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# Effect of Irrigation, Vermicompost and Sulphur on Growth and Yield of Summer Sesamum (*Sesamum indicum* L.)

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**A B S T R A C T**

An experiment was conducted at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during summer season of the year 2016 to study the effect of irrigation, vermicompost and sulphur on sesamum (*Sesamum indicum* L.). There were four irrigation schedules (IW: CPE ratios 0.4, 0.6 and 0.8 and irrigation at critical growth stages flowering, branching, capsule formation and seed filling stages), two vermicompost levels (0 and 2 t $ha^{-1}$) and two sulphur levels (0 and 20 kg $ha^{-1}$). Higher value of growth characters, yield attributes, seed and straw yield were recorded under treatment $I_3$ (0.8 IW: CPE ratio) which was at par with $I_2$ (0.6 IW: CPE ratio). Application of 2 t vermicompost $ha^{-1}$ and 20 kg sulphur $ha^{-1}$ significantly increase growth characters, yield attributes, seed and straw yield. The interaction of 0.8 IW: CPE ratio in combination with 2 t vermicompost $ha^{-1}$ resulted in better seed yield.

## Introduction

Sesamum (*Sesamum indicum* L.), which is known variously as *sesame, til, gingelly, simsin, gergelin* and *tillie etc.* It is annual or perennial herbs with edible seeds which belongs to the family *Pedaliaceae*. Sesamum seed provides excellent food, nutrition, health care, edible oil and biomedicine. It ranks first for the highest oil content *i.e.* 50 per cent as well as seeds are rich source of protein *i.e.* 20.28 per cent, sugar 14-16 percent and minerals 5-7 percent. Sesamum seeds are digestive, rejuvenative, anti-aging and rich source of quality oil for which it is known as "Queen of oilseed crops". In India, it occupies an area of about 17.47 lakh hectares with production of 8.27 lakh tones having the productivity of 474 kg $ha^{-1}$ (Anon., 2015). Irrigation to this crop is mostly based on physiological growth stages and the latest approach of scheduling irrigation through irrigation water depth: cumulative pan evaporation (IW: CPE) ratio has not yet been amply tried in almost states of India. Therefore, it is important to compare the previous methods with the latest approach of scheduling irrigation to identify the most suitable frequency, time and depth of irrigation for higher yield of sesamum. Vermicompost application has been known to improve physical, chemical and biological

properties of soil. Application of vermicopmost showed higher growth, yield attributes and seed yield in sesamum (Tejada *et al.*, 2009). Sulphur as a plant nutrient can play a key role in augmenting the production and productivity of oilseeds in the country as it has a significant influence on quality and development of oilseeds (Tandon, 1991). Since research work on these aspects of this crop is very meagre, the present experiment was planned and conducted.

## Materials and Methods

A field experiment was conducted at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand, (Gujarat) during the summer season of the year 2016. The soil of experimental field was loamy sand in texture having good drainage, low in organic carbon content (45%), low in available nitrogen (219.52 kg $ha^{-1}$), low in available phosphorus (25.53 kg $ha^{-1}$), medium in available potassium (218.28 kg $ha^{-1}$) and low in available sulphur (10.34 kg $ha^{-1}$) with 8.4 soil pH. The soil had 82.05% sand, 11.73% silt and 5.04% clay with 14.57% F.C. and 4.52% PWP. The treatment comprising four levels of irrigation ($I_1$ 0.4 : IW: CPE ratio, $I_2$ : 0.6 IW: CPE ratio, $I_3$ : 0.8 IW: CPE ratio and $I_4$ : irrigation at B+F+C+S), two levels of vermicompost *viz*. ($V_0$ : 0 t vermicompost $ha^{-1}$ and $V_1$ : 2 t vermicompost $ha^{-1}$) and two levels of sulphur *viz*., ($S_0$ : 0 kg S $ha^{-1}$ and $S_1$ : 20 kg S $ha^{-1}$) laid out in a split plot design with four replications. Combination of irrigation and vermicompost were assigned to main plots and levels of sulphur were assigned to the sub plots.

Irrigation water of 50 mm (measured with the help of Parshall flume) was allowed to run in each plot at each irrigation. The irrigation treatment was given on the base of fraction of pan evaporation. Daily pan evaporation was measured with the help of USDA Class-A pan evaporimeter installed at the meteriological observatory. Nitrogen (25 kg $ha^{-1}$) and phosphorus (25 kg $ha^{-1}$) were applied as basal through urea and DAP respectively. Entire quantity of vermicompost and S through gypsum applied at time of sowing. Crop was harvested in fourth week of May. Sesamum was sown on 24 February with seed rate 2.5 kg $ha^{-1}$.

