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Effect of micronutrient foliar application on yield and economics of Niger (*Guizotia abyssinica* L.) Under Rainfed Condition

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Abstract
The field experiment was conducted during *Kharif* 2019 at Experiment farm of Department of Agronomy, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiment was laid out in a randomized block design with eight Treatmentss and three replications. The Treatmentss were T_1: Control (No any foliar application), T_2: B (0.5%), T_3: Zn (0.5%), T_4: Fe (0.5%), T_5: B (0.5%) + Zn (0.5%), T_6: B (0.5%) + Fe (0.5%), T_7: Zn (0.5%) + Fe (0.5%) and T8: B (0.5%) + Zn (0.5%) + Fe (0.5%). Application of micronutrients in Treatments T_8 i.e. B (0.5%) + Zn (0.5%) + Fe (0.5%) to niger crop recorded significantly higher seed yield (505 kg ha-1) followed by the Treatments T7 i.e. Zn (0.5%) + Fe (0.5%) at flowering. In case of gross monetary returns, the Treatments T_8 recorded significantly higher gross monetary returns (GMR) 29,997 ₹ /ha-1, net monetary returns (NMR) 13,206 ₹ /ha-1 and B:C ratio i.e. 1.81 with same trend followed by the Treatments T_7. On the basis of above findings, it may be inferred that, for getting maximum seed yield kg ha-1, higher gross monetary returns (GMR) ₹ /ha-1, net monetary returns (NMR) ₹ /ha-1 and B:C ratio application of B (0.5%) + Zn (0.5%) + Fe (0.5%) at flowering and capitula formation was found to be effective in increasing production of niger crop. The lowest gross monetary returns (GMR) ₹ / ha, net monetary returns (NMR) ₹ / ha and B:C ratio values of the above mentioned parameters was recorded with Control (No any foliar application) was applied in (T_1).

Keywords: Micronutrient, Niger, yield and economics

Introduction
India is the largest economy in the world with 21 percent of the world' sare abut accounts for less than 10 percent of the world's agricultural production to meet the need of about 16 percent of the world's population. Oil seed is the second largest agricultural commodity after cereals sharing13 percent of the country's gross crop ped area and accounting for nearly 6 percent of gross national production and10 percent of the value of all agricultural commodities.

There has been a serious imbalance in the availability through domestic production and demand of oil in the country because of phenomenal incease in human population. The increased demand of edible oil in country and low productivity of oil seeds led to tremendous increase in prices of oil seeds and edible oil. The increased rate of consumption coupled with geometrically increased population will exalt the dimension of oil deficit problems (Acharya, 1989) [1]. The review of experiences indicated that there has been serious imbalance in the availability through the domestic production and demand of oil in the country. Annual per capita consumption of oil sand fats remained only 14.8 kg as against 41 kg in developed countries and 26 kg world average (Hegde 2012) [4].

The low productivity of Niger in Maharashtra due to grown on the light soil, low yielding ability, lack of fertilizer and irrigation responsive genotypes and lack of information regarding micronutrient application, sowing time, seed rate and varieties suitable for specific region. Almost 72% of the total oilseeds area is confined to rainfed farming, cultivated mostly by small and marginal farmers. The problem of micronutrient deficiency zinc (Zn), iron (Fe) and boron (Bo) is becoming more serious due to introduction of high yielding varieties, increasing cropping intensity, use of high analysis fertilizers and limited use of organic manures These are causes for poor productivity of oilseed crops. According to Marschner (1993) [5], in arid regions' soils encountering Zn and Fe deficiency, soil application of Zn and Fe are not effective. Instead, foliar application of such nutrients in the early growth period of grain crops would increase their performance. Findings have demonstrated that spraying of micronutrients such as Bo, Zn and Fe significantly increases the number of seeds per head, 1000 seeds'

weight, grain yield, oil, and protein content (Ravi *et al.* 2008) [8]. Foliar application of nutrients has become an efficient way to increase yield and quality of crops (Romemheld and El-Fouly, 1999). It is reported that foliar Zn and Mn application can improve the seed yield and seed quality of safflower (*Carthamus tinctorius* L.) grown under drought stress (Mohsen Movahhedy-Dehnavy, 2009) [6]. Micronutrient deficiency are now frequently observed in Marathwada region so for overcoming these problems and getting higher yield of niger must need to use foliar application of micronutrients. Hence, it is necessary to study adopt the proper micronutrient management practices increasing the productivity of oilseed crops.

