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Full Length Research Paper

Effect of secondary and micronutrients on growth, yield parameters and nutrient uptake of sunflower (*Helianthus annuus* L.)

Raghu MS*, Manjunatha Chari K, Tuppad GB and Upperi SN

Department of Soil Science and Agriculture, Chemistry College of Agriculture, UAS, Dharwad-5, Karnataka.

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A field experiment was carried out to study the effect of secondary and micronutrients on growth, yield parameters and nutrient uptake of sunflower (*Helianthus annuus* L.). The results revealed that the highest seed yield was recorded in the treatment with application of T_8 (RDF + secondary nutrients + micronutrients + cow urine spray at 30 and 50 DAS) (1391.73 kg ha^{-1}) and it was significantly superior over T_1 (1166.66 kg ha^{-1}) and T_4 (1263.21 kg ha^{-1}) but on par with the rest of treatments. The Highest total dry matter accumulation was observed in treatment T_8(RDF + secondary nutrients + micronutrients and cow urine spray at 30 and 50 DAS) (4117.67 kg ha^{-1}) and significantly superior over T_1 (3444 kg ha^{-1}), T_3(3462 kg ha^{-1}), T_4 (3490 kg ha^{-1})and T_7(3541 kg ha^{-1}) but it was on par with other treatment. Significantly highest growth parameters noticed in T_8 than others treatments. The application with T_8: RDF + secondary nutrients + micronutrients and cow urine spray at 30 and 50 DAS, recorded, higher uptake of Nitrogen (76.92 kg ha^{-1}), Phosphorous (13.87 kg ha^{-1}) andPotassium (72.48 kg ha^{-1}). Significantly higher seed oil content (38.44 per cent) and oil yield (535 kg ha^{-1}) in application of secondary and micronutrients along with RDF (T_8) compared to control (35.34 percent and 413 kg ha^{-1} respectively).

Keywords: Secondary nutrient, micronutrients, nutrient uptake, yield parameters, sunflower.

INTRODUCTION

In India, sunflower is grown in an area of 1.48 mha with an annual production of 0.90 mt with an average productivity of 607 kg/ha (Anon., 2010). In Karnataka, it is grown over an area of 7.9 lakh hectares with a production of 4.22 mt with having a productivity of 552 kg/ha (Anon., 2010).

Sunflower (*Helianthus annuus* L.) is an important oilseed crop in the world and ranks third next only to groundnut and soybean in crop production. In India, sunflower has recently established as a potential oilseed crop of economic importance. Chances to increase the area under oilseeds being limited, increase in the oilseed production has to come primarily from land saving technologies, encompassing a combination of high yielding plant types, standard agronomic practices and balanced plant nutrition attainable through integrated supply system. Cow urine might act as a stimulator for accumulation of nutrients in the plant biomass, proliferation of plant growth, promoting, phosphate solubilising, a biotic stress tolerant and antagonism towards plant pathogenic fungi in the rhizosphere of plants, and enhance the total phenolic contents of the plants and controlling plant pathogenic fungi, and also it's effective in the enhancement of plant growth and soil health (Nautiyal et al., 2004).

Sustained agriculture production needs constant supply of all the nutrients both organic and inorganic in required quantities. Which not only improve physical and chemical properties of the soil like aeration, soil reaction, but also increases the percentage base saturation in red sandy

*Corresponding author E-mail: achu.agri@gmail.com

soils. Multiplex Samrudhi, fertiliser available in the market, consists of secondary nutrients, such as Calcium, Magnesium, and Sulphur in 9:3:3 proportion and widely accepted for red soils by the farming community.

