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Effect of macro and micronutrients on soil properties under groundnut crop (*Arachis hypogaea* L.) in coastal sandy soils

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ABSTRACT

A field experiment was conducted at Agricultural College Farm, Bapatla during *rabi*, 2021-22 to study the effect of macro and micronutrients on soil properties under groundnut in coastal sandy soil. The results of the experiment revealed that the application of macro and micronutrients significantly influenced the available nutrient status of N, P, K, Ca, S, Zn and B. The highest values of N, K, S, Ca, Zn and B were recorded by the treatment T_5 (125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}) and onpar with T_4 & T_7while the P availability was maximum with T_3 (125% RDF). Whereas the physico-chemical properties such as pH, EC, organic carbon and CEC and available nutrient status of Mg, Fe, Cu and Mn were not significantly influenced by the treatments.

Keywords: *Boron, Groundnut, Micronutrients, Soil, Zinc.*

Groundnut (*Arachis hypogeae* L.) is an important oilseed crop grown in the tropics and semi-tropics of the world. It is also a leguminous crop which can fix atmospheric nitrogen by the bacteria *Rhizobium* present in the nodules and hence it requires less N containing fertilizers. It contains high oil and protein content hence it is called as the king of oil seed crops. India ranks first in groundnut area with an area of 4.89 million hectares and second in production with 10.10 million tonnes. Major states producing groundnut are Gujarat, Rajasthan and Andhra Pradesh. Andhra Pradesh stands fourth in production with an area of about 0.66 million ha and production of 0.85 million tonnes and its productivity is about 1282 kg ha^{-1} (Directorate of Economics and Statistics, 2020). It is a rich source of edible oil and high-quality protein and hence it is valued for both oil and confectionary purposes.

Groundnut is mostly grown in light textured soils especially sandy loam and sandy soils mainly because it has underground pod bearing habit. But these soils have poor nutrient status especially micronutrients, iron (Fe), zinc (Zn) and boron (B) due to leaching, low nutrient retention capacity and low organic matter status. Groundnut, being an exhaustive crop, removes large amount of macro and micronutrients thereby leading to nutrient deficiency in the soils. In cropping system, if a legume like groundnut is a component crop which leaves considerable mineralizable nitrogen in the soil to the succeeding crop (Satpute *et al.*, 2020). Soil application of micronutrients would be beneficial in improving the micronutrients status in the soil. Keeping all these points in view, this experiment was conducted to evaluate the effect of macro and micronutrients on physico- chemical properties and nutrients availability groundnut crop in coastal sandy soils.

MATERIAL AND METHODS

The experiment was conducted during rabi, 2021-22 at Agricultural College Farm, Bapatla situated in Krishna zone of Andhra Pradesh (15p 55'N latitude and 80p 30' E longitude) at an altitude of 5 m above mean sea level and about 8 km away from Bay of Bengal. The experimental soil was sandy in texture, neutral in reaction (6.65), non-saline (0.09 dS m^{-1}), low in organic carbon (0.09 g kg^{-1}) & available nitrogen (135 kg ha^{-1}), medium in available phosphorus (39.5 kg ha^{-1}) and low in available potassium (118 kg ha^{-1}), calcium (320 mg kg^{-1}) and

magnesium (42 mg kg^{-1}) and sufficient in sulphur (20 mg kg^{-1}), manganese (3.59 mg kg^{-1}), copper (0.69 mg kg^{-1}) and deficient in boron (0.29 mg kg^{-1}), iron (3.95 mg kg^{-1}) and zinc (0.29 mg kg^{-1}). The experiment was laid out in RBD with seven treatments replicated thrice. the effect of macro and micronutrients on soil properties under groundnut in coastal sandy soil. The treatments are T_1- Control, T_2- 100% RDF, T_3- 125% RDF, T_4- 100% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}, T_5- 125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}, T_6- 100% RDF + Foliar application of $ZnSO_4$@ 2 g L^{-1}, $FeSO_4$@ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS, T_7- 125% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$@ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS. A common dose of 30 kg nitrogen ha^{-1}, was applied through urea in two equal split doses, half as basal, and a half at 30 DAS by considering the plot size. A common dose of phosphorus @ 40 kg ha^{-1} in the form of single super phosphate, and potassium @ 50 kg ha^{-1} in the form of muriate of potash were applied as basal before sowing. $ZnSO_4$ and borax were applied at the rate of 50 kg ha^{-1} and 10 kg ha^{-1} respectively, to the plots as per the treatments as basal and foliar application of $ZnSO_4$, $FeSO_4$ and borax were applied at the rate of 2 g L^{-1}, 5 g L^{-1} and 1.5 g L^{-1} at 45 DAS and 65 DAS to the respective plots as per the treatments.

The groundnut variety TAG-24 was planted in the second week of November with a spacing of 30 x 10 cm. The crop was raised with all the standard packages of practices as they required. Soil samples were collected at peg penetration, pod development and harvest stages and analyzed using standard procedures in the laboratory. Available soil micronutrients (Zn, Fe, Cu and Mn) were analyzed by DTPA extraction method using AAS (Lindsay and Norvell, 1978). Available soil boron was extracted with hot water and estimated by using Azomethine-H method using spectrophotometer at 430 nm (Tandon, 2009). The data were analyzed statistically by following the analysis of variance (ANOVA) technique as suggested by Panse and Sukhathme (1978) for RBD.

