Legume Research. 38 (3) 2015: 363-366
Print ISSN:0250-5371 / Online ISSN:0976-0571

AGRICULTURAL RESEARCH COMMUNICATION CENTRE
www.arccjournals.com/www.legumeresearch.in

Content and uptake of macronutrients by groundnut (*Arachis hypogaea* L.) as influenced by soil application of zinc and boron in sandy loam soils of Karnataka, India

S.A. Nadaf* and H.M. Chidanandappa

Dept. of Soil Science & Agricultural Chemistry,
College of Agriculture, Shivamogga-577 204, India.
Received: 19-11-2013 Accepted: 17-05-2014 DOI: 10.5958/0976-0571.2015.00026.0

ABSTRACT

To study the effect of zinc and boron on content and uptake of macronutrients by groundnut (*Arachis hypogaea* L.) a field experiment was conducted on sandy loam soil of Shivamogga (Karnataka) *Typic Haplustalf* deficient in available zinc and boron. Results showed that N, P and K contents in haulm and kernel, and their uptake was significantly increased due to application zinc sulphate at three level 5, 10 and 20 kg ha^{-1} either alone are in combination with borax @ 5 kg ha^{-1}. However, borax a non significant relation was found with N content in haulm of groundnut due to application of zinc and boron. Application of borax did not influence the nitrogen content of the kernels also. Further the content and uptake of zinc increased in the treatment which received increased level of zinc application.

Key words: *Arachis hypogaea*, Content, Macro nutrient, Micronutrient, Sandy loam, Uptake.

INTRODUCTION

The intensive cropping system involving oil seed crops may remove as much as 350 to 780 kg of major nutrients (N, P_2O_5 and K_2O kg ha^{-1}). Deficiency of micronutrients observed due to the intensive cropping with continuous use of high analysis micronutrient free chemical fertilizers, non-application of organic manures, and improper agronomic practices. This has become a limiting factor for high productivity of oil seed crops. Therefore, it is imperative to apply balanced micronutrients to deficient soil for high productivity of oil seed crops. Among the micronutrients, zinc and boron play an important role in legumes and oil seed crops productivity. Hence, a study was under taken to know the effect of zinc and boron application on macronutrient content and uptake of these macronutrients by groundnut and the results obtained during the investigation are discussed.

MATERIALS AND METHODS

A field experiment was conducted at the Zonal Agricultural Research Station (ZARS) Navile, Shivamogga comes under the Southern Transition Agro-climatic zone of Karnataka. The soil *(Typic Haplustalf)* of the experimental site belongs to the class of sandy loam texture. Before conducting the field experiment a composite soil sample was collected from the experimental site and analyzed for its physical and chemical properties. Soil texture was sandy loam, soil pH 5.86, EC 0.07 dS m^{-1} at 25^{o} C, organic cordon 0.36 %, CEC 10.23 cmol (p^{+}) kg ^{1}. Soil available nitrogen 178.60, available P_2O_5 68.70, and available K_2O 167.60 kg ha^{-1} respectively. Exchangeable Calcium 4.10 cmol (p+) kg^{-1} and Magnesium 01.40 cmol (p+) kg-1 and available Sulphur 12.00 (mg kg^{-1}). Available boron 0.43 mg kg^{-1}) and DTPA-Zinc 0.46 mg kg^{-1}. Eight treatments were drawn in completely randomized block design (RCBD) with three replications using groundnut as (*Arachies hypogaea* L.) test crop.

As per the recommendation, FYM @ 12 t ha^{-1} was applied uniformly to all plots well in advance (25 days) and recommended NPK fertilizers (25: 50 : 25 kg ha^{-1}) respectively. Three levels of zinc sulphate @ 5, 10 and 20 kg ha^{-1} and borax @ 5 kg ha^{-1} were applied into the respective treatments. Groundnut seeds were sown with a spacing of 30 cm between the rows and 15 cm between the plants. The crop was raised as per package of practices published by the University of Agricultural Sciences, Bangalore. Collected samples of haulm and kernels were dried at 60^{0}C, powdered and preserved for analysis (Jackson, 1973). Total nitrogen, P and K of plant samples was determined by adopting slandered method.

$$\underset{(Kg\ ha^{-1})}{\text{Nutrient uptake}} = \underset{(\%)}{\text{Nutrient concentration}} \times \underset{(kg\ ha^{-1})}{\text{Dry matter yield}}$$

*Corresponding author’ e-mail: saiyad_nadaf@yahoo.com.

