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EFFECT OF INORGANIC, ORGANIC AND BIO FERTILIZERS ON YIELD AND YIELD COMPONENTS OF SUNFLOWER Under Newly Reclaimed Soils

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ABSTRACT

Tow field trials were carried out in 2010 and 2011 summer seasons to study the effect of mineral, organic, natural rocks and biofertilizers on yield and yield components of Sahka 53 and Giza 102 sunflower varieties in newly reclaimed soils. The field experiments were layout at the Agricultural Experimental Desert station, Faculty of Agriculture, Cairo University at Wadi El-Natroon, El-Beheira Governorate, Egypt. The results showed that the applying of organic fertilizers, natural mineral rocks and biofertilizers had positive effect on yield and yield components of two sunflower varieties under sandy soil condition as compared to NPK mineral fertilizers. Fertilizing with various rates of compost, natural mineral rocks and biofertilizers increased head diameter, seed yield /plant, seed yield /faddan and 100-seed weight by 4%, 5%,13% and 5% as compared to plants received recommend NPK mineral fertilizer dose**,**respectively at the first season and the corresponding values at the second one were 4%,8%,19% and 3% in the same order. The obtained results showed that, there were no significant effect of the interaction between the varieties and various form of fertilization (organic, bio and mineral) application in most of the studied traits except in seed oil content and seed protein content in both seasons. On the other hand, applying of compost, bio fertilizers and natural mineral rocks had support Rhizosphere microorganism (RMO) and gave higher values of total bacteria counts, nitrogenase and dehydrogenase activity as compared to untreated treatments.

INTRODUCTION

Sunflower *(Helianthus annus* L.), is one of the most important oil seed crop in the world and Egypt. In addition, sunflower is one of the crops, which have high availability to planting and produce high yield under stress such as (drought, salinity or temperature).

Sunflower (*Helianthus annuus* L.), is one of the most important oil seed crops in the world's oil seed production, because it offers advantages in crop rotation systems, such as high adaptation capability, suitability to mechanization, low labor needs and easy cultivated and grown in different conditions and soils (Kaya and Kolsarici, 2013). It ranges fourth next to soybean, palm oil and canola as a source of edible oil in the world (FAS USDA, 2008). The oil extracted (48 - 53%) edible from this crop, about 80% of the oil is used for edible purpose and rest being non-edible, used for industrial purposes (Bhuvaneshwari, *et al* 2011) Several investigators showed the effect of mineral and organic fertilizers application on sunflower as; Abou khadrah *et al*., (2002), Mohamed (2003) and Awad, (2004) In news, reclaimed soil plant nutrients (especially nitrogen, phosphorus, and potassium) are essential for crop production, It must be applied in proper quantities and at appropriate times, to help in achieving optimum crop yields. However, in proper applying of plant nutrients can cause many agricultural and environmental problems. In addition, the availability and plant uptake of nutrients under new reclaimed soil are very difficult. Schaefer, *et al*, 2007).

For optimum plant growth, nutrients must be available in sufficient and balanced quantities. Soils contain natural reserves of plant nutrients, but these reserves are largely in forms unavailable to plants, and only a minor portion is released each year through biological activity or chemical processes. This release is too slow to compensate for the removal of nutrients by agricultural production and to meet crop requirements. Therefore, fertilizers are designed to supplement the nutrients already present in the soil. The use of chemical fertilizer has disadvantages in the context of nutrient supply, crop growth and environmental quality. Intensive farming practices to produce high crop yields and quality require using large amounts of fertilizers, therefore, the excessive use of mineral fertilizers is undesirable because of, the chemical application lead to diverse environmental, agricultural, health consequences, and enhance the decomposition of soil OM, moreover, nutrients are easily lost from soils through fixation, leaching or gas emission and can lead to reduced, fertilizer efficiency. On the other hand, the production of chemical fertilizers is a costly process. In addition, most of the energy for fertilizers production is provided by the consumption of non-renewable fossil fuels. (Chen, 2006 ؛ Akbari, *et al*., 2011؛ Akbari,*et al*., 2011 and Ahmed, *et al*., 2010)

Considering the environmental and health problems arising from chemical fertilizers usage, many attention has been directed towards the application of bio organic farming to avoid the heavy use of agrochemicals that result in enormous environmental troubles, the organic fertilizers have emerged as a promising component of integrating nutrient supply system in agriculture. These systems depend in many important ways, on microbial activities, which appear to be a tremendous potential for making use of microorganisms in increasing crop production. (Ahmed, *et al.*, 2010, Mahmoud *et al.*,2010, Javahery and Rokhzadi, 2011, Akbari *et al.*, 2011, Namvar *et al*., 2012) and Esmaeilian, *et al*., 2012).

