International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(6): 2983-2986

Received: 04-09-2020
Accepted: 13-10-2020

**YS Satish Kumar**
Regional Agricultural Research Station, Nandyal, ANGRAU, Andhra Pradesh, India

**D Venkatesh Babu**
Regional Agricultural Research Station, Nandyal, ANGRAU, Andhra Pradesh, India

**A Mohan Vishnu Vardhan**
Regional Agricultural Research Station, Nandyal, ANGRAU, Andhra Pradesh, India

**ESV Narayana Rao**
Regional Agricultural Research Station, Nandyal, ANGRAU, Andhra Pradesh, India

**Corresponding Author:**
**YS Satish Kumar**
Regional Agricultural Research Station, Nandyal, ANGRAU, Andhra Pradesh, India

# Soil test based nutrient management and fertilisation strategies for sunflower crop

**YS Satish Kumar, D Venkatesh Babu, A Mohan Vishnu Vardhan and ESV Narayana Rao**

**Abstract**
A field experiment was conducted for three *rabi* seasons (2014-15, 2015-16 & 2016-17) at Regional Agricultural Research Station, Nandyal, Andhra Pradesh to study the influence of different levels of fertilizers on yield attributes, seed yield, benefit cost ratio and available soil nutrient status of sunflower. The results revealed that the maximum plant height (cm), capitulum diameter (cm), capitulum weight(g), were obtained with STCR Equation-2+ VC @ 2 t $ha^{-1}$, maximum test weight, stalk yield and seed yield (2208 kg/ha) were obtained with STCR Equation along with vermicompost @ 2t/ha. While the minimum values of yield attributes and seed yield (1000 kg ha-1) and yield attributes were recorded with farmers practice. The study indicated that Nutrient management based on soil tested data besides maintaining the available N, P and K of soil, leading to positive nutrient balance.

**Keywords:** Sunflower, target yield approach, STCR equations, STBF, RDF & BCR

## Introduction
Sunflower (*Helianthus annuus* L.) is an important oilseed crop of the world and it ranks third in production next to groundnut and soybean. In India, it is cultivated over an area of 4.7 lakh hectares producing 4.3 lakh tons with a productivity of 697 kg. $ha^{-1}$. For over 40 years, soil testing has been a recommended means of predicting the kind and amount of fertilizers needed. Yet many farmers still do not use this relatively simple tool but apply fertilizers as per their will. Farmers still apply fertilizer where none is required or at lower rates than required or at higher rates than required to optimize yields. Farmers also apply inadequate rates or use ineffective application methods. Among the various methods of fertiliser recommendations, the one based on yield targeting is unique because this method not only considers the soil test-based fertilizer dose but also the level of yield the farmer can achieve if good agronomic practices are followed to raise the crop. This targeted yield approach is also scientifically sound as the balanced fertilisation is ensured not only among the fertiliser nutrients but also the soil available nutrients (Suresh & Santhi 2018). Soil testing and fertilizer recommendation provide a practical tool to synchronize crop nutrient demand and soil nutrient supply (Zhang *et al*. 2013). Among the various approaches for crop nutrition, the targeted yield approach has been found to be highly popular in India. As the production potential of sunflower crop is much higher than the present average on the farmers' field, there is a scope to increase the production by matching with balanced nutrition through soil testing and crop demand.
Regional mean optimal fertilizer recommendation rate (RMOR), depending on the average crop yield and soil nutrient content, will be an appropriate method to advise small farmers to use fertilizer reasonably (Gebremedhin *et al*. 2015). However, greater variability of soil nutrient content is a frequent occurrence, especially for small farmers. Therefore, based on the fertilizer recommended dose of fertilizers, small adjustments according to the specific conditions will be an easy and effective approach to improve crop yield and fertilizer use efficiency at the regional level (Prabhakar *et al*., 2017)

