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Effect of Biofertilizers on Growth and Yield of Sunflower Comparison in Indolybian Natural Condition

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Abstract: *The experiment was conducted at the Department of Biological Sciences, SHIATS, Allahabad and Botany Department, faculty of Science (Zintan), University of El-JabalWl-Gharby, Libya during year 2013-15. The experiment was laid out in Randomized Block Design (RBD). There were eleventh treatments including control replicated 3 times in which several fertilizer application control (FYM @ 2.51 t/ha, Vermicompost @ 2.5 t/kg, Trichodermaharizanum @10g/kg), In the view of present investigation the most effective growth treatment was T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha),compared to control and other treatments was found to be the best in terms of plant height, number of leaves, number flower, Number of filled seed per capita, Weight of dry flowers (g), and Oil content (%).As far as planting condition concerned, Indian emerged superior in compare to Libyan condition.*

Keywords: *Sunflower, biofertilizers, FYM, Vermicompost and Trichodermaharizanum,*

I. Introduction

Sunflower (*Helianthus annuus*L.) is an important oilseed crop and is native to southern parts of USA and Mexico. Sunflower ranks third next only to groundnut and soybean in total production of oilseed of the world. Sunflower is cultivated in an area of 28.57 million hectares with an annual production and productivity of 26.65 million tonnes and 1271 kg per hectare, respectively in the world (Anon., 2004). Sunflower crop was introduced to India during 1969 as a supplement to introduce oilseed crops to bridge the gap of recurring edible oil shortage in the country. The commercial cultivation of sunflower started in India during 1972-73 with a few imported varieties from USSR and Canada. Now, the crop has been well accepted by the farming community because of its desirable attributes such as short duration, photoperiod insensitivity, adaptability to wide range of soil and climatic conditions, drought tolerance, lower seed rate, higher seed multiplication ratio and high quality of edible oil. Now, India has emerged as second major sunflower producing country in Asia after China. In India, sunflower is cultivated over an area of about 2.4 million hectares with a production of 1.44 million tonnes and productivity of 608 kg per hectare (Anon., 2007). The cultivation of sunflower is largely 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 (Anon., 2007). However, recently sunflower has moved to northern parts of the country where the productivity is very high. Karnataka is the leading sunflower producing state in the country and contributes nearly 44 per cent of the total area and 28 per cent of the total production in the country. It is grown over an area of 0.91 million hectares with a production and productivity of 0.42 million tonnes and 456 kg per hectare, respectively (Anon., 2002). Hence, there is an urgent need to workout a suitable agro-production technology to explore potentiality of sunflower to meet the increasing demand of hybrid seed. The commercial yield in sunflower is the product of interaction between three important components *viz.*, seed, nutrients and climatic conditions. In this interaction seed plays a decisive role and it is therefore, necessary to use seeds of high quality and genetic purity. Organic agricultural practices aim to enhance biodiversity, biological cycles and soil biological activity so as to achieve optimal natural systems that are socially, ecologically and economically sustainable (Samman et al. 2008). Manure has always been considered as a valuable input to the soil for crop production. Even under scientific seed production programmes in Indian conditions, it has not been possible to realize full potential of these open pollinated varieties in view of their heterogenous nature and erratic performance. Under such circumstances, hybrid sunflower is preferable over open pollinated varieties, since hybrids ensure homogeneity and stability to productivity.

