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VB Awasarmal
Associate Professor, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

SV Thombre
Assistant Professor, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

AB Thombre
PG Scholar, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

AR Shikari
M.Sc (Agri), Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Corresponding Author:
VB Awasarmal
Associate Professor, Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Effect of sulphur levels and spacings on yield and economics of Linseed (*Linum usitatissimum* L.)

VB Awasarmal, SV Thombre, AB Thombre and AR Shikari

Abstract
The field experiment was conducted during *rabi* season 2020-21 at Department of Agronomy, College of Agriculture, Parbhani with a view to study Effect of sulphur levels and spacings on yield and economics of Linseed. The experiment was conducted in split plot design consisting of 12 treatments replicated thrice. The gross and net plot sizes were 5.4 m x 4.5m and 4.8 m x 4.2 m respectively. The seeds were sown at different spacings as per treatments. Results found that post harvest studies like weight of capsules plant^{-1}, number of seeds capsule^{-1}, weight of seeds plant^{-1} were recorded significantly superior in treatment T_4 *i.e.*, spacing of 45 cm x 15 cm. Whereas, seed yield (kg ha^{-1}) was significantly higher in narrow spacing *i.e.*, 30 cm x 10 cm (T_2). But sulphur showed significant difference in all cases. In treatments where 20 kg sulphur (Bensulf (S-90%)) per ha was applied (S_3) recorded significant result than rest of the treatments. Net monetary return and B: C ratio was highest in treatment T_2 (30 cm x 10 cm) and S_3 (20 kg ha^{-1}). Thus, it was concluded that treatment T_2 (30 cm x 10 cm) and S_3 (20 kg ha^{-1}) was productive and profitable as compared to all other treatment.

Keywords: Linseed, spacings, sulphur levels, seed yield, economics

Introduction
Linseed (*Linum usitatissimum* L.) also known as flax, is one of the earliest cultivated field crops and belongs to family Linaceae. Sulphur (S) plays an important role in determining the quality of oil derived from these crops. Sulphur is required for the formation of proteins, vitamins and chlorophyll. Use of sulphur free fertilizers is one of the main reasons for the shortage of sulphur in Indian soils. A balanced fertilization which includes sulphur is necessary for the quality growth of oilseed crops. The use of sulphur is one of the most important factors in increasing yields. Sulphur plays an important role in the formation of amino acids, synthesis of proteins, chlorophyll and oil (Singh and Singh, 2007) [11]. Balanced use of sulphur commensurate with crop needs and soil nutrient status is indispensable for sustained production of high yield level. Experimental evidences indicate that sulphur is most essential plant nutrient which is generally lacking in Indian soil. Sulphur is also associated with flowering, nodulation and the quality of oilseeds. The sulphur deficiency disrupts nitrogen metabolism, reduce protein quality and induces carbohydrates accumulation. Spacing is dependent upon the expected growth of a particular crop and variety in a given agro-climatic condition. Therefore, optimum plant spacing is one of the most important factors in increasing the yield hectare^{-1}. At closer spacing, number of capsules per plant, number of seed per capsule, weight of capsule and seed weight per plant were decreased and vice versa. Therefore, it is necessary to find out the optimum plant population for getting higher yield.

Materials and Methods
The current study was conducted at the Agricultural Research Farm within the Department of Agronomy at the College of Agriculture in Parbhani, Maharashtra, during the Rabi season. The soil in the experimental area had a clayey texture and a slightly alkaline pH, with low levels of organic carbon, available nitrogen, and phosphorus, but moderately high levels of available potassium. The field experiment followed a Split plot design with three replications, and the gross plot size was 5.4 m × 4.5 m. The treatments included four different spacings as main plot treatments and three levels of sulphur as sub-plot treatments. The main plot treatments (spacing) were designated as follows: T_1: 30 × 15 cm², T_2: 30 × 10 cm², T_3: 45 × 10 cm² and T_4: 45 × 15 cm².The sub-plot treatments (sulphur levels) were designated as: S_1: 0 kg ha^{-1}, S_2: 10 kg ha^{-1}, S_3: 20 kg ha^{-1}.

