Effect of zinc and boron on growth, yield and economics of linseed (*Linum usitatissimum* L.) under medium land of Jharkhand

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**Abstract**

An experiment was conducted during *Rabi* 2018-19 and 2019-20 at Research Farm of Birsa Agricultural University, Kanke, Ranchi, Jharkhand to study “The effect of Zinc and Boron on growth, yield and economics of Linseed (*Linum usitatissimum* L.) under medium land of Jharkhand”. The experiment was laid out in randomized block design with three replications. The treatments comprised soil application of Zn @ 5 kg/ha, foliar application of ZnSO₄ @ 0.5% at 45 DAS, soil application of Zn @ 5 kg/ha + foliar application of ZnSO₄ @ 0.5% at 45 DAS, soil application of B @ 1.5 kg/ha, foliar application of Borax @ 0.3% at 45 DAS, soil application of B @ 1.5 kg/ha + foliar application of Borax @ 0.3% at 45 DAS, foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS, soil application of Zn @ 5 kg/ha + soil application of B @ 1.5 kg/ha compared with control treatment along with RDF (40:20:20 kg NPK/ha) common to all treatments. Foliar application of ZnSO₄ @ 0.5% + foliar application of borax @ 0.3% at 45 DAS found superior in terms of maximum plant height (53.75 cm and 55.14 cm), plant stand (201 and 216), dry matter accumulation (3.66 g/plant and 3.70 g/plant) yield attributing characters viz., number of capsules per plant (29.02 and 38.67), number of seeds per capsule (6.00 and 7.64), seed yield (7.59 g and 7.64 g), seed yield (12.99 q/ha and 13.35 q/ha), net return (₹ 33230/ha and ₹38201/ha) and B:C ratio (1.82 and 2.19) in both years respectively.

**Keywords:** Linseed, zinc, boron, growth, yield attributes, yield and economics

**Introduction**

Next to rapeseed and mustard, linseed is a major *rabi* oilseed crop of the country. India is the fourth largest linseed growing country in the world (10.8%) after Kazakhstan, Canada and Russia but production wise it ranks fifth in the world after Canada, Russia, China and Kazakhstan. Linseed seed rich in protein (20%), oil (41%) and dietary fibre (28%). Each part of linseed has own economic importance. The seed of linseed contains 33-47 percent oil. Linseed oil is an excellent drying oil used in manufacturing paint and varnishes, oilcloth, waterproof fabrics (Matheson, 1976) [4]. At present linseed is cultivated in about 326.01 thousand ha and contribute 173.62 thousand tonnes to the annual oilseed production of the country with the productivity of 545 kg/ha While in Jharkhand it is cultivated over 52.07 thousand ha with production of 29.68 thousand tonnes (P.C. Report, 2018-19, AICRP on linseed). Linseed is generally grown under rainfed condition, however, its cultivation is widely extended in irrigated areas because of higher yield potential. Linseed has many industrial, medicinal properties and used for value added product. The productivity of linseed at national level is 1005 kg/ha (FAOSTAT, 2017) [2]. One of the limiting factors for low yield is due to poor management of inputs. The average yield of flax is very low in India due to many constraints like poor soil fertility, inadequate application of macro and micronutrients, competition with other crop and traditional crop management practices. Due to constantly increasing demand of the crop, there is a direct need to increase seed yield potential of flax crop. Its production can be increased by growing high yielding cultivators and by the uses of macro and micronutrients in balance quantity. Micronutrients especially zinc and boron play very important role in increasing growth and yield attributes. The deficiency of these two micronutrients in soil adversely affect the growth and development of linseed. Zinc is one of the essential micronutrients require for optimum crop growth and deficiency of it causes various adverse effect on growth and yield of linseed. Boron plays a significant role in enzyme
activation, protein synthesis, improves photosynthesis and is associated with calcium uptake and its utilization. Boron application imposed a positive trend in production of more dry matter, seed yield and oil content. The research was on zinc and boron application and its effect on growth and development of linseed is very meagre. Therefore, an experiment was conducted to find out the suitable dose of zinc and boron for linseed in sole as well as combined application.

