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EFFECT OF DIFFERENT ZINC SOURCES AND LEVELS ON MORPHOLOGICAL CHARACTERISTICS OF SUNFLOWER (*HELIANTHUS ANNUUS* L.) HYBRID IN ALFISOLS

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ABSTRACT

A field experiment was conducted at Indian Institute of Oilseeds Research during the rainy season of 2014 with Sunflower (*Helianthus annuus* L.) hybrid DRSH-1 as a test crop on Alfisols.Three different zinc sources ($ZnSO_4.7H_2O$, $ZnSO_4.H_2O$ and Zn-EDTA) and levels (10, 15 and 20 kg/ha) with recommended dose of N, P_2O_5 and K_2O @ 90, 60 and 30 kg/ha were applied to soil. The results indicated that application of 20 kg $ZnSO_4.H_2O$ ha^{-1} with 90:60:30 kg NPK ha^{-1} recorded higher grain yield (1680 kg ha^{-1}), highest plant height (170.3 cm), greater head diameter (17.6 cm) and highest stem girth (8.1cm). Plant height, stem girth and head diameter increased up to 20 kg Zn ha^{-1} application.The increase in plant height with increased levels of Zn from 0 to 20 kg ha^{-1} and among sources $ZnSO_4.H_2O$ was superior to $ZnSO_4.7H_2O$ and Zn-EDTA at any level. Head diameter was significantly increased by 34 per cent in treatments that received 20 kg $ZnSO_4.H_2O$ ha^{-1} along with 100 per cent RDF followed by the treatment $ZnSO_4.H_2O$ @ 15 kg ha^{-1} along with 100 per cent RDF *i.e.*, 27 per cent and the lowest values being recorded in control at harvest.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) is an important nontraditional oilseed crop. The present acreage under sunflower cultivation in India is about 6.91 lakh ha area with production and productivity of 5.47 lakh t. and 791 kg/ha, respectively during 2013-14 (Padmaiah *et al.,* 2015). Sunflower can play a major role in meeting the shortage of edible oils in the country. Among oilseed crops, sunflower has gained much popularity because of its short duration, photo-insensitivity, wider adaptability to different agro-climatic regions and soil types. In semi-arid soils, especially Alfisol, among the several reasons attributed for its low production, deficiency of zinc an important micronutrient for crop growth has attained macro importance. Further, use of the micronutrient mixture for foliar sprays and chelates have led to very little residual fertility so hidden hunger of Zn is emerging wide spread. Zinc deficiency was reported in these soils (Srinivasa Rao and Sudha Rani 2013, Murthy *et al.,* 2009, Biswas and Poddar 2015) Sulphur, the fourth major nutrient plays an important role in oilseed production as a constituent of sulphur containing amino acids (Gangadhara *et al.*,1990). Hence, an attempt was made in the present investigation to find out an optimum dose and source of zinc for the sunflower hybrid DRSH-1 by studying yield attributes and seed yield.

MATERIALS AND METHODS

A field experiment was conducted at Indian Institute of Oilseed Research, Rajendranagar, and Hyderabad during the rainy season of2014. The soil of the experimental site was sandy loam in texture, moderately alkaline with pH 8.3, E.C 0.082 dS/m, very low in Organic carbon (0.26%), low in available nitrogen (150.68 kg/ha), available phosphorus (9.56 kg/ha), medium in available potassium (193.9 kg/ha), medium in sulphur (25.2 kg/ha) and deficient in DTPA extractable zinc (0.48 mg/kg). Recommended dose of nitrogen, phosphorus (P_2O_5) and potassium (K_2O) were applied at 90:60:30 kg/ha through urea, diammonium phosphate and muriate of potash, respectively.

The treatment details are presented in table 2. Randomized block design with three replications was adopted. The nitrogen was equally split and applied with 2nd and 3rd irrigation while, all phosphorus, potassium and zinc were applied as basal dose. The sunflower hybrid DRSH-1 was sown in 60 cm x 30 cm spacing. The crop was kept free of weeds by manual weeding. Yield attributes like plant height, stem girth and head diameter were recorded at 90 days after sowing (DAS) and seed yield at harvest. All the parameters were analyzed by following standard statistical procedure (Panse and Sukhatme (1978)).

