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# Effect of different levels of Phosphorus and Sulphur on Growth and Yield of Linseed (*Linum usitatissimum* L.)

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**A B S T R A C T**

A field experiment was conducted to determine the effect of different levels of phosphorus and Sulphur on oil and yield of linseed. The experiment was laid out in Randomized Block Design, with 12 treatments, each replicated thrice, in the *rabi* 2019 with the different levels of Phosphous (30,40,50 $P_2O_5$ Kg/ha) and Sulphur (0,15,20,30 S Kg/ha ) respectively at Crop Research Farm, Department of Agronomy, SHUATS, Prayagraj (U.P). Application of Phosphorus and Sulphur significantly influenced the growth parameters, yield attribute and yield. Addition of 40 kg $P_2O_5$ + 30 kg S/ha recorded the highest plant height (59.47cm), number of branches (3.43) and maximum dry weight is (10.86 g) at 80 DAS. Whereas, highest number of Capsules/plant (51.24), highest seed yield is (816.19 Kg/ha) and stover yield is (2050.40 Kg/ha) recorded with application of 40 Kg $P_2O_5$ + 30 kg S/ha.

## Introduction

Linseed is an important oil seed crop of central India, locally known as jawas. It has been grown from ancient time for flax (fibre) and for seed purpose, which is rich in oil. It is purely a cool season *rabi* crop. Temperate and cool climate conditions are best suited for growth. The minimum temperature regime is 100 C while the maximum is 380 C. Thus, the main season of growing linseed is October to November depending upon the availability of soil moisture. Early sowing helps the crop to escape the attack of powdery mildew, rust and linseed bud fly in different regions. The crop takes 120-140 days to mature depending on the cultivar. Drought and high temperature at early and seed filling stages are detrimental causing yield and quality. Flax seed contains 23% 18:3 Omega-3 fatty acids (mostly ALA) and 6% 18:2 Omega-6 fatty acids. One of the main components of Flax lignin which has plant oestrogen as well as anti-oxidants (flax contains up to 800 times more lignans than

other plant foods contain). Linseed or flax is an important crop with many uses. Its oil is used in the manufacture of paints, varnish, oil cloth and linoleum. If it contains much linolenic acid and little oleic acid, Oil having much oleic acid. On the other hand is valuable for human consumption, its fibre has been prized for millennia in the production of textiles and coarse twine. In India, linseed is cultivated in 5.25 lakh ha and total production of linseed is 2.12 lakh tones with average productivity of 403 kg / ha.

Among the nutrients, phosphorus and sulphur play important role in improving the quality and quantity of linseed (Yawalkar *et al.*, 2002). Majority of cultivated area linseed needs fertilization for good yield as phosphrous and sulphur content is low in soil.

Phosphrous stimulates root development and growth in seedling stage. It also stimulates fruit setting and seed formation (Yawalkar *et al.*, 2002). Sulphur involved in chlorophyll formation and encourages vegetative growth. Sulphur is essential for the synthesis of certain amino acids and oils (Das, 1996). Sulphur is essential for protein synthesis as a constituent of amino-acid (Cystine, Cysteine and methionine). It is required for chlorophyll formation and also for the synthesis of oils (Singh *et al.*, 1986 and Aulakh *et al.*, 1989).

Both sulphur uptake and sulphur translocation in linseed crop vary as a function of growth stages and plant part. Application of sulphur significantly increased yield as well as quality (Kumar *et al.*, 2008).

To, fulfil the necessities for sulphur nutrient, it is necessary to supply these to the hungry soil in concentrated and readily available form i.e. fertilizers. It is also essential to know optimum level of sulphur. Though many workers have worked on this aspect but requirement of sulphur vary from soil to soil and place to place. Even agro-climatic conditions have great influence on the sulphur requirement of a crop. Therefore, it is necessary to find out the most beneficial source and level of sulphur from the point of view of yield, nutrient uptake and quality of linseed.

## Materials and Methods

The experiment was carried out during *Rabi* season of 2019 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, SHUATS, Prayagraj (U.P). The soil of the experimental plot was sandy loam in texture, nearly neutral in soil reaction (pH 7.2), low in organic carbon (0.58%), medium in available N (238 Kg/ha), high in available P (32.10 Kg/ha) and low in available K (189 Kg/ha). The treatment consisted of 4 levels of sulphur *viz.* S1 (0 Kg S/ha), S2 (15 Kg S/ha), S3 (20 Kg S/ha) and S4 (30 Kg S/ha) and 3 levels of phosphorus P1 (30 Kg/ha), P2 (40 Kg/ha) and P3(50 Kg/ha). There are 12 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. It was sown on 22nd December 2019 with seed rate Kg/ha at spacing 30cm x 10cm. Recommended doses of nitrogen and potassium were applied.

## Results and Discussion

The growth parameters like plant height, No. of branches and Dry weight of plant were significantly affected by the application of phosphorus and sulphur.

## Growth parameters plant height

Linseed crop fertilized with 40 Kg P2O5 along with 30 Kg S/ha resulted significant increase in plant height (59.47 cms) at 80 DAS. The significant increase in plant height with sulphur application might be attributed to direct and indirect involvement of sulphur

in the photosynthetic process of plant reported by (Jagtap *et al.,* 2003).

## Number of branches/plant

Whereas, linseed fertilized with 40 Kg P2O5 along with 30 Kg S/ha resulted significant increased No. of branches (3.43) at 80 DAS. Maximum number of branches/plant were recorded with the application of 40kg Phosphorus and 30 kg sulphur/ha reported by (Sune *et al.,* 2006) and (Badiyala *et al.,* 1998).

