RESEARCH

5(14), August 1, 2013

ISSN 2278–5469 EISSN 2278–5450

Discovery

Effects of methods and quantities of zinc sulphate application on nodulation in irrigated groundnut (*Arachis Hypogaea* L.)

Sudhir Kamath KV[1]☼, Krishnakumar G[2], Hanumanthappa M[1], Mavarkar NS[3], Anand MR[1]

1.Agronomist's, Zonal Agricultural Research Station, Brahmavar- 576 213 (Udupi dist.), Karnataka State, India
2.Reader, Dept. of Applied Botany, Mangalore University, Mangalagangothri- 574 199 (S.K. dist.), Karnataka State, India
3.Associate Professor (Agronomy), College of Agriculture, Navile, Shimoga- 577 204 (Shimoga dist.), Karnataka State, India

☼Corresponding author: Agronomist, Zonal Agricultural Research Station, Brahmavar- 576 213 (Udupi dist.), Karnataka State, India

Publication History
Received: 18 June 2013
Accepted: 23 July 2013
Published: 1 August 2013

Citation
Sudhir Kamath KV, Krishnakumar G, Hanumanthappa M, Mavarkar NS, Anand MR. Effects of methods and quantities of zinc sulphate application on nodulation in irrigated groundnut (*Arachis Hypogaea* L.). *Discovery*, 2013, 5(14), 15-17

ABSTRACT

The deficiencies of micro nutrients particularly zinc is of critical importance for sustaining high productivity of groundnut particularly in irrigated intensive cropping systems. Zinc is required in small concentrations but critical to allow several key plants physiological pathways to function normally. About 50% of the groundnut soils in India show Zn deficiencies causing considerable yield losses. Zinc is known to play a key role in nodulation but information in this regard is meager. Hence study was conducted to optimize the zinc sulphate requirement of irrigated groundnut and to determine suitable application method in order to achieve maximum nodulation. The trial was laid out in RCBD with three replication of 11 treatments viz., seed treatment with zinc sulphate at 2.0, 4.0 and 6.0 g per kg seeds (T-1,T-2 and T-3, respectively), soil application of zinc sulphate at 7.5, 10.0 and 12.5 kg/ha (T-4, T-5 and T-6, respectively) and zinc sulphate foliar spray at 30 days after sowing at 0.5, 1.0 and 1.5 % (T-7, T-8 and T-9, respectively), which were compared with water spray control (T-10) and absolute control (T-11). At early pod development stage (60 DAS), soil application of ZnSo4 @ 10 kg/ha recorded significantly higher total as well as effective nodules per plant during 2006-07 (54.3 and 49.3) and 2007-08 (47.3 and 45.7), respectively as compared to control. At late pod development stage (80 DAS), soil application of ZnSO4 at 7.5, 10.0 and 12.5 kg/ha recorded significantly higher effective nodule numbers during 2006-07 (51.7, 52.3 and 49.0, respectively) and 2007-08 (43.7, 41.7 and 43.3, respectively) over respective controls. Similar trend was observed with respect to effective nodulation at harvesting stage of groundnut. In general across growth stages, the total nodulation in groundnut increased with soil application of zinc sulphate up to 10.0 kg/ha. Hence, it can be concluded from the present investigation that for irrigated groundnut crop soil application of ZnSO4 at 10.0 kg/ha is sufficient to obtain higher nodulation.

Key words: Micronutrients, Zinc, Method, Quantities, Nodulation, Irrigated, Groundnut, Days after Sowing (DAS)

