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Effect of Micronutrients on Growth and Yield of Linseed Crop under Limited Irrigation

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ABSTRACT: The field experiment was conducted during rabi season of 2020-21 at Oil Seed Farm of Chandra Shekhar Azad University of Agriculture and Technology, Kanpur to find out better treatment combination of micronutrient under limited water supply in linseed crop. There were 9 treatment combination applied under the test. The experiment consisted of 9 treatments in which; T₁: Control, T₂: Soil application of ZnSO₄ @ 25 kg ha⁻¹, T₃: Foliar application of ZnSO₄ @0.5% at 45 DAS, T₄: Soil Application of ZnSO₄ @ 25 kg ha⁻¹ + Foliar application of ZnSO₄ @0.5% at 45 DAS, T₅: Soil application Borax @ 1.5 kg ha⁻¹, T₆: Foliar application of Borax @ 0.3 % at 45 DAS, T₇: Soil application of Borax @ 1.5 kg ha⁻¹ Foliar application of Borax @ 0.3 % at 45 DAS, T₈: Foliar application of ZnSO₄ @ 0.5% + Borax @ 0.3% at 45 DAS and T₉: Soil application of ZnSO₄ @ 25 kg ha⁻¹ + Borax @ 1.5 kg ha⁻¹. The results revealed that maximum seed yield, stover yield, oil content, gross return, net return and B: C ratio obtained under T₈ treatment and lowest figures in this regards were obtained in T₁ treatments (control), respectively.

KEYWORDS: micronutrients, zinc-sulphate, borax, soil application, foliar application.

I. INTRODUCTION

The sustainable and productive agriculture system will depend on efficient use and management of natural resources harnessing the potentialities of integrating farming system, conservation agriculture and bio resources etc. which will definitely bring resilience in agriculture production system. Conservation of agriculture diversity using on farm inputs, appropriate crop management to manage and sustain soil health and nutrition of food use the paths to a sustainable future. Strategies also need to be developed to double the farmer's income as per the initiatives of central government through judicious use of nature resources as well as agricultural inputs, adoption of improved techniques and ensuring sustainability of the agriculture production.

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Conservation agriculture practice is promoted for its natural resource saving practice and better use of scarce water resources. Application of fertilizers by the farmers in fields without prior knowledge of soil fertility status might result in adverse effects on soils as well as crops both in terms of micronutrients deficiency and toxicity either by inadequate or over use of fertilizers. It is anticipated that with higher yields and more intensive agriculture the secondary and micronutrient deficiency will increase both in amount and in extent.

Imbalanced and inadequate use of fertilizers coupled with low use of efficiency of other inputs led to decline in the response efficiency of chemical fertilizer, nutrients under intensive agriculture in recent years. Micronutrients are important for maintaining soil health and increasing use efficiency of major nutrients and ultimately the crop productivity.

The deficiency of micronutrients has become major constraints in sustainable productivity of soils. Water resources management and land management are inextricably linked. Increasing competing demands will reduce land and water availability for food production. At the same time, expected increase in food demands will require an increase in agricultural production and agricultural water use. These pressure and problems are further compounded by reduction in water productivity.

The global growth in food demand is placing unprecedented pressure on the land and water resources of our planet. Water and nutrients are important key biophysical factors determining food production. While advances in technology have allowed humanity to economically produce massive quantities of nitrogen fertilizers, water still remains a critical input limiting global food production. To halt agricultural expansion and meet the increasing demand for food

commodities, agricultural production will likely have to intensify by expanding irrigation to water-limited croplands that are currently rain-fed.

Water scarcity refers to a condition of imbalance between freshwater availability and demand where freshwater demand exceeds availability. Water scarcity represents a multidimensional state of human deprivation characterized by lack of access to affordable and safe water to satisfy societal needs or a condition in which these needs are met at the expenses of the environment. While water scarcity may affect entire regions, it is the most vulnerable and poor people that suffer the most severe consequences. This fact points to the strong role played by economic and institutional factors as determinants of water scarcity. Therefore, water scarcity is generally considered both from the perspective of its physical constraints and economic determinants.