Different organic nutrient management practices have been found to be technically and financially beneficial, but they differ considerably as to their effectiveness and resource requirements. Adding nutrients in the form of organic fertilizers has many advantages, eg, they enhance soil biological activity, which improves nutrient mobilization, enhance root growth due to better soil structure , release nutrients slowly and contribute to the residual pool of organic N and P in the soil, Also using organic fertilizers reducing N leaching loss and P fixation; they can also supply micronutrients, increase the organic matter content of the soil, therefore improving the exchange capacity of nutrients, increasing soil water retention, promoting soil aggregates. (Place, *et al* ., 2003) and (Chen, 2006).

Different plants are relatively easy to cultivate using organic methods if enough nutrients are available due to the application of biofertiliser into the soil. Soil microorganisms play an important role in regulating the dynamic of organic matter decomposition and the availability of plant nutrients such as N, P, K and S. Its well-recognized that microbial inoculants constitute an important component of integrated nutrient management that leads to sustainable agriculture.(Chen,2006 and Akbari *et al*., 2011)

Recently, biofertilizers have emerged as a promising component of integrating nutrient supply system in agriculture. Agricultural systems depend in many important ways, on microbial activities, which appear to be a tremendous potential for making use of microorganisms in increasing crop production. Microbiological fertilizers are so important to the environment and considered as a friendly sustainable agricultural practices.
[Bloemberg,*et al* (2000).] and Ahmed,*et al* (2010)

Biofertilizers differ from chemical and organic fertilizers in the sense that they do not directly supply any nutrients to crops and are cultures of special bacteria and fungi. The production technology for biofertilizers is relatively simple and installation cost is very low compared to chemical fertilizer plants. (Ahmed, *et al* (2010).

Azotobacters and Azospirillum, are free-living bacteria that fix atmospheric nitrogen in cereal crops without any symbiosis and they do not need a specific host lant. Azotobacters are abundant in well-drained, neutral soil. They can fix 15-20 kg/ha N per year. Azotobacters sp. can also produce antifungal compounds to fight against many plant pathogens. They also increase germination and vigor in young plants leading to improved crop stands.

The objective of the present study was found out the most suitable organic and inorganic fertilizer combination for higher growth, oil yield and quality of sunflower.

MATERIAL AND METHODS

Two field experiments were conducted during 2010 and 2011 summer seasons, to study the effect of Chemical, organic, natural mineral rocks and Bio fertilization on yield and yield components of tow sunflower varieties in new reclaimed soil. The field experiments were carried out at the Agricultural Experiment Desert Station, Faculty of Agriculture, Cairo University at Wadi El-Natroon, El-Beheira Governorate, Egypt. The experiments included 16 treatments which were the combinations of:

1. Tow seed oil sunflower varieties, Sakha 53 and Giza 102.
2. Recommended treatment mineral fertilizers as a slow release NPK fertilizer Hydrocomplex N: P: K (12: 11: 18),
3. Organic fertilizer (compost),
4. Natural mineral rocks mainly composed of rock phosphate (15%P_2O_5), feldspars (10% K_2O) and dolomite (15%MgO),
5. NPK biofertilizers, (different kinds of microorganisms were used as Biofertilizers and /or PGPR, (1) Azotobacter chroccoum and Azospirillum brasilense as associative N2-Fixing bacteria. (2) Bacillus megaterium as phosphate dissolving bacteria (PDB) and (3) Bacillus circulans as potassium releasing bacteria. Strains and isolates bacteria were kindly

obtained from central laboratory of organic agriculture, Ariculture Research Center (ARC), Giza, Egypt.

