Linseed (Linum usitatissimum L) growth and yield influenced by boron and zinc application in central plain zone of Uttar Pradesh

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Abstract

A field experiment was conducted during the Rabi season of 2020-21 at the Agronomy Research Farm of Faculty of Agricultural Sciences and Allied Industries; Rama University, Kanpur Nagar, Uttar Pradesh. Three replications were used in the randomized block design experiment. The 9 treatments included basal application of $ZnSO_4$ @ 20 kg/ha, foliar spray of Zn-EDTA @ 0.5% at 40 days after sowing, basal application of $ZnSO_4$ @ 20 kg/ha + foliar spray Zn- EDTA of @ 0.5% at 40 days after sowing, basal application of borax @ 1.5 kg/ha, foliar spray of B- EDTA @ 0.3% at 40 days after sowing, basal application of borax @ 1.5 kg/ha + foliar spray of B-EDTA @ 0.3 at 40 days after sowing, basal application of $ZnSO_4$ @ 20 kg/ha + borax @ 1.5 kg/ha, foliar spray of Zn-EDTA @ 0.5% + B-EDTA @ 0.3% at 40 days after sowing and control. Treatment Foliar spray of Zn-EDTA @ 0.5% + B-EDTA @ 0.3% at 40 days after sowing recorded significantly higher growth, yield attributes and seed yield. With a foliar spray of Zn-EDTA @ 0.5% + B-EDTA @ 0.3 % at 40 days after sowing and a basal application of $ZnSO_4$ @ 20 kg/ha + borax @ 1.5 kg/ha, the maximum seed yield (2,047 kg/ha), gross monetary return (Rs.92,116/ ha) and net monetary return (Rs.65,990/ha) and benefit cost ratio (3.46:1) were recorded.

Keyword: Basal & Foliar application, Boron, Economics, Linseed, Yield, Zinc

Introduction

Linseed (Linum usitatissimum L.) is India's most important rabi oilseed crop. It is a cool-season, temperate-climate crop that requires a mild to cool climate. it is one of the oldest oilseed crops, having been farmed for both oil and fibre purposes for thousands of years. It is typically farmed with agricultural inputs on marginal and sub-marginal soils in Indian states. Linseed is an important crop on a global scale, with an output of 2.65 million tonnes from 2.62 million/ha with an average productivity of 1011 kg/ha, compared to 0.15 million tonnes from 0.28 million/ha with an average productivity of 541 kg/ha in our country. India has ranked fourth in terms of area covered and third in terms of production, after Canada, Russia, China and the United States of America (https://icar-iior.org.in/sites/default/files/iiorcontent/annual-report/ann-rep-2020.pdf).

India's linseed productivity (541 kg/ha) is much behind that of Germany (1,500 kg/ha), Canada (1,385 kg/ha), Ethiopia (1065 kg/ha) and China (1,000 kg/ha). Each component is economically significant in and of itself. Linseed seeds contain 33-45 per cent oil. Linseed oil is utilized in industry for a variety of purposes, including pulp production, paper production, paint production, and fibre production (Rowland et al., 1995). Linseed seed crop is a beneficial secondary oilseed crop that is frequently used for industrial purposes, as well as for bioremediation of badly contaminated soil with heavy metals. Linseed has the potential to accumulate Fe, Cu, and Zn, in that order.

For the development of linseed yield as well as the distribution of heavy metals in different plant portions, the optimal dose of micronutrients such as copper, iron, and zinc are required. Zinc is one of the 17 important elements for plant development and growth. It activates various enzymes in plants and is directly involved in the manufacture of growth factors like auxin, which is important for plant development and cell division (Tahir et al., 2014).Zinc stimulates enzymes involved in the creation of certain proteins. It aids the plant's ability to survive low temperatures by assisting in the creation of chlorophyll and certain carbohydrates, as well as the conversion of starches to sugars.

Auxins aid in growth regulation and stem elongation, and zinc is required for their formation. Zinc deficiency has a variety of negative consequences on crop growth and output. Zinc also aids in the synthesis of crop starch. Zinc is also important for grain production and nourishment. Zinc aids in the manufacture of cytochromes, a pigment, as well as maintaining plasma membrane integrity and leaf cuticle formation. Seeds with more zinc can perform better in the following activities: seed germination, seedling health, crop growth, and yield advantage. As a result, Zn deficiency in linseed is one of the major roadblocks to increased output (Bakry et al., 2015). In general, suboptimal boron supply to oilseed crops slows down or impedes the growth of roots and shoots by limiting cell expansion and cell division in plants, affects the development of vascular bundles, and lowers pollen germination and pollen tube growth. Furthermore, boron deficiency causes seed quality to deteriorate, resulting in abortion-damaged embryos or shrunken next-generation crops. The absorption of other dietary components, such as nitrogen intake and assimilation, was influenced by increasing boron supply from inadequate to optimal levels.