## Materials and Methods
A field experiment was conducted for three *rabi seasons of* 2014- 15, 2015-16 & 2016-17 at Regional Agricultural Research Station, Nandyala under Irrigated Dry (ID) conditions during the soil of experimental site was medium deep black, low in organic carbon (0.36%) &

Nitrogen (140kg/ha) high in available $P_2O_5$ (58.65 kg ha-1) and available $K_2O$ (435 kg ha-1). Treatments comprised of ten nutrient management practices, wherein, recommended NPK (75:90:30 N, $P_2O_5$, $K_2O$ kg ha-1), soil test based NPK (Soil Test Based Fertilizer method), Soil Test Crop Response Co relation (STCR) approach (Yield target: 25 q ha-1) with vermicompost 2 t $ha^{-1}$ and micronutrients Zn, B, S combinations and farmer adopting dose. The experiment was carried out in randomized block design (RBD) with three replications. The sunflower hybrid NDSH -1 was used with a seed rate of 5 kg $ha^{-1}$ at a spacing of 60 cm x 30 cm. The crop was raised under ID condition and received four irrigations during the crop growth period in both the years. Vermicompost was incorporated in furrows as per the treatments one month before sowing and entire quantity of $P_2O_5$ and $K_2O$ were applied as basal dose, 33.5% of nitrogen applied as basal dose and remaining 66.5% nitrogen applied as topdressing through urea as per the treatments at 30 and 50 days after sowing. Phosphorus was applied in form single superphosphate whereas potassium was applied in the form of muriate of potash for all the treatments. The data related to plant height and yield attributes was recorded on ten randomly selected plants in each plot. Net seed and stalk yield were recorded for net plot and computed as kg $ha^{-1}$. Soil and plant samples were collected in each treatment and analyzed by following standard procedures. All the data was subjected to statistical analysis. Revision of Fertilizer doses for different crops is essential with the changed scenario of soil fertility status chopping up to micronutrient deficiencies, build-up of some of the nutrients like phosphorus and change of cropping pattern and introduction of new varieties etc; Infact, this revision is overdue long pending need. Hence, an experiment for revising the fertilizer recommendations in Sunflower crop had formulated with following treatments.

**Treatments details**

**$T_1$:** Current RDF (N, P, K, Zn, S, B)
**$T_2$:** Soil Test based Fertilizer Usage (N, P, K,) (30% Excess / Less) + Zn, S, B, if deficient- Full RDF
**$T_3$:** T2+ 2 t Vermicompost /ha
**$T_4$:** STCR based Eq: Prod-I (Current Highest in Dist / Zone) + RD of Zn / B / S if soil is deficient) (FN = 8.23 T – 0.46 SN, $FP_2O5$ = 8.91 T – 4.24 SP, $FK_2O$ = 3.80 T – 0.10 SK)
**$T_5$:** T4+ 2 t Vermicompost /ha
**$T_6$:** STCR based Eq: Prod-II (15% Higher) + RD of Zn / B / S if soil is deficient)
**$T_7$:** T6+2 t Vermicompost /ha
**$T_8$:** New Treatment For P-I: N=150% RDN if avail is < 140 kg /ha else 125% RDN P=100% RDP if avail P is high, Else125%, K=125% RDK if Low Else 100% RDK: Zinc = 125% RD ZN if Def, Else 25% RD Zn, S = 125% RD S if Def, Else 25% RD S, B = 125% RD B if Def, Else 25% RD B
**$T_9$:** T8+2 t Vermicompost /ha
**$T_{10}$:** New Treatment For P-II: N=200% RDN if avail is < 140 kg /ha else 150% RDN P=100% RDP if avail P is high, Else150%, K=125% if Low Else 100% RDK, Zinc = 125% RD ZN if Def, Else 25% RD Zn, S = 125% RD S if Def, Else 25% RD S, B = 125% RD B if Def, Else 25% RD B
**$T_{11}$:** T10+ 2 t Vermicompost /ha
**$T_{12}$:** Farmers Practice

