ha^{-1}) and B:C ratio (2.09) was observed with an application of 50 kg P ha^{-1} (P_3) Higher seed yield (1864 kg ha^{-1}), oil yield (718.27 kg ha^{-1}), GMR (Rs.74560 ha^{-1}), NMR (Rs.36640 ha^{-1}) and B:C ratio (1.97) was observed with an application of 45 kg S ha^{-1} (S_3). In case of seed yield and net monetary returns (Rs. ha^{-1}), application of 50 kg P ha^{-1} and 45 kg S ha^{-1} performed better.

Keywords: Mustard, phosphorus, Sulphur, yield, quality and economics

1. Introduction
Oilseeds are important crops in India after cereals. There are nine important oilseeds crops grown in India namely groundnut, soyabean, sesame, safflower, sunflower, castor, Niger, mustard- rapeseed, linseed in which castor and linseed are non - edible oil crops (Samba Murty and Subramanyam, 1989) [14]. Indian Mustard (*Brassica juncea* L.) is popular by different names according to different regions such as Chinese mustard, Rai or Loha, Raya, Brown mustard, leaf mustard and locally known as khardal (Rafiei *et al*., 2011) [12]. According to Sanskrit records, dating back about 3000 BC mustard is one of the oldest and domisticated spices. In Latin word, mustard means 'must or mustum'. It belongs to Cruciferae family and originated from middle-east, India and China. In the World mustard is most important oilseed crop after palm and soyabean. It is cool season crop and follows C_3 pathway and requires temperature range between 06-26 °C. It has efficient photosynthetic response at 15-20 °C. It is generally grown under rainfed condition, well-drained soil and moderately tolerant to acidic soil. Its low water requirement (240-400 mm) is sufficient for rainfed cropping system. Seed colour of the Indian mustard is dark brown and having rough seed coat. It has tapering root system and height of plant is about 90-200 cm. It is self-pollinated, flower has 4 sepals and 4 petals having dark yellow - pale yellow colour.
Oil cakes manures contains sinirgin', which is in bitter taste so that causes palatability problem to animals. Strong mustard can make allergy such as eyes water and throat irritation. It is believed that cardiac malfunctioning found due to more use of erucic acid (40-50%) containing oil. In such way that high amount of sulphur compounds as glucosinolates upto 80-160 micro molecules g^{-1}) considered as the precursors of goitrogenic chemicals (Pachauri, 2001) [7]. Some factors are responsible for low production of mustard in India such as low temperature is adversely affecting the flowering of oilseed crops.

Mustard crop is highly sensitive to fertilizers. Phosohorous and sulphur are essential nutrient for well development of mustard. Generally, equal quantiy of phosphorus and sulphur are absorbed by the plants. Phosphorus occurs in plants at 0.1-0.4% and it is absorbed by plants mostly in orthro phosphate ions from soil and available as monovalent and divalent ion forms from soil. It is one of the important nutrient among first three macronutrient. Phosphorus is important for establishment of healthy root system. Deficiency of phosphorus results in stunted growth of the plant. Plants will have purple discoloration on the stem and leaves with severe deficiency. Oil content in mustard is increased by applying the low analysis fertilizers (Ahmad *et al*., 2005) [1]. Mustard gives high yield and quality produce by applying balanced nutrients and S play vital role in balancing of nutrient and synthesis of amino acids also. The crops of cruciferae family contains high amounts of glucosinolates and they require high sulphur demand (Rathore and Manohar, 1992) [13]. Mustard's highest requirement of sulphur ranging from 20 to 60 kg S ha^{-1} depending on the S status and yield potential of the soil. Sulphur is key nutrient for oil production in mustard. It causes the source of pungency in the mustard oil. Indian mustard is mainly responded to sulphur application as it plays major role in quality and development of seed. From above information, RDF, phosphorus and sulphur essentially required by Indian mustard for improving growth, yield and quality. Taking into consideration the factors discussed, this investigation was carried out.

