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Effect of Micronutrients Application on Availability of Zn, Fe and B of Sunflower (*Helianthus annus* L.) in Inceptisol

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ABSTRACT

Keywords

Zinc, Iron, Boron, Nutrient availability, Sunflower.

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The experiment was laid in Randomized Block Design with three replications and eight treatments. The field experiment was conducted in College of Agriculture, Latur farm during the *kharif* season 2016-2017. The result reveled that micronutrient application along with RDF had significant effect on nutrient availability. The availability of Zn, Fe and B was maximum with application of treatment T_8 (RDF+20 kg ha^{1} $ZnSO_4$+20 kg ha^{1} EDTA $FeSO_4$+2 kg ha^{1} Borax) at different growth stages of sunflower over control. The availability of all the nutrients was initially higher and gradually decreased as crop grows up to harvest. The treatment receiving RDF + three micronutrient combination show significant response in respect with nutrient availability of sunflower than RDF + alone micronutrient combination.

Introduction

Sunflower (*Helianthus annuus* L.) is an important oilseed crop in India popularly known as “Surajmukhi.” It belongs to the family Compositeae. It is one of the fastest growing oilseed crops in India. In India, sunflower is cultivated over an area of about 5.2 lakh hectares with a production of 3.35 lakh tones and a productivity of 643 kg per hectare (Anon., 2015-16). Sunflower seed contain 45-50 % good quality oil and high amount of protein in cake. The oil contains 64% linolic acid, 20-25% oleic acid and 40-44% protein in cake along with sufficient amount of vitamin A, D and E. Because of high linolic acid contain (64%). It contains sufficient amount of calcium, iron and vitamins like A, D, E and B complex. Application of micronutrients plays a major role in increasing seed setting percentage and influence growth and yield.

Adequate and balanced fertilizer is essential for obtaining better yield. Generally farmers do not apply micronutrients to sunflower crop hence the quality production is low therefore, for wide spread adoption and exploitation of high yield potential of the crop, it is necessary to work out the influence of micronutrient application *viz.*, Zn, Fe and B on sunflower in inseptisol.

Materials and Methods

The experiment was laid in Randomized Block Design with three replications and eight treatments. The field experiment was conducted in College of Agriculture, Latur farm during the *kharif* season 2016-2017.This experiment was laid out in randomized block design with 3 replication and 8 treatments. The experimental soil was clayey in texture, slightly alkaline reaction, low in content of available nitrogen, medium in available phosphorous, high in available potassium and medium in zinc, and boron, low in iron. The experiment consist of 8 treatments T_1: RDF, T_2: RDF+20 kg ha^1 $ZnSO_4$, T_3: RDF+20 kg ha^1 EDTA $FeSO_4$, T_4: RDF+2 kg ha^1 Borax, T_5: RDF+20 kg ha^1 $ZnSO_4$+20 kg ha^1 EDTA $FeSO_4$, T_6: RDF+20 kg ha^1 $ZnSO_4$+2 kg ha^1 Borax, T_7: +20 kg ha^1 EDTA $FeSO_4$+2 kg ha^1 Borax,T_8: RDF+20 kg ha^1 $ZnSO_4$+20 kg ha^1 EDTA $FeSO_4$+2 kg ha^1 Borax. Recommended dose of fertilizer (90:45:45) was applied through urea, SSP and MOP and micronutrient through $ZnSO_4$, chelated $FeSO_4$ and Borax was applied treatment wise at the time of sowing. Full dose of phosphorus, potassium and micronutrients along with 50 percent dose of nitrogen of each treatment was applied as basal dose and remaining 50 percent nitrogen dose of each treatment was applied 30 days after sowing. The soil samples were drawn at 35, 55, 75 and harvest stage of sunflower and analyzed for available Zn and Fe by DTPA $CaCl_2$ solution and concentration measured on Atomic Absorption Spectrophotometer AAS-1, at different wavelength for Zn and Fe. Available B by Azomethine method on Spectrophotometer at 420 nm wavelength.

