

Original Research Article

A Meta Analysis of the Effects of Different Levels of Phosphorus Supply on the Growth of Linseed crop (*Linum usitatissimum* L.)

Abstract:

During Rabi season of 2022-23, a field experiment was carried out at SAGE Agricultural farm under the aegis of School of Agriculture, SAGE University, Bhopal (M.P). The study aimed to investigate the "A Meta Analysis of the Effects of Different Levels of Phosphorus Supply on the Growth of Linseed crop (*Linum usitatissimum* L.)" under irrigated conditions." The experimental design employed for the study was Randomized Block Design (RBD) having Factorial arrangement with three replications covering an area of 215 square meters. In this experiment, fifteen distinct treatments combinations including five varying levels of phosphorus application as P1- 0 kg/ha, P2- 30 kg/ha, P3- 40 kg/ha P4- 50 kg/ha, and P5- 100Kg/ha were used. It was found that highest plant height (75.8 cm), highest number of branches per plant (4.41), highest maximum dry weight (10.84 g), highest number of capsules (42.9), test weight (8.02 g), highest seed yield (1.01q/ha), and stover yield (2.84 q/ha) at maximum crop growth stage was recorded in plots treated with application of phosphorus @ 100 kg/ha in combination. It was concluded from the results that linseed 100Kg/ha observed maximum in all the three attributes namely growth, yield and economics.

Keywords: Linseed, Phosphorus, Quality, Stover yield, Yield

Introduction

India is one of the major oilseeds grower and importer of edible oils in the world. India stands at rank 4th in vegetable oil economy. The oilseed accounts for 13% of the Gross Cropped Area, 3% Gross National Product and 10 % of the value of all agricultural commodities. Almost 72% of the total oilseeds area is confined to rainfed condition and cultivated mostly by marginal and small farmers of India. India has been cultivating almost all oilseed crops. Major ones are Soybean,

Groundnut, Rapeseed-Mustard, Sesame, Sunflower, Castor, Safflower, Linseed and Niger. Among the nine oilseed crops in India, the highest average contribution to total production of oilseeds is of soybean (38%) followed by Rapeseed-Mustard (27%) and groundnut (27%) (Average of 2016-17 to 2020-21). Similarly, highest average area contribution to total oilseed area is of soybean (44%) followed by Rapeseed-Mustard (24%) and Groundnut (20%). On an average, total Kharif oilseed crops contribution to total production is about 67% and the remaining 33% is of Rabi / summer oilseed crops. Lack of appropriate technologies, cultivation under input-scarce conditions, combating the biotic and abiotic stresses are some of the major causes for poor productivity of Oilseeds. Although launching of Technology Mission on Oilseeds was a major breakthrough in increasing Oilseeds production in which an integrated approach was used for introducing new crop production technologies, better supply of inputs and extension services support for marketing, post-harvest technologies and excellent coordination/cooperation between various concerned organizations/ departments and Ministries. Oilseed crops are grown for the purpose of extraction of oil, which is found in their seeds. Oil content of different oilseed crops varies from 20% for Soybean to 40% of Sunflowers etc. Seed oils have enormous uses in industrial as well as edible purposes. Studying the production, cultivation and sustainable usage of oilseed crops and looking forward to its future applications including biodiesel and bio-energy production from oilseed crops is the concern of the researchers. (Solo *et al.*, 2021).

Among oilseeds, Linseed enjoys an important place, being used for domestic, medicinal, edible and industrial purposes (Meena *et al.*, 2011). Linseed (*Linum usitatissimum L.*) is also known as flax and is a member of family Linaceae. Linseed is a self-pollinated crop considerably shaped to temperate climate. In India, linseed has been cultivated from pre-historic times. Linseed is basically an industrial oilseed crop and its each and every part is endowed with commercial and medicinal importance.

India ranks fifth in the world after Canada in terms of area and third with respect to Linseed production. Almost every part of the linseed plant is utilized either directly or after processing for commercial purpose. The average yield of 544 kg/ha in India was found to be very low compared to the world average yield of 927 kg/ha and highest average yield of 1497 kg/ha in Canada (FAOSTAT, 2018) . The major factors found responsible for low yield of oilseed crops are poor fertile conditions of the soil, traditional crop management practices and inadequate supply of fertilizers. Among these, the imbalance of nutrients appears to be the most crucial one. Research studies have validated that the crop yield can be elevated by choosing varieties of linseed that are high yielding along with considerable supply of nutrients through fertilizers (Jain *et al.*, 1989).