Fertilizer treatments

1. **T_1:** NPK fertilizer (60 kg N + 30 Kg P_2O_5 +60 K_2O kg /fad)
2. **T_2:** Compost (8.75 ton/ fad)
3. **T_3:** Compost (8.75 ton/ fad) with 50% of NPK fertilizer
4. **T_4:** Compost (8.75 ton/ fad) with 350 kg/fad natural mineral rocks (15%P_2O_5, 10% K_2O, 15%MgO)
5. **T_5:** Compost (8.75 ton/ fad) + NPK- Biofertilizers mixtures
6. **T_6:** Compost (8.75ton/fad) +350kg/fad natural mineral rocks + NPK-Biofertilizers mixtures.
7. **T_7:** Compost (8.75 ton/ fad) + 50% of NPK +NPK- Biofertilizers mixtures
8. **T_8:** Compost ((8.75 ton/ fad) + 50% of NPK fertilizer + 350 Kg/fad natural mineral rocks + mixtures NPK- Biofertilizers

Experimental design

The experiment was laid out in Split Plot design with four replicates. The main plots were used for fertilizer treatments and the split one for sunflower varieties, the plot size was 18 m^2. Each sub-plot consisted of two rows, 0.9 meter apart and 10 meter long.

Agricultural practices

Planting date was 03-06-2010 and 18-05-2011 in first season and second season, respectively. At harvest time, ten randomly plants were collected from each sub plot to measur the harvesting characters and the rest of the plants per each plot (18 m^2) were collected to determine the total seed yield / fad.

The field experiments at the two seasons were conducted under drip irrigation with 30 cm distance between dippers (2L. /hour) with two rows of plants on both said of dripper, in both seasons

For mineral fertilizer, slow release NPK fertilizer Hydrocomplex was used and its was applied as basic dose to the soil beside the seed line just after sowing .that was done with all the mineral treatments fertilizer .

The compost and /or the natural raw materials' rocks were added to each sub plot, which has compost or natural raw materials' rocks two weeks before planting.

All the mixture of biofertilizers were in a liquid form was mixed with vermiculite as a carrier material and adhesive reagent then thoroughly mixed with sunflower' seeds just before planting.

Composite soil samples were collected from 0 to 30 cm depth and analyzed for some physical, chemical and some biological soil properties as well as fertility determination. The details of the soil characteristics are given in (Table. 1)

Sample of irrigation water and local compost were analyzed. The irrigation water chemical properties were shown in (Table, 2) and the chemical properties of organic fertilizer (compost) were cleared in (Table, 3). According to methods mentioned in Black (1982) , Hesse (1971) , Jakson (1967) and micronutrient according to Lindsay and Norvell (1978) and Olsen (1982).

Statistical analysis:

The statistical analysis of the data on individual character was carried out on the mean values over three replications. The statistical methods adopted were as follows:

All data were subjected to statistical analysis by the technique of analysis of variance of the split-plot design as mentioned by Gomez and Gomez (1984). Main effects and interactions were tested using the error terms appropriate for the analysis of variance of split-plot experimental design. After these analyses and when the F test showed statistical significance, the least significant differences (L.S.D.) test for multiple comparisons among treatment means, at the level of significance of α=0.05, was applied.

All statistical analysis was carried out using analysis of variance technique (ANOVA) by means of "CoStat" computer software package (1990).

Data recorded

The heads were harvested manually by cutting the disk from the rest of the plant in each sub plot after fully maturing, about 90 DAS in Sakha 53 variety and 120 DAS in Giza 102 variety.

Harvesting characters

1. Head diameter (cm)
2. Seed yield per plant (g)
3. Seed yield per faddan (kg)
4. 100-seed weight (g)
5. Seed oil content (%) and seed protein content (%), according to the procedure outlined in A.O.A.C. (2000).

Microbiological determination:

1. Total account bacteria.
2. Microbial activity

Microbial activities of the plant rhizosphere after 45 day from sowing and yield period were conducted. The samples were analyzed for :

a. Dehydrogenase (DHA) activity according to the method described by Thalmam (1967)
b. Nitragenase activity was estimated according to Shollhorn and Burris (1967)

RESULTS AND DISCUSSION

Effect of sunflower varieties

Data in Table (4) shows the effect of sunflower varieties (Giza 102 and Sakha 53) on yield and some yield characters. Data revealed that, the varieties had significant effects on seed yield/plant and seed yield/faddan, in both 2010 and 2011 seasons, Whereas, there was no significant effect of varieties on head diameter, 100-seed weight, seed oil content and seed protein content in 2010 season. Also, the data showed Giza 102 variety superior over Sakha 53 variety in most of studied characters in 2010 growing season, but in 2011 season Sakha 53 variety significantly superior over Giza 102 variety in head diameter, seed yield/plant, seed yield/faddan, and seed oil content.