MATERIAL AND METHODS

The field experiment was carried out on sunflower *var.* KBSH-I at Agricultural College Farm, Raichur, during *kharif* season. Raichur is situated in North Eastern Dry Zone (Zone-2) of Karnataka at 16^{o} 15' N latitude and 77^{o} 20' E longitude with an altitude of 389 meters above the mean sea level**.** The texture of the soil was sandy clay loam. The soil of the experimental field was neutral (pH 7.29) with low organic carbon (0.42 %) and electrical conductivity of 0.36 dSm^{-1}. The available N (261 kg ha^{-1}), P (29 kg ha^{-1}), K (230 kgha^{-1}), S (35 kg ha^{-1}), Exchangeable calcium (6 C mol (p^{+}) kg^{-1}) and magnesium (2.4 Cmol (p^{+}) kg^{-1}), Fe (4.2 mg kg^{-1}), Zn (0.5 mg kg^{-1}), Cu (0.3 mg kg^{-1}), Mn (1.9 mg kg^{-1}) and B (0.48 mg kg^{-1}) respectively. The experiment was laid out in a randomized block design having eight treatments replicated thrice. The calculated quantity of nitrogen was applied in the form of urea, phosphorus in the form of diammonium phosphate and potassium in the form of muriate of potash and uniform basal dose of nitrogen with 35 kg ha^{-1}, phosphorous with 50kg ha^{-1}, potassium with 35 kg ha^{-1} and Samruddhi with 125 kg ha^{-1} was applied and nutrients were analysed by standard procedure. The crop was harvested at 90-95 days after sowing (DAS). At 30, 60 DAS and at harvest, five plants were randomly selected in each treatments for recording dry matter production. The plant samples were oven dried at 70^{0}c till uniform constant weight was obtained. Randomly tagged plants were selected in each treatment for recording growth and yield parameters. The yield was recorded and expressed in kg ha^{-1}.

RESULTS AND DISCUSSION

Plant height and number of leaves

The significant height of plant height was recorded in treatment (T_8) with 69.01cm, 184.20 cm and 186.00 cm, which was on par with T_6, T_5 and T_2 and it was significantly superior over treatments including control (T_1) 62.07 cm, 152.87 cm and 153.60 cm at 30 DAS, 60 DAS and at harvest, respectively (Table 1). It was due to vigorous root growth, formation of chlorophyll and higher photosynthesis. The results of this investigation are in consonance with the findings of Sreemannarayana and Raju (1993). Similarly significantly highest number of leaves were recorded in T_8 was 13.66, 16.46 and 12.50 and least number of leaves were noticed in control (T_1) was 10.27, 12.86 and 9.77 at 30, 60 DAS and at harvest, respectively. Increasing plant height and number of leaves due to the improvement in availability of native soil nutrients and synchronized uptake of nutrients. Similar results were reported by Syed *et al*. (2006), they are also of the opinion that the increased availability of the nutrient especially nitrogen, which is associated with protoplasm synthesis and vigorous vegetative growth.

Test weight and head diameter

Application of T_8: RDF + secondary nutrients + micronutrients and cow urine spray at 30 and 50 DAS recorded higher test weight (4.89 g) and head diameter (14.71 cm), over other treatments, was due to supplement of secondary and micronutrients and the results are in agreement with the findings of Venkatakrishnan and Balasubramanian (1996) in sunflower (Table 1). The increased test weights is due to the synthesis of phytin (is oinsitol hexaphosphate) which is a salt of Ca, Mg, and P. which was taken up from the applied samrudhi and cow urine (Anon., 2007).

Total dry matter production

The highest dry matter accumulation was recorded in the treatment T_8**:** RDF + secondary nutrients + micronutrients and cow urine spray at 30 and 50 DAS(4117.67 kg ha^{-1}) and it was on par with the treatment T_6 : RDF + secondary nutrients + cow urine spray at 30 and 50 DAS (4083.33 kg ha^{-1}), T_5 :RDF + secondary nutrients + micronutrients spray at 30 and 50 DAS (4032.33 kg ha^{-1}), T_2 :RDF + secondary nutrients (3699 kg ha^{-1}) and it was significantly superior over T_1 (3444 kg ha^{-1}), T_3 (3462 kg ha^{-1}), T_4 (3490 kg ha^{-1})and T_7 (3541 kg ha^{-1}) (Table 1). Increased in dry matter productions in the treatments were attributed to higher photosynthetic capacity of plants, which depends upon number of leaves, plant height and dry matter accumulation in plants. Similar results were reported by Reddy et al. (2002).