Seeds of the LSL-93 variety were sourced from the Oilseed Research Station in Latur, V.N.M.K.V., Parbhani. Sowing was carried out by dibbling the seeds at a depth of 5 cm, following the specified spacing for each treatment. Gap filling was promptly performed after emergence, and thinning took place 12 days after sowing. The produce from each designated plot was harvested, appropriately labelled, bundled, and placed in the threshing yard. After thorough drying, the bundles were threshed, winnowed, and cleaned, with the weight of the seeds recorded for analysis.

Results and Discussion

Post harvest studies

Number of capsules plant^{-1}

Data pertaining to number of capsules plant^{-1} as influenced by different treatments are presented in Table 1. The mean number of capsules recoded at harvest was 64.07 plant^{-1}. The spacing of 45 cm x 15 cm (T_4) produced maximum number of capsules plant^{-1} (66.81) over spacing 30 cm x 15 cm (T_1) and 30 cm x 10 cm (T_2) however it was at par with treatment T_3 (45 cm x 10 cm). Wider spacing promotes increase in number of branches which results in production of more number of reproductive structure. This was might be due to less competition between plants for nutrient, soil moisture, space and solar radiation etc. in wider spacing than closer spacing. This also confirms the results of Kushwaha *et al.* (2020) [8] and Chaudhary (2009) [3]. The application of 20 kg sulphur ha^{-1} (S_3) recorded significantly higher number of capsules plant^{-1} (68.37) than rest of the treatments. Lowest number of capsules were recorded by S_1 (32.99) where no sulphur was given. This might be due to availability of sulphur which leads to increase in synthesis of fatty acid and increased protein content that had increased more capsules plant^{-1}. These results coincide with the findings of Ghosh *et al.* (2000) [5] Banerjee *et al.* (2001) [2] and Bainade *et al*. (2019) [1].

The interaction effect of spacings and sulphur levels on number of capsules plant was found non-significant.

Weight of capsules plant^{-1} (g)

The data on weight of capsules plant^{-1} recorded at harvest is presented in Table 1. Mean weight of capsules plant^{-1} recorded was 4.86 g. The data presented in Table 1 revealed that among different spacings. Treatment T_4 (45 cm x 15 cm) recorded maximum weight of capsule plant^{-1} (5.79 g) which was at par with T_3 (45 cm x 10 cm) over rest of the treatments. Lower weight of capsule plant^{-1} was observed in narrow spacing T_2 (30 cm x 10 cm). This was due to wider spacing which produces a greater number of capsules plant^{-1}. Similar results were recorded by Gaikwad *et al*. (2016) [4]. Data of sulphur levels showed that application of 20 kg sulphur ha^{-1} recorded highest weight of capsule plant^{-1} (7.91 g) and was significantly superior over rest of the treatments *i.e.*, S_1 (control) & S_2 (10 kg ha^{-1}).

The interaction effect of spacing and sulphur levels on weight of capsules plant^{-1} was absent.

Weight of seeds plant^{-1} (g)

Mean weight of seeds plant^{-1} was given in Table 1. The mean seeds weight plant-1 was found 3.44 g. Spacing of treatment T_4 (45 cm x 15 cm) produced maximum weight of seeds plant^{-1} over treatment T_1 (30 cm x 15 cm) and T_2 (30 cm x 10 cm) however it was at par with treatment T_3 (45 cm x 10 cm). This might be due to timely sown crop which gets favourable weather conditions for longer duration and thus recorded better growth and yield attributes. Similar results were also recorded by Chaudhary (2009) [3] and Shinde *et al.* (2011) [9]. In case of sulphur levels, application of 20 kg sulphur ha^{-1} recorded highest weight of seeds plant^{-1} than rest of the treatments. It was observed that 20 kg sulphur ha^{-1} was significant. Sulphur application has been reported to increase in weight of seeds due to proper partitioning of photo syntheses from source to sink.

There was no significant interaction between spacing and sulphur levels that could influence weight of seeds plant^{-1}.

Number of seeds capsule^{-1}

Number of seeds capsule^{-1} was unaffected with both spacings and sulphur levels. Data on mean number of seeds per capsule was not influenced with different treatments, neither with spacing nor with sulphur levels. Mean number of seeds per capsule was 6.94.

Interaction between spacing sand sulphur levels was non-significant for number of seeds capsule^{-1}.