However, it has been reported in some studies that it is possible to take up two and more even three crops in a year through careful selection of crops and efficient management of limited irrigation water. Productive soils are those, which contain adequate amount of all essential nutrients in readily available forms to plants are in good physical conditions to support plant and contain just the right amount of water and air for desirable root growth. Thus, soil fertility, good management practices, availability of water supply and a suitable climate contribute towards soil productivity.

Roots are the principal organs of nutrients absorption. The absorption of nutrients depends upon the distribution of roots in soil. The shallower the root system, the more dependent the plant is on fertilizers. Hence, any manipulation, which encourages deep rooting will encourage better utilization of nutrients. It is well known that some plants are better scavengers of certain nutrients than others. This is mainly because of the preferential absorption of these nutrients by the roots of those plants.

The efficient management of rainwater with canilare moisture conservation practice and fertilizer appreciation are needed for attaining sustainable field of crops. About 7% of our population depends on agriculture and one third of our national incomes from it. Water is considered as liquid gold and most vital input in agriculture. Crop yield response to irrigation water input can be helpful for various water management practices in the crop. Normal plant leaves contain between 25 and 100 ppm boron. Most of available boron in soil is associated with organic matter.

Excess zinc may cause iron deficiency in some plants. Fe deficiency increased the thiol content of the plant. These results indicate that Fe deficiency causes excess uptake and accumulation of Zn. Whereas, boron deficiency causes disintegration of softer tissues, browning of cauliflower, reduced transpiration due to defunctioning of stomata. Leaf tips become followed by necrosis. Leaves get a scorched appearance and later fall off. Boron is a cell wall element is associated with pectin substance and provides a substantial strength and stability to cell walls. Major role of boron is pollination, fertilization, and fruit setting.

II. MATERIALS AND METHODS

- Geographical situation and climate: Experimental field is situated at an elevation of 129.0 meters above mean sea level. It lies between 25° 26' and 26° 58' North latitude and 79° 31' and 80° 34' East longitude. Sub-tropical zone having semi-arid climate. The average annual rainfall is 800 mm, a major portion of which is received during the monsoon season from the last week of June to first week of October.

- Soil of the experimental field: The soil of experimental field was typical gangetic alluvium, having poor content of organic carbon (0.34%) and available nitrogen (170.8 kg ha⁻¹). Available phosphorus (16.9 kg ha⁻¹) and potassium (156.5 kg ha⁻¹) status of soil was medium. Soil reaction was normal (7.7) with some alkaline tendency. Soil sample is taken from 5 place in the field at depth of 0-25 cm.

- Cultural practices: Field preparation was done by victory plough with cross ploughing by tractor drawn cultivator followed by planking. Fertilizer application as per requirement of treatments the dose of inorganic fertilizers with recommended doses of N, P₂O₅, K₂O. Nitrogen, phosphorus and potassium were applied through urea, diammonium phosphate and muriate of potash, respectively. The seeds of linseed cv 'Shekhar', was sown @ 30 kg ha⁻¹, in shallow furrow behind *desi* plough with the help of manual labour at a row spacing of 25 cm apart. Planking was done after sowing to cover the seed properly. Harvesting of linseed crops in all the plots were done at maturity. Border around the experimental area was harvested first. The net plot area was harvested later on. Harvesting was done with hand sickles by manual labour. Thereafter, produce was tied in bundles plot-wise. Bundles were tagged, weighted properly and left in respective plots for drying.