Boron is important for a variety of plant functions, including cell wall development and stability, cell membrane structural and functional integrity, sugar and energy transport into developing sections of plants, pollination, and seed set. Boron, as a micronutrient, has a significant impact on the growth and production of agricultural crops (Mishra and Dhakar, 2016). As a result, an experiment was carried out to determine the best dose of zinc and boron for linseed in both solitary and tandem applications..

Material and methods

The experiment was conducted during Rabi season of 2020-21 at the Agronomy Research Farm of Faculty of Agricultural Sciences and Allied Industries, Rama University, Kanpur Nagar, U.P. in randomized block design with three replications. The experiment consisted of 9 treatments viz. basal application of $ZnSO_4$ @ 20 kg/ha, foliar spray of Zn-EDTA @ 0.5% at 40 days after sowing, basal application of $ZnSO_4$ @ 20 kg/ha + foliar spray Zn-EDTA of @ 0.5% at 40 days after sowing, basal application of borax @ 1.5 kg/ha, foliar spray of B-EDTA @ 0.3% at 40 days after sowing, basal application of borax @ 1.5 kg/ha + foliar spray of B-EDTA @ 0.3 at 40 days after sowing, basal application of $ZnSO_4$ @ 20 kg/ha + borax @ 1.5 kg/ha, foliar spray of Zn-EDTA @ 0.5% + B-EDTA @ 0.3% at 40 days after sowing and control. The soil at the study site had a sandy loam texture, was low in organic carbon (0.35 percent), available nitrogen (179 kg/ha), and available phosphorus (22.5 kg/ha). Linseed variety 'Shekhar' was seeded in 25 cm rows at a seed rate of 20 kg/ha, and seed was treated with thiram at a rate of 2.5 g per kg of seed. Urea, diammonium phosphate, and muriate of potash were used to apply the recommended doses of N, P, and K (80 kilogramme N, 40 kg P2O5, and 20 kg K_2O per ha, respectively). At the time of sowing, a half dose of nitrogen and a full dose of phosphate and potash are administered as a basal.
After the initial irrigation, the remaining nitrogen dose was administered. At the time of sowing, a basal application of $ZnSO_4$ hepta hydrate @ 20 kg/ha and a foliar spray of Zn-EDTA @ 0.5 per cent and B-EDTA @ 0.3 per cent were applied, as well as a foliar spray of Zn-EDTA @ 0.5 per cent and B-EDTA @ 0.3 per cent at 40 days after sowing. Extra plants were removed via thinning at the 20 days stage of the crop to keep each location to a single plant. At 50 days after sowing, only one irrigation was administered.

Result and discussion

Growth and yield attributes

The treatment foliar spray of Zn-EDTA @ 0.5 per cent + borax @ 0.3 per cent applied at 40 days after sowing significantly improved the growth and yield attributes of plant height, number of primary branches/plant, number of capsules/plant, number of seeds/capsules, plant population, and test weight when compared to the control treatment. The significantly increased plant height and number of primary branches observed after foliar application of zinc and boron could be due to the availability of these micronutrients to the crop at the appropriate vegetative stage, which could have increased nutrient uptake and chlorophyll content, resulting in increased plant growth (Table 1). In comparison to other treatments, the foliar spray of Zn-EDTA @ 0.5 per cent + borax @ 0.3 per cent at 40 days after sowing significantly increased plant height, number of branches/plant, number of seeds/capsule, and test weight of linseed, and was followed by a basal application of $ZnSO_4$ @ 20 kg/ha + borax @ 1.5 kg/ha because foliar and basal application of micronutrients effectively met the nutrient requirements of the linseed. The foliar spray of Zn-EDTA @ 0.5 per cent + borax @ 0.3 per cent at 40 days after sowing resulted in significantly higher plant height (57.97cm), number of branches/plant (4.01), number of capsules/plant (53.89), number of seeds/capsule (8.72), and test weight (8.30g) because the plants in these treatments had better nutrient availability, especially zinc and boron, at the branching stage for their growth and development, tends to result in. Plant height (55.19 cm), number of branches/plant (3.84), number of capsules/plant (51.60), number of seeds/capsule (8.35), and test weight were all higher in the treatment basal application of $ZnSO_4$ @ 20 kg/ha + borax @ 1.5 kg/ha (8.09g). Plant height (45.65 cm), number of branches/plant (3.15), number of capsules/plant (42.33), number of seeds/capsule (6.85), and test weight were all lower in the control treatment (7.65g). Similar findings were also found by Mousa et al., 2010 and Singh et al., 2020.