Organic farming is considered a remedy to cure the ills of modern chemical agriculture. It is essential to develop a strong workable, compatible package of nutrient management through organic resources for various crops, capable of providing all the essential minerals for promoting growth. Vermicomposting is being used

increasingly as plant growth media and soil amendments. In vermicompost, accelerated bioxidation of organic matter is achieved mostly by high-density earthworm populations (Dominguez et al., 1997; Subler et al., 1998). It produces peat like material with high porosity, aeration, drainage water holding capacity and microbial activity which is stabilized by interactions between earthworm and micro-organisms in a non thermophilic process (Edwards & Burrows, 1988). Nutrients present in vermicompost are readily available for plant uptake (Orozco et al., 1996; Edwards, 1998)

Other Information Sunflower is perceived to be a drought tolerant crop as it roots deeply and extracts water at depths not reached by other crops. Sunflower is comparable to maize in many ways although it can extract water more efficiently in low-rainfall areas. The seedbed should be prepared so that a moist soil environment is available for germination and growth. The soil surface should be left as rough as possible to reduce the risk of soil erosion, drifting and blowing soil can seriously damage young seedlings. If the soil becomes compacted prior to planting reduced aeration and restricted water movement will occur, these conditions will increase the risk of downy mildew occurring. Breakdown of soil structure also reduces nutrient and water uptake and therefore yield. Sunflower has a wide potential sowing window.

II. Materials And Methods

The materials used and methods adopted in the present experiment "Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition" with a brief description of site of experiment, soil properties, climatic condition prevalent in the locality, cropping history, sampling techniques and statistical analysis adopted are dealt with in this chapter.

Experimental site

The experiment was conducted during the *Rabi* season 2013-14 at the Crop Research Farm, Department of Biological Sciences, SHIATS, Allahabad and Botany Department, faculty of Science (Zintan), University of El-JabalWl-Gharby, Libya. The Crop Research Farm is situated at 25^0 57' N latitude, 87^0 19' E longitude and 98 m altitude from the sea level. This area is situated on the right side of the river *Yamuna* and by the opposite side of Allahabad city. All the facilities required for crop cultivation are available.

Seed treatment

Fym culture

The culture containing FUM were obtained from Department of Plant Protection, SHIATS, Allahabad (U.P) The bacterial slurry was prepared and applied as per procedure mentioned below.

- The FYM culture was thoroughly mixed for slurry preparation in above solution.
- Seeds were treated with this mixture carefully, so that seed coat was not injured and a uniform coating is made.
- Treated seeds were dried under shade on gunny bags and then usedfor sowing.

Vermicopost culture

The culture containing vermicopost were obtained from Department of Plant Protection, SHIATS, Allahabad (U.P) The bacterial slurry was prepared and applied as per procedure mentioned below.

- The vermicopost culture was thoroughly mixed for slurry preparation in above solution.
- Seeds were treated with this mixture carefully, so that seed coat was not injured and a uniform coating is made.
- Treated seeds were dried under shade on gunny bags and then used for sowing.

Trichoderma culture

The culture Trichoderma were obtained from Department of Plant Protection, SHIATS, Allahabad (U.P) The bacterial slurry was prepared and applied as per procedure mentioned below.

- 200 g of jaggery was dissolved in 200 ml of water. Jaggery solution as per the volume of seed was prepared.
- Trichodrma was thoroughly mixed for slurry preparation in above solution.
- Seeds were treated with this mixture carefully, so that seed coat was not injured and a uniform coating is made.
- Treated seeds were dried under shade on gunny bags and then used for sowing.

Treatment combinations

T_0-Contro
T_1-FYM @ 2.51 t/ha
T_2-Vermicompost @ 2.5 t/kg
T_3-Trichoderma harizanum @10g/kg

T_4-Trichoderma viridie @10 g/kg
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg

III. Results And Discussion

The present investigation entitled **"Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition"** was carried out during the *kharif* season of two successive experiments India and Liybya, years' *e. i.* 2013 and 2015 at the Crop Research Farm, Department of Biological Science, Sam Higginbottom Institute of Agriculture, Technology and Science, Allahabad. The data were subjected to statistical analysis for the convenience of drawing valid conclusions. In this chapter the result presented in details

