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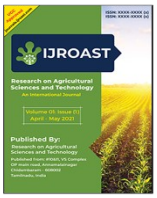

Impact of Sulphur fertilization on nutrient uptake of sunflower (*Helianthus annuus* L.).

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ABSTRACT

Experimental trials were conducted during two consecutive seasons on 2014-15 at Experimental Farm, Annamalai University, Annamalai Nagar, Tamil Nadu, India to assess the response of different sources and levels of sulphur on hybrid sunflower (*Helianthus annuus* L.). The experiments comprised ten treatments including RDF, and combines with three sources and levels of sulphur Viz., elemental sulphur, gypsum and pyrite with each applied at three levels such as 15, 30 and 45 kg S ha^{-1}. The trials were laid out in randomized block design and replicated thrice. Among the treatment combinations, elemental sulphur @ 45 kg ha^{-1} with RDF (T_4) was found to be promising with increased nutrient uptake over RDF alone during both periods of experimental study. Application of RDF + Sulphur @ 45 kg ha^{-1} through elemental sulphur enhanced the availability of nutrients and eventually increased the nutrient uptake of N, S, P and K and thereby increasing the growth and yield of hybrid sunflower.

Introduction

Sunflower holds a huge hope in meeting the shortfall of edible oils in India with higher yield potential and enhanced oil quality. Because of its short duration life cycle, and photo and thermo-insensitivity, the crop has wider adaptability in different agro-climatic regions and soil types. Besides, it has tolerance to drought and high polyunsaturated fatty acid contents are added advantages. Nowadays, intensive cropping is unavoidable circumstances with regards to food production to meet the national goal. For that adoption of high yielding varieties and intensive cropping systems require more attention to nutrient management to increase crop yield and quality. Scientific reports indicate that the soils of the north Cauvery deltaic region are low in N and S but moderate in P, K. Nitrogen is the major nutrient that enhances the metabolic processes that lead to an increase in vegetative, reproductive and yield of crops. Sulphur, the fourth major nutrient plays an important role in oilseed production as a constituent of sulphur-containing amino acids 1]. Apart from the major nutrients, sulphur is increasingly being recognized as the fourth major plant nutrient after nitrogen, phosphorus and potassium [2]. Sulphur plays a predominant role in improving the grain quality of sunflower crops and also the use efficiency of nitrogen and phosphorus. In oilseeds, sulphur plays a vital role in the development of seed and improving the quality [3]. This study is the moment of an effort to understand the effect of N and S fertilization on nutrient uptake of the sunflower which paves a way for enhanced growth and yield of sunflower in the northern part of the Cauvery deltaic region.

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Materials and Methods

Study area

To study the effect of different sources and levels of sulphur on the yield and nutrient (N, P, K and S) uptake of sunflower, the experiment was conducted at Annamalai Nagar, experimental farm, Cuddalore district, Tamil Nadu, India during June to September of 2014 and Feb to Apr 2015. The experimental site of the study details is furnished in Table.1 Soil was analyzed for its physical and chemical properties. A composite soil sample was collected at a depth of 0-30

cm. It was air-dried, crushed, and tested for physical and chemical properties. The soil was clay loam in texture with soil reaction of (pH 7.9), electrical conductivity 0.49 dS m^{-1}, organic matter (0.59%), low available nitrogen (242.5kg ha^{-1}), available phosphorus (19.4 Kg ha^{-1}), and low available sulphur (16.9 kg ha^{-1}). The experimental design was carried out in a randomized block design with the arrangement of treatments in three replications. Experimental plots consist of three sulphur sources (Elemental sulphur, Gypsum and pyrite), levels (15, 30, 45 kg ha^{-1}) and control i.e., recommended N, P and K (60:90:60 kg. ha^{-1}) alone.