Seed yield and economics

The findings in table-2 clearly showed that linseed seed yield responded positively to various treatments. The foliar spray of Zn-EDTA hepta hydrate @ 0.5 per cent + borax @ 0.3 per cent at 40 days after sowing significantly increased seed yield (2,047 kg/ha) in linseed, which may have influenced carbohydrate metabolism positively, resulting in increased translocation and partitioning of photosynthates toward growth and yield attributing characters, thereby increasing yield of linseed, with a 49 per cent increase in seed yield over control. With respect to seed yield (1676 kg/ha), the treatment basal application of $ZnSO_4$ @ 20 kg/ha + borax @ 1.5 kg/ha came in second, with a 22 per cent increase above control. Because of better growth and yield attributing characters in these two treatments, foliar spray of Zn-EDTA @ 0.5 per cent + borax @ 0.3 per cent at 40 days after sowing and basal application of $ZnSO_4$ @ 20 kg/ha + borax @ 1.5 kg/kg treatments recorded higher seed yield in comparison to other treatments, while control treatment did not Alam et al., 2021 similar findings were also recorded. Data accessible in table-2 discovered that maximum gross monetary return (Rs 92115 per ha) with the treatment foliar spray of Zn-EDTA @ 0.5 per cent + borax @ 0.3 per cent at 40 days after sowing and was followed by basal application of ZnSO4 @ 20 kg/ha + borax @ 1.5 kg/ha and maximum net monetary return (Rs 65990 per ha) and B:C ratio (3.46:1) with the treatment foliar spray of Zn-EDTA @ 0.5 per cent + borax @ 0.3 per cent at 40 days after sowing and was followed by treatment basal application of ZnSO4 @ 20 kg/ha + borax @ 1.5 kg /ha.

Conclusion

On the basis of present investigation, it may be concluded that the application of inoculants (PSB + Azotobacter +40 percent NPK) increased growth yield and nutrional quality of okra. Therefore, it is recommended to the okra growers for the application of inoculants (PSB + Azotobacter + 40 percent NPK) for higher production and quality of okra under Rama university kanpur condition.

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Table 1: Growth and yield attributes of linseed as influenced by zinc and boron application

Treatments	Plant population at harvest (m^{-2})	Plant height At harvest (cm)	Number of primary branches/ plant	Number of capsule plant-1	Number of seed capsule-1	Test weight (g)
T1 - Basal application of $ZnSO_4$ @ 20 kg ha^{-1}	70.88	50.35	3.52	47.16	7.62	7.73
T2 - Foliar spray of Zn-EDTA @ 0.5% at 40 DAS	71.02	47.32	3.26	44.04	7.14	7.70
T3 - Basal application of $ZnSO_4$@ 20 kg ha^{-1} + Foliar spray of Zn-EDTA @ 0.5% at 40 DAS	70.33	49.72	3.42	46.11	7.45	7.74
T4 - Basal application of Borax @ 1.5 kg ha^{-1}	70.81	46.75	3.24	43.42	7.03	7.68
T5 - Foliar spray of B-EDTA @ 0.3 % at 40 DAS	70.98	46.77	3.26	43.65	7.07	7.66
T6 - Basal application of Borax @ 1.5 kg ha^{-1} + foliar spray of B-EDTA @ 0.3 % at 40 DAS	71.61	50.55	3.50	46.92	7.58	7.74
T7 - Foliar spray of Zn-EDTA @ 0.5 % + B-EDTA @ 0.3 % at 40 DAS	72.71	57.95	4.00	53.90	8.70	8.29
T8 -Basal application of ZnSO4 @ 20 kg ha^{-1} + Borax @ 1.5 kg ha^{-1}	72.52	55.16	3.85	51.58	8.32	8.28
T9 - Control	68.62	45.62	3.14	42.32	6.84	7.64
SEm±	2.11	1.32	0.09	1.22	0.19	0.20
C.D. (P=0.05)	1.32	3.99	0.25	3.71	0.60	0.29

Table 2: Effect of zinc and boron application on seed yield and economics of linseed

Treatments	Seed yield (kg ha^{-1})	Straw yield (Kg ha-1)	Biological yield (Kg ha-1)	Harvest index (%)	Net return (Rs. ha-1)	B: C ratio
T1 - Basal application of $ZnSO_4$ @ 20 kg ha^{-1}	1535	1091	2702	56.80	43,959	1.75:1
T2 - Foliar spray of Zn-EDTA @ 0.5% at 40 DAS	1436	1754	2524	56.89	40,070	1.63:1
T3 - Basal application of $ZnSO_4$@ 20 kg ha^{-1} + Foliar spray of Zn-EDTA @ 0.5% at 40 DAS	1506	1887	2645	56.93	42,140	1.64:1
T4 - Basal application of Borax @ 1.5 kg ha^{-1}	1414	2073	2492	56.74	28,840	1.56:1
T5 - Foliar spray of B-EDTA @ 0.3% at 40 DAS	1424	1828	2507	56.80	38,545	1.51:1
T6 - Basal application of Borax @ 1.5 kg ha^{-1} + foliar spray of B-EDTA @ 0.3 % at 40 DAS	1525	1796	2692	56.64	65,990	2.54:1
T7 - Foliar spray of Zn-EDTA @ 0.5% + B-EDTA @ 0.3 % at 40 DAS	2048	2008	2755	74.33	65,506	2.46:1
T8 -Basal application of ZnSO4 @ 20 kg ha^{-1} + Borax @ 1.5 kg ha^{-1}	1675	2126	2722	61.28	49,943	1.85:1
T9 - Control	1366	1956	2427	56.26	37,810	1.50:1
SEm±	00.37	0.77	0.06	1.57		
C.D. (P=0.05)	01.13	2.30	0.20	4.76		