Seed yield (kg ha^{-1})

The data of seed yield was presented in Table 1. Mean seed yield recorded was 855.72 kg ha^{-1}. Among different spacing on seed yield presented in Table 1 revealed that the treatment T_2 (30 cm x 10 cm) produced significantly highest seed yield which was found at par with treatment T_1 (30 cm x15 cm) than rest of the treatments. This may be due to greater planting density as optimum plant population was very important yield component in field crops (Khare *et al*. 1996) [7]. Significantly highest seed yield was recorded with the application of 20 kg sulphur ha^{-1} than rest of the treatments *i.e.*, S_1 (control) and S_2 (10 kg ha^{-1}). Increase in seed yield with increase in sulphur level was might be due to the reason that sulphur was involved in the formation of chlorophyll, which promotes photosynthesis and activation of enzyme (Jimo & Singh 2017) [6]. Lowest seed yield was recorded in treatments where sulphur was not applied. Sulphur application has been reported to favour yield due to proper partitioning of photo syntheses from source to sink (Singh *et al.* 2013) [10].

The interaction of spacings and sulphur levels on seed yield was not found significant.

Table 1: Number of capsules plant^{-1}, Weight of capsules plant^{-1} (g), Weight of seeds plant^{-1} (g), Number of seeds capsules^{-1} and Seed yield (kg ha^{-1}) of linseed as influenced by different treatments

Treatments	Number of capsules plant^{-1}	Weight of capsules plant^{-1} (g)	Weight of seeds plant^{-1} (g)	Number of seeds capsules^{-1}	Seed yield (kg ha^{-1})
Spacings (cm)					
T_1: 30 cm x 15 cm	55.50	4.05	2.96	6.82	927.40
T_2: 30 cm x 10 cm	51.91	3.91	2.75	6.68	1022.13
T_3: 45 cm x 10 cm	67.89	5.70	3.70	7.03	789.65
T_4: 45 cm x 15 cm	80.97	5.79	4.35	7.26	683.72
SE ±	6.68	0.69	0.49	1.92	86.41
CD at 5%	16.35	1.69	1.20	NS	211.46
Sulphur levels (kg ha^{-1})					
S_1: 0	42.94	1.73	1.03	6.03	619.44
S_2: 10 kg ha	64.41	4.96	3.43	7.37	856.61
S_3: 20 kg ha	84.87	7.91	5.88	7.43	1091.14
SE ±	6.60	0.80	0.73	4.86	77.97
CD at 5%	19.80	2.41	2.21	NS	233.76
Interaction (T X S)					
SE ±	9.68	1.1	0.92	5.50	119.61
CD at 5%	NS	NS	NS	NS	NS
GM	64.07	4.86	3.44	6.94	855.72

Economics

Gross monetary returns (Rs ha^{-1})

The data of GMR revealed that differences in GMR was significant in spacing as well as in sulphur levels. Narrow spacing of treatment T_2 (30 cm x 10 cm) produced significantly higher gross monetary returns which was at par with treatment T_1 (30 cm x 15 cm) and T_3 (45 cm x 10 cm) over rest of the treatments i.e., T_4 (45 cm x 15 cm). In case of sulphur levels, significantly higher level of sulphur dose i.e., 20 kg ha-1 recorded maximum GMR over S_1 (control) and S_2 (10 kg ha-1). This might be due to seed yield, straw yield and biological yield which was higher in treatment T_2 (30 cm x 10 cm).

Interaction between spacing and sulphur levels for gross monetary returns was non evident.

Net monetary returns (Rs ha^{-1})

Data regarding net monetary returns showed that different treatments showed significant difference in NMR. Mean net monetary return recorded was Rs 25,455 ha^{-1}. Among different spacing closer spacing of 30 cm x 10 cm produced maximum net monetary returns. Highest Net Monetary Return recorded by treatment T_2 (30 cm x10 cm) is Rs 34338 ha^{-1} however it was at par with treatment T_1 (30 cm x10 cm) and T_3 (45 cm x10 cm). Among sulphur levels application of 20 kg sulphur ha^{-1} recorded highest NMR (Rs 36,655 ha^{-1}) over rest of the treatment. Lowest NMR was observed in treatments where sulphur was not applied i.e., S_1 (control).

Interaction between spacing and sulphur levels for net monetary returns was non-significant.

