Original Research Article

Assessment of effect of Nitrogen and Phosphorus fertilization module on Growth, Yield and Quality of Linseed (*Linum usitatissimum* L.)

Abstract

Quantity of nitrogen and phosphorus assessed for growth, yield and quality of linseed during *rabi* 2022-23 at Agronomy Instructional Farm, Chimanbhai Patel College of Agriculture, S.D.A.U., Sardarkrushinagar. Nine treatment combinations comprising nitrogen (40, 60 and 80 kg N/ha) and phosphorus (30, 40 and 50 kg P2O5/ha) were tested in FRBD and replicated thrice in loamy sand. Significantly higher plant height, branches/plant, capsules/plant, test weight, seed yield (1540 kg/ha), stover yield (2330 kg/ha), oil content in seed, nitrogen (content and uptake), phosphorus uptake by linseed were recorded under 80 kg N/ha. The same treatment gave maximum net realization (Rs.61716/ha) and BCR (2.51). Significantly higher plant height, branches/plant, capsules/plant, test weight, seed yield (1524 kg/ha), stover yield (2297 kg/ha), oil content in seed, nitrogen uptake, phosphorus (content and uptake) by seed and stover recorded under 50 kg P2O5/ha. The same treatment gave maximum net realization (Rs. 59941/ha) and BCR (2.45). Application of 80 kg N/ha and 50 kg P2O5/ha were at par with 60 kg N/ha and 40 kg P2O5/ha, respectively. Based on the result of one year experimentation, it is concluded that to achieve better growth, yield and quality of linseed, it should be fertilized with 60 kg N/ha and 40 kg P2O5/ha.

Keywords: Linseed, Nitrogen, Phosphorus, Capsule, Yield, Quality

Introduction

"Linseed (*Linum usitatissimum* L.) is also known as flax, belongs to the family *Linaceae*. It is also known as *Agasi* or *Akshi* in Kannada, *Jawas* or *Alashi* in Marathi, *Alsi* in Hindi and *Ousahalu* in Telugu. It is worldwide cultivated commonly for flax, while in India it is cultivated for oil. Linseed fibre is amongst the oldest fibre crops in the world after silk" (Hussain *et al*. 2009). In the world, linseed crop cultivated area is 4.14 mha and production is 3.33 mt. Madhya Pradesh, Karnataka, Jharkhand, Bihar, Uttar Pradesh and Chhattisgarh are the leading states in linseed production in India (Anonymous, 2021). "Looking to the area under linseed crop, India is the second largest (21.21%) linseed growing country in the world after Canada and production-wise, it ranks fourth (8.20%) in the world after Canada (40.51%), China (18.68%) and USA (10.89%)". (Saikh *et al*., 2021). "In India, linseed is

cultivated on around 1.83 lakh ha of land with a production of 1.11 lakh tonnes" (Anonymous, 2021).

"Nitrogen is a structural component of chlorophyll and protein therefore adequate supply of nitrogen is beneficial for both carbohydrates and protein metabolism" (Lawania *et al*., 2015). "Excess supply of nitrogen also results in a poorly developed root system, low root/shoot ratio and decrease oil content. Sufficient nitrogen availability is linked to robust vegetative growth and a deep green colour of leaves. It promotes cell division and cell enlargement, resulting in more leaf area and thus ensuring better growth, development, plant vigour and yield" (Patel *et al*., 2017). "Phosphorus is an important plant nutrient that helps in plant growth and development and ultimately improves crop yield. It is an essential part of the skeleton of plasma membrane, nucleic acid, many co-enzymes and phosphorylated compounds. It additionally encourages fruit development and the formation of seeds. In contrast to nitrogen, an excess supply of phosphorus results in increased root growth compared with shoot growth" (Devedee *et al*., 2018). So, the good supply of phosphorus is usually associated with increased root density and proliferation, these structures assist in thorough exploration and the delivery of nutrients and water to the developing plant components, leading to enhanced growth and yield characteristics. Considering the above situation based facts, the present study was conducted to assess the effect of the above nutrients on linseed.