Materials and Methods
The study was conducted during two consecutive year of 2018-19 and 2019-20 in rabi season at Crop Research Farm, Eastern Section of the Birsa Agricultural University, Ranchi-834006 (Jharkhand) to evaluate “The effect of Zinc and Boron on growth, yield and economics of linseed (Linum usitatissimum L.) Under medium land of Jharkhand”. The variety of linseed taken for experimentation was “Priyam”. The experiment was laid out in Randomized Block Design with three replications with nine treatments viz., soil application of Zn @ 5 kg/ha, foliar application of ZnSO₄ @ 0.5% at 45 DAS, soil application of Zn @ 5 kg/ha + foliar application of ZnSO₄ @ 0.5% at 45 DAS, soil application of B @ 1.5 kg/ha, foliar application of Borax @ 0.3% at 45 DAS, soil application of B @ 1.5 kg/ha + foliar application of Borax @ 0.3% at 45 DAS, foliar application of ZnSO₄ @ 0.5% at 45 DAS, soil application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS, soil application of Zn @ 5 kg/ha + soil application of B @ 1.5 kg/ha + foliar application of ZnSO₄ @ 0.5% at 45 DAS, soil application of Zn @ 5 kg/ha + soil application of B @ 1.5 kg/ha + soil application of Borax @ 0.3% at 45 DAS (52.81 cm and 53.77 cm) and soil application of Zn @ 5 kg/ha + soil application of Borax @ 0.3% at 45 DAS (50.54 cm and 52.30 cm), foliar application of Borax @ 0.3% at 45 DAS (48.92 cm and 51.41 cm), soil application of B @ 1.5 kg/ha + foliar application of Borax @ 0.3% at 45 DAS (52.81 cm and 53.77 cm) and soil application of Zn @ 5 kg/ha + soil application of B @ 1.5 kg/ha (47.30 cm and 50.89 cm). At harvest, treatment with foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS recorded significantly highest dry matter accumulation (3.66 g/plant and 3.70 g/plant) followed by soil application of B @ 1.5 kg/ha + foliar application of Borax @ 0.3% at 45 DAS (3.58 g/plant and 3.62 g/plant) respectively. The significantly increased plant height and dry matter accumulation observed in combined application of zinc and boron as foliar may be due to availability of these micronutrients to the crop at appropriate vegetative stage, which may have increased the nutrient uptake and chlorophyll content and resulted in increase in plant growth and it also might improve photosynthetic area of plants that cumulatively contribute to higher dry matter accumulation. The results are in accordance with Singh et al. (2020) [10], Eldaiem et al. (2016) [11], Mousa et al. (2010) [8].

Results and Discussion
Effect of Zn and B on growth parameters of linseed
Application of Zinc and Boron had not significant effect on plant stand of linseed in both the years of experimentation. At harvest the treatment with foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS had found significantly maximum plant stand (201 and 216) over control (183 and 197) during both years respectively. Effect of zinc and boron nutrition realized significant effect on plant height of linseed (Table 1). At harvest, the treatment with foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS attained significantly maximum plant height (53.75 cm and 55.14 cm) over control (42.18 cm and 43.53 cm) during both years. However, plant height was found significantly at par with soil application of Zn @ 5 kg/ha + foliar application of ZnSO₄ @ 0.5% at 45 DAS (52.81 cm and 53.77 cm) and soil application of Zn @ 5 kg/ha + soil application of B @ 1.5 kg/ha (47.30 cm and 50.89 cm). At harvest, treatment with foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS recorded significantly highest dry matter accumulation (3.66 g/plant and 3.70 g/plant) followed by soil application of B @ 1.5 kg/ha + foliar application of Borax @ 0.3% at 45 DAS (3.58 g/plant and 3.62 g/plant) respectively. The significantly increased plant height and dry matter accumulation observed in combined application of zinc and boron as foliar may be due to availability of these micronutrients to the crop at appropriate vegetative stage, which may have increased the nutrient uptake and chlorophyll content and resulted in increase in plant growth and it also might improve photosynthetic area of plants that cumulatively contribute to higher dry matter accumulation. The results are in accordance with Singh et al. (2020) [10], Eldaiem et al. (2016) [11], Mousa et al. (2010) [8].

| Treatments | Plant stand at harvest (000/ha) | Plant height (cm) at harvest | Dry matter at harvest (g/plant) |
|------------|--------------------------------|-----------------------------|--------------------------------|
| T₁: (control) | 183 | 42.18 | 43.53 | 2.28 |
| T₂: Soil application Zn @ 5 Kg/ha | 185 | 43.23 | 48.67 | 3.29 |
| T₃: Foliar application ZnSO₄ @ 0.5% at 45 DAS | 186 | 40.05 | 47.90 | 3.32 |
| T₄: Soil application Zn @ 5 Kg/ha + Foliar application of ZnSO₄ @ 0.5% at 45 DAS | 188 | 50.54 | 52.30 | 3.51 |
| T₅: Soil application B @ 1.5 kg/ha | 190 | 45.67 | 48.92 | 3.33 |
| T₆: Foliar application Borax @ 0.3% at 45 DAS | 196 | 48.92 | 51.41 | 3.45 |
| T₇: Soil application B @ 1.5 kg/ha + Foliar application Borax @ 0.3% at 45 DAS | 198 | 52.81 | 53.77 | 3.58 |
| T₈: Foliar application ZnSO₄ @ 0.5% at 45 DAS + Foliar application Borax @ 0.3% at 45 DAS | 201 | 53.75 | 55.14 | 3.66 |
| T₉: Soil application Zn @ 5 Kg/ha + Soil application B @ 1.5 kg/ha | 192 | 47.30 | 50.89 | 3.39 |
| SEm± | 7.27 | 2.18 | 1.77 | 0.09 |
| CD (P=0.05) | NS | 6.55 | 3.13 | 0.28 |
| CV (%) | 6.6 | 7.5 | 7.9 | 6.1 |

