# Oil yield, protein content and agronomic efficiency as influenced by INM practices in sunflower (helianthus annuus L.)

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## ABSTRACT

Field experiments were carried out at the Annamalai University, Experimental Farm, Department of Agronomy, Annamalai Nagar, Tamil Nadu to study the effect of INM practices on oil yield, protein content and agronomic efficiency in sunflower (*helianthus annuus L.*) for two season during Feb – May (2010) and July – Sep (2010). The experiment was laid out in a randomized black design with ten treatments each replicated thrice. The treatments were $T_1$- control (no fertilizer and no organic manure), $T_2$- recommended dose of nitrogen, $T_3$ - 75% RDN +FYM @ 12.5 t $ha^{-1}$, $T_4$ - 75%RDN + pressmud @ 10 t $ha^{-1}$, $T_5$ - 75% RDN + sewage sludge @ 2.5t $ha^{-1}$, $T_6$ - 75% RDN + sugarcane trash compost @ t $ha^{-1}$, $T_7$ - 75% RDN + FYM vermicompost @ 2.5 t $ha^{-1}$, $T_8$ - 75% RDN + pressmud vermicompost @ 2.5 t $ha^{-1}$, $T_9$ -75% RDN + sewage sludge vermicompost @ 2.5 t $ha^{-1}$, $T_{10}$ – 75% RDN + sugarcane trash vermicompost @ 2.5 t $ha^{-1}$. The results revealed that crop raised with pressmud vermicompost in two seasons had significant influence on the growth and seed yield of sunflower. Plots receives with pressmud vermicompost @ 2.5 t $ha^{-1}$ along with 75 % RDN significantly registered higher plant height, number of seeds $head^{-1}$ seed yield and harvest index. Also the same treatment recorded significantly higher values of oil content and crude protein content, oil yield and agronomic efficiency. The least values were recorded in absolute control (no organic and chemical fertilizers). From the results of the field trials, it can be concluded that application of pressmud vermicompost @ 2.5 t $ha^{-1}$ along with 75 % RDN to sunflower was significantly registered higher seed and oil yield of sunflower in tail end area of cauvery deltaic zone of Tamil Nadu.

**Keywords**: Sunflower, vermicompost, INM, seed yield, protein content, oil yield and agronomic efficiency

## INTRODUCTION

Sunflower has gained popularity of all the oilseed crops, because of its excellent quality oil due to its richness with high degree polyunsaturated fatty acids, anticholesterol properties, short duration, wide adaptability to soil and climatic conditions, photo and thermo-insensitiveness, drought tolerance and higher oil yield per unit area (Thimmegowda *et al.*, 2007). It is fourth oil seed crop grown worldwide by area (Koutroubas *et al.*, 2008). Indian vegetable oil economy is the fourth largest in the world, accounting for about 14.5 per cent of the world's oil seeds area and 6.65 per cent of the production and plays the second important role in the agricultural economy, next only to food grains in terms of area and production. The occupies an area of 27.86 m. ha with 27.98 mt of production Registering productivity level of 1004 kg $ha^{-1}$ (Anon., 2009). About 14 million persons are engaged in production and another one million in processing of oil

seeds. The recommendation of nitrogen use thus needs attention. Despite growth in nitrogen use, research over the past 20 - 30 years has showed that nitrogenous use efficiency of different N fertilizers are generally low or decreasing. Poor utilization of nitrogenous fertilizer by sunflower is thought to be largely due to different losses of nitrogen. In view of escalating cost of fertilizers and their hazardous polluting effects on environment, there is an awareness among the research biological farming or organic farming. Through India has a industrial by products like pressmud, urban waste like sewage sludge, etc, the potentially of the organic resources has not yet been fully tapped. Although research work on organic wastes with inorganic fertilizer on sunflower crop was in plenty, different vermicompost made from various organic sources in sunflower is almost meagre. Therefore, present study was conducted to study the effect of INM practices on oil yield, protein content and agronomic efficiency in sunflower crop under tail end area of Cauvery deltaic zone of Tamil Nadu.