- Growth characters: In tagging operations 3 plants were randomly selected from each plot and tagged for detailed study to take each and every observation from the same plant with least error and strain. After final thinning number of plants per plot in square meter were counted. Plant population per square meter in each plot was also counted at harvest. The figures of plant stand were converted into plants ha⁻¹ for each treatment. Plant height of 3 tagged linseed plant was measured at 30, 60, 90 and at harvesting stage. For this purpose, randomly selected 3 plants

were measured in cm from ground level to the top of the plant. Mean height of three plants were used for analysis. The number of days required for 50% flowering was noted by visual observation. The number of days required for physiological maturity of crop as indicated by brownish yellow colour of the crop were recorded. Later on, number of days computed from sowing to maturity of the crop.

- Post-harvest studies: Number of capsules were counted on 3 sample plants in each case and their mean values was recorded as number of capsule plant⁻¹ in linseed crop. For number of seed per capsule, 20 pods were selected randomly and threshed for separating seed from husk. Their total seeds were counted and divided by 20 to get mean number of seed which were recorded in each case. For weight of 1000-seeds, the 1000-seeds were counted with the help of automatic seed counter. The weighing of 1000-seeds was done on electronic balance in grams.

- Yield studies: After threshing and cleaning of seed yield of each plot was weighted in kilogram and there after it is converted in to quintal per hectare. The stover and husk were worked out for each plot by subtracting the seed yield from the total biological production in kilogram and later on it is was converted into quintal per hectare.

- Oil content: The oil content of the oven dried seeds was estimated by extracting oil using petroleum ether (60-80°C) as solvent and Soxhlet apparatus as given by **Sadasivum and Manickam, (1992)**. The oil yield (kg ha⁻¹) was calculated using following formula:

$$\text{Oil yield (kg ha}^{-1}\text{)} = \text{Seed oil content (\%)} \times \text{Seed yield (kg ha}^{-1}\text{)}$$

III. RESULT AND DISCUSSION

The data pertaining to different growth observations, yield attributes and yield observations presented in Table-1 showed that-

- Initial and final plant stand (000 ha⁻¹): Plant stand of linseed did not influence significantly by different treatments of micronutrient application. Similar findings have also been reported by **Chaudhary (2009)**.

- Plant height (cm): The highest plant height at 30, 60 90 days after sowing is recorded under T9 Treatment (Soil application of ZnSO₄ @ 25 kg ha⁻¹ + Borax @ 1.5 kg ha⁻¹) as compared to all the treatments and lowest plant height was recorded under T₁ (Control).

Dry matter accumulation (g plant⁻¹): The highest dry matter accumulation is found under T7 Treatment (Soil application of Borax @ 1.5 kg ha⁻¹ + Foliar application of Borax @ 0.3% kg ha⁻¹) as compared to all the treatments and lowest figures recorded under T₂ (Soil application of ZnSO₄ @ 25 kg ha⁻¹) at 30, 60, 90 days after sowing.

- Days to 50% flowering and maturity: All the treatments having micronutrient application resulted best treatment of soil application of ZnSO₄ @ 25 kg ha⁻¹ + Borax @ 1.5 kg ha⁻¹ were identified for days to 50% flowering and days to maturity is earlier than other treatments.

- 1000- seed weight: The highest 1000-seed weight was recorded in treatment (T₉) (Soil application of ZnSO₄ @ 25 kg ha⁻¹ + Borax @ 1.5 kg ha⁻¹) as compared to all the treatments and lowest under control (T₁).

- Seed yield (q ha⁻¹) and stover yield (q ha⁻¹): The data pertaining to seed and stover yield presented in Table-1, revealed that maximum seed & stover yield ha⁻¹ were recorded in T₈ treatments, followed by T₇ treatment and lowest figures in this regard were obtained under T₁ treatment (control). Similar results were reported by **Patel et al. (2015) and Gupta et al. (2016)**.

- Biological yield (q ha⁻¹) and harvest Index (%): The highest biological yield (q ha⁻¹) were recorded under T₉ treatment (Soil application of ZnSO₄ @ 25 kg ha⁻¹ + Borax @ 1.5 kg ha⁻¹) as compared to all treatment applied under the test and lowest under control (T₁). These findings in accordance with findings of Singh and Rana (2017).

