

# Nutrient Use Efficiency of Hybrid Sunflower in Response to Sulphur and Zinc Fertilization of Tambirabarani Tract

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**Abstract:** In India, oil seed production is not available to meet domestic requirements. India has been facing a recurring shortage of edible oils for many years. Presently, about 23% of sunflower oil being consumed in India has to be imported. To improve our country sunflower production by proper fertilizer management and used sunflower hybrids in the production. This research was conducted to study the yield, seed quality and economics of hybrid sunflower variety CO 2 on alfisol of tambirabarani tract using a randomized complete block design replicated thrice with eight treatments in 2016-17. The experiment consisted of eight treatments viz. T<sub>1</sub>-Control, T<sub>2</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]25 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup>, T<sub>3</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]12.5 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]0.5 % foliar spray, T<sub>4</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]25 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]0.5 % foliar spray, T<sub>5</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]37.5 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]0.5 % foliar spray, T<sub>6</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]12.5 kg ha<sup>-1</sup> + S[at]0.2 % foliar spray, T<sub>7</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup> + S[at]0.2 % foliar spray and T<sub>8</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]37.5 kg ha<sup>-1</sup> + S[at]0.2 % foliar spray. Application of RDF as 60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]25 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup> (T<sub>2</sub>) produced significantly seed yield (2101 kg ha<sup>-1</sup>) and maximum nutrient use efficiency. Hence, the above study concluded that application of recommended dose of fertilizer as 60: 90: 60 kg of NPK ha<sup>-1</sup> with S[at]25 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup> is found to be the best for getting optimum yield of sunflower in an Alfisol of Tambirabarani tract.

**Key words:** Sulphur, Zinc Sulphate, Nutrient Use Efficiency and National Sunflower Association

## 1. Introduction

Sunflower (*Helianthus annuus* L.) accounts the fourth place among the vegetable oilseeds ensuing to soybean, oil palm and canola within the world. Nowadays, world zone under sunflower is 27.29 million ha with an annual production and productivity of 49.56 million tons and 1820 kg ha<sup>-1</sup>, respectively (NSA, 2019). In India, it is cultivated over an area of approximately 0.39 million ha with a generation of 0.34 million tons and productivity of 842 kg ha<sup>-1</sup> (USDA, 2018). The optimization of the nutrients is the key to achieve the production of sunflower, as it has very high nutrient requirement. The recently released high yielding hybrid varieties remove more nutrients from the soil, so proper management of nutrient is essential for sustainable production. Despite its considerable importance, little work has been done on sunflower with particular reference to its ability to grow well in Rabi season in the southern regions of Tambirabarani tract. With the above background, the present investigation was planned to study the effect of soil and foliar applications of S and Zn along with NPK fertilizers on sunflower seed yield, nutrient uptake and nutrient use efficiencies.

## 2. Materials and Methods

A field experiment was conducted at Agricultural College and Research Institute, Killikulam, Thoothukudi during Rabi season between November-February on 2015-16 to 2016-17. The experiment consisted of eight treatments viz. T<sub>1</sub>-Control, T<sub>2</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]25 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup>, T<sub>3</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]12.5 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]0.5 % foliar spray, T<sub>4</sub>-60:

90: 60 kg of NPK ha<sup>-1</sup> + S[at]25 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]0.5 % foliar spray, T<sub>5</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at]37.5 kg ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]0.5 % foliar spray, T<sub>6</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]12.5 kg ha<sup>-1</sup> + S[at]0.2 % foliar spray, T<sub>7</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup> + S[at]0.2 % foliar spray and T<sub>8</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + ZnSO<sub>4</sub>[at]37.5 kg ha<sup>-1</sup> + S[at]0.2 % foliar spray was carried out in randomized block design (RBD) with three replication.

### Indices for Assessment of Nutrient Efficiencies

#### Agronomic Efficiency (AE):

$$AE = \left\{ \frac{\text{Seed yield in fertilized plot (kg ha}^{-1}) - \text{Seed yield in unfertilized plot (kg ha}^{-1})}{\text{Quantity of nutrient applied (kg ha}^{-1})} \right\}$$

#### Physiological Efficiency (PE):

The physiological efficiency is the seed yield obtained per unit of nutrients absorbed. It was computed as follows (Yoshida, 1981).

$$PE = \left[ \frac{\text{Seed yield in fertilized plot (kg ha}^{-1}) - \text{Seed yield in unfertilized plot (kg ha}^{-1})}{\text{Nutrient uptake in fertilized plot (kg ha}^{-1}) - \text{Nutrient uptake in unfertilized plot (kg ha}^{-1})} \right]$$