RESULTS AND DISCUSSION

Plant height

The data on plant height indicated that lowest and highest values being recorded in T_1 and T_7 at 90 DAS, respectively.

Increase in plant height from 151.9 cm to 185.5 cm in treatments received 0 and 20 kg $ZnSO_4.H_2O$ kg/ha, respectively was observed. Among the different zinc levels and sources though there was an increase in plant height from 0 to 20 kg Zn/ha zinc application had not shown any significant effect on plant height. Similar results were found by Ahmadi (2010) and Khan *et al*. (2009).

Stem girth

Among different sources and levels of zinc, higher stem girth was (8.1 cm) recorded in T_7 (RDF + $ZnSO_4.H_2O$ @ 20 kg/ha) at 90 DAS might be ascribed to the adequate supply of nutrients that resulted in greater plant height, higher production of photosynthates and higher dry matter production in stem. Stem girth is an inherent character of plant which does not effect due to external factors such as environmental as well as agronomic factors.

Head diameter

At 90 DAS, among the three sources of zinc, application of zinc through zinc sulphate monohydrate @ 20 kg/ha gave significantly maximum head diameter (17.6 cm) over other sources, which was on par with 10, 15 and 20 kg $ZnSO_4.7H_2O$/ha. The lowest head diameter (13.2 cm) was observed in control. Among zinc levels, application of zinc at 20 kg/ha resulted in significantly maximum head diameter (17.6 cm) than at low levels (10, 15 kg/ha) but were on par with each other.

Zinc application was effective on head diameter and increased capitulum growth because it is important for proper functioning of many enzyme systems, synthesis of nucleic acids and normal crop development and growth (Ebrahimian *et al*., 2010). These results are in agreement with the observations of Khan *et al*. (2009). Highest head diameter (17.8 cm) was recorded in treatment that received 10 kg zinc and further suggested that greater head diameter increase can be achieved with high dose of zinc alone or in combinations with other micronutrients.

Seed yield

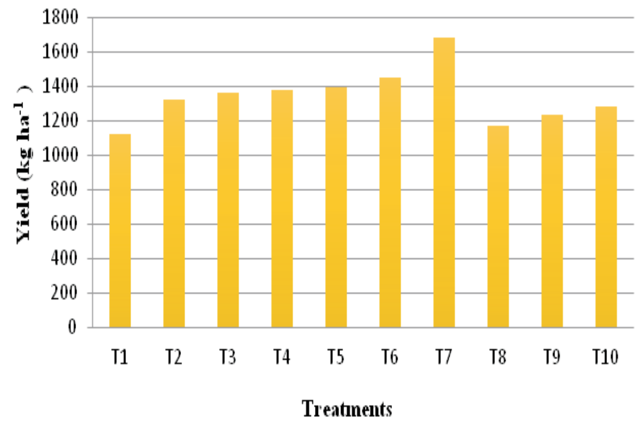

Figure1: Effect of sources and levels of zinc on yield (kg ha^{-1}) of sunflower

The results revealed that there was significant increase in seed yield of sunflower with increasing levels of zinc. Among various sources, RDF + $ZnSO_4.H_2O$ @ 20 kg/ha recorded significantly highest seed yield as compared to control. Seed yield was lowest at $T_{1:}$ control (1122 kg/ha) and highest at $T_{7:}$ $ZnSO_4.H_2O$ @ 20 kg/ha (1680 kg/ha) with recommended dose of N, P, K for sunflower. On an average, the percent increase in seed yield was 49% in the treatment T_7 over the control T_1.