Material and Methods

A field experiment was conducted during *rabi* season 2022-23 to assess the effect of nitrogen and phosphorus on the growth, yield and quality of linseed (*Linum usitatissimum* L.) at Agronomy Instructional Farm, C.P.C.A., S.D.A.U., Sardarkrushinagar. The experiment was laid out in Randomized Block Design with factorial concept and replicated three times. The treatment comprised three levels of nitrogen (40, 60 and 80 kg N/ha) and three levels of phosphorus (30, 40 and 50 kg P2O5/ha). Present experiment was conducted in loamy sand soil with light brown in colour, well-drained, fairly retentive of moisture and low in available nitrogen, while medium in available phosphorus and higher in available potassium. Linseed variety, 'T 397' ware sown at 45 cm row spacing with 20 kg/ha seed rate. Fertilizer application was done as per respective treatments. In which, full dose of phosphorus (thorough SSP) and half dose of nitrogen (through urea) was applied as basal. Whereas, remaining dose of nitrogen (through urea) was top-dressed at 30 DAS. All the agronomic practices were followed as and when required. The biometric observations were recorded

from five randomly selected tagged plants within each net plot for all parameters *viz*., plant height (cm), number of branches/plant, number of capsules/plant and number of seeds/capsule. Apart from this, other parameters such as; test weight (g), seed yield (kg/ha), stover yield (kg/ha), harvest index (%), oil content (%), Gross return, net return and BCR were calculated on net plot basis.

Result and discussion

Effect on growth parameters

Among different levels of nitrogen, significantly higher plant height (59.08 cm) at harvest was recorded with the application of 80 kg N/ha and remained at par with 60 kg N/ha. That might be due to an adequate supply of nitrogen promotes cell division and elongation, which contribute to plant height. It also enhances the production of chlorophyll, which is essential for photosynthesis. Application of 80 kg N/ha also recorded significantly higher number of branches per plant (6.69) and at par results were found with 60 kg N/ha. The results were in accordance with those of Chopra and Badiyala (2016) and Solo *et al*. (2021).

Application of 50 kg P_2O_5/ha recorded significantly higher plant height (58.86 cm) as well as number of branches per plant (6.67). This both parameters remained at par with 40 kg P_2O_5/ha. An increase in plant height and number of branches per plant due to phosphorus could be ascribed to the overall improvement in plant growth, vigour and production of sufficient photosynthetic material. The results were closely related with the finding of Patil *et al*. (2018) and Bunkar and Chaturvedi (2022).

The interaction effect between nitrogen and phosphorus levels for growth parameters of linseed was found non-significant.

Effect on yield attributes and yield

Different levels of nitrogen exerted significant impact on yield attributes and yields of linseed. Significantly higher number of capsules per plant (57.49) was found under 80 kg N/ha. Which was not differ significantly with 60 kg N/ha. Application of 80 kg N/ha also recorded significantly higher test weight (7.65 g) over other nitrogen levels. Significantly superior seed (1540 kg/ha) and stover (2330 kg/ha) yields were obtained when the crop fertilized with 80 kg N/ha. Which remained at par with 60 kg N/ha. Adequate application of nitrogen to crop leads to vegetative growth and subsequently increase flower production, more number of capsule per plant and higher test weight of seed. Cumulative effect of all these parameters resulted in higher seed and stover yield of linseed. These findings were corroborate the results reported by Parmar *et al*. (2020), Solo *et al*. (2021) and Patel *et al*.

(2022). The number of seeds per capsule and harvest index did not affected significantly due to different levels of nitrogen.

Among different levels of phosphorus, significantly higher number of capsules per plant (57.53), test weight (7.66 g), seed yield (1524 kg/ha) and stover yield (2297 kg/ha) were recorded with the application of 50 kg P_2O_5/ha and that ware did not differ significantly with 40 kg P_2O_5/ha. As phosphorus is the main constitute of energy-rich phosphate molecules *viz*., ADP and ATP, which acts as energy currency within the plants, coordinated with demand for the crop development of more reproductive structure eventually, which results in the higher number of capsules per plant and number of seeds per capsule with bold size seeds, due to this reason significantly increased the seed yield of linseed. Similar response trend was also observed by Patil *et al*. (2018), Parmar *et al*. (2020) and Bunkar and Chaturvedi (2022).

Different combinations of nitrogen and phosphorus levels tested in this experiment failed to show its significant effect on yield attributes and yield of linseed.

Effect on quality parameters

Application of 80 kg N/ha recorded significantly higher oil content (39.72%) in seed. Which remained at par with 60 kg N/ha. Adequate nitrogen availability promotes protein synthesis in plants. Proteins are involved in various metabolic pathways, including lipid metabolism and oil synthesis. Higher protein content can contribute to increased oil content in plants. This finding were confirms to those reported by Parmar *et al*. (2020) and Patel *et al*. (2022).