RESULTS AND DISCUSSION

Nitrogen (N) content of the haulm did not increase significantly due to the imposed treatment (Table 1). However, an application of zinc sulphate at three levels (5, 10 and 20 kg ha^{-1}) with or without borax increased the nitrogen content in kernels significantly compared to the control (3.40 %). Application of borax did not influence the N content of the kernels. Application of zinc sulphate @ 20 kg ha^{-1} was found to be superior in increasing the N content of kernels compared to the level of 5 kg zinc sulphate ha^{-1}. An increase in N content of the kernels due to the application of zinc sulphate may be attributed to the increase in the root nodulation and N-fixation by groundnut. Similar results were reported by Dongale and Zende (1976); Patel and Golakiya (1986); Patil (1987); Jagadish Mishra and Singh (1996); Wasmatkar *et al.* (2002) and Ali and Chattopadhyay (2005).

Phosphorus (P) content of haulm and kernels was not influenced by the application of borax @ 5 kg ha^{-1}. While application of zinc sulphate @ 20 kg ha^{-1} with or without borax significantly increased P content in both haulm and kernels. However, the treatment which received zinc sulphate @ 20 kg ha^{-1} along with borax recorded a maximum P content of haulm (0.39 %) and kernels (0.63 %). Dongale and Zende (1976); Patel and Golakiya (1986); Joshi *et al.* (1987); Patil (1987); and Ali and Chattopadhyay (2005) also reported the similar results.

Potassium (K) content of both haulm and kernels was not influenced by the application of borax. However, the application of zinc sulphate @ 20 kg ha^{-1} with or with out borax significantly increased the K content of both kernels and haulm. A maximum of 2.60 % K content in kernel was noticed due to application of zinc sulphate @ 20 kg ha^{-1} along with borax. This might be due to the enhanced root development, uptake and translocation of nutrients in plant in presence of zinc and boron. Similar results were also reported by Dongale and Zende (1976); Patel and Golakiya (1986); Joshi *et al.* (1987); Patil (1987); Tripathy *et al.* (1999) and Ali and Chattopadhyay (2005).

Application of borax @ 5 kg ha^{-1} (Table 2) did not increase the calcium (Ca) content of haulm and kernels. However, application of zinc sulphate with or without borax significantly increased the Ca content of both haulm and kernels. Further, a non significant increase in the Ca content of both haulm and kernels was observed when zinc sulphate was applied along with borax. Maximum Ca content in haulm (0.69 %) and kernels (0.80 %) was recorded in the treatment, which received zinc sulphate @ 20 kg ha^{-1} along with borax and NPK fertilizers. Valencia (1968); Tiwari and Mandal (1971) and Patel and Golakiya (1986) also reported similar results.

Magnesium (Mg) content of both haulm and kernels was not influenced by the imposed treatments (Table 2). But, **sulphur** (S) content was significantly increased due to zinc sulphate application with or without borax. This suggests that an increase in the S content of both haulm and kernel was due to the supply of S trough zinc sulphate and was supported by an increase in the available S in easer, which received zinc sulphate. The results were in tune with those of Patgiri (1995) and Meena *et al* (2006).

Total uptake of N by groundnut (Table 3) was significantly increased 76.73 kg ha^{-1} from 70.56 kg ha^{-1} in control due to the application of borax @ 5 kg ha^{-1}. Also, application of zinc sulphate either alone or in combination with borax significantly increased the total N uptake by groundnut. This may be attributed to the increase in haulm and kernel yield levels due to increased availability of zinc and boron in soil. However, P uptake was not influenced by the borax application. While, application of zinc sulphate significantly increased the total uptake of P. Maximum P

TABLE 1: Nitrogen (N), Phosphorous (P) and potassium (K) content in haulm and kernels of groundnut as influenced by zinc and boron application

Treatments	Nitrogen (%)		Phosphorus (%)		Potassium (%)	
	Haulm	Kernel	Haulm	Kernel	Haulm	Kernel
T_1- Control (RDF)	1.02	3.40	0.27	0.46	1.31	2.21
T_2- (T_1 + $ZnSO_4$ @ 5 Kg ha^{-1}) -	1.04	3.49	0.28	0.51	1.33	2.29
T_3- (T_1 + $ZnSO_4$ @ 10 Kg ha^{-1})	1.05	3.51	0.29	0.53	1.36	2.41
T_4- (T_1 + $ZnSO_4$ @ 20 Kg ha^{-1})	1.06	3.59	0.30	0.59	1.38	2.50
T_5- (T_1 + Borax @ 5 Kg ha^{-1})-	1.03	3.45	0.28	0.48	1.33	2.28
T_6- (T_5 + $ZnSO_4$ @ 5 Kg ha^{-1}) -	1.04	3.53	0.32	0.54	1.36	2.41
T_7- (T_5 + $ZnSO_4$ @ 10 Kg ha^{-1})	1.06	3.56	0.34	0.59	1.39	2.49
T_8- (T_5 + $ZnSO_4$ @ 20 Kg ha^{-1})	1.07	3.66	0.39	0.63	1.42	2.60
S.Em ±	0.02	0.02	0.01	0.01	0.01	0.03
CD@ 5%	NS	0.07	0.03	0.03	0.04	0.11

