The Pharma Innovation Journal 2022; 11(11): 422-425

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; 11(11): 422-425

www.thepharmajournal.com
Received: 11-09-2022
Accepted: 19-10-2022

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Effect of phosphorus and sulphur application on growth attributes and growth rate of linseed (*Linum usitatissimum* L.) grown under sandy loam soil

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Abstract
A field experiment was conducted to determine the effect of different levels of phosphorus (P) and sulphur (S) on growth attributes and growth rate of linseed. The experiment was laid out in randomized block design (RBD), with nine treatments in the *Rabi* season of 2022 with three different levels of P (40, 50 and 60 kg P_2O_5/ha) and S (30, 40 and 50 kg S /ha) at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). Application of P and S significantly influenced the growth attributes and growth rate of linseed. Conjoint application of recommended dose of fertilizer (RDF) + 50 kg P ha^{-1} + 50 kg S ha^{-1} recorded the highest plant height 41.66 and 60.02 cm at 60 and 90 DAS, respectively whereas, number of branches per plant documented maximum value 4.86 and 9.81 at 60 and 90 DAS. The same treatment (T6) showed the maximum crop growth rate (5.92 and 9.19 g/m^2/day) and relative growth rate (4.86 and 9.81 g/g/day) at 30 – 60 and 60 – 90 DAS, respectively.

Keywords: Crop growth rate, linseed, phosphorus, relative growth rate, sulphur

Introduction
Next to rapeseed and mustard, linseed is a major *Rabi* oilseed crop of the country. India is the fourth largest linseed growing country in the world (10.8%) after Kazakhistan, Canada and Russia but production wise India ranks fifth in the world after Canada, Russia, China and Kazakhistan. Linseed is rich in protein (20%), oil (41%) and dietary fiber (28%). The seed of linseed contains 33-47% oil. Linseed oil is an excellent drying oil used in manufacturing paint and varnishes, oilcloth, waterproof fabrics, etc (Alam and Kumari 2021) [1]. At present linseed is cultivated in about 326.01 thousand ha and contribute 173.62 thousand tonnes to the annual oilseed production of the country with the productivity of 545 kg/ha (P.C. Report, 2018-19, AICRP on linseed) [2]. One of the limiting factors for low yield is due to poor management of inputs. The average yield of flax is very low in India due to many constraints like poor soil fertility, inadequate application of macro and micronutrients, competition with other crop and traditional crop management practices. Due to constantly increasing demand of the crop, there is a direct need to increase seed yield potential of flax crop. Its production can be increased by growing high yielding cultivators and by the uses of macro and micronutrients in balance quantity.

Macronutrients especially phosphorus (P) and sulphur (S) play very important role in increasing growth and yield attributes of linseed. The deficiency of these two macronutrients in soil adversely affects the growth and development of linseed. Phosphorus stimulates root development and growth in seedling stage. It also stimulates fruit setting and seed formation**.** Sulphur involved in chlorophyll formation and encourages vegetative growth. Sulphur is essential for the synthesis of certain amino acids and oils**.** Sulphur is also essential for protein synthesis as a constituent of amino-acid (cystine, cysteine and methionine) (Aulakh *et al.*, 1989) [3]. However, majority of linseed cultivated areas are deficient in P and S. To, fulfill the necessities for P and S nutrient, it is necessary to supply these to the hungry soil in concentrated and readily available form. Hence an attempt has been made for in the present investigation to study the effect of P and S application on growth attributes and growth rate of linseed (*Linum usitatissimum* L.) grown under sandy loam soil.