The data as regards to oil content obtained under various treatments applied under the test, the maximum values of oil content was obtained in T₈ treatment, followed by T₃, T₄, T₆, T₇ and T₉ treatments, respectively, and lowest values obtained under T₁ treatment (control).

As regards to net return and B:C ratio of various treatments applied under the test, data in this regards presented in Table-2 showed that the T₈ treatment fetched highest net return and B:C ratio quite remunerative for higher productivity over other treatments applied under the test lowest values in this regards noted under T₁ treatments (control). Similar findings was also reported by **Husain et al. (2017)**.

Table. 1- Effect of micro-nutrients on Final plant population, final plant height (cm), Seed yield q ha⁻¹, Stover yield q ha⁻¹ and oil content (%) under different treatments.

Treatments	Final plant population	Final plant height (cm)	Dry matter accumulation at harvest g plant ⁻¹	1000-Seed weight (g ha ⁻¹)	Seed yield q ha ⁻¹	Stover yield q ha ⁻¹	Oil content (%)
T1 : Control	697	45.30	4.78	8.2	14.76	27.33	39
T2 : Soil application of ZnSO₄ @ 25 kg ha⁻¹	710	47.70	4.25	8.27	15.33	24.29	39
T3 : Foliar application of ZnSO₄ @0.5% at 45 DAS	673	44.70	4.96	7.67	13.34	28.37	40
T4 : Soil Application of ZnSO₄ @ 25 kg ha⁻¹ + Foliar application of ZnSO₄ @ 0.5% at 45 DAS	673	40.00	5.75	8.23	15.00	33.00	40
T5 : Soil application Borax @ 1.5 kg ha⁻¹	683	48.30	5.33	7.93	14.10	30.48	39
T6 : Foliar application of Borax @ 0.3 % at 45 DAS	690	47.00	5.40	7.85	14.10	30.86	40
T7 : Soil application of Borax @ 1.5 kg ha⁻¹ Foliar application of Borax @ 0.3 % at 45 DAS	680	56.30	7.53	8.34	16.76	43.05	40
T8 : Foliar application of ZnSO₄ @ 0.5% + Borax @ 0.3% at 45 DAS	708	47.70	6.88	8.23	20.47	39.33	41
T9 : Soil application of ZnSO₄ @ 25 kg ha⁻¹ + Borax @ 1.5 kg ha⁻¹	733	58.70	5.80	8.66	15.24	33.14	40
SE (d)	0.720	0.016	0.002	0.023	0.002	0.022	0.016
CD	1.540	0.035	0.004	0.049	0.004	0.046	0.035

Table.2- Effect of micro-nutrients on Economics under different treatments.

Treatments	Cost of cultivation Rs ha ⁻¹	Gross return Rs ha ⁻¹	Net return Rs ha ⁻¹	B:C ratio
T1 : Control	23653	66435	42782	2.81
T2 : Soil application of ZnSO₄ @ 25 kg ha⁻¹	32577	69000	36423	2.12
T3 : Foliar application of ZnSO₄ @0.5% at 45 DAS	23837	60045	36208	2.52
T4 : Soil Application of ZnSO₄ @ 25 kg ha⁻¹ + Foliar application of ZnSO₄ @ 0.5% at 45 DAS	32587	67500	34913	2.07
T5 : Soil application Borax @ 1.5 kg ha⁻¹	24727	63435	38708	2.57
T6 : Foliar application of Borax @ 0.3 % at 45 DAS	23437	63435	39998	2.66
T7 : Soil application of Borax @ 1.5 kg ha⁻¹ Foliar application of Borax @ 0.3 % at 45 DAS	24737	75435	50698	3.05
T8 : Foliar application of ZnSO₄ @ 0.5% + Borax @ 0.3% at 45 DAS	23847	92310	68463	3.86
T9 : Soil application of ZnSO₄ @ 25 kg ha⁻¹ + Borax @ 1.5 kg ha⁻¹	33477	68580	35103	2.05

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