## Results and Discussion

### Effect of irrigation

Data presented in Table 1 indicated that application of irrigation at 0.8 IW:CPE ratio recorded significantly higher plant height at 45 DAS and at harvest (56.15 cm and 99.33 cm, respectively), number of branches $plant^{-1}$ (3.44), number of capsule $plant^{-1}$ (60.96) and number of seeds $capsule^{-1}$ (67.54) and it remained at par with treatment $I_2$ (0.6 IW:CPE ratio). This might be due to more availability of soil moisture when plant needed for its growth. As a result, soil moisture maintained in readily available range might have provided congenial conditions for favourable growth in term of cell division and increase into cell size resulting in expansion of plant in terms of plant height and number of branches $plant^{-1}$. The other reason for increasing number of capsule $plant^{-1}$ and seeds $capsule^{-1}$ was frequent water supply and higher amount of water to soil that resulted into increasing uptake of water and provided the longest reproductive phase with larger photosynthetic green surface and reproductive storage capacity, ultimately that was focus on increase yield attributes. The present findings are close agreement with those reported by Rao and Raikhelkar (1993) and Damdar *et al.*, (2015).

Application of irrigation at 0.8 IW: CPE ratio ($I_3$) recorded significantly the higher seed

yield (794 kg $ha^{-1}$) and remain at par with irrigation at $I_2$ (0.6 IW: CPE ratio). Stalk yield (2145 kg $ha^{-1}$) and test weight (3.74 g) recorded significantly highest under treatment $I_3$ (0.8 IW: CPE ratio). The reason might be due to increase in numbers of irrigation applied at shorter intervals and total consumptive use of water. This situation avoids soil moisture stress and thus, provided favourable conditions for moisture and nutrients availability. Other reason for improving seed yield was higher level of available soil moisture during cropping season that directly focuses on seed yield. Likewise, the another reason might be due to more vigourous crop growth and higher order of yield attributes under frequent irrigations as the atmosphere had high demand of evapotranspiration during crop period. The results are in close conformity with Rao and Raikhelkar (1993) and Damdar *et al.,* (2014).

## Effect of vermicompost

Application of 2 t vermicompost $ha^{-1}$ recorded significantly highest plant height at 45 DAS and at harvest (58.06 and 96.38 cm), number of branches $plant^{-1}$ (3.30), number of capsule $plant^{-1}$ (59.10) and number of seeds $capsule^{-1}$ (65.96). This might be due to supply of macro as well as micro nutrients through organic source, which improve soil physical and biological properties and increase the availability of nutrients and solubilizing them.

The other reason is supply of nutrient from diversified sources and prolonged availability of nutrients to the growing plant. So that process of tissue differentiation from somatic to reproductive meristematic activity and development of floral primordial might have increased, resulting increase in growth and yield attributes. The present findings are close agreement with those reported by Chaithanya *et al.,* (2003) in groundnut and Erfani *et al.,* (2016) in sesamum.

Significantly highest test weight (3.58 g), seed yield (814 kg $ha^{-1}$) and stalk yield (1876 kg $ha^{-1}$) were registered in vermicompost level $V_1$ (2 t vermicompost $ha^{-1}$). This might be due to synergistic relation between nutrients, increased vigorous growth of plant as well as more nutrient uptake which improved overall growth of plant and development of the floral primordial. Proper fertilization coupled with increased net photosynthesis on the one hand and greater mobilization of photosynthates towards reproductive structures on the other hand, which might have increased the yield attributes and finally the seed and straw yield. Similar results were obtained by Chaithanya *et al.,* (2003) in groundnut and Erfani *et al.,* (2016) in sesame.

## Effect of sulphur

The presented result revealed that sulphur application @ 20 kg S $ha^{-1}$ recorded significantly highest plant height at 45 DAS and at harvest (57.34 and 96.43 cm), number of branches $plant^{-1}$ (3.26), number of capsule $plant^{-1}$ (58.67) and number of seeds $capsule^{-1}$ (65.18). The increase in plant height might be due to the beneficial effect of sulphur on various metabolic activities and also because of sulphur play important role in cell division, photosynthetic process and formation of chlorophyll in leaf. The present findings are close agreement with those reported by Duary and Mandal (2006) and Bhosale *et al.,* (2011).

Application of 20 kg sulphur $ha^{-1}$ recorded significantly highest seed yield (711 kg $ha^{-1}$) and stalk yield (1870 kg $ha^{-1}$). This might be due to sulphur containing amino acid (Cystine and Methionine), which helps in chlorophyll formation, photosynthetic process, activation of enzymes and finally seed formation. sulphur application could be ascribed to accelerated nutrients uptake helped the plant to put under optimum growth.

