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Soil moisture status and foliar nutrition on growth, yield, quality and economics of sunflower (*Helianthus annuus* L.) in *Vertisol* of N-E Karnataka

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Abstract

Field study was conducted during 2017 and 2018 in *Vertisol*, Raichur Karnataka to evaluate the performance of sunflower by foliar application of different sources of nutrients. Treatments consists of growing environments rainfed and irrigated system with foliar application of urea spray @ 2% DAP @ 1% ZnSO₄ @ 0.5% 19:19:19 @ 1% Borax @ 0.2%, cattle urine @5% compared with water spray at 45 and 60 DAS. Pooled results indicated that foliar application of NPK fertilizer through 19:19:19 @1% has resulted 29.9 % and 13.0% greater grain yield compared to water spray and urea spray @ 2%. It also resulted greater head diameter, 100 seed weight, oil content and oil yield compared to other types of foliar spray. Whereas, irrigated sunflower has produced 18.8 % (1167 kg/ha) higher grain yield and 19.7 % (431 kg/ha) oil yield than rainfed crop. Economics returns has indicated that irrigated sunflower along with foliar application of 19:19:19 @ 1% gave higher gross returns and B:C ratio over rest of the treatment combinations. Results of the study was inferred that yield and economics were enhanced by foliar application of 19:19:19 @ 1% at 45 and 60 DAS for irrigated sunflower in *Vertisol*.

Keywords: Foliar spray, oil yield, Rainfed, Urea, Zinc sulphate

Introduction

Sunflower (*Helianthus annuus* L.) is one of the important edible oilseed crops cultivated in India on various soil types. Soil fertility in terms of nutrient sufficiency and deficiency for all types of Indian soils including *Vertisol* of N-Karnataka is reported over years. Sunflower is an exhaustive oilseed crops need balanced and optimum nutrients to harness potential yield. It is highly sensitive to nutrient particularly at pre flowering and early seed development. It is known as boron indicator plant deficiency observed on leaves, stems, reproductive parts which ultimately reflected in dry matter production and yield (Shehzad, *et al.*, 2016) ^[12]. In low fertile soils under nourishment may results lower yield and quality of sunflower. Among the factors responsible for increasing sunflower yield and quality fertilizer use is one of the most important. Of all the nutrients in fertilizer, N is the most important for enhancing metabolic processes based on proteins and leads to increases in vegetative growth, reproductive growth and yield of the crops (Li, *et al.*, 2017) ^[7].

Over years, foliar fertilization of nutrient has become an established procedure to increase yield and improve the quality of crop products by better nutrient utilization and lowering of the environmental pollution. The effects of foliar application of fertilizers on sunflower have been described previously particularly Boron (Mekki, 2015) ^[8], Potassium (Akram *et al.*, 2007) ^[2], sulphur (Sarkar and Mallick, 2009) ^[11], Zinc (Asadzade, 2015 and Torabian *et al.*, 2016) ^[3, 13], urea (Oad, *et al.*, 2015) ^[9], NPK fertilizers (Hussain *et al.*, 2016) ^[4]. Soil moisture availability will also play pivotal role to increase fertilizer use efficiency (Asadzade, *et al.*, 2015) ^[3]. However, little work has been done to elucidate the effects of foliar application of fertilizer on sunflower and oil quality in *Vertisol*. In this study we hypothesized that in-season nutrient requirement of sunflower will be fulfilled by foliar application of fertilizers. In this regard, present field experiment was conducted with an objective to enhance seed yield and quality by foliar application of fertilizers under irrigated and rainfed condition.

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Materials and Methods

Field experiment was conducted to evaluate sunflower performance affected by foliar application of different sources of nutrients during *Kharif* 2017 and 2018 at Main Agricultural Research Station, UAS, Raichur. Prior to the beginning of experiment, soil samples were taken in order to determine the physical and chemical properties. A composite soil samples were collected at a depth of 0-15 cm. It was air dried, crushed, and tested for physical and chemical properties. The research field had a clay loam soil. Details of soil properties are shown in (Table 1). A soil of the experimental site is medium black with pH 7.74, organic carbon content of 0.60 % and EC 0.21 dS m⁻¹. The available N, P₂O₅ and K₂O were 293.3, 39.7 and 365.9 kg ha⁻¹, respectively. The experiment was carried out in split plot design with three replications. Main plots were growing environments rainfed and irrigated plots, sub plot treatments were foliar application of urea spray @ 2% DAP @1% ZnSO₄ @ 0.5% 19:19:19 @ 1% Borax @ 0.2%, cattle urine @5% compared with water spray at 45 and 60 DAS. Fertilizers were applied on the basis of plant density of each crop in the form of urea, di-ammonium phosphate and muriate of potash. Recommended dose of fertilizers for sunflower was 90:90:60 kg N, P₂O₅ and K₂O ha⁻¹, respectively. The 50% of N and full dose of P and K fertilizers were applied at basal and top dressed at 30 DAS. Two seeds of sunflower were hand dibbled at 0.6 m rows

on 17th and 22nd June in 2017 and 2018 respectively. Plot size was 6.0 m x 4.5 m and at maturity Economics was worked out by considering cost towards expenditure on seeds, fertilizers, weed management and plant protection chemicals. At maturity, the crop was harvested and plot wise yields were recorded. Data on these various parameters were recorded at different days and their means values were analyzed statistically as per the procedure of analysis of variance (ANOVA) at probability 5% of significance.