Phosphorus(P) is usually associated to increased root density proliferation, which aids in extensive exploration, supply of nutrients and water to growing plant parts, thus increase growth and yield (Awasthi *et al.*, 2019). Phosphorus is a element of crucial molecules similar as nucleic acids, phospholipids and ATP. It's necessary for maintenance and transmission of energy, transfer of inheritable characteristics and salutary for root development, vigorous growth, better yield and quality and bump conformation in oil painting seed crops. Phosphorus is an important factory nutrient which help in growth and development of a factory and eventually better crop yield. It involves in numerous biochemical functions in physiological system of a factory. It is essential part of skeleton of plasma membrane, nucleic acid, many co – enzymes and phospho related compound. It also stimulates fruit setting and seed formation (Yawalkar *et al.*, 2002).

Since last few decades, the growth, development and productivity of oilseed crops have been hampered due to a number of factors including the unbalanced plant mineral nutrient in soil. In fact, the extra pressure on the limited land resources and use of high yielding varieties to feed rapidly increasing production have led to the present scenario of shortage of important plant mineral nutrient in major soils on the globe. The deficiency of soil P & S in the agriculture soil has been reported frequently over the past several years (Patil *et al.*, 2018). Taking this into account a study entitled "A Meta Analysis of the Effects of Different Levels of Phosphorus Supply on the Growth of Linseed crop (*Linum usitatissimum* L.)".

Material and Method

The field experiment was conducted on the SAGE Agricultural Farm, SAGE University,

Bhopal in Rabi season 2022-23. The experiment was laid out in Factorial Randomized Block Design (FRBD) replicated four times with net plot size 3.60 x 2.40 m². The soil of the experimental plot was well drained and sandy loam in texture with pH 6.3, available N 293.08 kg ha⁻¹, P₂O₅ 22.4 kg ha⁻¹, K₂O 210.3 kg ha⁻¹ and S 8.50 mg kg⁻¹. Different rates of phosphorus were applied to the plots as per treatments. The treatment comprised of 5 levels of P (0, 30, 40, 50 and 100 kg ha⁻¹). The sowing was done on November 22, 2023 with healthy viable seed @35 kg ha⁻¹ was used for sowing in furrows with spacing of 30cm x 10cm. The data were recorded at 30, 60, and 90 and at harvest. Crop was raised with recommended package of practice and was harvested at maturity during the April 20, 2023. The seed and stover yield were recorded treatment wise and were separated, air dried; all parameters were analyzed by following standard statistical procedure. Half dose of phosphorus was applied as basal dose and remaining half dose of phosphorus was applied in two equal splits during first and second irrigation. All the other agronomic practices were applied uniformly to all the treatments.

RESULTS AND DISCUSSION

Effect of Phosphorus on Growth attributes

Data presented in Table 1 revealed the effect of different phosphorus levels on growth of Linseed (*Linum usitatissimum* L.). Three growth attributes were considered for observations in this experiment i.e. plant height (cm) number of branches per plant and dry weight. The growth parameters of Linseed were significantly influenced with increasing the levels of Phosphorus. The highest (75.8 cm) plant height was recorded in T4 (100 kg/ha Phosphorus in the form of P₂O₅) which was significantly superior over all the treatment combinations. Number of branches per plant and dry weight per plant were significantly influenced by the increased levels of phosphorus. Maximum (4.41) branches per plant and highest (10.84 g/plant) dry weight were observed in T5 (100 kg/ha Phosphorus). On the other hand, the lowest plant height was observed in the P0 treatment under without phosphorus was applied @ 0 kg/ha. This might be due to higher availability of P and their uptake that progressively enhanced the vegetative growth of the plant. The increased number of leaves that produce more nutrients for the plant's growth may account for the rapid increase in height seen in the early stages of development. In fact, larger leaves were responsible for making more photosynthates, which made it easier for cells to divide and made the plants

grow quickly. The increase in plant height and number of branches per plant was also reported by Bharat *et al.* (2013), Kumar *et al.* (2016) and Vyasa *et al.* (2020).