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Effect of fertilizer treatments (chemical, organic and Bio fertilization)

The effect of chemical, organic and Bio fertilization on yield and yield components of tow sunflower varieties in new reclaimed soil were presented in Table (5). The results obtained from the variance analysis of data indicated that ,all fertilizer treatments had no significant effects on head diameter, seed yield/plant, seed yield/faddan, and 100-seed weight in 2010 growing season and on head diameter and 100-seed weight in 2011 grow in season. The highest head diameter were observed when adding organic fertilizer (compost) with 50% of mineral fertilizer and mixtures NPK- Biofertilizers'(T_7) in 2010 season, but in 2011 season the highest values were obtained by adding organic fertilizer (compost) with natural mineral rocks and mixtures NPK- Biofertilizers'(T_6).

Sunflower applied with compost at rate of 8.75 ton/ fad, with natural mineral rocks at rate of 350 kg/fad (T_4) recorded the highest seed yield/plant (94.3 gm) and 100-seed weight (9.3 gm) without significant difference with the rest treatments in 2010 season. while, the combination of compost with 50% of mineral Fertilizer, natural mineral rocks, and mixtures Biofertilizers'(T_8) recorded the highest seed yield/palnt (63.9 gm) without significant differences with treatments (T_3,T_6 and T_7) the significant increase of seed yield/plant may be due to the role of biofertilizers which act as plant growth promoting rhizobacteria (PGPR) and gave the plant more availability of the main macro elements (N,P and K) in presence of organic fertilizer (compost).

Data presented in Table (5) also illustrated that, T_6 treatment (compost with natural mineral rocks and mixtures Biofertilizers' recorded the highest seed yield/faddan (2263.8 kg) without significant differences with the rest treatments in 2010 season. This result means that, the addition of mineral fertilizer had no significant increase in seed yield/faddan, when the soil treated with organic and biofertilizers under this conditions These results may be due to the beneficial effect of adding compost with bioertilizers , These results are in harmony with those obtain by (Chen, 2006) , he studied the effect of adding nutrients in the form of bio-organic fertilizers and reported that ,they enhance soil biological activity, which improves nutrient mobilization, enhance root growth due to better soil structure , release nutrients slowly and contribute to the residual pool of organic N and P in the soil, reducing N leaching loss and P fixation; they can also, supply micronutrients, increase the organic matter content of the soil, therefore improving the exchange capacity of nutrients, increasing soil water retention.

In 2011 season, the combination of compost with 50% of mineral fertilizer and mixtures Biofertilizers (T_7) , recorded the highest seed yield/faddan (2263.8 kg) without significant differences with the Organic fertilizer (compost) (8.75 ton/ fad), with 50% of mineral fertilizer (NPK), 30 kg N, 15 kg P_2O_5 and 30kg K_2O fad. The effect of application of compost especially with a minimum dose of inorganic fertilizer may be attributed to the provision of favorable soil condition (improve soil pH, electrical conductivity and organic matter content) and supply of proper nutrients for better growth and yield. Similar results have also been reported by Wong and Ho (1991), on amending soils with composts. NPK fertilizers are more efficient than the organic manures in supplying N, P and K in the short run, while the compost had an advantage in supplying other macro and micro nutrient elements not contained NPK fertilizer in the long term as well as in slow releasing nature. These results are in harmony with those obtained by Prakash and Adholeya.(2004) and Rotkittikhun *et al*., (2007) they showed the suitability of application of high proportions of compost with lower doses of inorganic fertilizer for higher biomass production of field crops such sunflower. Similar results have also been reported by (Guisquiani *et al*., 1995; Wong and Ho, 1991) they reported that , applying of compost have great effects on plant growth and yield as well as promote the soil physical and chemical properties. Increased plant yield may also be due to increased soil aggregate stability which might have favored the beneficial microbes which in turn could have contributed to improve biomass production, These results are in line with the findings of other researchers (Bwenya and Terokun, 2001; Basso and Ritchie, 2005).