## 3. Result and Discussion

### Seed Yield and Nutrient Use Efficiencies

Application of S and Zn micronutrient had remarkable influence on efficiencies of sunflower. Among the

treatments, treatment T<sub>2</sub>-60: 90: 60 kg of NPK ha<sup>-1</sup> + S[at] 25 kg ha<sup>-1</sup> +

**Table 1:** Effect of treatments on Seed yield and Nutrient use efficiency

Treatment	Seed yield (Kg ha <sup>-1</sup> )	Agronomic efficiency					Physiological efficiency				
		N	P	K	S	Zn	N	P	K	S	Zn
T <sub>1</sub> -Control	975	-	-	-	-	-	-	-	-	-	-
T <sub>2</sub> -60: 90: 60 kg of NPK ha <sup>-1</sup> + S[at]25 kg ha <sup>-1</sup> + ZnSO <sub>4</sub> [at]25 kg ha <sup>-1</sup>	2101	18.77	12.51	9.43	45.04	45.04	8.81	33.33	13.36	37.53	2458.5
T <sub>3</sub> -60: 90: 60 kg of NPK ha <sup>-1</sup> + S[at]12.5 kg ha <sup>-1</sup> + ZnSO <sub>4</sub> [at]0.5 % foliar spray	1712	12.28	8.19	2.95	58.96	245.67	34.43	139.45	41.70	141.19	6639.6
T <sub>4</sub> -60: 90: 60 kg of NPK ha <sup>-1</sup> + S[at]25 kg ha <sup>-1</sup> + ZnSO <sub>4</sub> [at]0.5 % foliar spray	1801	13.77	9.18	4.43	33.04	275.33	13.45	55.48	16.79	42.49	3344.1
T <sub>5</sub> -60: 90: 60 kg of NPK ha <sup>-1</sup> + S[at]37.5 kg ha <sup>-1</sup> + ZnSO <sub>4</sub> [at]0.5 % foliar spray	1892	15.28	10.19	5.95	24.45	305.67	10.91	40.44	14.11	30.63	3026.4
T <sub>6</sub> -60: 90: 60 kg of NPK ha <sup>-1</sup> + ZnSO <sub>4</sub> [at]12.5 kg ha <sup>-1</sup> + S[at]0.2 % foliar spray	1757	13.03	8.69	3.70	651.67	62.56	17.41	101.39	27.41	92.32	3969.5
T <sub>7</sub> -60: 90: 60 kg of NPK ha <sup>-1</sup> + ZnSO <sub>4</sub> [at]25 kg ha <sup>-1</sup> + S[at]0.2 % foliar spray	1813	13.97	9.31	4.63	698.33	33.52	12.20	49.13	15.45	51.16	2415.0
T <sub>8</sub> -60: 90: 60 kg of NPK ha <sup>-1</sup> + ZnSO <sub>4</sub> [at]37.5 kg ha <sup>-1</sup> + S[at]0.2 % foliar spray	1980	16.75	11.17	7.42	837.50	26.80	9.77	38.05	14.04	47.58	2233.3
SEd	43.16										
CD (P=0.05)	92.58										

ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup> registered the higher seed yield (2101 kg ha<sup>-1</sup>), agronomic efficiency of 12.28 kg N, 8.19 kg P<sub>2</sub>O<sub>5</sub> and 2.95 kg of K<sub>2</sub>O, 58.96 kg of S and 245.67 kg of Zn and physiological efficiency of 34.43, 139.45, 41.70, 141.19 and 6639.6 kg of N, P<sub>2</sub>O<sub>5</sub>, K<sub>2</sub>O, S and Zn respectively of rabi irrigated sunflower crop. In view of the above results it is decided that hybrid sunflower is highly responsive crop to Zn and S micronutrient fertilization and have positive effects on the uptake and utilization of major nutrients at the whole plant level and it may improve efficiency parameters. The present results supported the observations of Hawkesford *et al.* (2014).

(2014). Nutrient use efficiency in plants: concepts and approaches. Springer, Int. Pub., Switzerland, 279

#### 4. Conclusion

From the present investigation it is concluded that 60 kg N, 90 kg P<sub>2</sub>O<sub>5</sub> and 60 kg K<sub>2</sub>O ha<sup>-1</sup> along with soil application of S[at]25 kg ha<sup>-1</sup> ZnSO<sub>4</sub>[at]25 kg ha<sup>-1</sup> was the optimal agronomic nutrient management treatment for obtaining maximum seed yield, maximum nutrient use efficiencies, agronomic efficiency and physiological efficiency of irrigated hybrid sunflower crop.

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