**Table 1:** Plant growth, yield attributes and seed yield of sunflower as influenced by different soil test based nutrient management

| Treatments No. | Treatments | Fertilisers kg/ha | Plant height (cm) | Capitulum diameter (cm) | Test Weight(g) 1000 seeds | Seed yield (kg/ha) | Stalk yield (kg/ha) | Single Capitulum weight (g) |
|---|---|---|---|---|---|---|---|---|
| T1 | RDF | 75:90:30 | 177.4 | 13.6 | 45.6 | 1423 | 2926 | 44.8 |
| T2 | STBF | 98:63:20 | 180.7 | 14.0 | 47.8 | 1618 | 2938 | 45.7 |
| T3 | STBF +VC 2t/ha | 128:67:24 | 185.1 | 14.5 | 51.2 | 1674 | 2952 | 46.3 |
| T4 | STCR eq-1 | 140:8:53 | 184.0 | 15.6 | 48.6 | 1788 | 2935 | 56.1 |
| T5 | STCR eq-1 +VC 2t/ha | 170:12:57 | 182.6 | 16.2 | 55.2 | 2208 | 3217 | 59.6 |
| T6 | STCR eq-2 | 183:50:70 | 185.1 | 16.2 | 49.6 | 1916 | 3001 | 60.4 |
| T7 | STCR eq-2 + VC 2t/ha | 213:54:74 | 188.0 | 16.5 | 51.8 | 2036 | 2682 | 62.0 |
| T8 | New treatment prod.-1 | 113:90:30 | 185.7 | 13.2 | 49.5 | 1781 | 3163 | 55.0 |
| T9 | New treatment prod.-1+VC2t/ha | 143:94:34 | 184.2 | 14.8 | 45.8 | 1838 | 2935 | 56.2 |
| T10 | New treatment prod.-1 | 150:90:20 | 181.0 | 16.0 | 49.2 | 1862 | 3021 | 61.0 |
| T11 | New treatment prod.-1+VC2t/ha | 180:94:24 | 182.7 | 14.5 | 51.0 | 1804 | 3038 | 57.3 |
| T12 | Farmers practice | 60:40:20 | 173.3 | 13.0 | 42.8 | 1000 | 2889 | 44.0 |
| | S. Em+ | | 8.20 | 0.84 | 9.5 | 85.48 | 141.15 | 2.55 |
| | C. D. (P=0.05) | | NS | NS | NS | 239.26 | NS | 7.14 |
| | C V (%) | | - | - | - | 12.40 | -- | 13.2 |

**Table 2:** Economics of sunflower as influenced by different soil test based nutrient management for 3 years

| Treatments No. | Treatments | Fertilizers kg/ha | Seed yield (kg/ha) | Cost of cultivation | Gross returns | Net returns | B:C Ratio |
|---|---|---|---|---|---|---|---|
| T1 | RDF | 75:90:30 | 1423 | 25000 | 42690 | 17690 | 1.71 |
| T2 | STBF | 98:63:20 | 1618 | 23766 | 48540 | 24774 | 2.04 |
| T3 | STBF +VC 2t/ha | 128:67:24 | 1674 | 33867 | 50220 | 16353 | 1.48 |
| T4 | STCR eq-1 | 140:8:53 | 1788 | 22169 | 53640 | 31471 | 2.42 |
| T5 | STCR eq-1 +VC 2t/ha | 170:12:57 | 2208 | 32200 | 66240 | 34040 | 2.06 |
| T6 | STCR eq-2 | 183:50:70 | 1916 | 25141 | 57480 | 32339 | 2.29 |
| T7 | STCR eq-2 + VC 2t/ha | 213:54:74 | 2036 | 35210 | 61080 | 25870 | 1.73 |
| T8 | New treatment prod.-1 | 113:90:30 | 1781 | 25496 | 53430 | 27934 | 2.10 |
| T9 | New treatment prod.-1 + VC 2t/ha | 143:94:34 | 1838 | 35550 | 55140 | 19590 | 1.55 |
| T10 | New treatment prod.-1 | 150:90:20 | 1862 | 25794 | 55860 | 30066 | 2.17 |
| T11 | New treatment prod.-1 + VC 2t/ha | 180:94:24 | 1804 | 35860 | 54120 | 18260 | 1.51 |
| T12 | Farmers practice | 60:40:20 | 1000 | 22304 | 30000 | 7696 | 1.35 |