Table.1 Effect of Phosphorus on Growth parameters of Linseed (90 DAS)

Treatments	Plant height (cm)	No. of branches /plant	Dry weight (g/plant)
T1 - 0 Kg P ₂ O ₅	72	3.17	7.39
T2 - 30 Kg P ₂ O ₅	74.2	3.48	7.90
T3 - 40 Kg P ₂ O ₅	74.8	3.69	8.24
T 4- 50 Kg P ₂ O ₅	75	4.22	10.51
T 5- 100 Kg P ₂ O ₅	75.8	4.41	10.84
SEm±	0.228	0.137	0.03
CD (p=0.05)	0.643	5.945	0.09

Table.2 Effect of Phosphorus on Yield parameters of Linseed

Treatments	Seeds/ Capsule	Capsules/ plant	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)
T1 - 0 Kg P ₂ O ₅	7.20	35.48	7.0	0.82	1.89
T2 - 30 Kg P ₂ O ₅	7.63	37.14	6.9	0.84	2.07
T3 - 40 Kg P ₂ O ₅	7.86	38.62	7.10	0.91	2.25
T 4- 50 Kg P ₂ O ₅	8.96	41.92	7.15	0.93	2.62
T 5- 100 Kg P ₂ O ₅	9.33	42.90	8.02	1.01	2.84
SEm±	0.18	0.53	0.37	0.03	0.17
CD (p=0.05)	0.65	1.51	1.13	0.15	0.44

Data presented in Table 2 indicated the effect of phosphorus levels on yield of Linseed (*Linum*

usitatissimum L.). The yield characters that were considered in this experiment are seeds/capsule (No.), capsules/plant (No.), test weight (g), seed yield (t/ha) and stover yield (t/ha). The yield attributes of linseed were significantly influenced with increasing the levels of phosphorus. Significantly Maximum number of (9.33) seeds/capsule was obtained with the application of T5 (100 kg/ha Phosphorus). The highest (42.90) number of capsules/plant was recorded in T5 (100 kg/ha Phosphorus) which was significantly superior over all other treatments. Significantly maximum (8.02 g) test weight of seed was found with application of highest treatment combination i.e. of T5 (100 kg/ha Phosphorus) Highest (1.01 t/ha) seed yield was recorded in T5 (100 kg/ha Phosphorus). In stover yield highest (2.84 t/ha) significant value was shown in T5 (100 kg/ha Phosphorus). Application of each increasing level of phosphorus significantly increased the number of seeds/ capsules, capsules/plant and test weight. Application of nitrogen & phosphorus might exert flower initiation and seeds/capsules by increasing the rate of photosynthesis and transport of source to sink sites. The tissue differentiation caused by phosphorus application resulted into greater production of flowers which later develops into capsules which is similar to the results of Kalita *et al.*, (2005) and Singh *et al.*, (2013). The higher yield of linseed can be ascribed due to higher values of growth parameters like plant height, number of branches plant-1 which was reported by Kashyap *et al.*, (2018). The seed yield is increased due to overall improvement in plant vigour and production of sufficient photosynthates owing to higher availability of P resulting in better yield attributes viz. capsules/plant, seeds/capsule, 1000- seed weight was finally reflected to seed yield. Thereafter, the increase in fertilizer dose significantly improves stover yield, this might be due to higher supply of nutrients to the linseed crop upon use of fertilizer dose thereby resulting in better growth and development of the crop. The similar findings were also witnessed by Gupta *et al.*, (2017) and Tanwar *et al.*, (2011).

Table.3 Effect of Phosphorus on Economical parameters of Linseed (90 DAS)

Treatments	Cost of cultivation (INR /ha)	Gross returns (INR /ha)	Net returns (INR /ha)	B: C ratio
T1 - 0 Kg P ₂ O ₅	48185	72625.00	42440	0.84
T2 - 30 Kg P ₂ O ₅	49822	77175.56	37353	0.92
T3 - 40 Kg P ₂ O ₅	50070	115244.15	61455.90	1.27
T 4- 50 Kg P ₂ O ₅	50473	100800.23	60327	1.20
T 5- 100 Kg P ₂ O ₅	51370	116601.45	65231.45	1.33

Data presented in Table 3 shows the economics performance of different treatment combination evaluation based on cost of cultivation (INR/ha), gross return (INR/ha), net return (INR/ha) and benefit cost ratio (B: C). Highest cost of cultivation (51370 INR/ha), gross return (116601.45 INR/ha), net return (65231.45INR/ha) and benefit cost ratio (1.33) were found with the application of T5 (100 kg/ha Phosphorus). Increasing levels of phosphorus significantly increased the net returns and benefit cost ratio. The gross monetary return and net monetary returns were influenced variably due to different levels of fertilization. It Similar results were recorded by Gaikwad *et al.*, (2020) and Patel *et al.*, (2012), Kumar and Deka (2016).

Conclusion

On the basis of the seasonalexperiment in Linseed it may be concluded that the application of 100 kg of Phosphorus/ha showcased superiority in growth and yield attributing characters such as seed yield (1.20 t/ha) and stover yield (2.84 t/ha) and as well as it is economically more profitable, hence it is more desirable and preferable to farmers for uplifting their socio-economic condition and fetching remunerative fair price to the farming community.

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