Among different phosphorus levels, 50 kg P_2O_5/ha recorded significantly higher oil content (39.85%) in seed. Which remained at par with 40 kg P_2O_5/ha. That might be due to phosphorus is involved in ATP (adenosine triphosphate) production, which is the energy currency of cells. This energy is necessary for lipid metabolism and oil synthesis. That's why increasing phosphorus levels resulted in higher oil content in seed. These results were in accordance with the findings of Kassaye *et al*. (2018) and Bunkar and Chaturvedi (2022).

The interaction of different levels of nitrogen and phosphorus did not bring any perceptible increase in the quality parameter (oil content) of linseed.

Effect on economics

Gross and net realizations were increased with the increase in nitrogen levels from 40 to 80 kg N/ha but the rate of increase in net return was higher with an increase in nitrogen level from 40 to 60 kg N/ha as compared to 60 to 80 kg N/ha. The highest gross realization (Rs.1,02,451/ha), net realizations (Rs.61,716/ha) and BCR (2.51) were recorded with the application of 80 kg N/ha, which were followed by the application of 60 kg N/ha. As

compared to 40 kg N/ha, the magnitude of increase in net profit due to 80 and 60 kg N/ha was 32.83 and 19.21 per cent, respectively. The increase in profitability is mainly due to increase in seed as well as stover yield under adequate supply of nitrogen as discussed earlier. These results match the findings of Parmar *et al*. (2020), Solo *et al*. (2021) and Patel *et al*. (2022).

The maximum gross realization, net realizations and BCR of Rs.1,01,336/ha, Rs.59,941/ha and 2.45 were observed under the application of 50 kg P_2O_5/ha in linseed, respectively. These were followed by 40 kg P_2O_5/ha. The rate of increase in net profit was higher between levels of 30 to 40 kg P_2O_5/ha as compared to 40 to 50 kg P_2O_5/ha. The per cent increase in net returns with every increase in phosphorus levels from 30 kg P_2O_5/ha to 40 kg P_2O_5/ha and 40 kg P_2O_5/ha to 50 kg P_2O_5/ha was 14.18% and 8.51%, respectively. Remarkable effect of phosphorus application on seed and stover yield of linseed was recorded which might be increased net profit with an increase in phosphorus levels from 30 to 50 kg/ha. This result matches the finding of Patil *et al*. (2014) and Parmar *et al*. (2020).

Conclusion

Based on the result of one year experimentation, it is concluded that to achieve better growth, yield and quality of linseed, it should be fertilized with 60 kg N/ha and 40 kg P_2O_5/ha.

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Table 1: Effect of different levels of nitrogen and phosphorus on growth, yield attributes, yield and quality of linseed.

Treatment	Plant height (cm)	Branches/plant	Capsules/plant	Seeds/ capsule	Test weight (g)	Yield (kg/ha)		Harvest index (%)	Oil content (%)
						Seed	Stover		
Nitrogen level (N)									
N_1 : 40 kg N/ha	51.31	5.91	49.64	7.80	7.20	1302	1984	39.70	37.40
N_2 : 60 kg N/ha	56.51	6.27	52.87	7.93	7.40	1440	2219	39.31	38.55
N_3 : 80 kg N/ha	59.08	6.69	57.49	8.07	7.65	1540	2330	39.83	39.72
S.Em.±	1.68	0.18	1.76	0.26	0.12	49.08	70.92	1.06	0.54
C.D. (P=0.05)	5.05	0.53	5.26	NS	0.35	147	213	NS	1.63
Phosphorus level (P)									
P_1 : 30 kg P_2O_5/ha	52.42	6.00	49.00	7.69	7.11	1321	2030	39.51	37.17
P_2 : 40 kg P_2O_5/ha	55.62	6.20	53.47	8.00	7.47	1438	2206	39.45	38.65
P_3 : 50 kg P_2O_5/ha	58.86	6.67	57.53	8.11	7.66	1524	2297	39.88	39.85
S.Em.±	1.68	0.18	1.76	0.26	0.12	49.08	70.92	1.06	0.54
C.D. (P=0.05)	5.05	0.53	5.26	NS	0.35	147	213	NS	1.63
Interaction (N × P)									
S.Em.±	2.91	0.31	3.04	0.45	0.20	85.01	122.83	1.83	0.94
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V. %	9.08	8.44	9.88	9.77	4.67	10.31	9.77	8.01	4.22

Table 2: Effect of different levels of nitrogen and phosphorus on the economics of linseed.

