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RESEARCH ARTICLE

EFFECT OF SPACING AND PHOSPHORUS LEVELS ON GROWTH AND YIELD OF LINSEED (*LINUM USITATISSIMUM* L.)

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ABSTRACT

The experiment was conducted during the period from November to March, 2020-21 at Crop Research Farm, Department of Agronomy, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj to study the effect of spacing and phosphorus levels on growth and yield of linseed. The variety Neelam was used as test crop during this experiment. It consists of two factors: Factor A: Spacing (3 levels); 20cm×10cm, 30cm×10cm, 40cm×10cm and Factor B: Phosphorus (3 levels); 20, 30 and 40 kg/ha. The experiment was conducted by following a randomized block design with three replications. The results revealed that treatment combination of Spacing at 20cm×10cm + Phosphorus at 40 kg/ha obtained highest in plant height (62.43 cm), dry weight (12.60 g), crop growth rate (5.00 g/m^2/day), relative growth rate (0.013 g/g/day), seeds per capsule (8.46), capsule per plant (52.47), test weight (6.40 g), seed yield (0.82 t/ha), stover yield (2.36 t/ha) and oil content (38.47%) respectively. It may be defined that spacing and phosphorus had a significant influence on the growth and yield of linseed and spacing 20cm×10cm and 40 kg P per hectare can be the optimum dose for attaining higher yield.

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INTRODUCTION

Linseed also referred as flax (*Linum usitatissimum L.*), is a self-pollinated crop widely adapted to temperate climates of the world. It is an annual plant belongs to the genus Linum and the family Linaceae. The name Linum originated from lin or "thread" and the species name usitatissimum is a Latin word meaning "most useful". When grown for fibre it is known as 'flax', if grown for seed oil it is called 'linseed' but when it is cultivated for both fibre and oil it is called 'dual-purpose flax'. It is also popularly known as Alsi, Tisi, Jawas, Aksebija in Indian languages. Linseed is a commercially important oil seed crop grown extensively both for oil and fiber. The linseed seed contains 6.9-7.4% moisture, 30-40% oil, 3.9-4.0% mineral (ash), 20.0- 24.8% protein, 37.8-43.2% fat and 6.8-9.9% crude fiber. India is an important linseed growing country in the world and it contributes 7 percent to the world linseed pool .India holds fifth rank in area with 320 thousand hectares with annual production of 174 thousand tonnes and productivity of 543.80 kg/ha (FAOSTAT, 2020). Major linseed growing states in India are Madhya Pradesh, Uttar Pradesh, Chhatisgarh, Bihar, Rajasthan, Orissa and Karnataka. In Uttar Pradesh, linseed is grown on 1.32 lakh ha with average productivity of 430 kg/ha. Linseed is one of the widely grown economically important species, cultivated in many countries and production share of important countries like Russia (23%), Canada (19.8%), Kazakhastan (19.2%), China (12.4%), USA (7.5%), India (4.3%). The current worldwide acreage of linseed is 3.27 million hectares with a total annual production of 3.18 million tonnes and productivity of 975.10 kg/ha. Spacing plays an important role in increasing production per unit area. Row spacing is an important agricultural factor and has great effect on seed yield and the yield components of individual plants (Diepenbrock, 2000). proper spacing provides interaction of light, satisfactory absorption of nutrients, water from the soil due to proper development of root system and results in higher yield. Therefore, it is necessary to find out the optimum plant population for getting higher yield.

Plant nutrition is key input to increase the productivity. Phosphorus (P) is an important macro nutrient, necessary for the normal growth and development of upper plants. Plants need phosphorus throughout their lifecycle, especially during maturity stage for seed formation and increased seed weight (Lafond *et al.,* 2003).Phosphorus stimulates root development and growth in seedling stage. It also stimulates fruit setting and pod formation (Yawalkar *et al.,* 2002). Phosphorus has significant effect on growth and development of plants along with increase in grain yield of oil seed crops (Grant *et al.,* 2010). (Ahmed *et al.,* 1997) reported that the application of phosphorus plays a vital role in the formation and translocation of carbohydrates, root development, crop maturation and resistance to disease pathogens. It significantly increases seeds/capsule, capsule/plant, seed yield, oil and protein content of cultivar. Keeping the above facts in view, the present experimentation was laid to find the response of linseed to various spacing and phosphorus levels under eastern Uttar Pradesh condition.