## MATERIALS AND METHODS

Field experiments were conducted at the Experimental farm, department of Agronomy, Annamalai University, Annamalai nagar, to study Effect of INM practices on Oil yield, protein content and agronomic efficiency in sunflower (*helianthus annuus L.*) in two season during Feb – May (2010) and July – Sep (2010). The experimental farm is geographically located at 11°24'N latitude, 79° 44'E longitude and +5.79 m above mean sea level. The experimental soil was clay loam in texture with pH 7.9, EC 0.45 $dsm^{-1}$, organic carbon 0.54 and low N (210 Kg $ha^{-1}$), medium in P (27 Kg $ha^{-1}$) and high in K (278 Kg $ha^{-1}$). The experiment comprising of ten treatments *viz.*, $T_1$- control (no fertilizer and no organic manure), $T_2$- recommended dose of nitrogen, $T_3$ - 75% RDN + FYM @ 12.5t $ha^{-1}$, $T_4$ – 75%RDN + pressmud @ 10 t $ha^{-1}$, $T_5$ - 75% RDN + sewage sludge @ 2.5t $ha^{-1}$, $T_6$ – 75% RDN + sugarcane trash compost @ t $ha^{-1}$, $T_7$ – 75% RDN + FYM vermicompost @2.5 t $ha^{-1}$, $T_8$ – 75% RDN + pressmud vermicompost @ 2.5 t $ha^{-1}$, $T_9$ – 75% RDN + sewage sludge vermicompost @ 2.5 t $ha^{-1}$, $T_{10}$ – 75% RDN + sugarcane trash vermicompost @ 2.5 t $ha^{-1}$. Organic manures and different source of vermicompost were applied as basal one week before sowing as per treatment schedule. The experiment was laid out in a randomized block design with three replications. The sunflower cultivar CO 4 was chosen for the study. The recommended seed rate of 15 kg $ha^{-1}$ was used for the experiment. The seeds were sown by dibbling with a spacing of 45 X 30 cm. Vermicompost was prepared using heap method. After 3 months, matured vermicompost was applied to experimental plots as per the treatment schedule. A fertilizer schedule of 50 kg N, 60 kg $P_2O_5$ and 40 kg $K_2O$ $ha^{-1}$ was applied. Nitrogen was applied as per the treatment schedule. 50 per cent of recommended N was applied as basal and remaining 50 per cent was applied on 30 DAS. Entire dose of $P_2O_5$ and K2O were applied as basal. N, $P_2O_5$ and $K_2O$ were supplied through urea, single superphosphate and muriate of potash, respectively. All other improved recommended package of practices were followed to sunflower as per the Crop Production Guide .

Five sample plants from each treatment plot were selected at random and tagged for biometric observations. The sunflower heads from the each treatment plot were harvested, threshed, sun dried to attain 14 per cent moisture, weighed and the seed yield was expressed in kg $ha^{-1}$.

### Harvest index (HI)

The harvest index for each treatment was calculated by using the following formula

$$\text{Harvest index} = \frac{\text{Seed yield}}{\text{Biological yield}} \times 100$$

### Quality characters

### Oil content

The oil content of the seed was estimated using diethyl ether as extractant by Soxhlet extractor and expressed in percentage (A.O.C.S., 1946).

**Oil yield**

The oil yield was worked out by multiplying the oil content with seed yield and expressed in kg $ha^{-1}$.

**Crude protein content**

Crude protein content of the seed was calculated by multiplying the nitrogen percentage of the kernel with factor 6.25 (Humphries, 1956).

**Agronomic Efficiency (AE)**

In this approach, agronomic efficiency was calculated in terms of seed yield obtain from fertilized plot and unfertilized plot to $kg^{-1}$ of nitrogen applied. It was computed using the formula as given below:

$$AE = \frac{\text{Grain yield in fertilized plot (kg ha}^{-1}\text{)} - \text{Grain yield in unfertilized plot (kg ha}^{-1}\text{)}}{\text{Amount of nitrogen applied (kg ha}^{-1}\text{)}}$$

The data on various studies recorded during the investigation were subjected to statistical scrutiny as suggested by Gomez and Gomez (1984).