At Indian condition the maximum plant height was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (109.00 cm) followed by T_1-(FYM @ 2.51 t/ha) (105.33) and minimum plant height recorded in T_0 (Control) (70.33). While similar trend was noticed at all the stage. In case of number of leavesthe maximum was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (23.00) followed by T_1-(FYM @ 2.51 t/ha) (22.33) and minimum number of leaves found in T_0 (Control) (15.33). The maximum number of flowerwas recorded in the maximum number of flowerwas recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (1.00) followed by T_1-(FYM @ 2.51 t/ha) (1.00) and minimum number of flower recorded in T_0 (Control) (0.67). While the maximum number of filled seed per capita was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (420.56) followed by T_1-(FYM @ 2.51 t/ha) (418.11) and minimum number of filled seed per capita recorded in T_0 (Control) (176.56). The maximum number of unfilled seed per capita was recorded in T_0-(Control), (180.21) followed by T_{10}-(Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg) (175.00) and minimum number of unfilled seed per capita recorded in T_1 (FYM @ 2.51 t/ha l) (138.47). The maximum weight of flowers was found in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (18.52) followed by T_1-(FYM @ 2.51 t/ha) (18.30) and minimum weight of flowers recorded in T_0 (Control) (10.21). The maximum oil content was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (40.00) followed by T_1-(FYM @ 2.51 t/ha) (40.00) and minimum oil content recorded in T_0 (Control) (37.00). The maximum weight of flowers was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (18.52) followed by T_1-(FYM @ 2.51 t/ha) (18.30) and minimum weight of flowers recorded in T_0 (Control) (10.21). The maximum oil content was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (40.00) followed by T_1-(FYM @ 2.51 t/ha) (40.00) and minimum oil content recorded in T_0 (Control) (37.00).

At Libyan Condition

The maximum plant height was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (89.67 cm) followed by T_1-(FYM @ 2.51 t/ha) (84.33) and minimum plant height recorded in T_0 (Control) (43.33). The maximum number of leaveswas recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (24.67) followed by T_1-(FYM @ 2.51 t/ha) (23.67) and minimum number of leaves recorded in T_0 (Control) (16.33). The maximum number of flowerwas showed in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (1.00) followed by T_1-(FYM @ 2.51 t/ha) (1.00) and minimum number of flower recorded in T_0 (Control) (1.00). While the maximum number of filled seed per capita was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (426.67) followed by T_1-(FYM @ 2.51 t/ha) (421.67) and minimum number offilled seed per capita recorded in T_0 (Control) (181.67). In number of unfilled seed per capita the maximum was recorded in T_0-(Control), (184.32) followed by T_{10}-(Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg) (180.12) and minimum number ofunfilled seed per capita recorded in T_1 (FYM @ 2.51 t/ha l) (147.58). The maximum weight of flowers was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (17.56) followed by T_2-(Vermicompost @ 2.5 t/kg) (17.13) and minimum weight of flowers recorded in T_0 (Control) (9.11). In case of oil content the maximum was recorded in T_5-(FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha), (39.00) followed by T_1-(FYM @ 2.51 t/ha) (39.00) and minimum oil content recorded in T_0 (Control) (35.00).

Table 1: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on Plant height (cm) at Indian condition.

Treatments	Plant height (cm)
T_0-Control	70.33
T_1-FYM @ 2.51 t/ha	105.33
T_2-Vermicompost @ 2.5 t/kg	103.00
T_3-Trichoderma harizanum @10g/kg	98.33
T_4-Trichoderma viridie @10 g/kg	98.00
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	109.67
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	83.33
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	96.67
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	98.67
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	100
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	71.33
Overall mean	**94.06**
F- test	S
S. Ed. (±)	7.862
C. D. (P = 0.05)	16.517

Table 2: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of leaves per plant at Indian condition.

Treatments	Number of leaves per plant
T_0-Control	15.33
T_1-FYM @ 2.51 t/ha	22.33
T_2-Vermicompost @ 2.5 t/kg	22.00
T_3-Trichoderma harizanum @10g/kg	14.67
T_4-Trichoderma viridie @10 g/kg	16.00
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	23.00
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	18.33
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	16.00
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	17.67
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	17.00
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	16.33
Overall mean	**18.06**
F- test	S
S. Ed. (±)	2.705
C. D. (P = 0.05)	5.684

Table 3: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of flower per plant at Indian condition.

