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Effect Of Compost Tea On Growth Character Of Sunflower (*Helianthus Annuus* L.) Under Surface And Subsurface Drip Irrigation

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Abstract: Vegetable oils food has become at the forefront of goods where the food gap is growing in Egypt and increase the severity from year to year so the problem of providing food oils Egyptian consumer has become one of the largest major economic challenges in the agricultural sector. Field experiments were conducted during two successive growing seasons in split-split plot design to investigate the effect of compost tea extracted from chicken manure-based thermo-philic compost (30, 50 and 70 L/fed: CT1, CT2 and CT3) under surface (SD) and sub-surface drip (SSD) irrigation system on sunflower (*Helianthus annuus* L.) productivity. The investigation was carried out in Research and Production Station, National Research Centre, El-Nubaria, El-Behera Governorate, on a sandy loamy soil (23% silt; 8% clay). Water applied relative to the available metrological data in site as evapotranspiration (ET) in mm. The total amounted applied to the plots was 767.5 mm/ season (3223.5 m^3/fed).

Data indicated that SSD surpassed SD in all the growth characters. Increasing the applied compost tea positively affected the studied growth characters. Compost tea, beside its ability to improve the nutrient supply in the soil, also increases the efficiency of added chemical fertilization. Yield of both seeds and oil were improved under irrigation method SSD compared with SD irrigation system, with values 1314.4, 1200.9; 467.1 and 423.6 kg/fed, respectively. while increasing compost tea from CT1 to CT3 improved seed and oil yield by 11 and 31 % , respectively. Regarding to the irrigation system, SSD improved WUE than SD for both seed and oil content by about 0.41, 0.37; 0.14, 0.13 kg/m^3 irrigation water for CT3 with increasing rate 0.11 and 0.33 in same sequences.

Keywords : Sun flower Productivity, organic fertilizer, humic acid, compost tea.

Introduction

Supply of nutrients to the soil is very important for organic farmers. Soil management in organic agriculture improves the soil fertility supplying with composted material[1]. Organic composts and other solid manures are great but they take a while to break down in the soil and become available to plants. So, compost tea is an increasingly popular product in organic agriculture largely[2].Compost tea is an infusion of compost in water for a period of time, the compost is removed and the remaining solution is the compost tea, which is then applied to plant to provide beneficial not only microorganism but also supply essential plant nutrients to the plant and soil [3,4]. Furthermore, it is also claimed to be a readily available form of compost supplying nutrients more quickly than compost additions to soil. In this regard, [5] indicated that humic acids are important soil components; they can improve nutrient availability and have impact on other important chemical, biological, and physical properties of soils. It can supply water and fertilizer timely and rightly through fertigation technique and improve nutrients uptake and water use efficiency[6].

Properties affect the biological, physical, and chemical properties of compost as impact the properties of the compost tea that injection of compost tea could improve plant growth, yield and nutritional quality

Mature composts generally release higher levels of soluble mineral nutrients and fewer phyto-toxic organic acids and heavy metals than immature materials[7].

Sunflower is the fourth oil grain crop grown worldwide by area [8]. Fertilizer management is an important part of crop production. This is due in part to increasing costs for fertilizer materials, particularly nitrogen (N) fertilizer. Producers need to know how different production inputs affect crop yields so that they can choose technically efficient input combinations. They also need to know how input usage affects the profitability of their operations with varying input and crop prices. Fertilizer is an input that can easily be reduced, thus lowering input costs. However, fertilizer is a crop input that has a high return on investment if applied at appropriate level.

The aim of the work was to investigate the effect of compost tea extracted from chicken manure under surface and sub-surface drip irrigation system on sunflower (*Helianthus annuus* L.) productivity.

Materials and Methods

Experiments were conducted at the Agricultural Research and Production Station (National Research Centre), El-Nubaria district, Egypt, (latitude of 30°30\ N and longitude of 30°20\ E). Field experiments were conducted in two successive growing seasons to study the effect of organic fertilization on sun flower productivity under surface and subsurface drip irrigation in newly reclaimed soil. Soil is characterized by sandy loamy in texture (23% silt; 8% clay), pH (8.3), EC in soil paste (0.38 dSm^{-1}), $CaCO_3$ (4.7%) and OM (0.65 %). Soil water content were 21.0 % (saturation percentage), 14.8 % (field capacity), 4.7 % (wilting point) and soil available water is 10.1 % on weight basis and percentage of drainable pore is 24.8 % relative to the soil total porosity.