**RESULTS AND DISCUSSION**

**Effect of INM practices on plant height and seed yield**

All the treatments exerted significant influence on the plant height, number of seeds $head^{-1}$ and seed yield of sunflower. Among the treatment of 75% RDN + pressmud vermicompost @ 2.5 t $ha^{-1}$ ($T_8$) significantly registered the higher plant height of 169.80 and 176.58 cm, number of seeds $head^{-1}$ of 591.50 and 625.71 and seed yield of 1825 and 1898 kg $ha^{-1}$ during first and second season, respectively. This treatment followed by $T_9$ (75% RDN + FYM vermicompost @ 2.5 t $ha^{-1}$). This might be due to the fact that pressmud vermicompost offer a balanced nutritional release pattern to plants, providing nutrients such as available N, soluble K, exchangeable Ca, Mg and P that can be taken readily by plants (Edwards and Fletcher, 1988; James Pitchai *et al*., 2009) and greater microbial diversity and activity resulting in higher plant height, number of seeds $head^{-1}$ and seed yield (Edwards, 2004). The superiority of inorganic fertilizer along with vermicompost over inorganic fertilizer alone on sunflower was earlier reported by Bhattacharya *et al*. (2001). The treatment control ($T_1$) registered the lowest plant height of 46.04 and 48.45 cm, number of seeds $head^{-1}$ of 138.96 and 146.89 and seed yield of 495 and 520 kg $ha^{-1}$ during first and second season, respectively.

**Harvest index**

The higher harvest index of 30.52 in first and 30.93 in second season was recorded with 75% RDN + pressmud vermicompost @ 2.5 t $ha^{-1}$ ($T_8$). The least harvest index (27.45 and 28.06 in first and second season, respectively) was recorded in control ($T_1$).

**Quality character**

**Effect of INM practices on oil content, crude protein content and oil yield**

The treatment of 75% RDN + pressmud vermicompost @ 2.5 t $ha^{-1}$ ($T_8$) significantly registered the highest oil content of 40.47 and 40.86 per cent crude protein content of 13.36 and 13.48 per cent and oil yield of 738.89 and 775.80 kg $ha^{-1}$ during first and second season, respectively. This might be due to better availability of macro, micro nutrients especially sulphur and trace elements in pressmud vermicompost (Rathika *et al*., 2008). The control ($T_1$) resulted in the lowest oil content of 39.09 and 39.35 per cent, crude protein content of 12.90 and 12.99 per cent and oil yield of 193.50 and 205.01 kg $ha^{-1}$ during first and second season, respectively.

**Effect of INM practices on agronomic efficiency (AE)**

Different INM treatments had marked influence on agronomic efficiency. Among the treatments, $T_8$ (75% RDN + pressmud vermicompost @ 2.5 t $ha^{-1}$) registered the higher agronomic efficiency of 14.87 and 15.39 during first and second season respectively. This might be due to increased availability of nitrogen in pressmud vermicompost in the form of mucous, nitrogenous excretory substances which were not present in other organic sources (Viel *et al*., 1987). Nitrogen fixing bacteria were also found to be more in this vermicompost which might have reduced the loss of nitrogen from the soil and increased the use efficiency of inorganic fertilizers applied (Ihseen *et al*., 2003). The next best in order was $T_9$ (75% RDN + sewage sludge vermicompost @ 2.5 t $ha^{-1}$) the least agronomic efficiency of 7.60 and 7.80 was recorded during first and second season, respectively under $T_2$ (100% RDN).

**Conclusion**

From the results of the field trials, it can be concluded that application of pressmud vermicompost @ 2.5 t $ha^{-1}$ along with 75 % RDN to sunflower was significantly registered higher seed and oil yields and crude protein content of sunflower in tail end area of Cauvery deltaic zone of Tamil Nadu.