Treatments	Number of flower per plant
T_0-Control	0.67
T_1-FYM @ 2.51 t/ha	1.33
T_2-Vermicompost @ 2.5 t/kg	1.00
T_3-Trichoderma harizanum @10g/kg	1.00
T_4-Trichoderma viridie @10 g/kg	1.00
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	1.67
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	1.00
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	1.00
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	1.00
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	1.00
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	1.00
Overall mean	**1.00**
F- test	NS
S. Ed. (±)	0.049
C. D. (P = 0.05)	0.103

Table 4: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of filled seed per capita at Indian condition.

Treatments	Number of filled seed per capita
T_0-Control	176.56
T_1-FYM @ 2.51 t/ha	418.11
T_2-Vermicompost @ 2.5 t/kg	410.56
T_3-Trichoderma harizanum @10g/kg	400.20
T_4-Trichoderma viridie @10 g/kg	395.22
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	420.56

T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	359.56
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	358.56
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	340.22
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	373.56
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	323.53
Overall mean	**361.51**
F- test	S
S. Ed. (±)	0.743
C. D. (P = 0.05)	1.561

Table 5: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of unfilled seeds per capitulum at Indian condition.

Treatments	Number of unfilled seeds per capitulum
T_0-Control	180.21
T_1-FYM @ 2.51 t/ha	138.47
T_2-Vermicompost @ 2.5 t/kg	142.74
T_3-Trichoderma harizanum @10g/kg	150.51
T_4-Trichoderma viridie @10 g/kg	140.41
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	147.12
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	168.57
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	170.24
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	168.70
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	171.56
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	175.00
Overall mean	**159.41**
F- test	S
S. Ed. (±)	0.980
C. D. (P = 0.05)	2.060

Table 6: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on weight of dry flowers (g) at Indian condition.

Treatments	Weight of dry flowers (g)
T_0-Control	10.21
T_1-FYM @ 2.51 t/ha	18.30
T_2-Vermicompost @ 2.5 t/kg	18.03
T_3-Trichoderma harizanum @10g/kg	17.83
T_4-Trichoderma viridie @10 g/kg	17.67
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	18.52
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	14.73
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	15.50
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	14.67
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	14.83
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	16.03
Overall mean	**16.03**
F- test	S
S. Ed. (±)	0.554
C. D. (P = 0.05)	1.164

Table 7: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on Plant height (cm) at Indian condition.

Treatments	Oil content (%)
T_0-Control	37.00
T_1-FYM @ 2.51 t/ha	40.00
T_2-Vermicompost @ 2.5 t/kg	39.00
T_3-Trichoderma harizanum @10g/kg	40.00
T_4-Trichoderma viridie @10 g/kg	40.00
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	40.00
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	39.00
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	40.00
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	40.00
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	40.00
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	38.00
Overall mean	**39.36**
F- test	S
S. Ed. (±)	0.410
C. D. (P = 0.05)	0.870

Table 2.1: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on Plant height (cm) at Libyan condition.

Treatments	Plant height (cm)
T_0-Control	43.33
T_1-FYM @ 2.51 t/ha	84.33
T_2-Vermicompost @ 2.5 t/kg	81.00
T_3-Trichoderma harizanum @10g/kg	71.67
T_4-Trichoderma viridie @10 g/kg	79.67
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	89.67
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	75.33
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	72.00
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	65.00
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	69.00
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	53.33
Overall mean	**71.30**
F- test	S
S. Ed. (±)	4.591
C. D. (P = 0.05)	9.646

Table 2.2: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of leaves per plant at Libyan condition.