1. INTRODUCTION

Among the nine oilseed crops, groundnut is an important edible oilseed crop of our country and edible oil economy primarily depends upon groundnut production. In India groundnut is cultivated on an area of 6.87 m ha producing 5.31 m t of pods with a productivity of 774 kg/ha. The productivity of the crop is very low when compared to average world productivity of 1370 kg/ha. In irrigated intensive crop production systems, the use of high yielding varieties along with increasing use of chemical fertilizers containing major nutrients (N, P, K) have no doubt contributed to increased production of groundnut in the recent past but also have contributed significantly towards depletion of micronutrient reserves in the soil and thus has caused a number of micronutrient disorders and associated nutrient imbalances. Hence, deficiencies of micro nutrients are of critical importance for sustaining high productivity of groundnut particularly in irrigated intensive cropping systems. Among micronutrients, Zn deficiency is most prevalent in India. About 50% of the groundnut soils show Zn deficiencies causing considerable yield losses (Singh, 2004; Singh et al. 2004). Zinc is required in small concentrations but critical to allow several key plant physiological pathways to function normally. These pathways have important roles in photosynthesis, sugar formation, nucleic acid metabolism, protein synthesis, fertility, seed production, growth regulation, defense against diseases and several other growth functions (Sayed, 2011). Where zinc is deficient these physiological functions will be impaired and the health and productivity of the plants will be adversely affected resulting in lower yield. Further, the role of zinc on nodulation in ground nut and other pulses have been highlighted by several workers (Joshi et al. 1987, Malewar et al. 1992, Geeta Goudar et al. 2008, Soheil et al. 2011). However, a detailed study on effects of different quantities and methods of zinc application on nodulation at different growth stages of groundnut crop would add valuable information in effective management of zinc nutrition in groundnut. Viewing these the present investigations were taken up to standardize required dosage and to asses suitable method of zinc sulphate application to achieve maximum nodulation in groundnut.

2. MATERIALS AND METHODS

Field experiments were conducted at Zonal Agricultural Research Station, Brahmavar, Udupi (Karnataka) for two consecutive rabi/summer seasons of 2006-07 and 2007-08 to optimize the zinc sulphate requirement of irrigated groundnut and to determine suitable application method in order to achieve maximum nodulation. The experiment consisted of 11 treatments comprising of seed treatment with zinc sulphate at 2.0, 4.0 and 6.0 g per kg seeds (T-1,T-2 and T-3, respectively), soil application of zinc sulphate at 7.5, 10.0 and 12.5 kg/ha (T-4, T-5 and T-6, respectively) and zinc sulphate foliar spray at 30 days after sowing at 0.5, 1.0 and 1.5 % (T-7, T-8 and T-9, respectively), which were compared with water spray control (T-10) and absolute control (T-11), which were laid out in RCBD with three replications. All treatments received a common dose of 25-75-37.5 kg/ha NPK. The soil from experimental site was medium in total nitrogen, high in available phosphorus and low in potash. Groundnut variety TMV-2 was used for experimentation, which was sown at a spacing of 30 cm X 15 cm. The nodulation was recorded on five randomly selected plants through destructive sampling in the row next to the border in the gross plot at different growth stages. The soil from experimental plot contained on an average 0.47 ppm of Zn.

Table 1

Nodules per plant at different growth stages as affected by quantities and methods of zinc sulphate application in groundnut during 2006-07