RDF= Recommended dose of N P K fertilizer (25 kg N ha^{-1}, 50 kg P_2O_5 ha^{-1} and 25 kg K_20 ha^{-1})

TABLE 2: Calcium (Ca), magnesium (Mg) and sulphur (S) content in haulm and kernel of groundnut as influenced by zinc and boron application

Treatments	Calcium (%)		Magnesium (%)		Sulphur (%)	
	Haulm	Kernel	Haulm	Kernel	Haulm	Kernel
T_1- Control (RDF)	0.62	0.71	0.31	0.51	0.27	0.37
T_2- (T_1 + $ZnSO_4$ @ 5 Kg ha-$^{-1}$) -	0.64	0.74	0.32	0.52	0.43	0.47
T_3- (T_1 + $ZnSO_4$ @ 10 Kg ha-$^{-1}$)	0.65	0.76	0.34	0.53	0.46	0.49
T_4- (T_1 + $ZnSO_4$ @ 20 Kg ha-$^{-1}$)	0.67	0.77	0.36	0.54	0.48	0.57
T_5- (T_1 + Borax @ 5 Kg ha-$^{-1}$)-	0.64	0.73	0.32	0.51	0.29	0.39
T_6- (T_5 + $ZnSO_4$ @ 5 Kg ha-$^{-1}$) -	0.66	0.76	0.34	0.54	0.44	0.51
T_7- (T_5 + $ZnSO_4$ @ 10 Kg ha-$^{-1}$)	0.67	0.77	0.37	0.55	0.47	0.57
T_8- (T_5 + $ZnSO_4$ @ 20 Kg ha-$^{-1}$)	0.69	0.80	0.39	0.56	0.48	0.62
S.Em ±	0.006	0.007	0.03	0.02	0.008	0.01
CD@ 5%	0.02	0.02	NS	NS	0.02	0.04

uptake (23.50 kg ha^{-1}) was recorded by the treatment which received zinc sulphate @ 20 kg ha^{-1} along with borax. Even the K uptake by groundnut was found to be significantly increased (72.37 kg ha^{-1}) from (67.11 kg ha^{-1}) due to the application of borax @ 5 kg ha^{-1}. Similarly, the application of zinc sulphate also significantly increased the total uptake of K by groundnut. However, a maximum of 92. 68 kg ha^{-1} K uptake by groundnut was recorded by the treatment, which received zinc sulphate @ 20 kg ha^{-1} along with borax. The results are in conforming with (Dongale and Zende (1976); Patel and Golakiya (1986); Joshi *et al.* (1987); Patil (1987); Jagadish Mishra and Singh (1996); and Ali and Chattopadhyay (2005).

Among the secondary nutrients uptake Mg uptake was not affected by the imposed treatments. While, Ca uptake was significantly increased due to the application of borax and zinc sulphate either separately or in combination (Table 3). This is probably because of increase in the haulm and kernel yields of groundnut (Fig.1). The results are in conforming with Valencia (1968); Tewari and Mandal (1971) and Patel and Golakiya (1986).

Similarly, S uptake significantly increased from 20.54 to 26 .27 kg ha^{-1} as the levels of zinc sulphate application increased from 5 to 20 kg ha^{-1} with no effect of borax application. However, a maximum of 28.16 kg ha^{-1} uptake was recorded in the treatment which received zinc sulphate @ 20 kg ha^{-1} along with borax. This might be due to the additional supply of sulphur through zinc sulphate as supported by increased availability of sulphur in soil and increase in the haulm and kernels yield of groundnut. (Patgiri, 1995 and Meena *et al.*, 2006).

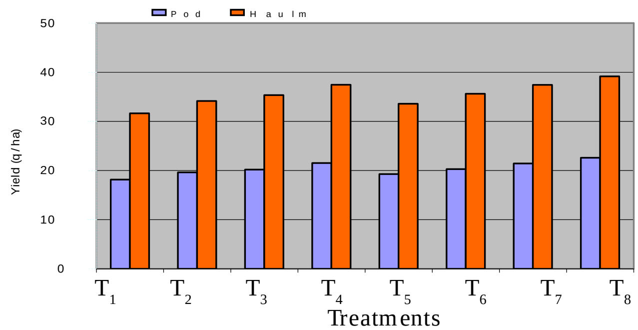

FIG 1: Pod and haulm yield of groundnut as influenced by zinc and boron application