*price 30/-per kg of sunflower seed

**Table 3:** Influence of Fertilization on soil Properties at the time of Harvesting

| T.N. | Treatments | Fertilisers kg/ha | Available N (Kg/ha) | Available $P_2O_5$ (Kg/ha) | Available $K_2O$ (Kg/ha) |
|---|---|---|---|---|---|
| T1 | RDF | 75:90:30 | 108.3 | 52.2 | 361.3 |
| T2 | STBF | 98:63:20 | 121.3 | 44.3 | 348.0 |
| T3 | STBF +VC 2t/ha | 128:67:24 | 138.3 | 46.0 | 345.0 |
| T4 | STCR eq-1 | 140:8:53 | 152.3 | 36.2 | 364.0 |
| T5 | STCR eq-1 +VC 2t/ha | 170:12:57 | 165.3 | 36.5 | 392.3 |
| T6 | STCR eq-2 | 183:50:70 | 182.7 | 47.5 | 425.0 |
| T7 | STCR eq-2 + VC 2t/ha | 213:54:74 | 195.7 | 45.7 | 408.3 |
| T8 | New treatment prod.-1 | 113:90:30 | 128.7 | 52.3 | 361.7 |
| T9 | New treatment prod.-1 + VC 2t/ha | 143:94:34 | 149.0 | 54.5 | 433.3 |
| T10 | New treatment prod.-1 | 150:90:20 | 144.7 | 53.9 | 376.7 |
| T11 | New treatment prod.-1 + VC 2t/ha | 180:94:24 | 170.3 | 56.9 | 431.0 |
| T12 | Farmers practice | 60:40:20 | 175.3 | 61.1 | 410.0 |
| | S. Em+ | | 4.57 | 5.00 | 19.77 |
| | C. D. (P=0.05) | | 12.80 | 13.99 | 55.33 |
| | C V (%) | | 13.19 | 17.69 | 14.82 |
| | Soil initial properties | | 140 | 58.65 | 435 |

## Results and Discussion

Data presented in Table 1 indicates a significant influence of application of vermicompost @ 2 t ha-[1] along with RDF, STBF and STCR over all other treatments. The higher plant height (188.0, 185.7 and 185.1 cm, respectively) was noticed with application of vermicompost @ 2 t ha-1 along with Recommended dose of fertilizers (RDF), STBF and STCR approach. The results also indicated application of micro nutrients zinc, boron and sulphur with RDF, STBF and STCR approach did not recorded significant influence on plant growth, yield and nutrient uptake. This may be due to sufficient availability of micro nutrients in soil. However, farmers practice (173.3 cm) was significantly inferior to rest of soil test based nutrient management practices. This clearly indicates the need for adding organic manures to the soil in conjunction with inorganic fertilizers, which increases the availability of nutrient considerably, resulting in positive effect on growth parameters. Similar findings were noticed by Imayavarmboni *et al.* (2002) who reported increased plant height in sunflower due to application of FYM (12.5 t ha-1) along with recommended dose of NPK fertilizers. The present findings are also in conformity with the findings of Byra Reddy *et al.* (2008), who obtained higher plant height with the application of FYM (8 t ha-1) along with recommended dose of NPK fertilizers as compared to NPK alone in sunflower. The yield parameters differed significantly due to treatments (Table 1). The higher capitulum diameter (16.5 cm) was noticed in STCR approach-2 + vermicompost @ 2 t ha-1(T7), whereas, lowest capitulum diameter noticed with farmers practice (T10) (13.0 cm). The increase in capitulum diameter might be mainly due to the higher nutrient availability which enhanced the size of the capitulum. The capitulum weight and capitulum diameter were also higher in T7 (62.0g and 16.5cm, respectively) which was on par with T6 and T10. Test weight was not influenced by nutrient management practices.