S No.	Nodules/Plant (40 DAS)				Nodules/Plant (60 DAS)				Nodules/Plant (80 DAS)				Nodules/Plant (At harvest)			
	Total	Effective	% Effective	% Effective over control	Total	Effective	% Effective	% Effective over control	Total	Effective	% Effective	% Effective over control	Total	Effective	% Effective	% Effective over control
1.	20.3	16.0	78.8	-	41.7	37.3	89.4	5.5	41.3	37.7	91.3	4.0	18.7	16.3	87.1	3.7
2.	20.0	17.3	87.8	2.7	40.0	35.7	89.2	5.3	42.7	38.3	89.7	2.2	16.7	15.0	89.8	6.9
3.	21.0	16.7	79.5	-	43.3	37.7	81.1	-	44.7	40.3	90.1	2.6	19.0	16.3	85.8	2.1
4.	20.3	17.3	85.2	-	50.7	46.0	90.7	7.1	53.7	51.7	96.3	9.7	24.3	22.7	93.4	11.2
5.	21.3	17.0	79.8	-	54.3	49.3	90.8	7.2	54.3	52.3	96.3	9.7	26.0	24.0	92.3	9.9
6.	21.0	16.3	75.1	-	49.0	46.6	95.0	12.2	51.0	49.0	96.1	9.4	25.7	23.3	90.7	8.0
7.	21.0	16.0	76.2	-	43.3	40.3	93.1	9.9	45.3	41.0	90.5	3.1	20.0	18.7	93.5	11.3
8.	18.7	15.7	83.4	-	41.7	36.7	88.0	3.9	46.7	41.7	89.3	1.7	21.3	17.3	81.2	-
9.	19.3	16.3	84.4	-	44.3	37.3	84.1	-	44.7	39.0	87.2	-	21.7	19.0	87.6	4.3
10.	21.3	17.3	81.2	-	41.7	35.7	85.6	1.1	45.0	38.7	86.0	-	18.0	16.3	90.6	7.8
11.	20.7	17.7	85.5	-	39.3	33.3	84.7	-	43.3	38.0	87.8	-	18.7	15.7	84.0	-
F-test S.Em±	NS	NS			S	S			NS	S			S	S		
CD 5%	1.7	1.2			2.0	1.9			2.7	1.8			1.6	1.2		
	-	-			5.9	5.6			-	5.3			4.7	3.5		

Table 2

Nodules per plant at different growth stages as affected by quantities and methods of zinc sulphate application in groundnut during 2007-08

Sl.No.	Nodules/Plant (40 DAS)				Nodules/Plant (60 DAS)				Nodules/Plant (80 DAS)				Nodules/Plant (At harvest))			
	Total	Effective	% Effective	% Effective over control	Total	Effective	% Effective	% Effective over control	Total	Effective	% Effective	% Effective over control	Total	Effective	% Effective	% Effective over control
1.	16.3	14.0	87.7	9.4	36.3	33.7	92.8	3.2	38.3	35.0	91.4	5.8	17.7	15.7	88.7	14.0
2.	18.7	14.0	74.9	-	34.7	31.3	90.2	0.3	39.0	34.7	89.0	3.0	18.0	16.3	90.6	16.4
3.	16.0	13.7	85.6	6.7	37.3	34.0	91.1	1.3	37.7	34.3	91.0	5.3	19.7	15.7	79.7	2.4
4.	15.7	12.3	78.3	-	46.0	44.7	97.1	8.0	46.3	43.7	94.4	9.2	19.7	17.7	89.8	15.4
5.	18.0	14.0	77.8	-	47.3	45.7	96.6	7.4	45.7	41.7	91.2	5.6	21.3	17.7	83.1	6.8
6.	16.7	13.7	82.0	2.2	47.0	45.3	96.4	7.2	47.3	43.3	91.5	5.9	18.7	15.7	84.0	8.0
7.	17.3	17.0	79.2	-	34.7	31.7	91.3	1.6	36.0	33.3	92.5	7.1	20.3	17.7	87.2	12.1
8.	16.3	13.7	84.0	4.7	36.3	33.7	92.8	3.2	38.7	33.0	85.3	-	17.7	14.3	80.8	3.8
9.	18.3	14.7	80.3	0.1	37.0	33.3	90.0	0.1	38.7	33.7	87.1	0.8	18.0	15.0	83.3	7.1
10.	17.0	14.0	82.3	2.6	36.3	33.0	90.9	0.1	34.0	29.7	87.3	0.1	16.7	12.3	73.6	-

11.	18.7	15.0	80.2	-	36.7	33.0	89.9	-	34.7	30.0	86.4	-	16.7	13.0	77.8	-
F-test	NS	NS			S	S			NS	S			NS	S		
S.Em±	1.2	1.0			2.4	1.9			2.6	1.9			1.4	1.0		
CD 5%	-	-			7.1	5.6			-	5.6			-	2.8		