T_1 = Control (RDF)
T_2 = (T_1 + $ZnSO_4$ @ 5 kg ha-$^{-1}$)
T_3 = (T_1 + $ZnSO_4$ @ 10 kg ha-$^{-1}$)
T_4 = (T_1 + $ZnSO_4$ @ 20 kg ha-$^{-1}$)
T_5 = (T_1 + Borax @ 5 kg ha-$^{-1}$)
T_6 = (T_5 + $ZnSO_4$ @ 5 kg ha-$^{-1}$)
T_7 = (T_5 + $ZnSO_4$ @ 10 kg ha-$^{-1}$)
T_8 = (T_5 + $ZnSO_4$ @ 20 kg ha-$^{-1}$)

TABLE 3: Total uptake of primary and secondary nutrients by groundnut as influenced by zinc and boron application

Treatments	Uptake of nutrients by groundnut (kg ha^{-1})					
	Nitrogen (N)	Phosphorous (P)	Potassium (K)	Calcium (Ca)	Magnesium(Mg)	Sulphur (S)
T_1- Control (RDF)	70.56	13.65	67.11	27.61	18.09	12.96
T_2- (T_1 + $ZnSO_4$ @ 5 Kg ha-$^{-1}$) -	78.50	15.94	74.09	31.07	18.58	20.54
T_3- (T_1 + $ZnSO_4$ @ 10 Kg ha-$^{-1}$)	82.60	17.96	78.49	32.88	19.80	22.48
T_4- (T_1 + $ZnSO_4$ @ 20 Kg ha-$^{-1}$)	91.14	20.92	87.61	36.37	20.31	26.27
T_5- (T_1 + Borax @ 5 Kg ha-$^{-1}$)-	76.73	15.31	72.37	30.32	18.43	14.55
T_6- (T_5 + $ZnSO_4$ @ 5 Kg ha-$^{-1}$) -	83.01	18.29	79.65	33.53	19.95	22.39
T_7- (T_5 + $ZnSO_4$ @ 10 Kg ha-$^{-1}$)	89.14	20.80	86.27	35.98	20.54	25.48
T_8- (T_5 + $ZnSO_4$ @ 20 Kg ha-$^{-1}$)	95.72	23.50	92.68	38.34	20.87	28.16
S.Em ±	1.41	0.65	1.47	0.57	0.94	0.55
CD@ 5%	4.27	1.97	4.47	1.72	NS	1.68

REFERENCES

Ali, S J and Chattopadhyay N.C. (2005) Influence of soil application of micronutrients on tuber yield, dry matter production and uptake of N, P and K under lateritic condition of West Bengal. *Indian Agric*., **49** (1-2): 117-128.

Dongale, J.R. and Zende, G.K. (1976) Response of groundnut to the application of Mn, B and S both in presence and absence of FYM through soil and foliar spray. *Indian J. Agron*., **21**: 321-326.

Jackson, M.L., (1973) Soil Chemical Analysis, Prentice Hall of India Pvt Ltd., New Delhi.

Jagadish Mishra and Singh, R.S. (1996) Effect of nitrogen and zinc on the growth and uptake of N and Zn by linseed. *J. Indian Soc. Soil. Sci.,* **44** (2): 338-340.

Joshi, P.K., Bhatt, D.M. AND Kulkarni, J.H (1987) Groundnut root nodulation as affected by micronutrients application and Rhizobium inoculation. *Intern. J. Trop. Agric*., **34**: 199-202.

Meena, M.C., Patel, K.P and Rathod, D.D (2006) Effect of Zinc Iron and Sulphur on mustered in loamy sand soil. *Indian Journal Fertilizers,* **2**(5): 55-58.

Patel, M.S and Golakiya, B.A (1986) Effect of $CaCO_3$ and B application on yield and nutrient uptake by groundnut. *J. Indian Soc. Soil. Sc*., **34**: 815-820.

Patgiri, D.K (1995 Effect of boron, sulphur and molybdenum on toria (*Brassica compestris* L.) in a typic haplaquept. *J. Indian Soc. Soil. Sc.,* **34**(2): 295-296.

Patil, G.D (1987) In, Proc. National symposium on micronutrient stress in crop plants. physiological and genetic approaches to control them *Mahatma Phule Agricultural University, Rahuri*, December, 16 – 18 1997 pp 88 –89.

Tiwari, S.N. and Mandal, S.C (1971) Effects of varying levels of B, Mo and Mn on the absorption of major nutrients by pea plants in solution culture. *J. Inst. Chem.,* (Indian) **43** (4): 148-150.

Tripathy, S. K. Patra, A. K and Samui, S. C (1999) Effect of micronutrients on nodulation, growth, yield and nutrient uptake by groundnut. *Indian J. Physiol.,* **41**(3): 207-209.

Valencia, A.G (1968) Response to the application of boron and zinc in coffee plantation at Fredonia, Antioquia. *Trop. Abstr.,* **23**(8): 523.

Wasmatkar, R.P., G. L. Ingole and P.D. Raut (2002) Effect of different levels of S and Zn on quality and uptake of nutrient of soyabean. J. *Maharashtra. Agric Univ* 27(3) 244-246.