Niger require relatively in smaller quantity micronutrients. They include iron (Fe), manganese (Mn), zinc (Zn), boron (B), copper (Cu), molybdenum (Mo) chlorine (Cl). In oilseeds these micronutrients play a major role in translocation of photosynthates, increasing seed setting percentage, essential for translocation of sugar, germination of pollen grains, stigma receptivity, amino acid and protein synthesis which ultimately increase the productivity of oilseed crops. Zinc, Boron, Ferrous is an essential micronutrient and plays a key role as a structural constituent or regulatory cofactor of a wide range of different enzymes and proteins in many important biochemical pathways like carbohydrate metabolism, photosynthesis, conversion of sugars to starch, protein metabolism, auxin (growth regulator) metabolism, pollen formation, integrity of biological membranes and resistance to infection by certain pathogens. Micronutrients are needed in small, but critical concentrations and if the amount available is not adequate, plants will suffer from physiological stress. Under Zinc, Boron, Ferrous deficient conditions, flowering and fruit development is reduced and growth period is prolonged resulting in delayed maturity, leading to lower yield, poor quality and suboptimal nutrient use efficiency.

Materials and Methods

The experiment was carried out at experimental farm, Department of Agronomy, College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani, during *Kharif* 2019. The topography of experimental plot was fairly levelled. The soil was medium black in colour, high retentive of moisture, deep well and fairly well drained, medium in organic carbon, poor in nitrogen, medium in available phosphorus and high in potash and slightly alkaline in reaction. Geographically parbhani is situated at 19016' North latitude and 76047' East longitude and at 409 m altitudes above sea level and has a semi- arid climate. The total rainfall received during the crop growth period (July to Nov. 2019) was 731.7 mm over 53 rainy days. During this period, monthly maximum rainfall 332 mm was received in the month of September and minimum rainfall 26.3 mm was received in the month of October.

The experiment was laid out in Randomized Block Design with three replications. The treatments were consisting of RDF and foliar application of micronutrient at flowering and capitula formation constituting eight treatments i.e. T_1: Control (No any foliar application), T_2: B (0.5%), T_3: Zn (0.5%), T_4: Fe (0.5%), T_5: B (0.5%) + Zn (0.5%), T_6: B (0.5%) + Fe (0.5%), T_7: Zn (0.5%) + Fe (0.5%), T_8: B (0.5%) + Zn (0.5%) + Fe (0.5%). The layout was consisted of 24 experimental units in three replications with 8 experimental units in each replication.

The gross and net plot size of each experimental unit was 5.4 m x 4.5 m and 4.8 m x 4.3 m, respectively. Sowing was done on 4th July 2019 by dibbling method at spacing of 30 x 10 cm. The recommended cultural practices and plant protection measures were undertaken. The recommended dose of fertilizer (40:20:20 kg N, P2O5, K2O ha^{-1}) was applied as basal dose at the time of sowing through urea SSP and muriate of potash was applied as per treatments. The crop was harvested on 14th October 2019.

Mean emergence count and final plant stand at harvest were taken from each net plot. The seed yield was recorded from each net plot at the time of harvest. The seed yield kg ha^{-1}, gross monetary returns (GMR) ₹ /ha-1, net monetary returns (NMR) ₹ /ha^{-1} and B:C ratio were also calculated.

Results and Discussion

The results as well as discussions of the various treatments have been presented under following heads:

Effect on yield

The effect of different treatments on seed yield (505 kg/ha^{-1}) was considerably higher with the application of B (0.5%) + Zn (0.5%) + Fe (0.5%) at flowering and capitula formation (T_8) (505.00 kg/ha^{-1}) followed by the application of Zn (0.5%) + Fe (0.5%) at flowering (T_7) seed yield (494.70 kg/ha^{-1}) Table 1. The lowest values of the above mentioned parameters was recorded with Control (No any foliar application) was applied in (T1) seed yield (358.33 kg/ha^{-1}). There was 40.93% increase in seed yield due to foliar applications of B (0.5%) + Zn (0.5%) + Fe (0.5%) at flowering and capitula formation stage (T_8).