3. RESULTS AND DISCUSSION

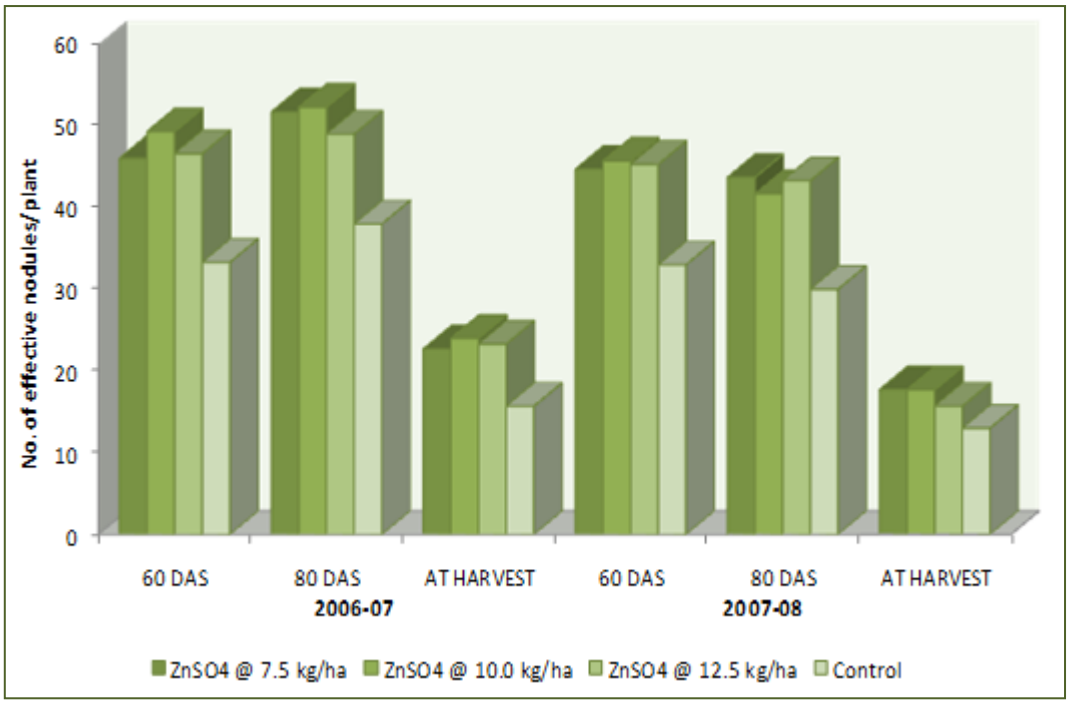

Figure 1

Effect of soil application of zinc sulphate at 7.5, 10.0 and 12.5 kg/ha and absolute control on effective nodules per plant of ground nut crop at 60 DAS (Days after sowing), 80 DAS and at harvest during 2006-07 and 2007-08

The quantities and methods of zinc sulphate application did not significantly influence the total as well as effective nodules per plant at 40 DAS, during both the years of study. The percent effective nodules at 40 DAS did not vary much during 2006-07 with $ZnSo_4$ seed treatment @ 4 g/kg seeds recording higher value of 87.8% and $ZnSo_4$ seed treatment @ 2 g/kg seeds recording 87.7% during 2007-08. At early pod development stage (60 DAS), the total and effective nodules varied significantly due to ZnSO4 application with soil application of ZnSo4 @ 10 kg/ha recording significantly higher values during 2006-07 (54.3 and 49.3) and 2007-08 (47.3 and 45.7), respectively as compared to control. The percent effective nodules and percent effective nodules over control were in general higher in zinc applied treatments irrespective of quantity or method of application (Except T-3 and T-9 during 2006-07). Such response may be due to the fact that zinc is known to play the role of activator of several enzymes in plants and is directly involved in the biosynthesis of growth substances such as auxins. Zinc is required for production of Indole acetic acid (IAA) which is important for nodulation in legumes. Similar increase in nodule number due to zinc sulphate application in different crops have been reported by several workers (Kapil dev and Gupta, 2006, Meena et al. 2007, Geeta et al. 2008; Soheil et al. 2011).