The experiments were carried out in split plot design with three replicates. There were four ridges for each treatment/replicate and four holes in each row with distance 30 cm between them, four seeds were placed in each hole and thinning was made after two weeks to maintain one plant $hole^{-1}$.Sun flower (*Huleanthusannus* L.) were sown at 15 April, in both summer seasons and irrigation process was stopped 14 days before harvest. The main plots were devoted to surface and subsurface drip irrigation system and sub-main plots were devoted to three levels of compost tea 30, 50 and 70 L/fed (CT_1, CT_2 and CT_3) that injected during the first two month of the growing season. Standard drippers (with discharge 4 Lh^{-1}) were spaced 30 cm apart along 30 m lateral. Water applied relative to the available metrological data in site as evapotranspiration (ET) in mm. The total amounted applied to the plots was 767.5 mm/ season (3223.5 m^3/fed)

All treatments were supplied with the full recommended dose of phosphorus (100 kg fed^{-1} of supper phosphate 15.5% P_2O_5) that applied during soil preparation, nitrogen (100 kg fed^{-1} of ammonium nitrate 33% N) was added at two equal batches, the first one was added after thinning and after two weeks from the first addition, the second amount of nitrogen was added and full dose of potassium fertilization (50 kg of potassium sulphate 48% K_2O) which was applied for all experiment treatments.

The total yield of each treatment as determined using a frame with area 1 m^2. The recorded plant characters are: plant height (cm), steam diameter (cm), head diameter (cm), seed yield (Kg/fed) and oil yield (Kg/fed).

Oil content of sunflower seeds was determined using Soxhlet apparatus and Petroleum ether as solvent according to [9]. Oil yield kg fed^{-1} was estimated as following equations:-

Oil yield kg fed^{-1} = Oil% x Seed yield fed^{-1}/ 100

Aerated tea was prepared at 1:10 (v:v) ratio of compost to water as described (Pant et al., 2009). The pH and electrical conductivity (EC) of the tea composts were measured using a conductivity/pH meter (SB80PC, symphony, VWR Scientific Products, MN). The main properties of the chicken manure-based thermo philic compost were 22.2 EC (mS cm^{-1}), 7.3 (pH) and humic acid 2.9 (mg L^{-1}), while the values for tea were 6.1 (mS cm^{-1}) and 7.6 (pH). Some macro nutrients in compost tea were 29.4, 1.4, 99.8, 2.4 and 35.8 ppm for total N, P, K, Ca and Mg, respectively. Extraction efficiency is a measure of the percentage of nutrients in the source compost that are present in the brewed compost tea. Means followed by the same letter are not significantly different ($P < 0.05$).

All obtained data were subjected to the analysis of variance according to the procedure outlined by [10]. The differences between means of the different treatments were compared using the least significant difference (LSD) at 5%.

Results and Discussion

According to the plant growth characters of sunflower plant as affected by both irrigation systems (SD and SSD) and compost tea application rate (Table 1). Obtained results showed that subsurface drip (SSD) irrigation system has more pronounced effect on improving most studied sunflower plant characters except flowering date. The rate of increase in the investigated growth characters were 10.8, 11.1 % foe plant height and stem diameter, respectively, relative to the SD irrigation system.

Although the rate of change in number of leaves per plant and leaf area index are very low , 3.5, 1.7 % as comparing SSD with SD, respectively. The rate of change in total leaves area per plant was high (4.7 %) in same sequence that reflect in disc diameter with improving rate 12.9%.

Also, irrigation system play an important role not only to maximize application uniformity, but also supply the cultivated plants in time and hence increase both seeds weight per disc and weight of 100 seeds, where the increase was about 22.2 and 15.4 %comparing SSD with SD irrigation system. This finding highlighted on the important of number of leaves per plant, leaf area index and total leaf area per plant in improving them and they are highly correlated with the irrigation system used and its efficiency and the total irrigation consumption by plants.

With respect to the effect of the compost tea application on the investigated growth characters of sunflower plants, one can notice that the 2nd rate of compost tea (50 l/fed) was the superior followed by 3rd one (70 l/fed) and the improvement rate in plant height and stem diameter was 51 and 44 %comparing CT2 with CT1, while the rate of increase were 38 and 9 % if CT3 compared with CT1. This result was appeared on flowering date where using CT3 led to decrease flowering date by -12.5 % when comparing with CT1 where as CT2 has superior effect in improving flowering date by 94 % comparing with CT1. This result could attribute to the compost teas, which may supply microbial biomass, fine particulate organic matter, organic acids, plant growth regulator like substances and soluble mineral nutrients to plant surface and soil 11,7,5.

Regarding to the most important plant growth characters no. of leaves/plant, leaf area and total leaf area/plant , compost tea lead moderately change in the previous growth characters with values 20.5, 11.3; 8.3, 38.1% and 18.9, 16.3 % for CT2 and CT3 comparing wit CT1, respectively. This results accepted by 12 that mentioned that humic acid application had a highly significant effect on improving soil characteristics such as aggregate size; soil pH and EC as compared with do not add humic acid treatment.