MATERIAL AND METHODS

The experiment was carried out during *rabi*, 2020-21 at Crop Research Farm, Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.) which is located at 25^0 24' 42'' N latitude, 81^0 50' 56'' E longitude and 98 m altitude above the mean sea-level.The experiment consisted of nine treatments which were replicated thrice in a randomized block design with three levels of spacing viz. 20cm×10cm, 30cm×10cm and 40cm×10cm and three levels of phosphorus viz. 20, 30 and 40 kg/ha . The treatment combinations which are T_1: S at 20cm×10cm + P at 20 kg/ha, T_2: S at 20cm×10cm + P at 30kg/ha, T_3: S at 20cm×10cm + P at 40 kg/ha, T_4: S at 30cm×10cm + P at 20 kg/ha, T_5: S at 30cm×10cm + P at 30 kg/ha, T_6: S at 30cm×10cm + P at 40kg/ha, T_7: S at 40cm×10cm + P at 20 kg/ha, T_8: 40cm×10cm + P at 30 kg/ha, T_9: 40cm×10cm + P at 40 kg/ha. The recommended dose of 60 kg N, 30 kg P, 20 kg K per ha was applied according to treatment details through Urea, SSP and MOP. Half dose of nitrogen and full dose of phosphorus and potassium were applied as basal application. Split dose of nitrogen is applied 40 days after sowing. Irrigation was based on the necessity and at the time of sowing. Growth attributes Vig., plant height, dry weight, crop growth rate, relative growth rate and Yield attributes Vig., seeds per capsule, capsule per seed, test weight, seed yield, stover yield, harvest index and oil content were recorded with standard basis of observation. The data was analysed statistically by using analysis of variance as applicable in Randomized Block Design (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Growth parameters: Data in Table 1 revealed plant height recorded a significant difference among treatment combinations. However, plant height (62.43cm) recorded significantly higher in S at 20cm×10cm + P at 40 kg/ha which was followed by the treatment combination of S at 30cm×10cm + P at 40 kg/ha (61.90cm) respectively. This is probably due to plant height decreases with increasing row spacing. Higher plant height might be due to unavailability of sufficient space and sunlight which forced the plants to grow vertically rather than horizontally. Increase in plant height be due to Phosphorus fertilization as P is important part of many enzymes that increases growth of plants. These results are in close conformity with Kumar *et al.* 2015 Ganvit *et al.* 2019 and Muhammad *et al.* 2020. Data presented in Table 1 show that dry weight recorded at harvest stage was found significant effect among treatments. However, highest dry weight (12.60 g) were recorded in S at 20cm×10cm + P at 40 kg/ha which is significantly superior over all treatments. Increase in dry matter production per plant might be the result of better growth and greater no of branches which might have resulted in higher photosynthetic activity and formation of more photosynthate. Production of more dry matter yield could be most probably due to positive interaction of P with other available soil nutrients and then efficiently utilizing of nutrients which in turn reflects in higher accumulation of dry matter. These results are in close conformity with Vyas *et al.* 2019 and Berhane *et al.* 2016.

Data depicted in Table 1 indicated that significantly higher crop growth rate (5.0 g/m^2/day) were recorded in S at 20cm×10cm at 40 kg/ha and in 30cm×10cm+ P at 30kg/ha . While at par values was observed in S at 20 cm × 10 cm + P at 30 kg/ha, S at 30 cm × 10 cm + P 30 kg/ha, S at 40 cm × 10 cm + P at 30 kg/ha and S at 40 cm × 10 cm + P at 40 kg/ha (3.30 g/m^2/day). Crop growth rate is a function of dry mater accumulated by the crop plant. Increase in dry weight due to P application could attribute to the fact that phosphorus is known to help in development of more extensive root system and thus enables plants absorb more water and nutrients from depth of soil. This in turn could enhance plant's ability to produce more assimilates which results in higher accumulation of dry matter. This is also conforms the results of Gobarah *et al.* 2006. Data in table 1 revealed that relative growth rate recorded at harvest stage was found non-significant effect among treatments. However, highest relative growth rate (0.013g/g/day) were recorded in S at 20cm×10cm + P at 40 kg/ha. While lowest relative growth rate (0.008 g/g/day) was observed in S at 40cm×10cm + P at 20 kg/ha respectively.