Treatments	Number of leaves per plant
T_0-Control	16.33
T_1-FYM @ 2.51 t/ha	24.33
T_2-Vermicompost @ 2.5 t/kg	23.67
T_3-Trichoderma harizanum @10g/kg	22.33
T_4-Trichoderma viridie @10 g/kg	20.33
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	24.67
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	22.33
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	23.00
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	20.33
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	19.33
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	21.00
Overall mean	**21.61**
F- test	S
S. Ed. (±)	2.156
C. D. (P = 0.05)	4.529

Table 2.3: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of flower per plant at Libyan condition.

Treatments	Number of flower per plant
T_0-Control	1.00
T_1-FYM @ 2.51 t/ha	1.00
T_2-Vermicompost @ 2.5 t/kg	1.00
T_3-Trichoderma harizanum @10g/kg	1.00
T_4-Trichoderma viridie @10 g/kg	1.00
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	1.00
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	1.00
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	1.00
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	1.00
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	1.00
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	1.00
Overall mean	**1.00**
F- test	NS
S. Ed. (±)	0.075
C. D. (P = 0.05)	0.159

Table 2.4: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of filled seed per capita at Libyan condition.

Treatments	Number of filled seed per capita
T_0-Control	181.67
T_1-FYM @ 2.51 t/ha	421.67
T_2-Vermicompost @ 2.5 t/kg	420.00
T_3-Trichoderma harizanum @10g/kg	415.33
T_4-Trichoderma viridie @10 g/kg	416.33
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	426.67
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	366.67

T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	371.67
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	360.33
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	377.67
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	320.52
Overall mean	**370.78**
F- test	S
S. Ed. (±)	0.926
C. D. (P = 0.05)	1.946

Table 2.5: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on number of unfilled seeds per capitulum at Libyan condition**.**

Treatments	Number of unfilled seeds per capitulum
T_0-Control	184.32
T_1-FYM @ 2.51 t/ha	147.58
T_2-Vermicompost @ 2.5 t/kg	152.85
T_3-Trichoderma harizanum @10g/kg	153.62
T_4-Trichoderma viridie @10 g/kg	149.52
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	151.24
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	171.68
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	175.35
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	172.80
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	176.67
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	180.12
Overall mean	**165.07**
F- test	S
S. Ed. (±)	1.329
C. D. (P = 0.05)	2.793

Table 2.6: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on weight of dry flowers (g) at Libyan condition.

Treatments	Weight of dry flowers (g)
T_0-Control	9.11
T_1-FYM @ 2.51 t/ha	16.41
T_2-Vermicompost @ 2.5 t/kg	17.13
T_3-Trichoderma harizanum @10g/kg	16.72
T_4-Trichoderma viridie @10 g/kg	17.21
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	17.56
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	17.73
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	14.40
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	13.56
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	13.43
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	15.25
Overall mean	**15.32**
F- test	S
S. Ed. (±)	0.456
C. D. (P = 0.05)	0.959

Table 2.7: Effect of biofertilizers on growth and yield of sunflower in indolybian natural condition on Plant height (cm) at Libyan condition.

Treatments	Oil content (%)
T_0-Control	35.00
T_1-FYM @ 2.51 t/ha	39.00
T_2-Vermicompost @ 2.5 t/kg	39.00
T_3-Trichoderma harizanum @10g/kg	37.00
T_4-Trichoderma viridie @10 g/kg	38.00
T_5-FYM @ 12.5 t/ha + vermicompost @ 2.5 t/ha	39.00
T_6-FYM @ 12.5 t/ha + Trichodermaharizanum @10g/kg	36.00
T_7- Vermicompost @ 2.5 t/kg + Trichodermaharzianum @10 g/kg	37.00
T_8- FYM @ 12.5 t/ha + Trichodermaviridie @10 g/kg	38.00
T_9- Vermicompost @ 2.5 t/kg + Trichodermaviridie @10 g/kg	37.00
T_{10}- Trichodermaharizanum @10g/kg +Trichodermaviridie @10 g/kg	36.00
Overall mean	**37.36**
F- test	S
S. Ed. (±)	0.50
C. D. (P = 0.05)	1.06

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