During rabi season from 2014-15 to 2016-17, the results indicated that, STCR eq-1 + Vermi compost 2 t/ha (213-54-74N, $P_2O_5$ and $K_2O$) recorded significantly maximum seed yield of 2208 kg/ha which is on par with STCR eq-2+ VC 2 t/ha (213:54:74 N, $P_2O_5$ and $K_2O$) 2036 kg/ha over different fertilizer doses tried. RDF (75-90-30 N, $P_2O_5$ and $K_2O$) dose recorded 1423 kg/ha and lowest seed yield recorded in farmers practice (60-40-25 N, $P_2O_5$ and $K_2O$) kg/ha) but significantly lower seed yield (1000 kg ha$^{-1}$) was recorded with farmers practice (T12) which is inferior compared with all other nutrient management practices. The results are in accordance with the findings obtained of Rajan Bhatt (2013) who obtained yield increase of about 8-12% in sunflower and 10-15% in *gobhi-sarson* crops when fertilization is followed on soil test basis results.

## Economics

The economic evaluation of soil test-based fertilization in sunflower revealed that maximum net returns were obtained in application of STCR for a target yield of 25 q/ha (T5: Rs. 34040 ha$^{-1}$). The cost incurred on vermicompost application reduced the net returns and B: C ratio (2.06) in this treatment and higher B: C ratio was obtained with application of fertilizers based on STCR equation for a target yield of 2.5 t ha-1 (T4: 2.42) due to higher economic yields obtained in these treatments. But the application of farmers practice fertilizers (T12) recorded lowest B: C ratio (1.35). Similar economic benefits have been reported by Thavaprakash and Malligawad (2002) in sunflower and Anand (2010) in chickpea and maize.

## Soil Nutrient Status after Crop Harvest

Data from table 3 indicates that highest available Nitrogen in soil was present in STCR + vermicompost@ 2 t/ha treatment (195.7 kg/ha) may be due to the application of higher dose of Nitrogen nutrition (213kg/ha) than normal recommended Nitrogen (75kg/ha) and available $P_2O_5$ (61.1 kg/ha) and available $K_2O$ (433.3 kg/ha) in farmers practice & new treatment production-1+vermicompost treatments. There is no significant change in available phosphorous and available potassium in soil than initial soil properties of the experimental site. The increased nutrient application through site specific nutrient management (SSNM) approach resulted in greater absorption of nutrients from soil and this in turn led to higher NPK content in seed and stalk. The results are in line with the findings of Mishra *et al.* (1995) and Thavaprakash (2002). A significant and positive relation was observed between applied fertilizer levels of N, P and K and their available forms in the soil. Similar results were also reported by Gebremedhin *et al*, (2015).

## Conclusion

From the results of the study, it could be concluded that the maximum plant height (cm), capitulum diameter (cm), capitulum weight(g), were obtained with STCR Equation-2+ VC @ 2 t ha$^{-1}$, maximum test weight, stalk yield and seed yield (2208 kg/ha) were obtained with STCR Equation along with vermicompost @ 2 t /ha. While the minimum values of yield attributes and seed yield (1015 kg ha-1) and yield

attributes were recorded with farmers practice. The study indicated that Nutrient management based on soil tested data besides maintaining the available N, P and K of soil, leading to positive nutrient balance. Application of higher doses of nitrogen, phosphorus and potassium leads to higher availability of nutrients in soil that resulted in higher nutrient uptake by plants. Soil nutrient status and better seed yield after crop harvest is also maintained by adopting target yield approaches like soil test crop responses. Thus, balanced nutrition concept focus on the use of plant nutrients in a definite proportion as required by the crops, which is possible only if one knows the available nutrient status of his soils.