Table 1: Soil physical and chemical properties (0-15 cm) during cropping period at experimental site

Soil Parameter	Values
Textural class	Clay loam
Soil pH	8.2
CEC (c mol/kg ⁻¹)	48.2
Organic carbon	0.6
N (kg ha ⁻¹)	265.2
P ₂ O ₅ (kg ha ⁻¹)	37.5
K ₂ O (kg ha ⁻¹)	389.5
Mn (ppm)	12.0
Fe (ppm)	3.90
Zn (ppm)	0.28
Cu (ppm)	1.00

Table 2: Grain yield (kg/ha) of sunflower grown in irrigated and rainfed condition with foliar nutrition in 2017 and 2018

Foliar spray (F)	2017			2018			Pooled		
	Growing Environment (G)								
	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean	Rainfed	Irrigated	Mean
Urea spray @2%	1208	1427	1318	976	1152	1064	1092	1290	1191
DAP @ 1%	956	1368	1162	762	1102	932	859	1235	1047
ZnSO ₄ @0.5%	1001	1245	1123	804	904	854	903	1075	989
19:19:19 @ 1%	1332	1692	1512	1080	1278	1179	1206	1485	1346
Borax @ 0.2%	1262	1385	1324	1022	1092	1057	1142	1239	1191
Cattle Urine @ 5%	1109	1245	1177	892	998	945	1001	1122	1061
Water spray	1049	1214	1131	908	972	940	979	1093	1036
Mean	1042	1262		921	1071		982	1167	
CD at 5% G	97			75			36		
F	122			106			110		
G x F	NS			NS			NS		

Oil yield (kg/ha)									
Urea spray @2%	415	488	452	372	462	417	394	475	435
DAP @1%	329	474	402	300	434	367	315	454	385
ZnSO ₄ @ 0.5%	341	483	409	309	353	331	325	418	370
19:19:19 @ 1%	465	579	522	417	489	453	441	534	488
Borax @ 0.2%	449	492	471	399	433	416	424	463	444
Cattle Urine @5%	391	443	417	344	392	368	368	418	393
Water spray	359	438	398	362	377	370	361	408	384
Mean	362	441		357	420		360	431	
CD (p=0.05) G	59			20			17		
F	48			43			31		
G x F	NS			NS			44		
	Grain yield (g/plant)			100 seed weight (g)			Oil content (%)		

	2017	2018	Pooled	2017	2018	Pooled	2017	2018	Pooled
Rainfed	1,232	921	1,076	5.79	3.54	4.66	34.7	38.9	36.8
Irrigated	1,352	1070	1,211	5.60	3.57	4.58	34.9	39.2	37.1
S.Em +	14.8	11.4	9.34	0.08	0.02	0.04	0.3	0.2	0.16
CD (p=0.05)	97.0	74.7	36.5	NS	NS	NS	NS	NS	NS
Urea spray @ 2%	1,368	1064	1,216	5.65	3.50	4.58	34.2	39.1	36.67
DAP @ 1%	1,212	932	1,072	5.717	3.80	4.76	34.6	39.4	36.98
ZnSO ₄ @ 0.5%	1123	854	989	5.767	2.90	4.33	34.1	38.8	36.46
19:19:19 @ 1%	1,562	1179	1,371	5.867	3.87	4.87	34.6	38.4	36.51
Borax @ 0.5%	1,374	1057	1,216	5.85	3.43	4.64	35.5	39.3	37.39

Cattle Urine @ 5%	1,227	945	1,086	5.633	3.38	4.51	35.4	38.9	37.17
Water spray	1,181	940	1,061	5.367	3.98	4.68	35.1	39.4	37.24
S.Em +	41.6	35.9	27.5	0.109	0.04	0.05	0.3	0.4	0.44
CD (p=0.05)	122.0	105.5	78.1	NS	0.10	0.02	0.9	NS	1.25
Interaction	39.2	30.2	38.8	0.08	0.06	0.06	0.49	0.6	0.62
	NS	NS	110.5	NS	NS	NS	NS	NS	NS

Sunflower seeds Market price: Rs. 37/kg Urea: Rs. 6.2/kg; DAP- Rs. 23.6/kg; MOP- Rs. 12.0/kg; ZnSO₄- Rs. 70.0/kg; Borax Rs. 150/kg; 19:19:19 Rs. 150/kg; Cow urine collection (labour charges): Rs. 150/-

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