2. Materials and Methods

An agronomic investigation was conducted at Experimental Farm, Agronomy Section, College of Agriculture, Latur, during *Rabi* 2020-21. The soil of experimental plot was very high in available nitrogen (231 kg ha^{-1}), medium in available phosphorous (15.90 kg ha^{-1}), very high in available potassium (475.27 kg ha^{-1}), low in available sulphur (7.73 kg Sha^{-1}) and moderately alkaline in reaction having pH 7.59. The soil was clayey in texture which was favourable for normal growth of the crop. The experiment was laid out in Factorial Randomized Block Design with nine treatments combination, consisting of two factors, phosphorus and Sulphur which includes three levels each of different phosphorus sulphur. The mustard variety Pusa bold was tested for this experiment along with these treatments. The treatments were (phosphorus) P_1-25 kg P ha^{-1}, P_2-37.5 kg P ha^{-1}, P_3-50 kg P ha^{-1} and (sulphur) S_1-15 kg S ha^{-1}, S_2-30 kg S ha^{-1}, S_3-45 kg S ha^{-1}. Each treatment was replicated three times. The gross plot size of each experimental unit was 5.4 x 4.5 m^2 and net plot size was 4.5 x 3.9 m^2. Sowing was done by dibbling method at spacing 45 cm x 15 cm, on 09th November, 2020. The recommended cultural practices and plant protection measures were undertaken. The nitrogen, phosphorus and sulphur were applied as per treatments through urea, diammonium phosphate and bensulf respectively. Whole dose of P and S and half dose of N was applied a basal dose at the time of sowing and remaining half dose of N was applied as top dressing at 30 DAS. The crop was harvested on 22nd February, 2021.

3. Results and Discussions

3.1. Seed yield ha^{-1} (kg)

The data pertaining to seed yield ha^{-1} are presented in Table 1. The mean seed yield ha^{-1} was 1724 kg.

3.1.1. Effect of phosphorus

An application of 50 kg P ha^{-1} was found significantly superior in seed yield ha^{-1} over 25 kg P ha and it was found at par with 37.5 kg P ha^{-1}. Increase in seed yield kg ha^{-1} might be due to result of better growth and yield attributing characters. The similar results reported by Paul *et al.*, (2016) [8], Singh and Thenua (2016) [16] and Gurjar *et al.*, (2017) [5].

3.1.2. Effect of sulphur

An application of 45 kg S ha^{-1} in seed yield kg ha^{-1} observed superior over 15 kg S ha^{-1} was found at par with 30 kg S ha^{-1}. The increase in seed yield ha^{-1} might be due to involvement of sulphur in the synthesis of fatty acids that had increased yield attributing characters. The similar result was reported by Chand *et al*., (1997) [4], Kachroo and Kumar (1999) [6] and Bohra and Srivastava (2002) [3].

3.1.3. Interaction effect

The interaction effect of phosphorus and sulphur on seed yield ha^{-1} was non- significant.

3.2. Quality attributes

3.2.1. Oil content (%)

The data pertaining to oil content is presented in Table 2. The mean oil content was 39.15%.

3.2.1.1. Effect of phosphorus

An application of 50 kg P ha^{-1} recorded significantly highest oil content (41.09%). An application of 25 kg P ha^{-1} recoded lowest oil content (37.03%). This might be due to application of phosphorus, it leads to proper activation of many enzymes in plants which help in oil synthesis of oil. Similar findings were observed by Punia *et al* (2002) [11], Singh and Thenua (2016) [16].

3.2.1.2. Effect of sulphur

An application of 45 kg S ha^{-1} recorded highest oil content (39.06%). An application of 15 kg S ha^{-1} recoded lowest oil content (38.73%). The increase in oil content might be due to supply of sulphur which is integral part of oil. Similar findings were observed by Singh and Kumar (2014) [15] and Piri *et al*., (2014) [9].