Yield attributes and Yield: Data in Table 2 revealed number of seeds per capsule recorded a significant difference among treatment combinations. However, significantly highest number of seeds per capsule (8.46) recorded in S at 20cm×10cm + P at 40 kg/ha which was followed by the treatment combination of S at 30cm×10cm + P at 40 kg/ha (8.40) respectively. Data presented in Table 2 show that number of capsule per plant recorded a significant effect among treatments. However, highest number of capsule per plant (52.47) were recorded in S at 20cm×10cm + P at 40 kg/ha which was followed by the treatment combination of S at 40cm×10cm+P at 40 kg/ha (51.5) respectively. Data depicted in Table 2 indicated that higher test weight (6.40 g) were recorded in S at 20 cm×10cm + P at 40 kg which was significantly superior over all treatments. The three main yield components of seed yield, i.e., no of capsules/plant, no of seeds/capsule and seed weight increased with application of P with adequate rates. These results are in conformity with Hocking and Pinkerton (1993) and Lafond *et al. 2003.*Data in table 2 revealed that seed yield was significantly higher in S at 20 cm×10cm + P at 40 kg (0.82 t/ha) which was on at par with S at 30cm×10cm + P at 40 kg/ha (0.81 t/ha) respectively.seed yield maximized at closer spacing of 20cm. such higher yield at 20cm spacing seems to be associated with no of plants/unit area which also maximized at same closer spacing. These results are in conformity with Kumar *et al.* 2015.

Table.1 Effect of Spacing and Phosphorus levels on growth parameters of Linseed

Treatments	Plant height (cm)	Dry weight (g)	Crop growth rate ($g/m^2/day$)	Relative growth rate (g/g/day)
S at 20cm×10cm + P at 20 kg/ha	55.31	11.54	2.50	0.011
S at 20cm×10cm + P at 30 kg/ha	58.25	11.97	3.30	0.011
S at 20cm×10cm + P at 40 kg/ha	62.43	12.60	5.00	0.013
S at 30cm×10cm + P at 20 kg/ha	53.54	11.48	2.50	0.010
S at 30cm×10cm + P at 30 kg/ha	57.66	11.85	3.30	0.011
S at 30cm×10cm + P at 40 kg/ha	61.90	12.42	5.00	0.013
S at 40cm×10cm + P at 20 kg/ha	50.41	11.35	2.50	0.008
S at 40cm×10cm + P at 30 kg/ha	56.48	11.70	3.30	0.011
S at 40cm×10cm + P at 40 kg/ha	59.5	12.3	3.3	0.012
F- test	S	S	S	NS
SEm ±	0.70	0.01	0.59	-
CD (P=0.05)	1.33	0.03	1.78	-

Table 2. Effect of Spacing and Phosphorus levels on yield attributes and yield of linseed

Treatments	Seed per capsule	Capsule per plant	Test weight (g)	Seed yield (t/ha)	Stover yield (t/ha)	Harvest index (%)	Oil content (%)
S at 20cm×10cm + P at 20 kg/ha	8.15	44.33	6.08	0.68	1.81	27.30	36.27
S at 20cm×10cm + P at 30 kg/ha	8.30	45.33	6.24	0.77	1.95	26.47	37.39
S at 20cm×10cm + P at 40 kg/ha	8.46	52.47	6.40	0.82	2.36	25.78	38.45
S at 30cm×10cm + P at 20 kg/ha	8.07	49.47	5.91	0.63	1.76	26.35	36.02
S at 30cm×10cm + P at 30 kg/ha	8.24	50.20	6.20	0.74	1.89	28.13	37.38
S at 30cm×10cm + P at 40 kg/ha	8.40	46.33	6.36	0.81	2.08	28.02	37.50
S at 40cm×10cm + P at 20 kg/ha	8.05	48.33	5.81	0.61	1.73	26.06	35.24
S at 40cm×10cm + P at 30 kg/ha	8.20	50.00	6.14	0.72	1.87	27.79	36.31
S at 40cm×10cm + P at 40 kg/ha	8.3	51.5	6.3	0.8	2.0	28.57	37.4
F- test	S	S	S	S	S	S	S
SEm ±	0.04	0.41	0.006	0.003	0.007	0.63	0.63
CD (P=0.05)	0.15	1.25	0.02	0.01	0.02	1.91	1.92

Data in table 2 revealed that significantly higher stover yield was recorded in S at 20 cm×10cm + P at 40 kg (2.36 t/ha) which was superior over all treatments. Higher straw yield might be due to healthy vegetative growth in terms of plant height obviously resulted in to more straw yield. This also conform the results of Ganvit *et al.* 2019. Data in table 2 revealed that highest harvest index was recorded in S at 40cm×10cm + P at 40 kg/ha (28.57%) which was on at par with S at 20cm×10cm + P at 20 kg/ha, S at 30cm×10cm+P at 30 kg/ha, S at 30cm×10cm + P at 40 kg/ha and S at 40cm×10cm + P at 30 kg/ha (27.30, 28.13, 28.02 and 27.79 %). Data in table 2 revealed that highest oil content was recorded in S at 20cm×10cm + P at 40 kg (38.47%) which was on at par with S at 20 cm× 10 cm + P at 30 kg/ha, S at 30 cm× 10 cm + P at 30 kg/ha , S at 30 cm× 10 cm + P at 40 kg/ha, and Spacing 40 cm× 10 cm + Phosphorus 40 kg/ha (37.39, 37.38, 37.50 and 37.4%) respectively.