At late pod development stage (80 DAS) though there was no significant influence of treatments on the total number of nodules per plant, the effective nodules per plant varied significantly (Figure 1). Soil application of $ZnSO_4$ at 7.5, 10.0 and 12.5 kg/ha recorded significantly higher effective nodule numbers during 2006-07 (51.7, 52.3 and 49.0, respectively) and 2007-08 (43.7, 41.7 and 43.3, respectively) over respective controls. The percent effective nodules and percent effective nodules over control were higher in $ZnSO_4$ applied treatments irrespective of doses and methods (Except T-9 during 2006-07 and T-8 during 2007-08). In groundnut fertilization with Zn along with other micronutrients resulted in increase in nodule number and percent effective pink coloured nodules (Joshi et. al., 1987). Further, at harvesting stage of groundnut, the total (Except during 2006-07) and effective nodules per plant were significantly affected due to soil application of zinc sulphate with $ZnSO_4$ at 7.5, 10.0 and 12.5 kg/ha recording significantly higher effective nodule numbers during 2006-07 (22.7, 24.0 and 23.3, respectively) and 2007-08 (17.7,17.7 and 15.7, respectively) over respective controls. The percent effective nodules and percent effective nodules over control were higher in $ZnSO_4$ applied treatments irrespective of doses and methods (Except T-8 during 2006-07). The increase in nodulation with balanced Zn and P nutrition in chickpea was attributed to an increase in leghaemoglobin concentration in nodules and increased plant growth resulting into enhanced activity of N fixing organisms (Yadav and Shukla, 1983). In general across growth stages, the total nodulation in groundnut increased with soil application of zinc sulphate up to 10.0 kg/ha.

4. CONCLUSION

Hence, it can be concluded from the present investigation that for irrigated groundnut crop soil application of $ZnSO_4$ at 10.0 kg/ha is sufficient to obtain higher nodulation.

REFERENCE

1. Geeta G, Mudenoor MG, Savalgi VP. Effect of micronutrient supplemented bradyrhizobium biofertilizers on nodulation, dry matter production and yield of soybean. *Legume Research*, 2008, 31(1), 20-25
2. Joshi PK, Bhatt DM, Kulkarni JH. Groundnut root nodulation as affected by micronutrients application and Rhizobium inoculation. *International Journal of Tropical Agriculture*, 1987, 5(3-4), 199-202
3. Kapil Dev, Gupta VK. Effect of foliar sprays of zinc sulphate and sodium molybdate on nodule number, shoot and root length. *Journal of Phytological Research*, 2006, 19(1), 149-150
4. Malewar GU, Indulkar BS, Malewar V. Involvement of zinc in nodulation and N fixing indices in peanut. *Annuals of Plant Physiology*, 1992, 6(2), 232-237
5. Meena S, Malarkodi M, Senthilvalavan P. Secondary and micronutrients for groundnut – A review. *Agricultural Reviews*, 2007, 28, 4
6. Sayed RM. Zinc in Crop Production and Interaction with Phosphorus. *Australian Journal of Basic and Applied Sciences*, 2011, 5(9), 1503-1509
7. Singh AL, Basu MS, Singh NB. Mineral Disorders of Groundnut. National Research center for groundnut (ICAR), 2004, Junagadh, India. 85 p
8. Singh MV. Micronutrient deficiencies in Indian soils and field usable practices for their correction. Paper presented in the IFA International Conference on Micronutrients, Feb. 23-24, 2004, New Delhi
9. Soheil K, Keyvan S, Siros E. Soybean nodulation and chlorophyll concentration (SPAD value) affected by some of micronutrients. *Annuals of Biological Research*, 2011, 2(2), 414-422
10. Yadav OP, Shukla UC. Effect of zinc on nodulation and nitrogen fixation in chick pea. *Journal of agricultural science*, 1983, 101, 559-563