RESULTS AND DISCUSSION

Physico-chemical properties

Soil reaction

The results revealed that there was no significant influence on soil pH, EC, CEC and organic carbon by the application of macro and micronutrients after harvest of groundnut (Table 1).

Macronutrients

The results of the investigation showed that there was a significant influence of application of macro and micronutrients on available macronutrients status of the soil at all the stages of the crop (Table 2). At all the stages, significantly highest available N and K status was observed under the treatment T_5 (125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}) statistically on par with T_7 and T_3. At all the stages, the phosphorus availability was significantly higher in the treatment T_3 (125% RDF) and it was on par with T_7 and T_5. The treatment T_1 (Control) recorded the lowest available macronutrients in the soil. This might be due to the direct addition of increased doses of fertilizers combined with FYM. However, there was a slight increase in the nitrogen availability by the application of micronutrients mostly due to increased nodulation which led to higher atmospheric N fixation, hence more availability of N availability in the soil (Elayaraja and Senthilvalavan, 2019). Similar findings were given by Abd EL-Kader and Mona (2013), Abhigna (2021) and Karunakaran *et al*. (2021).

Secondary nutrients

The results of the investigation showed that there was a significant difference in available calcium and sulphur observed among the treatments whereas magnesium availability was not significantly influenced (Table 3). The treatment T_5 (125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}) recorded significantly higher available calcium and sulphur in the soil which was on par with all the other treatments except T_1. This might be due to the application of gypsum which increased the availability of calcium and sulphur in the soil in those gypsum applied treatments. These results were in accordance with Poonia and Bhumbla (1973) and Akbari *et al*. (2003).

Micronutrients

The status of Zn and B in the soil at all the stages were significantly influenced by the application of macro and micronutrients application but the

Table 1: Effect of macro and micronutrients on physico-chemical properties of soil in groundnut crop

Treatments	pH	EC ($dS\ m^{-1}$)	CEC ($cmol\ (p^{+})\ kg^{-1}$)	Organic carbon ($g\ kg^{-1}$)
T_1: Control	6.58	0.09	5.75	0.85
T_2: 100% RDF	6.53	0.10	5.92	1.12
T_3: 125% RDF	6.46	0.12	6.00	1.23
T_4: 100% RDF + Soil application of $ZnSO_4$ @ 50kg ha^{-1} and Borax @ 10 kg ha^{-1}	6.47	0.11	5.97	1.18
T_5: 125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}	6.41	0.12	6.04	1.23
T_6: 100% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	6.52	0.10	5.77	1.19
T_7: 125% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	6.46	0.12	6.00	1.21
SEm (±)	0.21	0.01	0.24	0.07
CD (P=0.05)	NS	NS	NS	NS
CV (%)	5.48	12.71	6.94	10.97

Table 2: Effect of macro and micronutrients on available nitrogen, phosphorus and potassium in soil at different growth stages of groundnut

Treatments	Available N (kg ha^{-1})			Available P_2O_5 (kg ha^{-1})			Available K_2O (kg ha^{-1})		
	Peg penetration stage	Pod development stage	Harvest stage	Peg penetration stage	Pod development stage	Harvest stage	Peg penetration stage	Pod development stage	Harvest stage
T_1: Control	123	113	102	37.3	31.0	24.5	96	84	78
T_2: 100% RDF	157	141	136	51.0	43.6	41.0	127	117	108
T_3: 125% RDF	179	163	156	61.7	51.9	49.2	148	137	127
T_4: 100% RDF + Soil application of $ZnSO_4$ @ 50kg ha^{-1} and Borax @ 10 kg ha^{-1}	158	144	139	49.7	41.6	40.2	130	119	112
T_5: 125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}	181	165	158	60.5	50.8	48.2	151	142	130
T_6: 100% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	157	142	138	50.6	43.3	40.9	128	117	110
T_7: 125% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	180	164	157	61.4	51.8	49.1	149	137	127
SEm (±)	6.68	6.09	5.21	2.57	2.17	2.12	5.80	5.33	4.77
CD (P=0.05)	20.57	18.75	16.06	7.92	6.68	6.54	17.88	16.43	14.71
CV (%)	7.14	7.14	6.41	8.38	8.36	8.78	7.59	7.58	7.31

Table 3: Effect of macro and micronutrients on available calcium magnesium and sulpher in soil at different growth stages of groundnut