Results and Discussion

Zinc

Periodical availability of zinc at different growth stages of sunflower presented in table 1. From data it is indicated that available Zn was in range of (1.25 to 1.85 ppm) at 35 DAS due to application of RDF along with micronutrients. The maximum availability was found in range of (1.85, 1.82, 1.76 and 0.87 ppm) at 35, 55, 75 and harvest stage of sunflower respectively. While lowest availability of Zn was found (1.25, 1.18, 1.13 and 0.60) at 35, 55, 75 and harvest stage of sunflower respectively. Zinc content in soil maximum in $T_{6,}$ T_5 and T_7 than T1.The periodical availability of zinc in soil from 35 days to harvest showed decreasing trend with advancement of time. This decrease in available zinc in soil may be associated with the utilization of available zinc by crop. The requirement of zinc for crop earlier stages was relatively less and increased considerably with advancement of crop which in turns exhausts part of available zinc from soil. This is due to inorganic zinc may absorbed by clay collides and converted in to unavailable zinc. Similar results were also reported by Indulkar and Malewar (1990) reported that the periodical availability of Zn in soil from 30 days to harvest of rice crop showed decreasing trend with advancement of time. This decrease in available zinc in soil may be associated with the utilization of available zinc by crop. Bagal (2006) reported that the available Zn was in rang of 1.127 to 1.920 ppm at 30 DAS due to application of Zinc sulphate. Selvi *et al.,* (2008) studied that the effect of Zn on yield of rainfed castor and observed that the application of 25.0 kg $ZnSO_4$ registered the highest available Zn (1.60 ppm) while the control treatment (NPK alone) recorded the lowest available Zn (0.73 ppm) in the soil.

EDTA Iron (ppm)

Effect of micronutrients application on availability of iron (ppm) in soil at different growth stages of sunflower presented in table 2. From data it is indicated that available Fe was increased from (2.18 to2.28 ppm) at 35

DAS due to application of RDF along with micronutrients. Similarly significant variation was recorded among treatment T_5 and T_6 have consistently and significantly increase the availability of Fe content in soil over T_1. Application of T_8 has recorded significantly higher value (2.28, 2.18, 2.16 and 2.13 ppm) at 35, 55, 75 and harvest stage of sunflower respectively. Iron content in soil maximum in treatment containing RDF + micronutrient combination than alone micronutrient combination along with RDF.

The periodical availability of iron in soil from 35 days to harvest showed decreasing trend with advancement of time. This might be due to use of iron by plant from the part of iron in soil. The availability of micronutrients in soil is highly affected by inorganic ions in soil solution, free oxides of iron and aluminium and fertilizers i.e. $FeSO_4$ applied to soil. As experimental soil dominated by smectite mineral they contain micronutrient cations particularly Zn and Fe. These ions are released from the clay under certain soil conditions and fixed on colloidal surfaces if their concentration in soil solution is increases by micronutrient fertilizer application i.e. $FeSO_4$ and $ZnSO_4$. Similarly reported by Selvi *et al.,* (2008) studied that the effect of Fe on yield of rainfed castor and observed that the application of 50.0 kg $FeSO_4$ ha^{-1} registered the highest available Fe (4.27 ppm), while the control treatment (NPK alone) recorded the lowest available Fe (2.33 ppm) in the soil. Gebremedhin *et al.,* (2015) reported that the available nutrients kg ha^{-1} was obtained with $FeSO_4$ @ 0.5 % was applied nutrient management based on soil tested data besides maintaining the available N, P and K of soil, leading to positive nutrient balance in sunflower crop.

Table.1 Effect of micronutrients application on availability of Zn (ppm) in soil at different growth stages of sunflower

Treatments	**Available Zinc**			
	35 DAS	**55 DAS**	**75 DAS**	**At harvest**
RDF	1.25	1.18	1.13	0.60
RDF+20 kg ha^{1} $ZnSO_4$	1.43	1.31	1.23	0.73
RDF+20 kg ha^{1} EDTA $FeSO_4$	1.28	1.25	1.18	0.62
RDF+2 kg ha^{1} Borax	1.42	1.29	1.20	0.70
RDF+20 kg ha^{1} $ZnSO_4$+20 kg ha^{1} EDTA $FeSO_4$	1.72	1.69	1.51	0.76
RDF+20 kg ha^{1} $ZnSO_4$+2 kg ha^{1} Borax	1.83	1.80	1.60	0.85
RDF+20 kg ha^{1} EDTA $FeSO_4$+2 kg ha^{1} Borax	1.82	1.76	1.52	0.81
RDF+20 kg ha^{1} $ZnSO_4$+20 kg ha^{1} EDTA $FeSO_4$+2 kg ha^{1} Borax	1.85	1.82	1.76	0.87
S.E±	0.017	0.018	0.010	0.021
CD at 5%	0.052	0.053	0.030	0.064

Table.2 Effect of micronutrients application on availability of Fe (ppm) in soil at different growth stages of sunflower