B: C ratio

Data pertaining to Benefit: Cost ratio as influenced by various treatments are presented in Table 2. The mean Benefit: Cost ratio was recorded 1.2. The higher Benefit: Cost ratio (1.56) was recorded by the treatment T_2 (30 cm x 10 cm). Lowest B: C ratio was recorded in treatment T_4 (45 cm x15 cm). In case of sulphur levels Benefit: Cost ratio (1.56) was recorded maximum by S_3 (20 kg ha^{-1}) then followed by S_2 (1.2) and S_1 (0.65).

Table 2: Gross Monetary Returns, Net Monetary Returns and B: C ratio of linseed as influenced by different treatments

Treatments	GMR (Rs ha^{-1})	NMR (Rs ha^{-1})	B:C ratio
Spacings (cm)			
T_1: 30 cm x 15 cm	50985	29545	1.37
T_2: 30 cm x 10 cm	56210	34338	1.56
T_3: 45 cm x 10 cm	43450	22010	1.02
T_4: 45 cm x 15 cm	37620	16471	0.77
SE ±	4814	4621	-
CD at 5%	12864	12478	-
Sulphur levels (kg ha^{-1})			
S_1: 0	34100	13528	0.65
S_2: 10 kg ha	47135	25637	1.20
S_3: 20 kg ha	60005	36655	1.56
SE ±	4505	3925	-
CD at 5%	12820	10989	-
Interaction (T X S)			
SE ±	6305	6145	-
CD at 5%	NS	NS	-
GM	47072	25455	1.2

Conclusion

Among the different treatments, spacing of 30 cm x 10 cm was found productive and profitable as compared to 45 cm x 15 cm, except spacing of 30 cm x 15 cm and 45 cm x 10 cm. Among different sulphur levels, application of 20 kg ha^{-1} was found economically feasible than rest of the treatments.

References

1. Bainade SP, Parlawar ND, Korade SB, Hivare VS. Effect of sulphur on growth, yield and quality parameters of linseed (*Linum usitatissimum* L.). J Soils Crops. 2019;29(1):136-139.
2. Banerjee S, Basu TK, Bahowmick N, Bhattacharya J. Effect of potassium and sulphur on growth attributes, yield parameters and seed yield on linseed. J Interacademicia. 2001;5(3):318-325.
3. Chaudhary S. Study on row spacings for different varieties of linseed (*Linum usitatissimum* L.). Int J Plant Sci (Muzaffarnagar). 2009;4(2):373-374.
4. Gaikwad SR, Bhusari SA, Mane SG, Suryavanshi VP. Effect of spacing on growth and yield of linseed (*Linum usitatissimum* L.) varieties. Seed. 2020. p. 2.

5. Ghosh PK, Hati KM, Mandal KG, Misra AK, Chaudhary RS, Bandyopadhyay KK. Sulphur nutrition in oilseeds and oilseed-based cropping systems. Fertiliser News. 2000;45(8):27-40.
6. Jimo H, Singh R. Effect of sources and doses of sulphur on yield attributes, yield and quality of linseed (*Linum usitatissimum* L.). J Pharmacogn Phytochem. 2017;6(4):613-615.
7. Khare JP, Sharma RS, Dubey MP. Effect of row spacing and nitrogen on rainfed linseed (*Linum usitatissimum* L.). Indian J Agron. 1996;41(1):116-118.
8. Kushwaha S, Shrivastava A, Namdeo KN. Effect of sulphur on growth, yield and quality of linseed (*Linum usitatissimum* L.) genotypes. Ann Plants Soil Res. 2020;21(2):162-166.
9. Shinde SD, Raskar BS, Tamboli BD. Effect of spacing and sulphur levels on productivity of sesame (*Sesamum indicum* L.) under summer condition. J Maharashtra Agric Univ. 2011;36(1):28-31.
10. Singh DN, Bohra JS, Singh JK. Influence of NPK, S and variety on growth, yield and quality of irrigated linseed (*Linum usitatissimum* L.). Indian J Agric Sci. 2013;83(4):456-458.
11. Singh S, Singh V. Effect of sources and levels of sulphur on yield, quality and nutrient uptake by linseed (*Linum usitatissimum* L.). Indian J Agron. 2007;52(2):158-159.