The increase in oil content due to P application could be due the fact that P helped in synthesis of fatty acids and thus esterification by accelerating bio chemical vectors in glyoxalate cycle. These results are in close conformity with Bumbadiya *et al.* 2016.

CONCLUSION

Based on the findings of experimentation in one season in a year, it is concluded that application of spacing at 20cm×10cm as well as phosphorus at 40 kg/ha was found more helpful for attaining better growth and yield in linseed under Eastern U.P. climatic condition.

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REFERENCES

FAOSTAT. Available online at <http://fenix.fao.org/ faostat/ internal/en/#data/QC. 2020>;

Diepenbrock, W., 2000. Yield analysis of winter oilseed rape (*Brassica napus L.*): A review. *Field Crops Research* 67: 35-49.

Lafond, G., Grant, C., Mcandrew, A. and May, W. 2003. Management of nitrogen and phosphorus fertilizer in no-till flax. *Canadian Journal of Plant Sciences* 83: 681-688.

Yawalkar, K.S., Agarwal J.P and Bodke, S. 2002. Manure and fertilizer. 9th revised Edn.pp.8-13.

Grant, C.A., Monreal, M.A., Irvine, R.B., Mohr, R.M., Mclaren, D.L. and Khakbazan, M. 2010. Preceding crop and phosphorus fertilization affect cadmium and zinc concentration of flaxseed under conventional and reduced tillage. Plant and Soil, 333: 337-350.

Ahmed, M.K., Saad, A.O., Thalooth, A.T. and Kabesh, M.O.1997. Response of sesame to inorganic, organic and biofertilizer. *Annals of Agricultural Sciences* 42(2): 365-375.

Kumar, H., Umrao, R. and Tripathi, M.K. 2015.Varietal performance of linseed (*Linum usitatissimum*) planted at different spacing under teak (*Tectonagrandis*) based agroforestry system. *Journal of International Academic Research for Multidisciplinary* ISSN: 2320-5083, Volume 2, Issue 12.

Ganvit, J.B., Sharma, S., Vaishali, H.S and Ganvit, V.C. 2019. Effect of sowing dates and crop spacing on growth, yield and quality of linseed under south Gujarat condition. *Journal of Pharmacognosy and Phytochemistry* 8(1): 388-392.

Muhammad, H.F., Ahmad, A. and Tahir, M. 2020. Response of different phosphorus levels and application methods on the growth, yield and quality of linseed crop. *Biological and Clinical Sciences Research Journal* 2020: e019.

Vyas, V.V., Singh, R. and Singh, E.2020. Effect of different levels of phosphorus and sulphur on growth and yield Linseed (*Linum usitatissimum L.*). *International Journal of Current Microbiology and Applied Sciences* 9(12): 1692-1696.

Berhane, S., Guesh, T. and Melesse, H. 2016. Response of groundnut (*Arachis hypogaea L.*) to different rates of fertilizer at tanqua - abergelle district, Northern Ethiopia. *Basic Research Journal of Agricultural Science and Review* 5(1): 24-29.

Gobarah, M.E., Mohamed, M.H. and Tawfik, M.M.2006. Effect of phosphorus fertilizer and foliar spraying with zinc on growth, yield and quality of groundnut under reclaimed sandy soils. *Journal of Applied Science Research* 2(8): 491-496.

Hocking, P.J and Pinkerton, A. 1993. Phosphorus nutrition of Linseed (*Linum usitatissimum L.*) as affected by nitrogen supply: Effects on vegetative development and yield components. *Field Crops Research* 32: 101-114.

Bumbadiya,N.R., Jakasaniya, M.S., Bhairwa, M. and Hirapara, B.V. 2016. Influence of phosphorus and sulphur application on yield and chemical composition of Linseed (*Linum usitatissimum L.*). *Trends in Biosciences* 9(1): 01-05.

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