The increase in seed yield could be due to the increase in yield attributes (number of capsule per plant, weight of capsule per plant and weight of seed per plant) consequently. Niger required fully dry spell during flowering and seed setting, rainfall at flowering and seed setting period is very much detrimental for the crop yield, due to this reason yield variations were found among the experimental years. The increase in yield components can be due to the fact that available more water enhanced nutrient availability which improved nitrogen and other macro and micro elements absorption as well as enhancing the production and translocation of the dry matter content from source to sink. The superiority in seed yield due to foliar applications of micronutrients supplemented increases efficiency of nutrients as per needs by the crop. Several workers have emphasized for such improved nutrient use efficiency through the foliar applications of fertilizers in niger and other resembling crops under varying agro-climatic conditions (Fakeerappa Arabhanvi *et al.*, 2015, Hedage, 2012, Galvi *et al.*, 2012, Praveen *et al.*, 2020) [2, 7].

Effect on economics

The inputs and outputs prices of commodities prevailed during year of trial were considered for calculating cost of production, net monetary return and benefit-cost ratio (Table 1). Applications of B (0.5%) + Zn (0.5%) + Fe (0.5%) at flowering and capitula formation (T_8) recorded highest gross monetary returns (₹ 29997 ha^{-1}) net monetary return (₹ 13206/ha-1) and B:C ratio (1.81), followed by (T_7) applications of Zn (0.5%) + Fe (0.5%) at flowering and capitulla formation stages (₹ 12870/ha^{-1} and 1.78 respectively). The cost of production (₹ 14498/ha^{-1}) was

lowest in treatment (T_1) that is control (No any foliar application) and highest (₹ 16553/ ha^{-1}) with foliar applications of B (0.5%) + Zn (0.5%) + Fe (0.5%) at flowering and capitula formation (T_8). lowest gross monetary returns (₹ 2285 ha^{-1}), net monetary returns (6649 ha^{-1}) and benefit: cost ratio (1.47) was obtained by treatment T_1 (Control (No any foliar application). Similar finding has also been reported in niger crop under varying agro-climatic conditions (Hedage, 2012, Galvi *et al.*, 2012, Praveen *et al.*, 2020) [7].

Table 1: Effect of micronutrient foliar application on seed yield) kg ha^{-1} (Cost of cultivation) ₹ ha^{-1} (Gross monetary returns) ₹ ha^{-1} (Net monetary returns) ₹ ha^{-1} (and B:C ratio of niger crop as influenced by different Treatments.

Tr. No.	Treatments	Seed yield (kg ha^{-1})	Cost of cultivation (₹ ha^{-1})	Gross monetary Returns (₹ ha^{-1})	Net monetary returns (₹ ha^{-1})	B:C Ratio
T_1	Control (No any foliar application)	358.33	14498	21285	6649	1.47
T_2	B (0.5%)	370.00	14772	21978	6909	1.49
T_3	Zn (0.5%)	388.00	14834	23047	6669	1.55
T_4	Fe (0.5%)	402.33	15223	23899	9131	1.57
T_5	B (0.5%) + Zn (0.5%)	417.00	15441	24770	8913	1.60
T_6	B (0.5%) + Fe (0.5%)	432.00	15869	25661	10920	1.62
T_7	Zn (0.5%) + Fe (0.5%)	494.70	16533	29383	12870	1.78
T_8	B (0.5%) + Zn (0.5%) + Fe (0.5%)	505.00	16553	29997	13206	1.81
S.Em±		11.09	--	659.26	774.54	--
CDat5%		33.50	--	1990.46	2338.52	--
GM		420.91	15466	25002	9408	1.61

Conclusion

On the basis of present investigation, it can be concluded that the application of B (0.5%) + Zn (0.5%) + Fe (0.5%) at flowering and capitula formation will be beneficial and economically profitable for achieving higher seed yield with higher net monetary returns in niger. The lowest values of the above mentioned parameters was recorded with Control (No any foliar application) was applied in (T_1).

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