Table (1) Effect of the irrigation system and compost tea application rate on the some growth characters of sunflower.

Irrigation system	Compost tea treatments	Plan height	Stem diameter	Disc diameter	Flowering date	Seed weight	No. o leaves	Leaf area	
		cm				g /Disc		(cm^2)	cm^2/plant
SD	CT1	72.7	2.0	11.2	81.0	33.5	25	160	4000
	CT2	109.7	3.0	13.1	78.0	38.6	28	175	4900
	CT3	102.7	2.2	15.2	71.0	45.2	33	188	6204
	Mean	**95.0**	**2.0**	**13.0**	**77.0**	**39.0**	**29**	**174**	**5035**
SSD	CT1	82.0	2.3	12.3	79.0	41.5	28	165	4620
	CT2	123.7	3.2	15.6	72.0	48.6	31	177	5487
	CT3	110.3	2.5	16.7	69.0	53.2	3	190	570
	Mean	**105.3**	**3.0**	**15.0**	**73.0**	**48.0**	**21**	**177**	**3559**
LSD 5%	Irrigation system	3.2	0.6	0.9	3.4	1.3	2	5	105
	Compost tea	4.1	0.7	1.1	3.7	1.5	3	7	123
	interaction	3.3	0.6	1.2	3.9	1.5	4	7	124

SD: surface drip irrigation system, SSD: sub-surface drip irrigation system
compost tea treatments , $CT_1$30, CT_2 : 50 and 70 L/fed

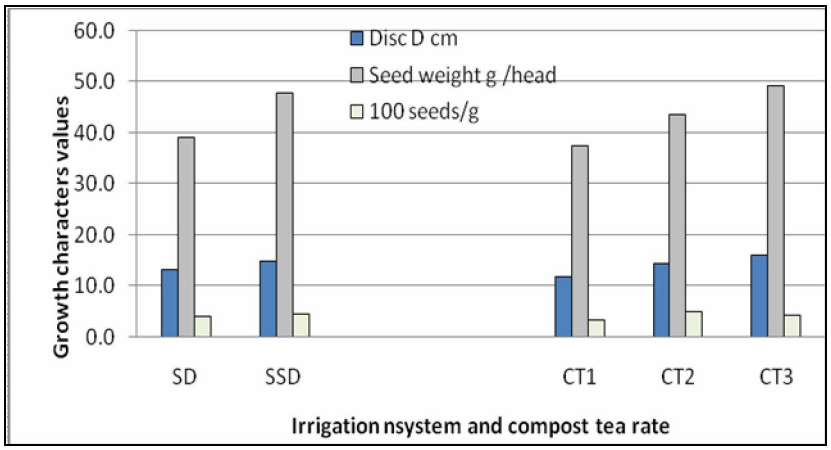

Fig.(1) Effect of the irrigation system or compost tea application rate on the some growth characters of sunflower.
SD: surface drip irrigation system, SSD: sub-surface drip irrigation system
compost tea treatments , $CT_1$30, CT_2 : 50 and 70 L/fed

According to the effect of compost tea application on the sunflower growth characters, disc diameter seed weight/disc and weight of 100 seeds, resulted data pointed out that increased of injected compost tea associated with increasing their values, except weight of 100 seeds at CT2. However, the change rate in these growth characters was related mainly to injection of compost tea rate, which was high at CT3 than CT2 with increase percentage 36, 31 %; 22 and 16.3 % comparing CT3 and CT2 with CT1, respectively for disc diameter and weight of seeds/disc. While the rate of increase were 46 and 29.3 % when CT2 and CT2 compared with CT1, respectively.

Irrigation was scheduled using a weather-based water budget during growing season and all drip line treatments received the same amount of irrigation water with a given growth period. There were neither statistically significant differences, nor consistent numerical trends in sunflower crop yield for any crop as affected by both irrigation system and injected compost tea. These finding was agreed with those obtained by 13,14.

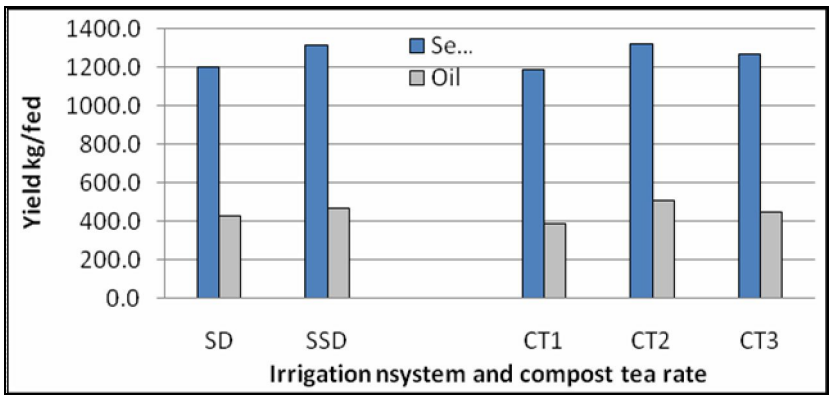

Fig.(2) Effect of the irrigation system and compost tea application rate on the some growth characters of sunflower.
SD: surface drip irrigation system, SSD: sub-surface drip irrigation system
compost tea treatments , $CT_1$30, CT_2 : 50 and 70 L/fed