Effect of Zn and B on yield attributes and yield of linseed
The data indicated that zinc and boron had significant effect on yield attributing characters of linseed viz., number of capsules per plant, number of seeds per capsule, 1000 seed weight and seed yield of linseed (Table 2). The significantly higher number of capsules per plant (29.02 and 38.67), number of seeds per capsule (6.00 and 8.57) and test weight (7.59g and 7.64g) were registered with foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS as compared to control during both the years of experimentation. Seed yield is the results of synchronized interplay of various yield attributes like number of capsules per plant, number of seeds per capsule and test weight. An appraisal of data revealed that foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS recorded significantly superior seed yield (12.99 q/ha and
Effect of Zn and B on economics of linseed
The data on economics of linseed cultivation as affected by different treatments is presented in Table 3. The gross return obtained by yield of crop varied significantly due to different treatments, which ultimately influenced the net return and benefit: cost ratio.

The magnitude of increase in gross return and net return with treatment where, foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS were applied to the tune of 39.34% and 58.43% respectively over control in the year 2018-19 whereas in the year 2019-20 the increase in gross and net return over control were 34.46% and 48.01% respectively.

The benefit cost ratio was observed maximum (1.82 and 2.19) with treatment where, foliar application of ZnSO₄ @ 0.5% + foliar application of Borax @ 0.3% at 45 DAS was applied and was followed by treatment where soil application of B @ 1.5 kg/ha + foliar application of Borax @ 0.3% at 45 DAS (1.51 and 1.80). The lowest benefit cost ratio was obtained with control (0.83 and 1.19) in both the years of experimentation. These finding are in the close vicinity with those reported by Singh et al. (2020) [8] and Tahir et al. (2014) [9].

Conclusion
Based on the findings of two years of experimentation it may be concluded that foliar application of ZnSO₄ @ 0.5% along with foliar application of Borax @ 0.3% at 45 DAS was found most effective for increasing growth, yield and economics of linseed.

Table 2: Effect of zinc and boron nutrition on yield attributes and seed yield of linseed

| Treatments | Number of capsules/plant | Number of seeds/capsule | 1000 seed weight (g) | Seed yield (q/ha) |
|------------|-------------------------|------------------------|----------------------|------------------|
| 2018-19    | 2019-20                 | 2018-19                | 2019-20             | 2018-19          | 2019-20         |
| T1: (control) | 20.17                  | 25.86                  | 3.45                | 6.57             | 8.67            | 7.20            | 7.92            | 8.85           |
| T2: Soil application Zn@ 5 Kg/ha | 22.68                  | 28.74                  | 4.47                | 7.18             | 7.18            | 7.36            | 10.15           | 10.72          |
| T3: Foliar application ZnSO₄ @ 0.5% at 45 DAS | 23.19                  | 29.86                  | 4.90                | 7.36             | 7.25            | 7.41            | 10.43           | 10.94          |
| T4: Soil application Zn@ 5Kg/ha + Foliar application of ZnSO₄ @ 0.5% at 45 DAS | 27.00                  | 36.92                  | 5.62                | 8.23             | 7.53            | 7.62            | 11.12           | 12.04          |
| T5: Soil application B @ 1.5 kg/ha | 23.34                  | 30.95                  | 5.22                | 7.52             | 7.32            | 7.49            | 10.74           | 11.03          |
| T6: Foliar application Borax @ 0.3% at 45 DAS | 25.74                  | 34.25                  | 5.49                | 8.04             | 7.41            | 7.54            | 11.32           | 11.55          |
| T7: Soil application B @ 1.5 kg/ha + Foliar application Borax @ 0.3% at 45 DAS | 28.05                  | 37.89                  | 5.85                | 8.41             | 7.48            | 7.56            | 12.12           | 12.28          |
| T8: Foliar application ZnSO₄ @ 0.5% at 45 DAS + Foliar application Borax @ 0.3% at 45 DAS | 29.02                  | 38.67                  | 6.00                | 8.57             | 7.59            | 7.64            | 12.99           | 13.35          |
| T9: Soil application Zn@ 5 Kg/ha + Soil application B @ 1.5 kg/ha | 24.17                  | 32.73                  | 5.37                | 7.89             | 7.38            | 7.53            | 10.82           | 11.06          |
| SEm±      | 1.63                    | 0.84                   | 0.23                | 0.39             | 0.24            | 0.21            | 0.46            | 0.49           |
| CD (P=0.05) | 4.89                   | 2.52                   | 0.69                | 1.17             | 0.71            | NS              | 1.37            | 1.48           |
| CV (%)    | 11.4                    | 4.43                   | 7.8                  | 8.70             | 5.57            | 4.90            | 7.24            | 7.5            |