3.2.1.3. Interaction effect

The interaction effect of phosphorus and sulphur on oil content (%) was not found significant.

3.2.2. Oil yield (kg ha^{-1})

The data pertaining to oil yield is presented in Table 2. The mean oil yield was 684.44 kg ha^{-1}.

3.2.2.1. Effect of phosphorus

An application of 50 kg P ha^{-1} recorded highest oil yield (779.72 kg ha^{-1}). An application of 25 kg P ha^{-1} recorded lowest oil yield (546.46 kg ha^{-1}). The highest oil yield (kg ha^{-1}) might be due to application of phosphorus which leads to activation of many enzymes which involved in glycosides formation. Similar findings were observed by Gurjar *et al* (2017) [5] and Potdar *et al*., (2019) [10].

3.2.2.2. Effect of sulphur

An application of 45 kg S ha^{-1} recorded highest oil yield (718.28 kg ha^{-1}). An application of 15 kg S ha^{-1} recoded lowest oil yield (645.13 kg ha^{-1}). The highest oil yield (kg ha^{-1}) might be due to application of sulphur which leads to biosynthesis of oil by activation of enzymes activation of. This might be effect of oil content and seed yield. Similar result were observed by Chand *et al*., (1997) [4] and Singh and Abraham (1999) [6].

3.2.2.3. Interaction effect
The interaction effect of phosphorus and sulphur on oil yield (kg ha^{-1}) was not found significant.

3.3. Economics of mustard cultivation
Data pertaining to gross monetary returns (Rs ha^{-1}), cost of cultivation (Rs. ha^{-1}), net monetary returns (Rs. ha^{-1}) and benefit cost ratio of different treatments are presented in Table 1.

3.3.1. Gross monetary returns (Rs. ha^{-1})
Data pertaining to gross monetary returns (Rs ha^{-1}) of different treatments presented in Table 1. The mean gross monetary returns ha^{-1} was Rs 68940.

Table 1: Seed yield (kg ha^{-1}), gross monetary returns (Rs. ha^{-1}), cost of cultivation (Rs. ha^{-1}), net monetary returns (Rs. ha^{-1}) and benefit cost ratio of mustard as influenced by different treatments at harvest

Treatments	Seed yield (kg ha^{-1})	Gross monetary returns (Rs. ha^{-1})	Cost of cultivation (Rs. ha^{-1})	Net monetary returns (Rs. ha^{-1})	Benefit cost ratio
(A) Phosphorus (P)					
P_1 – 25 kg ha^{-1}	1499	59960	35419	24541	1.69
P_2 – 37.5 kg ha^{-1}	1849	73960	36998	36962	1.99
P_3 – 50 kg ha^{-1}	1897	75880	36331	39549	2.09
SE±	63	2232	-	2332	-
CD at 5%	188	6692	-	6692	-
(B) Sulphur (S)					
S_1 – 15 kg ha^{-1}	1510	60400	34926	25474	1.73
S_2 – 30 kg ha^{-1}	1722	68880	36063	32817	1.91
S_3 – 45 kg ha^{-1}	1864	74560	37920	36640	1.97
SE±	63	2232	-	2232	-
CD at 5%	188	6692	-	6692	-
(C) Interaction (P X S)					
SE±	109	3866	-	3866	-
CD at 5%	NS	NS	NS	NS	NS
General mean	1724	69940	36276	33664	1.99

3.3.1.1. Effect of phosphorus levels
An application of 50 kg P ha^{-1} recorded significantly highest gross monetary returns (Rs. 75880 ha^{-1}) than 25 kg P ha^{-1} and it was found at par with application of 37.5 kg P ha^{-1}. Gross monetary returns influenced by the highest seed yield. Similar findings were observed by Bala and Nath (2015) [2], Singh and Thenua (2016) [16] and Gurjar *et al*., (2017) [5].