Moreover, Sunflower plants that have been treated with biofertilizer recorded the highest values in most of the studied characters, Inoculation with biofertilizers as an average of T_5,T_6,T_7 and T_8 treatments increased head diameter, seed yield /plant, seed yield/faddan and 100-seed weight about 4%, 5%, 13% and 5% than non-inoculated plants as an average of T_1,T_2,T_3 and T_4 ,respectively, in 2010 season the results also obtained on the second season at values for 4%, 8% , 19% and 3% .On the other hand there were no differences among inoculated and non- inoculated plants on seed oil content and seed protein content in 2010 and 2011 seasons . These results are in harmony with those obtained by Namvar *et al*. (2012) using commercial Egyptian biofertilizer (one of them was microbial containing nitrogen fixing bacteria and phosphate dissolving bacteria) found that significantly increased plant growth parameters compared with untreated plants (Mahmoud and Amara, 2000 , Mostafa and Abo-Bakr, 2010).The biofertilizer application had stimulated nutrient accumulation and plant growth comparable to the non treated plants (Amir *et al*., 2003), it also had a positive effect on N-gained from air and enhancement of fertilizer uptake (Gala *et al*, 2000)

Effect of interaction:

Results showed that, there were no significant effect of the interaction between the varieties and fertilizer application in most of the studied traits except in seed oil content and seed protein content in both seasons.

t-5 Microbiological determination:

Total bacterial counts:

Soil microbial status before cultivated, growth and harvest stage of experiment of two seasons were evaluated. Data presented in table (6) indicated that the initial numbers of total bacterial counts were 25 and 35 $x10^6$cfu g^{-1} dry soils for season 2010 and season 2011, respectively. And recorded the lower values as compared to all tested treatments of sunflower plants. Applying of mineral fertilizer led to give a significant difference at total bacterial counts as compared to initial counts and recorded percentage increase ranged from 168 to 132% for season 2010 and 46 to 86% for season 2011 as an average for Giza 102 and Sakha 53 sunflower plants .

Application of PGPR and / or compost as bio and organic fertilizer with or without mineral NPK fertilizers did support rhizosphere microorganism number (RMO) and gave higher values for total bacterial counts as compared to plants received only mineral NPK and /or before cultivated soil and such increases were raised from 150 to 191% at 45 DAP and 142 to 182 at 120 DAP for Giza 102 and Sakha 53 at 2010 season and 164 to 182 and 57 to 142.1 at 2011 season as compared to plant received only mineral NPK, respectively. The corresponding values as compared to before cultivate were 540 to 576, 300 to 316, 391 to 420 and 137 to 240 % at the same order.

This data are in agreement with (Pandy *et al*, 1998, Mahmoud *et al*, 2006 and Mahmoud *et al*, 2010) who reported that application of PGPR had support rhizospheric microorganisms and led to recorded higher values as compared to untreated ones.

Moreover, variety sakha 53 scored higher total bacteria counts values as compared to those scored by variety Giza 102 among the two seasons and such increases were 8 and 18% at 45 and 120 DAP for 2010 season and 5 and 33% for 2011 season at the same order. In general, the treatment which received compost (organic fertilizer), PGPR (biofertilizer) and Natural mineral rocks (MR) gave the higher values of total bacterial counts as compared to all tested treatments.

Mona, *et al* (2000) and Ragab*, et al* (2006) reported that, inoculation with diastrophic bacteria had stimulation effect on the population of rhizosphere microorganism and increased their numbers by more than 50 % at the end of the experiment compared with the numbers recorded before planting.

Nitroganse and dehydrogenize activity:

Data in Table (7) show the nitrogenase and dehydroganase activity as indication on higher and active number of soil microorganisms presented in sunflower rhizospher plants. Generally, the activity of both nitrogenase and dehydroganase gave the same trend, which obtained from the total bacterial counts where, applying of PGPR, and compost with or without NPK mineral fertilizers led to give higher significant deference as compared to plants treated with NPK mineral fertilizer as such. In addition, variety Sakha 53 recorded higher values of nitrogenase and dehydroganase activity as compared to variety Giza 102 between the two seasons. Again, plants which recived PGPR, compost and natural mineral rocks (MR) fertilizer recorded higher activities values as compared to all tested treatments. The values of the nitrogenase activity ,which is responsible for the nitrogenase fixation ,were higher in the microbial inoculated treatments than the untreated treatments .the dehydroganase activity was estimated as an indication of the respiratory activity of roots and soil microorganisms , this enigmatic activity was also higher in the microbial inoculated treatments than the untreated treatments there results are in harmony with those obtained by Abou-Aly (2005) and Shahein *et al* (2013) they found that microbial inoculation enhance the activities of nitrogenase and dehydroganase compared to control plants .