Seed yield is the function of several growth parameters (plant height, leaf area index and dry matter accumulation) yield attributing characters *viz*., head diameter, number of filled seeds, test weight and yield/plant. Among different levels and sources (namely $ZnSO_4.H_2O$, $ZnSO_4.7H_2O$ and Zn-EDTA), the $ZnSO_4.H_2O$ @ 20 kg/ha has shown (fig 1) better influence on seed yield. Greater head diameter, higher number of filled seeds/head and test weight due to adequate supply of recommended dose of fertilizers with zinc application had positively reflected in higher seed yield. Head diameter is the most important attributing character, which improves the seed yield by providing maximum number of florets for higher seed set. The cumulative effect of all these growth and yield

Table 1: Physico-Chemical and Chemical properties

pH	EC (dS m^{-1})	OC (%)	N(kg ha^{-1})	P_2O_5(kg ha^{-1})	K_2O(kg ha^{-1})	S(kg ha^{-1})	Zn(mg kg^{-1})
8.30	0.082	0.26	150.68	9.56	193.9	25.22	0.48

Table 2: Effect of different sources and levels of zinc on plant height, stem girth, head diameter and seed yield of sunflower hybrid DRSH-1.

Treatment		Plant height (cm)	Stem girth (cm)	Head diameter (cm)
T1	Control (RDF-90:60:-30)	151.9	7.2	13.1
T2	RDF + $ZnSO_4.7H_2O$ @ 10 kg/ha	171.1	7.6	16
T3	RDF + $ZnSO_4.7H_2O$ @ 15 kg/ha	172.7	7.6	16.2
T4	RDF + $ZnSO_4.7H_2O$ @ 20 kg/ha	176.3	7.9	16.6
T5	RDF + $ZnSO_4$. H_2O @ 10 kg/ha	179	7.3	15.5
T6	RDF + $ZnSO_4$. H_2O @ 15 kg/ha	181.6	7.9	16.7
T7	RDF + $ZnSO_4$. H_2O @ 20 kg/ha	185.5	8.1	17.6
T8	RDF + Zn-EDTA @ 10 kg/ha	160.5	7.3	13.3
T9	RDF + Zn-EDTA @ 15 kg/ha	163.8	7.4	13.4
T10	RDF + Zn-EDTA @ 20 kg/ha	168.7	7.6	13.5
SEm ±	7.5	7.5	0.68	
CD (P = 0.05)	NS	NS	2.04	

RDF: N: P_2O_5: K_2O (90:60:30)

components were reflected on seed yield.

Other studies have also revealed that the application of Zn significantly increased seed yield (Riley *et al*., 2000). The highest seed yield was obtained with zinc application of 60 kg Zn/ha. In increasing Zn levels provides better conditions for the pod formation and increases number of seeds per pod in rapeseed (Ahmadi, 2010).

Increase in seed yield may be attributed to the fact that soil under investigation was deficient in zinc and application of zinc and its role of zinc in biosynthesis of indole acetic acid (IAA) further its role in initiation of primordial for reproductive parts and partitioning of photosynthates towards them etc. which resulted in better flowering and fruiting. The finding of present investigations are also supported by Jat and Mehra (2007) and Deo and Khandelwal (2009).

Siddiqui *et al*., 2009 reported that the application of zinc @ 15 kg/ha gave superior seed yield (2251 kg/ha) beyond this dose, there was no further significant increase in sunflower seed yield. The result of the experiment are supported by Patil *et al*. (2006) also reported that soil application of $ZnSO_4$ (10 and 20 kg/ha) was the best treatment in increasing seed yield and quality of sunflower under black soil conditions. However, in the present study 20 kg/ha $ZnSO_4$. H_2O gave higher seed yield in Alfisols. One probable reason could be the increase in solubility of zinc in soil with the application of sulphur. In the present study, higher seed yield recorded in $ZnSO_4$. H_2O could be due to the better utilization of bioavailable Zn from this source compared to the other source.

Reliy *et al*. (2000) revealed that Zn-treated plants exhibited a significant increase in yield components compared to control. It is evident that this element plays important role in plants. The increase in yield induced by Zn treatments will markedly affect plant growth and development. The increased in yield attributes and yield of sunflower due to zinc may be attributed basically to the reason that Zn shows beneficial effect on chlorophyll content and so it indirectly affect the photosynthesis and reproduction.

Thus, from the above field studies, it can be inferred that soil application of 20 kg $ZnSO_4.H_2O$/ha in zinc deficient Alfisol is adequate to obtain higher seed yield (1680 kg/ha) of sunflower hybrid (DRSH-1).

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