Materials and Method

The experiment was laid out in the Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj. The Crop Research Farm is situated at 25º77 N latitude, 81º50 E longitude and 98 m altitude from the mean sea level (MSL). The experiment was conducted during 2022 in randomized block design (RBD) taking nine treatments *viz.*, T1: Recommended dose of fertilizer (RDF) + 40 kg P ha^{-1} + 30 kg S ha^{-1}, T2: RDF + 40 kg P ha^{-1} + 40 kg S ha^{-1}, T3: RDF + 40 kg P ha^{-1} + 50 kg S ha^{-1}, T4: RDF + 50 kg P ha^{-1} + 30 kg S ha^{-1}, T5: RDF + 50 kg P ha^{-1} + 40 kg S ha^{-1}, T6: RDF + 50 kg P ha^{-1} + 50 kg S ha^{-1}, T7: RDF + 60 kg P ha^{-1} + 30 kg S ha^{-1}, T8: RDF + 60 kg P ha^{-1} + 40 kg S ha^{-1} and T9: RDF + 60 kg P ha^{-1} + 50 kg S ha^{-1} and each treatment was replicated thrice. Early maturing linseed variety *Neelam* was taken as a test crop. The recommended dose of N, P and K for linseed in Prayagraj region is 30, 60 and 80 kg ha^{-1}, respectively. Urea, di-ammonium phosphate (DAP), muriate of potash (MOP) and bentonite sulphur was used to supply the NPKS to the crop. Sowing of linseed seeds were done in line method. Before sowing of crop, light irrigation was applied, thereafter four irrigations were provided based on the need and weather condition. For measuring plant height, five plants were tagged in each plot and plant height was measured at 30, 60 and 90 days after sowing (DAS). Number of branches per plant was recorded on the same tagged plants from each plot at 60 and 90 DAS. For measuring dry weight (g) two plants from each plot was uprooted randomly at 30, 60 and 90 DAS. The uprooted plants were washed with doubled distilled water and dried in hot air oven at 70 °C till constant weight. Thereafter, the dry weight of these dried plants was recorded.

The crop growth rate (CGR) was computed with the help of dry matter production recorded for each treatment at 0–30, 30–60 and 60–90 DAS with the help of following formula:

$$CGR\ (g/m^2/day) = \frac{W_2 - W_1}{t_2 - t_1}$$

Whereas, W_1 = dry matter production per unit area at time t_1, W_2 = dry matter production per unit area at time t_2, t_1 = days to first sampling, and t_2 = days to second sampling.

However, the relative growth rate (RGR) was calculated by using the formula:

$$RGR\ (g/g/day) = \frac{\log_e W_2 - \log_e W_1}{t_2 - t_1}$$

The data recorded for different characteristics were subjected to statistical analysis by adopting the method of analysis of variance (ANOVA) as described by Gomez and Gomez (1984) [4]. The significant difference values were computed for 5 percent probability of error.

Results and Discussion

Effect of phosphorus and sulphur application on growth attributes of linseed

Data pertaining on plant height of linseed was depicted on Table 1, and the observation revealed that application of P and S significantly impacted on plant height at 60 and 90 DAS however, at 30 DAS no effect of treatment combinations on plant height was observed. At 60 and 90 DAS, the maximum plant height (41.66 and 60.02 cm) was recorded with the application of RDF + 50 kg P ha^{-1} + 50 kg S ha^{-1} (T6) whereas, the minimum (33.64 and 47.88 cm) was in RDF + 40 kg P ha^{-1} + 30 kg S ha^{-1} (T1), respectively. In case of number of branches per plant (Table 2), treatment T6 (RDF + 50 kg P ha^{-1} + 50 kg S ha^{-1}) noted the highest value *i.e.*, 4.86 and 9.81 branches/plant at 60 and 90 DAS, respectively while, the lowest branches/plant (2.47 and 5.01) was documented in T1 (RDF + 40 kg P ha^{-1} + 30 kg S ha^{-1}). Data reviled that at 90 DAS the growth attributes of linseed were statistically at par among the treatments RDF + 50 kg P ha^{-1} + 30 kg S ha^{-1} (T4), RDF + 50 kg P ha^{-1} + 30 kg S ha^{-1} (T5) and T6. Phosphorus applied treatments stimulate plant growth and root development, which improve the growth characteristics of linseed and the results are in accordance with Vashistha *et al.* (1993) [5] and Sune *et al.* (2006) [6]. Sulphur is necessary for the synthesis of several essential amino acids, formation of chlorophyll and stimulates vegetative development, all of which support the growth characteristics of linseed. Similar results were also reported by Jagtap *et al.* (2003) [7].