Seed yield

Highest seed yield recorded with T_8: RDF + secondary nutrients + micronutrients and cow urine spray at 30 and 50 DAS (1392 kg ha^{-1}) (Table 1) which was on par with the treatment receiving T_6 : RDF + secondary nutrients + cow urine spray at 30 and 50 DAS (1316 kg ha^{-1}), T_5: RDF + secondary nutrients + micronutrients spray at 30 and 50 DAS (1314 kg ha^{-1}), T_2 :RDF + secondary nutrients (1299 kg ha^{-1}), T_3 :RDF + micronutrients spray at 30 and 50 DAS (1298 kg ha^{-1})and T_7 :RDF + cow urine spray + micronutrients spray at 30 and 50 DAS (1292 kg ha^{-1}) which was significantly superior over the treatments T_1:RDF (1167 kg ha^{-1}) and T_4: RDF cow urine spray at 30 and 50 DAS (1264 kg ha^{-1}), was due to synchronized supply of these nutrients during the vigorous growth stagesof sunflower from 30 to 70 DAS,

Table 1. Effect of secondary and micronutrients on dry matter production, growth and yield parameters of sunflower.

Treatments	Plant height (cm)			Number of leaves per plant			Head diameter (cm)	Total Dry matter production (Kg/ha)	Seed yield (Kg/ha)	Test weight (100gm)
	30 DAS	60 DAS	At Harvest	30 DAS	60 DAS	At Harvest				
T_1: Recommended doses of NPK, (35:50:35 kg NPKha^{-1})	62.07	152.87	153.60	10.27	12.86	9.77	11.31	3444	1167	3.68
T_2:RDF + *Secondary nutrients	68.40	165.40	167.60	12.93	13.73	10.93	12.43	3699	1299	4.81
T_3:RDF + Micronutrients spray at 30 and 50 DAS	62.40	170.32	172.50	10.75	14.20	10.87	12.46	3462	1298	4.80
T_4:RDF + Cow urine spray at 30 and 50 DAS	62.50	173.85	175.40	10.87	15.06	11.17	12.41	3490	1264	4.83
T_5:RDF + *Secondary nutrients + Micronutrients spray at 30 and 50 DAS	68.53	175.17	177.40	13.17	15.53	11.53	13.44	4033	1314	4.86
T_6:RDF + *Secondary nutrients + cow urine spray at 30 and 50 DAS	68.62	175.93	177.62	13.20	15.59	11.53	13.20	4084	1316	4.87
T_7:RDF +Micronutrients spray + cow urine spray at 30 and 50 DAS	63.01	162.73	164.53	10.90	14.66	11.44	13.01	3541	1292	4.84
T_8:RDF +*Secondary nutrients + Micronutrients spray + cow urine spray at 30 and 50 DAS	69.01	184.20	186.00	13.66	16.46	12.50	14.71	4118	1392	4.89
S. Em±	1.96	5.7	5.79	0.74	0.6	0.44	0.59	178.03	37.73	0.24
C.D (P=0.05)	5.94	17.3	17.57	2.24	1.81	1.32	1.80	540.01	114.45	0.74

**Note: ***Samruddhi 270-300 g/plot as a basal dose (125 kg ha^{-1})
Cow Urine spray 20 ml/1litre of water/plot at 30 and 50 DAS
Micronutrients spray 3 ml/1liter of water/plot at 30 and 50 DAS

as a result, crop requires higher amount of nutrients during this period. Similar results were reported by Arnab Roy Chowdhuryet al. (2010) in sunflower.

