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E Swetha

Department of Agronomy,
Annammalai University,
Chidambaram, Tamil Nadu, India

Dr. A Karthikeyan

Assistant Professor, Department of
Agronomy, Annammalai University,
Chidambaram, Tamil Nadu, India

Dr. S Babu

Associate Professor, Department of
Agronomy, Annammalai University,
Chidambaram, Tamil Nadu, India

Dr. K Dhanasekharan

Professor, Department of soil
science and agricultural chemistry,
Annammalai University,
Chidambaram, Tamil Nadu, India

Investigation on the influence of soil and foliar nutrients on growth characteristics and yield of hybrid sunflower

E Swetha, Dr. A Karthikeyan, Dr. S Babu and Dr. K Dhanasekharan

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Abstract

The field experiment was carried out in the experimental farm, Department of Agronomy, Faculty of Agriculture, Annammalai University, Annammalai Nagar, Tamil Nadu, India in 2022 to investigate the influence of soil and foliar nutrients on growth characteristics and yield of hybrid sunflower. The experiment was laid out in Randomized Block Design (RBD) comprised of ten treatments and replicated thrice. The treatments are T₁ – RDF alone (control), T₂ - RDF + MN mixture @ 12.5 kg ha⁻¹, T₃ -RDF + Gypsum @ 200 kg ha⁻¹ (soil application), T₄ - RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ (soil application), T₅ - RDF + MN mixture @ 12.5 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS, T₆ - RDF + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS, T₇ - RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS, T₈ - RDF + MN mixture @ 12.5 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS, T₉ - RDF + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS, T₁₀ - RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS. From the results, it is revealed that nutrient management practices (T₁₀ - RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS) have significant effect on growth characteristics and yield of hybrid sunflower.

Keywords: Hybrid sunflower, micronutrient, gypsum, ZnSO₄, Boron

Introduction

Oilseeds play a vital role in Indian agriculture as food for humans and feed for animals. The oilseed industry is an important determinant of the agricultural economy in India and occupies around 14% of the gross cropped area of the world. Among different edible oils, sunflower oil is considered the best for heart patients as it contains high value of linoleic acid and reduces cholesterol deposition in the coronary arteries of the heart. Sunflower (*Helianthus annuus* L.) is a day-neutral, short duration, drought, and salinity tolerant oilseed crop belonging to the Asteraceae family and is native to southern parts of the USA and Mexico. The cultivation of sunflower is confined to southern parts of the country comprising the states of Karnataka, Maharashtra, Tamil Nadu, and Andhra Pradesh. These four states contribute about 90 per cent of total acreage and 78 per cent of total production. In India, sunflower covers an area of 0.28 million hectares with production and productivity of 0.25 million tonnes and 905 kg ha⁻¹, respectively 2 during the year 2021-22 (Agricultural statistics at a glance, 2022). The dependency of India on import of edible oil supply is expected to decrease to 23% by 2030-31 which is currently 52% (GOI, 2023) [4]. This need to expand demand for oil production and dependency on import should be dealt with by augmenting oilseed production on a sustainable basis.

Materials and Methods

The present experiment was conducted at experimental farm, Department of Agronomy, Faculty of Agriculture, Annammalai University, Annammalai Nagar, Tamil Nadu, India during 2022. The soil of experimental field was Clay loam with low in available nitrogen, medium in available phosphorus and high in available potassium.

Corresponding Author:

E Swetha

Department of Agronomy,
Annammalai University,
Chidambaram, Tamil Nadu, India

The field experiment was laid out in Randomized Block Design (RBD) with 10 treatments and replicated thrice. The treatments were viz., T₁ – RDF alone (control), T₂ - RDF + MN mixture @ 12.5 kg ha⁻¹, T₃ -RDF + Gypsum @ 200 kg ha⁻¹ (soil application), T₄ - RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ (soil application), T₅ - RDF + MN mixture @ 12.5 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS, T₆ - RDF + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS, T₇ - RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS, T₈ - RDF + MN mixture @ 12.5 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS, T₉ - RDF + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS, T₁₀ - RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS. TNAU sunflower hybrid CO 2 was selected for the study. The individual plot size was 5.3x4.4 m formed with ridges and furrows. The experimental data were collected from the net plot (5x4 m) and statistically analysed as described by Gomez and Gomez (2010) [5]. The data for plant height, LAI and DMP were collected at harvest and establishment percentage at 7 days after sowing.