## Dry weight (g)

Linseed fertilized with 40 Kg P2O5 along with 30 Kg S/ha resulted significant increased dry weight (10.86 g) at 80DAS. Sulphur help in chlorophyll formation and encourages vegetative plant growth. It also increases root growth (Yawalkar *et al.,* 2002) increase in dry matter per plant with application of sulphur might be due to increase in metabolic activity reported by (Jagtap *et al.,* 2003).

40 kg phosphorus and 30 kg Sulphur. Increase in dry matter production per plant might be the result of better growth and a greater number of branches which might have resulted in higher photosynthetic activity and formation of more photosynthate. These results are in confirmation with the findings of (Idnani *et al.,* 1989) and (Jain *et al.,* 1989).

**Table.1** Effect of Phosphorus and Sulphur on growth parameters of Linseed (80 DAS)

| Treatments | Plant height (cm) | No. of branches /plant | Dry weight (g/plant) |
|---|---|---|---|
| **$T_1$ -30 kg $P_2O_5$ + 0 kg S/ha** | 45.52 | 2.63 | **7.39** |
| **$T_2$ -30 kg $P_2O_5$ + 15 kg S/ha** | 47.23 | 2.71 | **7.52** |
| **$T_3$ -30 kg $P_2O_5$ + 20 kg S/ha** | 46.57 | 2.76 | **7.90** |
| **$T_4$ -30 kg $P_2O_5$ + 30 kg S/ha** | 50.71 | 2.80 | **8.02** |
| **$T_5$ -40 kg $P_2O_5$ + 0 kg S/ha** | 47.99 | 2.84 | **8.24** |
| **$T_6$ -40 kg $P_2O_5$ + 15 kg S/ha** | 52.10 | 2.88 | **9.51** |
| **$T_7$ -40 kg $P_2O_5$ + 20 kg S/ha** | 46.67 | 2.93 | **10.72** |
| **$T_8$ -40 kg $P_2O_5$ + 30 kg S/ha** | 59.47 | 3.43 | **10.86** |
| **$T_9$ -50 kg $P_2O_5$ + 0 kg S/ha** | 49.79 | 2.93 | **10.51** |
| **$T_{10}$ -50 kg $P_2O_5$ + 15 kg S/ha** | 51.26 | 2.95 | **10.56** |
| **$T_{11}$ -50 kg $P_2O_5$ + 20 kg S/ha** | 53.09 | 3.07 | **10.63** |
| **$T_{12}$ -50 kg $P_2O_5$ + 30 kg S/ha** | 57.12 | 3.37 | **10.84** |
| **SEm±** | 1.37 | 0.03 | **0.03** |
| **CD (p=0.05)** | **4.01** | **0.09** | **0.09** |

**Table.2** Effect of phosphorus and sulphur on yield parameters of linseed

| Treatments | Capsules/plant | Seed yield (Kg/ha) | Straw yield (Kg/ha) |
|---|---|---|---|
| **$T_1$ -30 kg $P_2O_5$ + 0 kg S/ha** | 43.16 | 632.85 | 1720.92 |
| **$T_2$ -30 kg $P_2O_5$ + 15 kg S/ha** | 44.54 | 633.99 | 1758.57 |
| **$T_3$ -30 kg $P_2O_5$ + 20 kg S/ha** | 45.48 | 626.18 | 1736.59 |
| **$T_4$ -30 kg $P_2O_5$ + 30 kg S/ha** | 46.47 | 608.84 | 1747.13 |
| **$T_5$ -40 kg $P_2O_5$ + 0 kg S/ha** | 47.70 | 628.42 | 1745.92 |
| **$T_6$ -40 kg $P_2O_5$ + 15 kg S/ha** | 45.98 | 619.39 | 1769.90 |
| **$T_7$ -40 kg $P_2O_5$ + 20 kg S/ha** | 48.17 | 651.67 | 1752.70 |
| **$T_8$ -40 kg $P_2O_5$ + 30 kg S/ha** | 51.24 | 816.19 | 2050.40 |
| **$T_9$ -50 kg $P_2O_5$ + 0 kg S/ha** | 50.29 | 651.65 | 1755.66 |
| **$T_{10}$ -50 kg $P_2O_5$ + 15 kg S/ha** | 50.32 | 692.29 | 1712.82 |
| **$T_{11}$ -50 kg $P_2O_5$ + 20 kg S/ha** | 50.70 | 715.96 | 1818.82 |
| **$T_{12}$ -50 kg $P_2O_5$ + 30 kg S/ha** | 50.74 | 783.37 | 1976.30 |
| **SEm±** | 0.21 | 11.50 | 25.65 |
| **CD (p=0.05)** | 0.62 | 33.74 | 75.23 |

## Yield attributes

Yield attributes and yield were significantly affected by phosphorus and sulphur application. Linseed fertilized with 40 Kg P2O5 along with 30 Kg S/ha resulted significant increased No. of capsules/plant (51.24). Highest number of capsules/plant was recorded with the application of 40kgs phosphorus and 30 kgs sulphur. The results are in accordance with (Sune *et al.*, 2006). Highest seed yield recorded is (816.19 Kg/ha) and stover yield is (2050.40 Kg/ha).

Increase in the seed yield might be due to vigorous growth which might have helped in higher dry production resulting in more photosynthate accumulation in the sink which ultimately reflected interms of higher seed yield reported by (Awasti *et al.*,1989) and (Vashistha *et al.*,1993) (Table 1 and 2).

In conclusion, it is inferred from the present investigation that application of 40 Kg P2O5 along with 30 Kg S/ha in addition to the full doses of nitrogen and potassium is recommended for receiving higher growth and yield of Linseed.

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