T5
T6

T7

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تـأثير الأسـمدة المعدنيـة والعضـوية والحيويـة علـي محصـول عبـاد الشـمس تحـت ظروف الأراضي الجديدة

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أجريت تجربتان حقليتان في الموسمين الصيفيين (٢٠١٠,٢٠١١) وذلك بهدف دراسة تـأثير كـل مـن السـماد المعـدني والسـماد العضـوي والصـخور المعدنيـة الطبيعيـة، وأيضـا السـماد الحيـوي علـى المحصـول ومكوناته لنباتات عباد الشمس، صنفي سخا ٥٣ وجيزة ١٠٢ في الأراضي المستصلحة حديثاً.

وقد أقيمـت التجربتـان الحقليتـان بمحطـة البحوث للأراضـي الصـحراوية المستصـلحة والتابعـة لكليـة الزراعة - جامعة القاهرة، وذلك بوادي النطرون التابعة لمحافظة البحيرة، وقد أظهرت النتـائج المتحصـل عليهـا أن تطبيق واستخدام الأسمدة العضوية (الكمبوست) والحيوية وأيضا الصخور المعدنية لها تـأثيرات إيجابيـة علـى كـل مـن المحصـول ومكوناتـه لصـنفي عبـاد الشـمس تحت ظـروف الأراضـي الرمليـة، وذلـك مقارنـة باسـتخدام السماد المعدني بالجرعة الكاملة بمفرده.

وقد أعطت نباتات عباد الشمس، التـي تـم معاملتهـا بمستويات الكمبوسـت المختلفـة والصـخور الطبيعيـة والسماد الحيوي، زيادات معنوية في كلا موسمي الزراعة في كل من قطر القرص – محصـول النبـات بـالجرام – محصـول البذور/فـدان، ووزن ١٠٠ بـذرة، وكانـت تلـك الزيـادات ٤% ، و٥% ، و١٣%، و٥ % علـي الترتيب. وذلك بمقارنتها باستخدام الجرعـة الكاملـة للسماد المعدني فـي الموسم الأول (٢٠١٠) وكانـت النسبة المسجلة فـي الموسـم الثـاني (٢٠١١) هـي ٤%، و٨% ، و١٩% و ٣% علـي نفس الترتيـب. أوضـحت النتـائج المتحصل عليها أنه ليست هناك اختلافات معنوية عند استجابة صنفي عباد الشمس للصور المختلفة من الأسمدة المستخدمة (عضوية – حيوية – معدنية) في غالبية الصفات المدروسة ماعدا كل مـن نسبة الزيت والبروتين وذلك خلال موسمي التجربة.

على جانب آخر، أدى استخدام السماد العضوي والسماد الحيوي وكذا الصـخور المعدنيـة الطبيعيـة إلـى دعم وزيادة محتوى منطقة الريزوسفير من الكائنات الحية الدقيقة، معطيا قيمًا عالية للعد الكلـي للبكتريـا، وكـذلك نشـاط إنزيمـي النيتروجينيـز والديهـدروجينيز، وذلـك مقارنـة بالمعـاملات غيـر المضـاف إليهـا هـذه المعـاملات .وتوصـي الدراسـة بزراعـة دوار الشـمس صـنفي سـخا ٥٣ وجيـزة ١٠٢ تحـت مسـتويات مختلفـة مـن الاسـمدة (الكمبوست المختلفة – الصخور الطبيعية – السماد الحيوي)

قام بتحكيم البحث

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Table 1: Physical and chemical properties of soil at experimental site in 2010 and 2011 summer seasons.