Table 3: Effect of zinc and boron nutrition on economics of linseed

| Treatments | Cost of cultivation (₹/ha) | Gross return (₹/ha) | Net return (₹/ha) | B: C ratio |
|------------|-----------------------------|---------------------|-------------------|-----------|
| 2018-19    | 2019-20                     | 2018-19             | 2019-20           | 2018-19   | 2019-20     |
| T1: (control) | 17404                    | 16604               | 31217             | 36464     | 13813       | 19860       | 0.83            | 1.19          |
| T2: Soil application Zn@ 5 Kg/ha | 18404                    | 17604               | 40662             | 45050     | 22258       | 27446       | 1.21            | 1.56          |
| T3: Foliar application ZnSO₄ @ 0.5% at 45 DAS | 18034                    | 17234               | 41840             | 46064     | 23806       | 28830       | 1.32            | 1.67          |
| T4: Soil application Zn@ 5Kg/ha + Foliar application of ZnSO₄ @ 0.5% at 45 DAS | 19034                    | 18234               | 46996             | 50426     | 27962       | 32192       | 1.47            | 1.77          |
| T5: Soil application B @ 1.5 kg/ha | 18444                    | 17644               | 42835             | 46296     | 24391       | 28652       | 1.32            | 1.62          |
| T6: Foliar application Borax @ 0.3% at 45 DAS | 18112                    | 17312               | 44786             | 48121     | 26674       | 30809       | 1.47            | 1.78          |
| T7: Soil application B @ 1.5 kg/ha + Foliar application Borax @ 0.3% at 45 DAS | 19152                    | 18352               | 48042             | 51299     | 28890       | 32947       | 1.51            | 1.80          |
| T8: Foliar application ZnSO₄ @ 0.5% at 45 DAS + Foliar application Borax @ 0.3% at 45 DAS | 18232                    | 17432               | 51462             | 55634     | 33230       | 38201       | 1.82            | 2.19          |
| T9: Soil application Zn@ 5 Kg/ha + Soil application B @ 1.5 kg/ha | 19444                    | 18644               | 43349             | 46627     | 23905       | 27983       | 1.23            | 1.50          |
| SEm±      | 1286.14                  | 1551.18              | 1329.03           | 1551.18   |             |             |                 |               |
| CD (P=0.05) | 3855.44                  | 4640.64              | 3984.02           | 4649.95   |             |             |                 |               |
| CV (%)    | 5.1                      | 5.7                   | 9.2               | 9.1        |             |             |                 |               |
References

1. Abd Eldaiem MAM, El-Sherief MAB. Effect of organic, phosphorus and zinc fertilization on yield and quality of flax. Int. J Adv. Res. Biol. Sci 2016;3(1):161-173.

2. FAOSTAT. Food and Agricultural Organization of the United Nations, FAO Statistical Databases 2017. http://www.fao.org/faostat/

3. Gomez KA, Gomez AA. Statistical Procedures for Agricultural Research. John Wiley & Sons 1984.

4. Matheson EM. Linseed. Vegetable Oil Seed Crops in Australia. Holt, Rinehart and Winston, Sydney 1976, 111-121.

5. Mousa MA, El-Kady EA, Zedan ZS. Effect of nitrogen fertilizers and some micro-nutrients on flax yield and chemical composition characters. Journal of Plant Production 2010;1(5):713-720.

6. PC. Report, AICRP on Linseed 2018-19.

7. Rowland GG, McHughen A, Gusta LV, Bhatti RS, MacKenzie SL, Taylor DC. The application of chemical mutagenesis and biotechnology to the modification of linseed (Linum usitatissimum L.). Euphytica 1995;85(1):317-321.

8. Singh A, Singh D, Verma VK, Pyare R, Hussain MF. Studies on the effect of zinc and boron on growth and yield of linseed (Linum usitatissimum L.) under limited irrigation. International Journal of Chemical Studies 2020;8(5):1964-1966.

9. Tahir M, Irfan M, Rehman AU. Effect of foliar application of zinc on yield and oil contents of flax. Pakistan J Agric. Res 2014;27(4):287-295.