**Table.1** Effect of irrigation, vermicompost and sulphur on growth and yield attributing characters, yield and economics of sesamum

| Treatment | Plant height (cm) | | No. branches plant$^{-1}$ | No. of capsules plant$^{-1}$ | No. of seeds capsule$^{-1}$ | Test weight (g) | Seed yield (kg ha$^{-1}$) | Straw yield (kg ha$^{-1}$) |
|---|---|---|---|---|---|---|---|---|
| | At 45 DAS | At harvest | | | | | | |
| **(A)Main plot treatment** | | | | | | | | |
| **(i) Irrigation scheduling (I)** | | | | | | | | |
| **$I_1$:0.4 IW:CPE** | 52.36 | 91.79 | 2.93 | 54.61 | 59.37 | 3.34 | 592 | 1557 |
| **$I_2$:0.6 IW:CPE** | 57.03 | 96.36 | 3.25 | 59.18 | 66.72 | 3.48 | 748 | 1962 |
| **$I_3$:0.8 IW:CPE** | 59.85 | 99.33 | 3.44 | 60.96 | 67.54 | 3.74 | 794 | 2145 |
| **$I_4$: B+F+C+S** | 56.15 | 91.85 | 2.96 | 55.55 | 61.34 | 3.27 | 622 | 1637 |
| **S.Em.±** | 1.22 | 1.42 | 0.09 | 1.32 | 1.44 | 0.06 | 19 | 45 |
| **C.D. at 5%** | 3.58 | 4.18 | 0.26 | 3.87 | 4.22 | 0.19 | 55 | 134 |
| **(ii) Levels of vermicompost (V)** | | | | | | | | |
| **$V_0$: 0 t vermicompost ha$^{-1}$** | 54.63 | 93.28 | 2.99 | 56.05 | 61.53 | 3.34 | 564 | 1775 |
| **$V_1$: 2 t vermicompost ha$^{-1}$** | 58.06 | 96.38 | 3.30 | 59.10 | 65.96 | 3.58 | 814 | 1876 |
| **S.Em.±** | 0.86 | 1.01 | 0.06 | 0.93 | 1.02 | 0.04 | 13 | 32 |
| **C.D. at 5%** | 2.53 | 2.96 | 0.19 | 2.74 | 2.99 | 0.13 | 39 | 95 |
| **C.V. %** | 8..64 | 6.00 | 11.36 | 9.15 | 9.01 | 7.30 | 10.39 | 10.00 |
| **(B) Sub plot treatment** | | | | | | | | |
| **Levels of sulphur (S)** | | | | | | | | |
| **$S_0$: 0 kg S ha$^{-1}$** | 55.35 | 93.23 | 3.03 | 56.48 | 62.31 | 3.24 | 668 | 1781 |
| **$S_1$: 20 kg S ha$^{-1}$** | 57.34 | 96.43 | 3.26 | 58.67 | 65.18 | 3.50 | 711 | 1870 |
| **S.Em. ±** | 0.66 | 0.84 | 0.04 | 0.75 | 0.93 | 0.03 | 10 | 30 |
| **C.D. at 5%** | 1.91 | 2.44 | 0.13 | 2.18 | 2.70 | NS | 29 | 88 |
| **C.V. %** | 6.58 | 4.99 | 7.74 | 7.36 | 8.21 | 5.64 | 8.24 | 9.41 |
| **(C) Interaction effect** | | | | | | | | |
| **I × V** | **NS** | **NS** | **NS** | **NS** | **NS** | **NS** | **Sig.** | **NS** |

B=Branching, F=Flowering, C= Capsule formation and S=Seed filling stages
NS = Not significant, Sig. = Significant

**Table.2** Interaction effect of irrigation and vermicompost on seed yield of sesamum

| Irrigation (I) | Vermicompost levels (V) | |
|---|---|---|
| | **$V_0$ :0 t ha$^{-1}$** | **$V_1$ :2 t ha$^{-1}$** |
| $I_1$: 0.4 IW:CPE | 524 | 659 |
| $I_2$: 0.6 IW:CPE | 583 | 912 |
| $I_3$: 0.8 IW:CPE | 623 | 964 |
| $I_4$: B+ F +C+S | 525 | 719 |
| S.Em.± | 26 | |
| C.D. at 5 % | 78 | |
| C.V. (%) | 10.93 | |

The other reason is stimulatory effect of sulphur on synthesis of chloroplast and protein which in turn promoted greater photosynthesis ultimately resulted in higher seed and stalk yield. The results are in agreement with Duray and Mandal (2006) and Mamatha *et al.,* (2015).

## Interaction effect (I × V)

Interaction effect of irrigation and vermicompost on seed yield of Sesamum was found significant (Table 2). The significantly higher seed yield (964 kg $ha^{-1}$) was recorded under treatment combination $I_3V_1$ (0.8 IW: CPE ratio and 2 t vermicompost $ha^{-1}$), however this treatment combination was remained at par with the treatment combinations $I_2V_1$ (0.6 IW: CPE ratio and 2 t vermicompost $ha^{-1}$, 912 kg $ha^{-1}$). Lower seed yield (524 kg $ha^{-1}$) was observed under the treatment combination $I_1V_0$ (0.4 IW: CPE ratio and 0 t vermicompost $ha^{-1}$). This might be due to more vigourous crop growth and higher order of yield attributes under frequent irrigation with adequate supply of vermicompost during crop period resulted in higher seed yield. The result is in agreement with Tripathy and Bastia (2012).

From the foregoing study, it is concluded that for securing higher seed yield of sesamum crop should be irrigated with two common irrigations for crop establishment and remaining at 0.8 IW: CPE ratio in conjunction with 2 t vermicompost and 20 kg S per hectare as a basal application.

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