Table.1 Characteristic of the study area

Site characteristics	
District	Cuddalore (Annamalai Nagar)
Latitude and Longitude	$11^0 24'$ N and $79^0 44'$ E
Agro-climatic zone	Northern Cauvery deltaic zone
Mean Sea Level	+5.79mts
South-East Monsoon	400 mm
North-East Monsoon	1000 mm
Summer rain	100 mm
Major soils	Red soil, moderately clay loam and sandy loam

Plant analysis and uptake

Representative plants from each plot were sampled at maturity stages to determine N, P, K and S contents. The above-ground plant parts were removed and then dried at 70°C up to a constant weight was recorded. Plants samples were taken for each crop season during the experiment for estimation of the concentration of N through micro Kjeldahl method. For determination of P and K content, materials were digested in triple acid digestion method and estimated by spectrophotometer and flame photometer, respectively and sulphur was estimated through barium chloride turbidimetry method. Uptake of nutrients (N, P, K and S) by the crop was estimated for two consecutive seasons of 2015-16. The experimental data were statistically analyzed as suggested [4]. For significant results, the critical difference was worked out at 5 per cent level.

Results and Discussion

Effect of different sources and levels of sulphur on nitrogen uptake

Nutrient uptake by different parts of sunflower with different sources and levels of S at the time of harvest is shown in Table 2. Nutrient uptake (N, P, K and S) by sunflowers differs significantly due to different levels of sulphur fertilization. Among the different sources and levels of sulphur it was found that Elemental sulphur @ 45 kg ha^{-1} resulted from highest total nitrogen uptake though it was significantly different from its other levels and sources of sulphur. The increased per cent of (24.7 and 24.2) N uptake was noticed at 45 kg of S than the 0 levels in this study. This is due to a synergistic relationship between sulphur and nitrogen which might increase the nitrogen uptake when the sulphur level was increased. The results are the in line with studies of [5].

Effect of different sources and levels of sulphur on phosphorus uptake

The data about Phosphorus uptake of sunflower shown in Table 2 reveals that the increased P uptake of (19.2 and 20.0 kg ha^{-1}) was noticed in both the season of this study. This ensures that sulphur had a positive relationship with phosphorus uptake in sunflower in all sources and levels than the zero level of sulphur application. This might be due to the solubilisation of phosphorous by sulphur. [6,7] findings also confirmed with this present research work. Variation in total phosphorus uptake by different levels of sulphur in sunflower ranged from 26.3 to 56.3%.

Effect of different sources and levels of sulphur on potassium uptake

Different sources and levels of sulphur showed variation in potassium uptake in sunflower (Table 2). Different sources and levels of sulphur application significantly increased potassium uptake in sunflower crops. The increased per cent of (29.6 and 31.1) K uptake was noticed at 45 kg of S through Elemental sulphur than the 0 level in this study. An increase in potassium uptake with the increased rate of sulphur [8].

Effect of different sources and levels of sulphur on sulphur uptake

The data about the effect of different sources and levels of sulphur on the uptake of sulphur shown in Table 2 indicated that the increased level of S at 45 kg ha^{-1}through elemental sulphur significantly increased sulphur uptake. The increased per cent of (137.03 and 127.9) S uptake was noticed at 45 kg of S than the 0 level in this study. The increase in S uptake might be due to the increased availability of S from the applied sulphur with a concomitant increase in crop yield. Further, the properties of elemental sulphur reveal that when it is applied to the soil, absorbs moisture and disintegrates into fine and coarse particles [9]. The finer particles oxidise rapidly and coarser particles slowly which might have supplied sufficient sulphur to the soil pool throughout the growth period of sunflower and resulted in higher nutrient uptake than other sources like gypsum and pyrite respectively during both the period of crop study [10].

Conclusion

From the above-enlightened study, it is to be concluded that the application of sulphur through elemental sulphur (Sulphur source) @ 45 kg ha^{-1} with RDF (60:90:60 kg ha^{-1}) proved to be appropriate practice for augmenting the sunflower yield through enhanced crop growth thereby leading to better uptake of nutrients in clay loam soils of northern regions of Cauvery deltaic areas of sunflower growers.