3.3.1.2. Effect of sulphur levels
An application of 45 kg S ha^{-1} recorded significantly the highest gross monetary returns (Rs 74560 ha^{-1}) than 15 kg S ha^{-1} and it was found at par with anapplication of 30 kg S ha^{-1}. Maximum gross monetary returns obtained might be due to more yield recorded by 45 kg S ha^{-1} and comparative less yield due to 15 kg S ha^{-1}. Similar trends were noted by Bohra and Srivastava (2002) [3].

3.3.1.3. Interaction effect
The interaction effect of phosphorus and sulphur on gross monetary returns (Rs. ha^{-1}) was non-significant.

3.3.2. Net monetary returns (Rs. ha^{-1})
Data pertaining to net monetary returns (Rs. ha^{-1}) of different treatments are presented in Table 1. The mean net monetary returns ha^{-1} was Rs. 33664 ha^{-1}.

3.3.2.1. Effect of phosphorus
An application of 50 kg P ha^{-1} recorded significantly the highest net monetary return (Rs. 39549 ha^{-1}) than 25 kg P ha^{-1} and it was found at par with application of 37 kg P ha^{-1}. Similar trends were noticed by Bala and Nath (2015) [2] Singh and Thenua (2016) [16] and Gurjar *et al*., (2017) [5].

3.3.2.2. Effect of sulphur levels
An application of 45 kg S ha^{-1} recorded significantly the highest net monetary return (Rs. 36640 ha^{-1}) than an application of 15 kg S ha^{-1} and was found at par with an application of 30 kg S ha^{-1}. Similar trends were observed by Bohra and Srivastava (2002) [3].

3.3.2.3. Interaction effect
The interaction effect of phosphorus and sulphur on net monetary returns (Rs ha^{-1}) was not found significant.

3.3.3. Benefit: Cost ratio
Data pertaining to Benefit: Cost ratio of different treatments are presented in Table 1. The mean Benefit: Cost ratio was 1.99.

Table 2: Oil content (%) and oil yield (kg ha^{-1}) of mustard as influenced by various treatments at harvest

Treatment	Oil content (%)	Oil yield (kg ha^{-1})
(A) Phosphorus (P)		
P_1 – 25 kg ha^{-1}	37.03	546.46
P_2 – 37.5 kg ha^{-1}	39.32	727.14
P_3 – 50 kg ha^{-1}	41.09	779.72
SE±	0.42	26.64
CD at 5%	NS	79.87

(B) Sulphur (S)		
S_1 – 15 kg ha^{-1}	38.73	645.13
S_2 – 30 kg ha^{-1}	38.76	689.91
S_3 – 45 kg ha^{-1}	39.96	718.27
SE±	0.42	26.64
CD at 5%	NS	79.87
(C) Interaction (P X S)		
SE±	2.21	46.15
CD at 5%	NS	NS
General mean	39.15	684.44

3.3.3.1. Effect of phosphorus

Application of 50 kg P ha^{-1}was recorded higher B:C ratio (2.09) where as lowest B:C ratio was observed due to application of 25 kg P ha^{-1} (1.69). Similar trends were seen by Bala and Nath (2015) [2] Singh and Thenua (2016) [16] and Gurjar *et al.*, (2017) [5].

3.3.3.1.2. Effect of sulphur

Application of 45 kg S ha^{-1} recorded higher B:C ratio (1.73) where as lowest B:C ratio was observed due to application of 15 kg P ha^{-1} (1.97). Similar trends were reported by Bohra and Srivastava (2002) [3].