Treatments	Available calcium (mg kg^{-1})			Available magnesium (mg kg^{-1})			Available sulphur (mg kg^{-1})		
	Peg penetration stage	Pod development stage	Harvest stage	Peg penetration stage	Pod development stage	Harvest stage	Peg penetration stage	Pod development stage	Harvest stage
T_1: Control	293	277	260	48.7	44.0	35.3	17.6	16.5	15.5
T_2: 100% RDF	377	347	323	62.7	54.7	42.0	23.6	20.9	19.9
T_3: 125% RDF	390	373	340	65.3	59.3	44.7	24.1	21.3	20.4
T_4: 100% RDF + Soil application of $ZnSO_4$ @ 50kg ha^{-1} and Borax @ 10 kg ha^{-1}	383	357	333	62.7	56.7	42.3	24.9	21.9	20.7
T_5: 125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}	400	387	347	67.3	60.7	45.3	25.3	22.2	21.2
T_6: 100% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	381	353	327	60.7	56.0	41.3	24.2	21.2	20.2
T_7: 125% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	397	377	328	66.7	60.0	44.8	24.6	21.6	20.6
SEm (±)	21.14	17.82	14.34	4.17	3.07	2.57	1.10	0.98	1.09
CD (P=0.05)	65.14	54.92	44.20	NS	NS	NS	3.39	3.02	3.35
CV (%)	9.78	8.75	7.70	11.66	9.51	10.55	8.10	8.16	9.53

Table 4: Effect of macro and micronutrients on available zinc and mangnese iron, in soil at different growth stages of groundnut

Treatments	Available iron (mg kg^{-1})			Available zinc (mg kg^{-1})			Available manganese (mg kg^{-1})		
	Peg penetration stage	Pod development stage	Harvest stage	Peg penetration stage	Pod development stage	Harvest stage	Peg penetration stage	Pod development stage	Harvest stage
T_1: Control	3.51	3.41	3.39	0.38	0.35	0.29	3.25	2.85	2.41
T_2: 100% RDF	4.06	3.95	3.73	0.42	0.38	0.32	3.33	2.97	2.52
T_3: 125% RDF	4.12	4.00	3.76	0.44	0.39	0.33	3.37	3.01	2.54
T_4: 100% RDF + Soil application of $ZnSO_4$ @ 50kg ha^{-1} and Borax @ 10 kg ha^{-1}	4.11	4.02	3.81	0.84	0.74	0.65	3.33	2.97	2.51
T_5: 125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}	4.25	4.07	3.84	0.88	0.76	0.68	3.38	3.01	2.56
T_6: 100% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	4.14	4.10	3.87	0.44	0.39	0.33	3.34	2.99	2.51
T_7: 125% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	4.18	4.15	3.89	0.45	0.41	0.34	3.37	3.01	2.55
SEm (±)	0.23	0.25	0.19	0.03	0.03	0.02	0.17	0.13	0.10
CD (P=0.05)	NS	NS	NS	0.08	0.09	0.06	NS	NS	NS
CV (%)	9.80	10.92	8.88	8.54	10.46	7.53	8.95	7.79	7.11

Table 5: Effect of macro and micronutrients on available copper and boron in soil at different growth stages of groundnut

Treatments	Available copper (mg kg^{-1})			Available boron (mg kg^{-1})		
	Peg penetration stage	Pod development stage	Harvest stage	Peg penetration stage	Pod development stage	Harvest stage
T_1: Control	0.61	0.58	0.56	0.20	0.16	0.10
T_2: 100% RDF	0.64	0.60	0.58	0.21	0.17	0.11
T_3: 125% RDF	0.66	0.62	0.60	0.21	0.18	0.12
T_4: 100% RDF + Soil application of $ZnSO_4$ @ 50kg ha^{-1} and Borax @ 10 kg ha^{-1}	0.64	0.61	0.59	0.56	0.49	0.40
T_5: 125% RDF + Soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1}	0.65	0.63	0.61	0.60	0.51	0.42
T_6: 100% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	0.64	0.61	0.59	0.21	0.20	0.12
T_7: 125% RDF + Foliar application of $ZnSO_4$ @ 2 g L^{-1}, $FeSO_4$ @ 5 g L^{-1} and Borax @ 1.5 g L^{-1} at 45 and 65 DAS	0.65	0.62	0.60	0.22	0.20	0.14
SEm (±)	0.03	0.03	0.03	0.02	0.02	0.01
CD (P=0.05)	NS	NS	NS	0.05	0.06	0.03
CV (%)	8.38	8.04	7.74	8.89	11.81	9.16

availability of Fe, Cu and Mn were not significantly influenced (Table 4). Application of 125% RDF along with soil application of $ZnSO_4$ @ 50 kg ha^{-1} and Borax @ 10 kg ha^{-1} recorded the significantly higher soil available zinc (0.88, 0.76 and 0.68 mg kg^{-1}) and boron status (0.20, 0.16 and 0.10 mg kg^{-1}) which was on par with T_4. This significant buildup of zinc and boron status in the soil might be due to the adequate application of $ZnSO_4$ and borax to the soil. Similar findings were given by Haneena *et al*. (2021), Kamalakannan and Elayaraja (2020), Kumbhar *et al*. (2017) and Abhigna (2021).

CONCLUSION

The results of the investigation clearly indicated that the application of 125% RDF along with the soil application of Zn and B would be beneficial in enhancing the availability of N, P, K, Ca, S, Zn and B in the soil.

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