Major nutrients uptake (NPK)

The significantly differed with respect to total uptake of N, P and K by sunflower crop (Table 2). The application with T_8: RDF + secondary nutrients + micronutrients and cow urine spray at 30 and 50 DAS, recorded, higher uptake of nitrogen (76.92 kg ha^{-1}), phosphorous (13.87 kg ha^{-1}), potassium (72.48 kg ha^{-1}) were on par with treatment T_6 and T_5, which was significantly superior over T_1, T_2, T_3, $T_4$and T_7 was attributed to the higher dry matter production, seed and stalk yield, and concentrations. Similar results were reported byPatil et al. (2006) in sunflower

Secondary nutrients uptake (Calcium and Magnesium uptake)

The significant uptake of calcium (35.62 kg ha^{-1}) and magnesium (18.32 kg ha^{-1}) in T_8: RDF + secondary nutrients + micronutrients and cow urine spray at 30 and 50 DAS, over T_1: RDF (calcium 20.25 kg ha^{-1} and magnesium 9.38 kg ha^{-1}) and they on par with T_6. Increased nutrient uptake is due to higher concentrations calcium and magnesium in seeds and higher yield. The additional availability of nutrients in the leaves made it possible for the plants to respond to higher nutrient requirement and uptake. Similar results were reported by Sudhir et al. (1987) in groundnut.

Oil content and oil yield

Soil and foliar application of application of secondary and micronutrients along with RDF (T_8) resulted in significantly higher seed oil content (38.44 per cent) and oil yield (535 kg ha^{-1}) compared to control (35.34 percent and 413 kg ha^{-1} respectively). This might be due to role of sulphur in synthesis of oil;sulphur involved in the formation of glucosides and sulphydril-linkage and

Table 2. Effect of secondary and micronutrients on total uptake of nutrients and oil yield of sunflower.

Treatments	Nutrient uptake (Kg/ha)						Oil content (%)	Oil yield (Kg/ha)
	N	P	K	S	Ca	Mg		
T_1- RDF NPK, (35kgN_2, 50kgP_2O5, 35kgK_2O/ha)	56.47	7.19	53.04	10.13	20.25	9.38	35.34	413
T_2- RDF + Secondary nutrients	60.64	9.20	57.95	14.19	26.18	13.52	36.34	472
T_3- RDF + Micronutrients spray	57.88	7.96	54.58	11.20	21.35	10.21	37.35	485
T_4- RDF + Cow urine spray	59.02	8.65	56.85	11.98	22.45	10.25	36.53	462
T_5- RDF + Secondary nutrients + Micronutrients Spray	73.51	11.46	66.19	17.48	30.92	14.33	38.21	502
T_6- RDF + Secondary nutrients + Cow urine spray	74.11	12.61	68.25	17.92	32.78	15.75	38.24	503
T_7- RDF + Micronutrients spray + Cow urine spray	61.61	10.25	59.54	12.70	24.65	11.81	37.52	485
T_8- RDF + Secondary nutrients + Micronutrients Spray + Cow urine spray	76.92	13.87	72.48	18.53	35.62	18.32	38.44	535
S.Em. ±	4.94	0.67	3.14	0.97	1.13	0.86	0.65	21.43
C.D (P= 0.05)	14.98	2.04	9.53	2.96	3.44	2.59	1.97	65.01

Note: Samruddhi 270-300 gm/plot as a basal dose (50 kg/acre)
Cow Urine spray 20ml/1litre of water/plot at 30 and 50 DAS
Micronutrients spray 3ml/1liter of water/plot at 30 and 50 DAS

activation of enzymes which aid in biochemical reaction within the plant. This confirms the findings of Gangadhara et al. (1990) in sunflower.

It can be inferred that, the application of RDF with secondary nutrients + micronutrients + cow urine spray at 30 and 50 DAS improves seed yield of sunflower over application of RDF alone. This combination also recorded higher plant height and number of leaves and also uptake of primary and secondary nutrients. Increased total dry matter production, test weight of seed, oil yield and seed yield was noticed in same treatment due to synchronized supply of these nutrients, higher photosynthetic capacity of plants, synthesis of phytin, activation of enzymes which aid in biochemical reaction within the plant uptake of nutrients.

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