4. Conclusions

Higher seed yield (1897 kg ha^{-1}), oil yield (779.72 kg ha^{-1}), GMR (Rs.75880 ha^{-1}), NMR (Rs. 39549 ha^{-1}) and B:C ratio (2.09) was observed with an application of 50 kg P ha^{-1} which was followed by an application of 37.5 kg P ha^{-1} and it was significantly superior over an application of 25 kg P ha^{-1}. Higher seed yield (1864 kg ha^{-1}), oil yield (718.27 kg ha^{-1}), GMR (Rs.74560 ha^{-1}), NMR (Rs. 36640 ha^{-1}) and B:C ratio (1.97) was observed with an application of 45 kg S ha^{-1} which was followed by an application of 30 kg S ha^{-1} and it was significantly superior over an application of 15 kg S ha^{-1}. In case of seed yield and net monetary returns (Rs. ha^{-1}), application of 50 kg P ha^{-1} and 45 kg S ha^{-1} performed better.

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6. References

1. Ahmad A, Khan I, Anjunm NA, Diva I, Abrol YP, Iqbal IM. Effect of timing of sulphur fertilizer application on growth and yield of rapeseed. (*Brassica campestris* L.). Journal of Plant Nutrition. 2005;28(05):1049-1059.
2. Bala M, Nath K. Performance of groundnut (*Arachis hypogea* L.) as influenced by various resource constraints. International. Journal of development research. 2015;5(04):4261-4263.
3. Bohra JS, Srivastava RK. Studies on sulphur levels and sources at different fertility levels on yield and output-input ratio of Indian mustard. Research Crops. 2002;3(09):538-541.
4. Chand L, Sharma HC, Jat SC. Effect on foliar spray of urea and sulphur application on yield attributes of mustard (*Brassica juncea* L.). Annals Biological. (Ludhiana). 1997;13(09):99-10.
5. Gurjar R, Chimote A, Raut GL. Impact of irrigation and nutrient management on growth and yield of flaxseed (*Linum usitatissimum* L.). Trends International Bioscience. 2017;10(27):89-96.
6. Kachroo D, Kumar A. Seed weight, oil and protein contents of Indian mustard (*Brassica juncea* L.) as influenced by nitrogen and sulphur fertilization. Annals Agriculture Research. 1999;20(08):369-371.
7. Pachuri RK. Agriculture. TERI. Vision. 2001;37(6):1-2.
8. Paul SA, Nikam RR, Kale RV, Shelke RT. Effect of land configuration and nutrient management on yield attributes and economics of irrigated linseed. Journal of Soils & Crops. 2016;26(01):119-122.
9. Piri I, Nik MM, Tavassol A, Rastegaripour F, Babaeian M. Effect of irrigation frequency and application levels of sulphur fertilizer on water use efficiency and yield of Indian mustard (*Brassica juncea*). African Journal of Biotechnology. 2011;10(55):11459-11467.
10. Potdar DS, Purohit HS, Meena RH, Kaushik MK, Jain HK, Ameta KD. Effect of integrated phosphorus management on growth, yield and quality of mustard (*Brassica juncea* L.) Journal Pharmacognosy & Phytochemistry. 2019;8(04):1700-1704.
11. Punia BS, Singh J, Kumar R. Effect of levels and sources of phosphorus on yield and nutrient content of mustard (*Brassica juncea* L.). Annals of Biology. 2002;18(02):133-139.
12. Rafiei S, Delkhosh B, Shirani AH, Zandi H. Effect of sowing dates and irrigation regimes on Agronomic traits of Indian mustard in semi-arid area of Takestan. Journal of Science. 2011;7(10):721-728.
13. Rathore PS, Manohar SS. Effect of nitrogen content in different plants parts of Agronomy. 1992;15(08):160-163.
14. Samba Murty AVSS, Subramanyam NS. A textbook of economic botany. Wiley Eastern Limited, New Delhi. 1989;6(12):875-878.
15. Singh M, Kumar M. Effect of nitrogen and sulphur levels on seed yield and some other characters in mustard (*Brassica juncea* L.). International Journal of Agriculture Science. 2014;10(01):449-452.
16. Singh SB, Thenua OVS. Effect of phosphorus and sulphur fertilization on yield NPS uptake by mustard. International Journal of Agronomy. 2016;11(01):80-83.