**Acknowledgement**
The authors are extremely grateful to Acharya N G Ranga Agricultural University, Guntur, Andhra Pradesh for generous assistance for the said project**.**

**References**

1. Anand SR. Site specific nutrient management (SSNM) for maximization of crop productivity in southern Karnataka. Ph.D. Thesis, UAS, Bangalore 2010.
2. Byra Reddy K, Uppar DS, Vyakaranahal BS, Hiremath SM, Ravi Hunje *et al*. Effect of integrated nutrient management on Sunflower hybrid (KBSHI) seed production. Karnataka Journal Agricultural Sciences 2008;21(2):171-175.
3. Gebremedhin T, Shanwad UK, Desai BK, Shankergoud I, Gebremedhin W. Soil test based nutrient management for sunflower (Helianthus annuus L.): Analysis of growth, biomass, nutrient uptake and soil nutrient status. Journal of Biology, Agriculture and Healthcare 2015;5(15):2224-3208.
4. Imayavarambani V, Thanunathan K, Singaravel R, Manickam G. Studies on the influence of integrated nutrient management on growth, yield parameters and seed yield of sesame. Crop Research 2002;24:309-313.
5. Mishra A, Dash P, Palkaray RK. Yield and nutrient uptake by winter sunflower (*Helianthus annuus* L.) as influenced by nitrogen and phosphorous. Indian Journal of Agronomy 1995;40(1):137-138.
6. Mishra A, Dash P, Palkaray RK. Yield and nutrient uptake by winter sunflower (*Helianthus annuus* L.) as influenced by nitrogen and phosphorous. Indian Journal of Agronomy 1995;40(1):137-138.
7. Prabhakar K, Munirathnam P, Balaji Nayak S, Venkataramanamma S, Raghavendra T, Pulli Bai P *et al*. Soil test based nutrient management for *rabi* sunflower (*Helianthus annuus* L.). Journal of Research. ANGRAU 2017;45(1):16-21.
8. Rajan Bhatt. Soil test based fertilization to improve production of oil seed crops in Kapurthala district of Punjab. International Journal of Science, Environment and Technology 2013;2(3):521-526.
9. Sarkar RK, Mallick RB. Effect of nitrogen, sulphur and foliar spray of nitrate salts on performance of spring sunflower (*Helianthus annuus* L.). Indian Journal of Agricultural Sciences 2009;79(12):986-90.
10. Shanwad UK, Veeresh H, Bhat SN, Shankergoud I, Govindappa MR, Vikas Kulkarni *et al*. Second International Conference on Bio-Resource and Stress Management At: Hyderabad, India 2015.
11. Suresh R, Santhi R. Soil Test Crop Response Based Integrated Plant Nutrition System for Maize on Vertisol. International Journal of Current Microbiology & Applied Science 2018;7(8):1631-1641.
12. Tegegnework GW, Anantha Rama A, Shubha GV, Kantharaj T, Shreenivas BV. Influence of Soil Test Crop Response Approach as an Optimizing of Plant Nutrient Supply on Yield and Quality of Sunflower (*Helianthus annuus* L.). Environment & Ecology 2015;33(4A):1811-1814.
13. Thavaprakash N, Malligawad LH). Effect of nitrogen and phosphorus levels and ratios on yield and economics of sunflower. Research on Crops 2002;3:40-43.
14. Thavaprakash N, Sivakumar SD, Raja K, Senthil Kumar G. Effect of nitrogen and phosphorus levels and ratios on seed yield and nutrient uptake of sunflower hybrid DSH-1. Helia. 25. Nr. 37. 2002, 59-68.
15. Zhang S, Li Q, Lü Y, Zhang X, Liang W. Contributions of soil biota to C sequestration varied with aggregate fractions under different tillage systems. Soil Biology & Biochemistry 2013, 6.