Table 1: Effect of phosphorus and sulphur application on plant height (cm) of linseed

Treatments	Plant height (cm)		
	30 DAS*	60 DAS	90 DAS
T1	10.61	33.64	47.88
T2	12.64	36.96	51.21
T3	13.34	37.80	54.40
T4	14.17	38.64	58.56
T5	14.41	39.15	59.48
T6	15.36	41.66	60.02
T7	13.65	36.52	56.55
T8	13.46	36.84	57.05
T9	13.14	37.28	58.41
SEd (±)	1.50	0.70	1.79
CD (5%)	NS	1.49	3.75

*DAS: days after sowing

Table 2: Effect of phosphorus and sulphur application on number of branches per plant of linseed

Treatments	Number of branches per plant	
	60 DAS*	90 DAS
T1	2.47	5.01
T2	3.02	8.20
T3	3.35	8.45
T4	4.16	8.89
T5	4.43	9.19
T6	4.86	9.81
T7	3.55	7.02
T8	3.56	7.52
T9	3.54	7.54
SEd (±)	0.19	0.41
CD (5%)	0.40	1.10

*DAS: days after sowing

Effect of phosphorus and sulphur application on dry weight of linseed

The observation showed that the treatment T6 (RDF + 50 kg P ha^{-1} + 50 kg S ha^{-1}) documented the highest dry weight of linseed crop *i.e.*, 8.13 and 15.41 g/plant at 60 and 90 DAS, respectively however, the lowest 5.12 and 12.44 g/plant was recorded in T1 (RDF + 40 kg P ha^{-1} + 30 kg S ha^{-1}) (Table 3). At 60 DAS, treatments T4 (RDF + 50 kg P ha^{-1} + 30 kg S ha^{-1}), T5 (RDF + 50 kg P ha^{-1} + 40 kg S ha^{-1}), T8 (RDF + 60 kg P ha^{-1} + 40 kg S ha^{-1}) and T9 (RDF + 60 kg P ha^{-1} + 50 kg S ha^{-1}) were statistically at par with T6 with regards to plant dry weight whereas, at 90 DAS treatments T2 (RDF + 40 kg P ha^{-1} + 40 kg S ha^{-1}), T4 (RDF + 50 kg P ha^{-1} + 30 kg S ha^{-1}) and T5 (RDF + 50 kg P ha^{-1} + 40 kg S ha^{-1}) were statistically at par with T6. The increased number of branches, which may have resulted in increased photosynthetic activity and the

synthesis of more photosynthate, resulted in improved plant dry matter accumulation Sune *et al.* (2006) [6] and Patil *et al.* (2014) [8]. Moreover, increased straw yield might be attributed to improved growth and yield factors, leading in a plant with more dry matter accumulation. Similar result was also reported by Sune *et al.* (2006) [6].

Table 3: Effect of phosphorus and sulphur application on dry weight (g) per plant of linseed

Treatments	Dry weight (g)		
	30 DAS*	60 DAS	90 DAS
T1	1.25	5.12	12.44
T2	2.28	6.72	14.93
T3	2.10	6.22	14.49
T4	2.38	7.63	14.90
T5	2.51	7.80	15.18
T6	2.86	8.13	15.41
T7	2.10	6.19	13.70
T8	2.16	7.48	13.52
T9	2.23	7.50	14.05
SEd (±)	0.41	0.37	0.36
CD (5%)	NS	0.78	0.75

*DAS: days after sowing

Effect of phosphorus and sulphur application on different growth rate of linseed

The experimental findings revealed that crop growth rate and relative growth rate of linseed crop was significantly affected by different combination of P and S at 30 – 60 and 60 – 90 DAS (Table 4 and 5). The data showed that the application of RDF + 50 kg P ha^{-1} + 50 kg S ha^{-1} (T6) noted the maximum crop growth rate value of 5.92 and 9.19 g/m^2/day at 30 – 60 and 60 – 90 DAS, respectively whereas, the minimum in the T1 (RDF + 40 kg P ha^{-1} + 30 kg S ha^{-1}). With respect to crop growth rate treatment T4, T5, T8 and T9 were statistically at par with T6 at 30 – 60 DAS whereas, treatment T2, T3, T4, T5, T7 and T9 were statistically at par with T6 at 60 – 90 DAS. For relative growth rate of linseed crop, the highest value of 4.86 and 9.81 g/g/day was documented in T6 (RDF + 50 kg P ha^{-1} + 50 kg S ha^{-1}) at 30 – 60 and 60 – 90 DAS, respectively while, lowest in the T1 (RDF + 40 kg P ha^{-1} + 30 kg S ha^{-1}). Data reviled that at 60 – 90 DAS the relative growth rate of linseed crop were statistically at par among the treatments T2, T3, T7 and T6. These results are in confirmation with the findings of Vyas *et al.* (2020) [9], Gaikwad *et al.* (2020) [10] and Singh *et al.* (2022) [11].