Results and Discussion

The study revealed that there were significant differences for all the growth characteristics and yields investigated among the

different nutrient management methods. That data indicated that the lowest growth characters and yield were obtained in control treatment (T₁ – RDF alone). All the other treatments showed significantly superior results than control treatment. The highest growth characters and yield was found in T₁₀ (RDF + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS) viz., plant height (161.23 cm), LAI (5.05), DMP (6241.48 kg ha⁻¹) days to 50% flowering (55.67 days), seed yield (2619.86 kg ha⁻¹) and stalk yield (5181.99 kg ha⁻¹) whereas the lowest values were found in T₁ – RDF alone (plant height - 125.28 cm, LAI – 3.27, DMP – 4127.06 kg ha⁻¹, Days to 50% flowering – 61.55 days, seed yield – 1614.71 kg ha⁻¹ and stalk yield – 3544.11 kg ha⁻¹). The establishment percentage was found to be non-significant.

The higher values on establishment percentage were recorded in all the treatments experimented. This might be due to the hybrid seeds exhibiting higher germination percentage, seed viability and vigour. This result is in line with the result of Immanuel *et al.* (2020) [6]. The increased plant height might be because there are more nutrients readily available as a result of different nutrients applied, which might have boosted the essential physiological processes and promoted the transfer of photosynthates to developing meristematic tissues. These results are in accordance with the findings of Deepika and Singh (2022) [3].

Table 1: Effect of soil and foliar nutrients on growth characters and yield of hybrid sunflower

Treatments	Establishment percentage (%)	Plant height (cm)	LAI	DMP (kg ha ⁻¹)	Days 50% flowering (days)	Seed yield (kg ha ⁻¹)	Stalk yield (kg ha ⁻¹)
T ₁	92.99	125.28	3.27	4127.06	61.55	1614.71	3544.11
T ₂	93.11	135.9	3.71	4812.46	59.98	1926.79	4088.79
T ₃	93.05	129.88	3.49	4503.38	60.72	1783.90	3845.32
T ₄	93.23	140.24	3.93	5081.36	59.09	2054.14	4297.56
T ₅	93.37	144.55	4.16	5321.60	58.29	2162.39	4464.61
T ₆	93.41	146.42	4.28	5419.98	58.18	2216.77	4558.20
T ₇	93.58	150.77	4.51	5655.16	57.42	2331.34	4737.61
T ₈	93.65	155.09	4.72	5948.78	56.64	2462.67	4948.31
T ₉	93.74	156.98	4.83	6034.60	56.46	2514.92	5028.33
T ₁₀	93.86	161.23	5.05	6241.48	55.67	2619.86	5181.99
SEm ±	-	1.40	0.06	64.06	0.24	33.10	50.11
C.D(p=0.05)	NS	4.21	0.18	190.34	0.71	98.36	148.88

A balanced and adequate supply of nutrients ultimately increased the vegetative growth and photosynthetic activity of the crop. Nitrogen is a crucial component for chlorophyll formation and the synergetic effect of nitrogen and phosphorus in cell elongation and cell division might have contributed to increased leaf area per plant. Mallick and Majumder (2023) [9] and Ali and Noorka (2013) [2] also obtained the same results. The increase in dry matter production under adequate levels of nitrogen, phosphorus, potassium and other micronutrients might have improved respiration, energy transfer, cell division, efficient physiological and metabolic processes resulting in luxuriant vegetative and reproductive growth. Rajath *et al.* (2019) [10], Jagadala *et al.* (2020) [7] and Shekhawat and Shivay (2008) [14] also reported the relevant results regarding dry matter production.

Calcium and sulphur in the form of gypsum might have stimulated flowering by cell division and synthesis of certain amino acids responsible for flowering at earlier. Micronutrients like iron, magnesium and boron help in energy transfer and enzyme production which promotes early and prolific flowering.

These results are in harmony with the research results of Kalaiyarasan *et al.* (2019) [8] and Sandhya *et al.* (2021) [12]. The improved vegetative growth due to the application of macro and micronutrients throughout the crop period helps in better translocation of the source to the reproductive sink which showed an increment in the yield of the crop. These results are confirmed with the results of Ramesh (2017) [11].

Conclusion

Given the above comparative results, it has been concluded that the application of RDF (60:90:60 N:P₂O₅:K₂O kg ha⁻¹) + MN mixture @ 12.5 kg ha⁻¹ + Gypsum @ 200 kg ha⁻¹ + foliar application of ZnSO₄ @ 0.5% on 30 DAS and Boron @ 0.1% on 60 DAS (T₁₀) was the optimal nutrient management for maximum production in hybrid sunflower crop.

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