Treatments	**Available Iron**			
	35 DAS	**55 DAS**	**75 DAS**	**At harvest**
RDF	2.18	2.06	2.03	2.01
RDF+20 kg ha^{1} $ZnSO_4$	2.12	2.12	2.08	2.06
RDF+20 kg ha^{1} EDTA $FeSO_4$	2.12	2.08	2.05	2.04
RDF+2 kg ha^{1} Borax	2.13	2.11	2.06	2.02
RDF+20 kg ha^{1} $ZnSO_4$+20 kg ha^{1} EDTA $FeSO_4$	2.14	2.12	2.14	2.07
RDF+20 kg ha^{1} $ZnSO_4$+2 kg ha^{1} Borax	2.16	2.16	2.13	2.09
RDF+20 kg ha^{1} EDTA $FeSO_4$+2 kg ha^{1} Borax	2.20	2.19	2.16	2.12
RDF+20 kg ha^{1} $ZnSO_4$+20 kg ha^{1} EDTA $FeSO_4$+2 kg ha^{1} Borax	2.28	2.18	2.16	2.13
S.E±	0.013	0.003	0.008	0.002
CD at 5%	0.039	0.009	0.025	0.008

Table.3 Effect of micronutrients application on availability of B (ppm) in soil at different growth stages of sunflower

Treatments	**Available Boron**			
	35 DAS	**55 DAS**	**75 DAS**	**At harvest**
RDF	0.373	0.250	0.245	0.213
RDF+20 kg ha^{1} $ZnSO_4$	0.400	0.303	0.296	0.240
RDF+20 kg ha^{1} EDTA $FeSO_4$	0.387	0.253	0.231	0.220
RDF+2 kg ha^{1} Borax	0.390	0.270	0.261	0.220
RDF+20 kg ha^{1} $ZnSO_4$+20 kg ha^{1} EDTA $FeSO_4$	0.457	0.287	0.268	0.270
RDF+20 kg ha^{1} $ZnSO_4$+2 kg ha^{1} Borax	0.460	0.343	0.386	0.270
RDF+20 kg ha^{1} EDTA $FeSO_4$+2 kg ha^{1} Borax	0.460	0.323	0.378	0.270
RDF+20 kg ha^{1} $ZnSO_4$+20 kg ha^{1} EDTA $FeSO_4$+2 kg ha^{1} Borax	0.473	0.347	0.394	0.300
S.E±	0.009	0.0103	0.0106	0.0090
CD at 5%	0.028	0.0313	0.0318	0.0274

Boron availability (ppm)

Effect of micronutrients application on availability of boron (ppm) in soil at different growth stages of sunflower presented in table 3. Data presented in table reveled that almost all the treatments significantly increase the boron availability over T_1 (0.373). The treatment T_8 contributes highest B in soil i.e. 0.473 ppm at 35 DAS. Boron contain in soil was increased from 0.373 to 0.473 ppm at 35 DAS due to application of T_8. Similarly significant variation was recorded due to application of B in combination of Zn and Fe. Application of T_4, T_5, T_6 and T_7 has significantly increased the availability of B content in soil over T_1. Application of T_8 has recorded significantly higher value (0.473. 0.347, 0.394 and 0.300 ppm) at 35, 55, 75 and harvest stage of sunflower respectively. At 35 DAS the availability of B was maximum and thereafter as growth advanced B availability was decreased. The availability and utilization of boron was determined to a considerable extent by pH. Boron is held in organic combination from which it may be released for crop use plants root absorb boron from soil when its concentration is highest by application of borax which increase content of boron. The availability of boron was highest in treatment T_8 at all growth stages due to application of RDF + micronutrient combination than alone micronutrient combination along with RDF. These results confirmatory with the finding of Silva *et al.*, (2016) reported that fertilization with boron increased soil boron availability. Although this increase was linear in both layers, near neutral pH and low levels of organic matter reduced the boron absorption capacity. Nirmale (1991) reported that the available boron ranged from 0.18 to 0.37 mg kg^{-1} in soil. There was steady decrease with depth showing relatively more accumulation of available boron at surface layers.

The nutrient availability was significantly affected with application of treatments. The availability of Zn, Fe and B was maximum with application of treatment T8 (RDF+20 kg ha^1 $ZnSO_4$+20 kg ha^1 EDTA $FeSO_4$+2 kg ha^1 Borax) at all growth stages of sunflower over control. The availability of all the nutrients was initially higher and gradually decreased as crop grows up to harvest. The maximum availability was obtained at 35 DAS and thereafter as crop age advanced nutrient availability decreased.

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