Table 4: Effect of phosphorus and sulphur application on crop growth rate (CGR) (g/m^2/day) of linseed

Treatments	Crop growth rate (CGR) (g/m^2/day)		
	0 – 30 DAS*	30 – 60 DAS	60 – 90 DAS
T1	1.39	4.30	7.27
T2	2.53	4.94	9.12
T3	2.33	4.58	8.09
T4	2.64	5.84	8.07
T5	2.79	5.88	8.20
T6	3.18	5.92	9.19
T7	2.34	4.54	8.34
T8	2.40	5.86	6.70
T9	2.48	5.86	8.14
SEd (±)	0.44	0.41	0.57
CD (5%)	NS	0.86	1.20

*DAS: days after sowing

Table 5: Effect of phosphorus and sulphur application on relative growth rate (RGR) of linseed

Treatments	Relative growth rate (RGR) (g/g/day)	
	30 – 60 DAS*	60 – 90 DAS
T1	2.47	5.01
T2	3.02	8.20
T3	3.35	8.45
T4	4.16	8.89
T5	4.43	9.19
T6	4.86	9.81
T7	3.55	7.02
T8	3.56	7.52
T9	3.54	7.54
SEd (±)	0.19	0.41
CD (5%)	0.40	1.10

*DAS: days after sowing

Conclusion

In conclusion, it is inferred from the present investigation that application of 50 kg P ha^{-1} + 50 kg S ha^{-1} in addition to the full doses of N and K is recommended for obtaining maximum growth attributes and dry matter weight in linseed. Moreover, the treatment T6 recorded the highest crop growth rate and relative growth rate of linseed crop.

References

1. Alam MP, Kumari MS. Effect of zinc and boron on growth, yield and economics of linseed (*Linum usitatissimum* L.) under medium land of Jharkhand. The Pharma Innovation Journal. 2021;10(4):462-466.
2. PC. Report, AICRP on Linseed; c2018-19.
3. Aulakh MS, Pasricha NS, Azad AS, Ahuja KL. Response of linseed (*Linum usitatissimum* L.) to fertilizer nitrogen,

phosphorus and sulphur, and their effect on the removal of soil sulphur. Soil Use and Management. 1989;5(4):194-198.
4. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. John Wiley & Sons; c1984.
5. Vashishtha RP. Influence of nitrogen and phosphorus application on the yield, and oil content of linseed (*Linum usitatissimum*). Indian Journal of Agronomy. 1993;38:64-64.
6. Sune VS, Deshpande RM, Khavale VS, Bavisker PK, Gurao PB. Effect of phosphorus and sulphur Application on growth and yield of linseed (*Linum usitatissimum* L). Journals of Soils and Crops. 2006;16:217-221
7. Jagtap, AG. Effect of different sources and levels of sulphur on growth and yield of linseed. Unpublished M Sc. Agri. Thesis, Dr. PDKV, Akola; c2003.
8. Patil SS, Choudhary AA, Goley AV, Rasal SJ. Effect of phosphorus and sulphur on growth, yield and economics of linseed. Journal of Soils and Crops. 2014;24(1):159-164.
9. Vyas VV, Singh R, Singh E. Effect of Different levels of phosphorus and sulphur on oil and yield of linseed (*Linum usitatissimum* L.). International Journal of Current Microbiology and Applied Sciences. 2020;9(12):1692-1696.
10. Gaikwad, SR, Suryavanshi VP, Bhusari SA, Misal AM. Effect of fertilizers on growth and yield of linseed (*Linum usitatissimum* L.) varieties. The Pharma Innovation Journal. 2020;9(10):127-131.
11. Singh S, Mehera B, Singh S, Singh RP, Patra A. Effect of phosphorus and sulphur application on yield attributes and yield of linseed (*Linum usitatissimum* L.) grown in middle Gangetic plain. The Pharma Innovation Journal. 2022;11(10):214-216.