Regarding to the economic yield of sunflower (seed and oil) as affected by both SSD and SD irrigation systems and compost tea application rates, data on hand revealed that increasing compost tea associated with increasing in seeds and oil yield (Table 2 and Fig. 2). The highest and lowest values of seed and oil yield were attained at CT2 (488 kg/fed) and CT1 (521 kg/fed) under both investigated irrigation systems (SSD and SD), respectively. The resulted improvement in seed and oil yield relative to both irrigation system used was highly in seed yield and SSD irrigation system has a positive effect in increasing seed and oil yield by about 9.5 and 10.4 % comparing with SD irrigation system, respectively.

Although oil content ranged from an average of 353 kg/fed at SD-CT1 to 521 kg/fed at SSD-CT2, with significant differences at any of the investigated factors (irrigation system and compost tea application. The relationship between relative seed oil yield and irrigation system; compost tea rates are shown in Fig. (2).

In view of the obtained data, CT2 is the best rate that assessed the aim of the experiment with increase percentage 10.9 and 31.0 comparing with CT2 and its increase is doubled of CT3 comparing with CT1. These results agreed with those obtained by15, 16.

An assessment of relationships between biochemical properties of composts and their teas would improve current understanding of the mechanisms for compost tea's effects on crop yield and nutritive quality. Root intervention is also discounted as a strong factor in present study because; generally root distribution for the examined crop would typically be greater for shallow (surface) drip line depths and this study, the subsurface experienced greater reductions in flow rate.

The water-soluble biochemical compounds contained in compost are assumed to be extracted into compost tea, so compost age may contribute to the quality of compost tea. However, the effect of compost age on compost extract quality and subsequent effect on plant growth has not been well studied.

Regarding to the irrigation system, SSD improved WUE than SD for both seed and oil content by about 0.41, 0.37; 0.14, 0.13 kg/m^3irrigation water for CT3 with increasing rate 0.11 and 0.33 in same sequences.

Simple correlation was carried out among studied plant characters of sunflower. Data noticed that there were significant correlations between oil yield from side and plant height and stem diameter from the other one at 1% level with r values 0.595** and 0.941**, respectively and 5% with number of leaves per plant, total leaf area and disc diameter with r values 0.576*, 0.551* and 0.668*, in same sequence, while oil yield correlated negatively with flowering date at significant level 5% (-0.559*).

Conclusions:

From the above mentioned presentation, it can be summarized results in the follows: i) use of compost tea as plant nutrition materials in organic production systems should be considered, ii) the highest and the lowest sun flower yield was obtained with SSD irrigation system and the 2nd rate of compost tea , iii) the main effect of compost tea on the studied traits could be written the following ascending order CT1 <CT3<CT2, iv) the obtained data indicated that the subsurface drip irrigation exceeded the surface drip irrigation in all the studied treatments of compost tea, and v) the highest value of oil yield was achieved by using fertigation technique under 50L compost tea /fed. but the statistical analysis indicated that no significant deference was achieved between 50 and 70 L compost tea /fed., in the oil yield, this means saving 20Lfrom organic fertilizer.

Table (2) Effect of the irrigation system and compost tea application rate on the some growth characters of sunflower.

Irrigation system	Compost tea treatments	Weight 100 seeds/g	Yield (kg/fed)		Water use efficiency	
			Seed	Oil	Seed	Oil
SD	CT1	3.1	1114	353	0.35	0.11
	CT2	4.5	1260	488	0.39	0.15
	CT3	4.1	1228	429	0.38	0.13
	Mean	**3.9**	**1201**	**423**	**0.373**	**0.13**
SSD	CT1	3.6	1263	417	0.39	0.13
	CT2	5.3	1377	521	0.43	0.16
	CT3	4.6	1303	464	0.40	0.14
	Mean	**3.9**	**1314**	**467**	**0.406**	**0.143**
LSD 5%	Irrigation system	0.8	85	45	0.02	0.01
	Compost tea	0.9	96	67	0.04	0.02
	interaction	1.0	98	71	0.05	0.02

SD: surface drip irrigation system, SSD: sub-surface drip irrigation system
compost tea treatments , $CT_1$30, CT_2 : 50 and 70 L/fed

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