Table.2 Effect of different sources and levels of sulphur on nutrient uptake

Treatments	Nutrient Uptake Kg ha^{-1}							
	First Season				Second Season			
	N	P	K	S	N	P	K	S
T_1 – RDF	69.5	8.0	74.9	8.1	72.8	8.3	78.6	8.6
T_2 - RDF + 15 kg Sulphur ha^{-1} through Elemental Sulphur	715	10.1	80.0	11.1	74.0	10.5	84.1	11.8
T_3 - RDF + 30 kg Sulphur ha^{-1} through Elemental Sulphur	78.1	14.1	88.6	14.5	81.9	14.3	92.9	15.3
T_4 - RDF + 45 kg Sulphur ha^{-1} through Elemental Sulphur	86.7	19.2	97.1	19.8	90.5	20.0	103.1	19.6
T_5 - RDF + 15 kg Sulphur ha^{-1} through Gypsum	70.4	9.1	77.1	10.3	72.3	10.0	81.2	10.6
T_6 - RDF + 30 kg Sulphur ha^{-1} through Gypsum	75.4	12.3	85.5	13.7	78.0	12.8	90.0	14.4
T_7 - RDF + 45 kg Sulphur ha^{-1} through Gypsum	83.2	17.1	94.2	17.1	86.0	17.6	97.6	17.9
T_8 - RDF + 15 kg Sulphur ha^{-1} through pyrite	69.8	8.5	76.3	9.5	72.4	8.9	80.3	9.8
T_9 - RDF + 30 kg Sulphur ha^{-1} through pyrite	72.7	11.4	82.8	12.2	75.0	12.0	87.3	13.0
T_{10} - RDF + 45 kg Sulphur ha^{-1} through pyrite	80.4	15.8	91.7	15.6	83.2	16.2	95.5	16.2
$S.E_{(m)}$	1.02	0.47	0.90	0.30	0.95	0.51	0.91	0.34
C.D (P = 0.05)	2.18	1.01	1.93	0.64	2.03	1.09	1.95	0.73

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References

[1] Gangadhara, G. A., Manijunathaiah, H. M. and Satyanarayana, T. 1990. Effect of sulphur on yield, oil content of sunflower and uptake of micronutrient by plants. *J. Indian Society of Soil Science*.38: 693-965.

[2] Tandon, H. L. S. and Messick, D. L. 2002. *Practical sulphur guide*. The Sulphur Institute, Washington, D. C.

[3] Naser, A. Anjum , Sarvajeet, S. Gill, Shahid Umar, Igbal Ahmed, Armando C. Duarte. and Eduarda Pereira 2012. Improving growth and productivity of *Oliferous brassica* under changing environment. Significance of nitrogen and sulphur nutrient and underlying mechanisms, *The Scientific world Journal*, 12.

[4] Gomez A. A., Gomez, R. A. 1976, Statistical procedure for agricultural research with emphasis on rice. IRRI. Los Banos Philippines

[5] Legha, P.K. and Gajendra Giri. 2001. Dry matter accumulation and nutrient uptake by spring season sunflower as affected by N and S fertilization. Fert. News., 46(2): 57-58.

[6] Randhawa, P.S. and C.L. Arora. 1997. Effect of phosphorus and sulphur on their availability in soil. *J. Indian Soc. Soil Sci.,* 45(2): 306-310.

[7] Nasreen, Shamima and Imamul Hug, S. M. 2002. Effect of sulphur fertilizer on yield and nutrient uptake of sunflower crop in an Albaquept soil. *Pakistan J. Biological Sciences.* 5(5): 533-536.

[8] Shekhawat, K., Shivay, Y. S. and Kumar, D. 2008. Productivity and nutrient uptake of spring sunflower (Helianthus annuus L.) as influenced by nitrogen sources, sulphur and boron levels. *Indian J. Agricultural Science.* 78(1): 90-94.

[9] Vaiyapuri, V., Ravikumar, C., Sriramachandrasekharan, M.V. and Ravichandran, M. 2004. Effect of sulphur on growth, yield, quality and nutrient uptake of sunflower. *J. Interacademicia,* 8(3)**:** 371-376.

[10] Ravikumar C, Ganapathy M and Vaiyapuri V. 2016. Effect of sulphur fertilization on growth, yield and nutrient uptake of sunflower in north cauvery deltaic region. International Journal of Current Research Review 8(22): 13-17.