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**Table 1. Effect of INM practices on growth, yield attributes, seed yield and harvest index of sunflower**

| Treatments | Plant height (cm) | | Number of filled seeds head$^{-1}$ | | Seed yield (kg ha$^{-1}$) | | Harvest index | |
|---|---|---|---|---|---|---|---|---|
| | First season | Second season | First season | Second season | First season | Second season | First season | Second season |
| $T_1$ | 46.04 | 48.45 | 138.96 | 146.89 | 495 | 520 | 27.45 | 28.06 |
| $T_2$ | 81.39 | 84.74 | 408.37 | 427.58 | 875 | 911 | 28.23 | 28.59 |
| $T_3$ | 139.05 | 145.81 | 444.21 | 470.05 | 1495 | 1567 | 29.41 | 30.30 |
| $T_4$ | 151.39 | 157.16 | 493.90 | 523.89 | 1627 | 1689 | 29.99 | 30.54 |
| $T_5$ | 145.31 | 151.23 | 468.41 | 496.55 | 1562 | 1626 | 29.74 | 30.37 |
| $T_6$ | 135.75 | 141.81 | 433.05 | 453.93 | 1459 | 1524 | 29.27 | 30.06 |
| $T_7$ | 159.61 | 165.41 | 537.76 | 568.50 | 1716 | 1778 | 30.26 | 30.66 |
| $T_8$ | 169.80 | 176.58 | 591.50 | 625.71 | 1825 | 1898 | 30.52 | 30.93 |
| $T_9$ | 164.56 | 170.86 | 564.30 | 597.56 | 1769 | 1837 | 30.38 | 30.77 |
| $T_{10}$ | 156.74 | 162.09 | 522.67 | 551.55 | 1685 | 1742 | 30.23 | 30.62 |
| **SED** | 1.65 | 1.63 | 12.92 | 34.88 | 23.11 | 25.24 | 0.05 | 0.06 |
| **CD(p=0.05)** | 3.41 | 3.36 | 25.84 | 69.76 | 48.21 | 50.46 | 0.11 | 0.12 |

**Table 2. Effect of INM practices on oil, crude protein content, oil yield and Agronomic efficiency of sunflower**

| Treatments | Oil content (%) | | Crude protein content (%) | | Oil yield (kg ha$^{-1}$) | | Agronomic efficiency | |
|---|---|---|---|---|---|---|---|---|
| | First season | Second season | First season | Second season | First season | Second season | First season | Second season |
| $T_1$ | 39.09 | 39.35 | 12.90 | 12.99 | 193.50 | 205.01 | - | - |
| $T_2$ | 39.31 | 39.64 | 12.97 | 13.08 | 344.03 | 361.18 | 7.60 | 7.80 |
| $T_3$ | 39.55 | 39.91 | 13.05 | 13.17 | 591.33 | 625.73 | 9.76 | 10.21 |
| $T_4$ | 39.91 | 40.26 | 13.17 | 13.29 | 649.67 | 680.35 | 9.48 | 9.78 |
| $T_5$ | 39.73 | 40.09 | 13.11 | 13.23 | 620.77 | 651.92 | 12.63 | 13.08 |
| $T_6$ | 39.49 | 39.84 | 13.03 | 13.15 | 576.44 | 607.50 | 10.43 | 10.85 |
| $T_7$ | 40.11 | 40.51 | 13.24 | 13.37 | 688.40 | 720.53 | 14.24 | 14.67 |
| $T_8$ | 40.47 | 40.86 | 13.36 | 13.48 | 738.89 | 775.80 | 14.87 | 15.39 |
| $T_9$ | 40.29 | 40.67 | 13.30 | 13.42 | 712.94 | 747.18 | 14.52 | 15.00 |
| $T_{10}$ | 40.07 | 40.45 | 13.22 | 13.35 | 675.33 | 705.00 | 14.09 | 14.46 |
| **SED** | 0.08 | 0.08 | 0.02 | 0.02 | 11.24 | 13.46 | - | - |
| **CD(p=0.05)** | 0.16 | 0.17 | 0.04 | 0.05 | 22.48 | 26.93 | - | - |