Treatment	Gross realization (Rs./ha)	Cost of cultivation (Rs./ha)	Net realization (Rs./ha)	BCR
Nitrogen level (N)				
N_1 : 40 kg N/ha	86,636	40,176	46,460	2.16
N_2 : 60 kg N/ha	95,841	40,456	55,385	2.37
N_3 : 80 kg N/ha	1,02,451	40,735	61,716	2.51
Phosphorus level (P)				
P_1 : 30 kg P_2O_5/ha	87,895	39,517	48,379	2.22
P_2 : 40 kg P_2O_5/ha	95,698	40,456	55,242	2.36
P_3 : 50 kg P_2O_5/ha	1,01,336	41,395	59,941	2.45

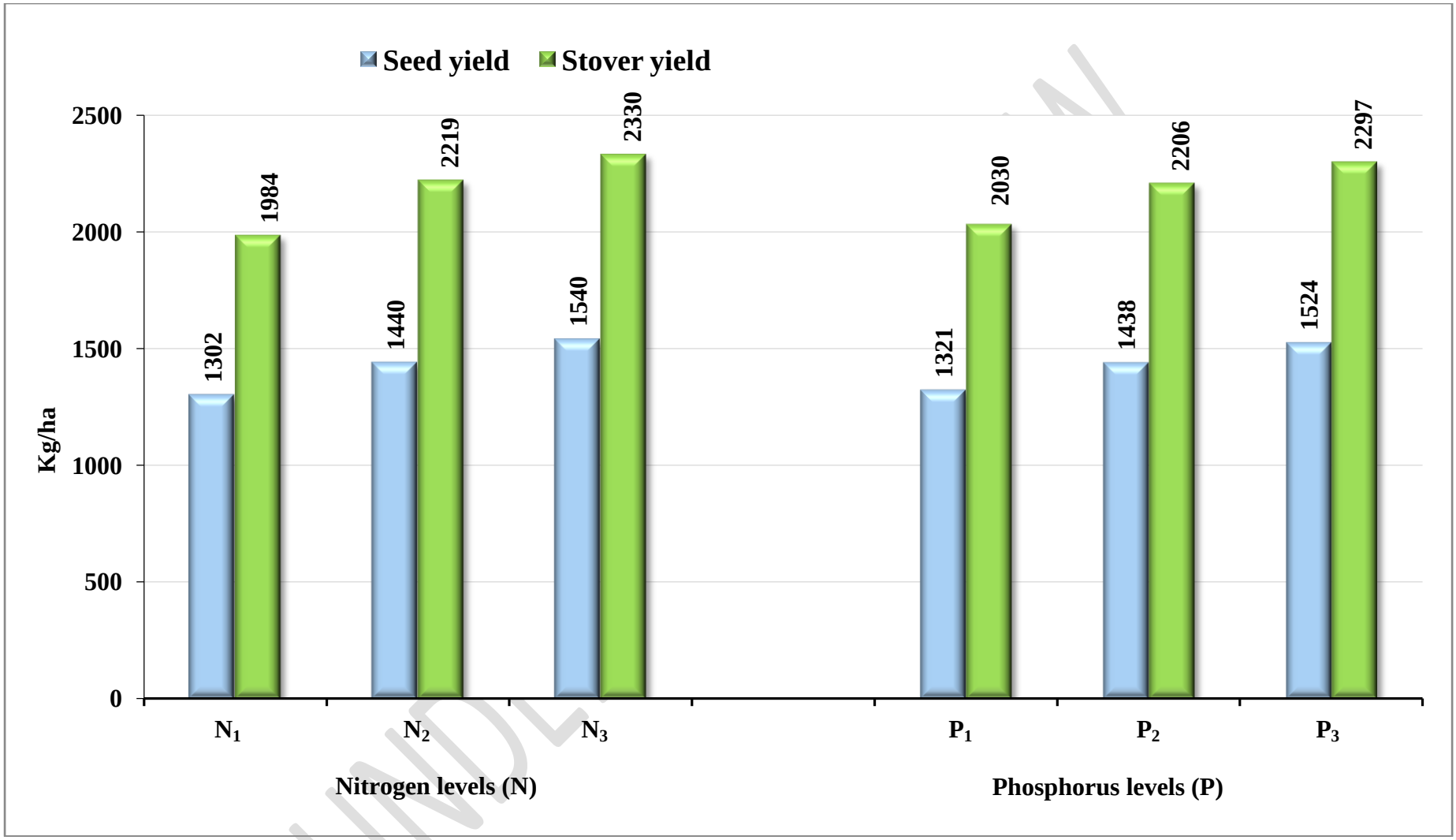

Figure 1: Effect of different levels of nitrogen and phosphorus on seed and stover yields of linseed.