Physical properties				Chemical properties				Available amounts of macro nutrients (mg/kg)		
Sand %	Clay%	Silt%	Soil texture	Soil (pH)	EC	O.M. %	$CaCo_3$ (%)	N	P	K
Season 2010										
91.66	2.86	5.48	Sandy	7.6	5.12	0.28	6.24	9.6	2.42	320
Season 2011										
92.32	2.72	4.96	Sandy	7.6	5.36	0.25	5.96	8.6	2.24	280

Table 2: The chemical properties of irrigation water at experimental site in 2010 and 2011 summer seasons.

pH	dS/m	EC ppm	Soluble anions (meq/l)			Soluble cations (meq/l)				SAR
			HCO3-	CL-	SO4-	Na+	K+	Ca++	Mg++	
Season 2010										
7.55	3.84	2470	4.22	21.20	12.98	30.24	0.36	3.86	3.94	15.32
Season 2011										
7.50	3.58	2300	3.92	18.96	12.72	27.76	0.32	3.72	3.80	14.32

Table 3:The main properties of organic fertilizer (compost) in 2010 and 2011 summer seasons.

Humidity %	Density (kg/m3)	pH (1:10)	EC (1:10)	(O.M) %	(O.C) %	C/N ratio	Total Macro nutrient %			Available nitrogen	
							N %	P %	K %	(NH4)+ (mg/kg)	(NO3)- (mg/kg)
Season 2010											
23.0	740	7.45	5.58	29.2	16.82	1:14.2	1.8	0.9	1.60	80	90
Season 2011											
22.4	720	7.5	4.96	28.0	16.24	1:14	1.7	0.8	1.56	78	86

Table 4.: yield and some yield characters as Effected by sunflower varieties (Giza 102 , sakha 53) in 2010 and 2011 seasons

Varieties	Head diameter (cm)	Seed yield per plant (g)	Seed yield per faddan (kg)	100-seed weight (g)	Seed oil content (%)	Seed protein content (%)
Season 2010						
Giza 102	22.5	90.1	2090.2	9.0	39.80	43.2
Sakha 53	22.3	80.1	1758.7	9.1	39.3	42.7
$LSD_{(0.05)}$	------	8.19	261	------	-----	-----
Season 2011						
Giza 102	13.96	47.1	980.0	10.5	38.7	25.7
Sakha 53	16.02	60.9	1328.9	9.7	43.10	19.5
$LSD_{(0.05)}$	0.94	4.52	146.9	0.65	1.4	1.32

Table 5: yield and some yield characters as affected by fertilizer treatments in 2010 and 2011 seasons

Fertilizer treatments	Head diameter (cm)	Seed yield per plant (g)	Seed yield per feddan (kg)	100-seed weight (g)	Seed oil content (%)	Seed protein content (%)
2010 Season						
T1	24.1	75.7	1808.4	9.0	39.5	38.8
T2	21.5	81.2	1631.1	8.3	39.1	44.8
T3	21.8	81.6	1574.8	8.8	39.5	46.1
T4	20.6	94.3	2137.9	9.3	39.9	40.7
T5	22.1	88.7	1966.8	9.2	41.3	45.8
T6	22.5	91.8	2263.8	9.2	39.9	43.5
T7	24.5	88.1	2100.7	9.3	39.6	37.8
T8	22.2	80.0	1912.3	9.4	37.4	46.4
$LSD_{(0.05)}$	---	---	---	---	1.67	4.7
2011 Season						
T1	15.4	48.0	776.7	9.5	41.73	38.8
T2	15.0	51.3	1082.7	9.9	42.77	44.8
T3	14.6	57.2	1217.8	10.3	37.53	46.1
T4	14.1	50.5	1062.0	10.2	40.70	40.7
T5	13.6	45.8	993.1	9.48	42.70	45.8
T6	16.0	55.7	1310.6	10.1	40.20	43.5
T7	15.8	60.0	1464.7	11.1	39.07	37.8
T8	16.3	63.9	1328.2	10.4	42.66	46.4
$LSD_{(0.05)}$	---	8.94	236.6	---	2.36	2.1

Table 6: Total bacterial counts (- $*10^{6}$cfu g^{-1} dry soil) of sunflower rhizosphere soil treatments at zero, 45 and 120 DAP on 2010 and 2011 seasons

Parameters	Season 2010						Season 2011					
	Zero			25			Zero			35		
	45 DAP		–	120 DAP		–	45 DAP		–	120 DAP		–
Treatments	V1	V2	χ	V1	V2	χ	V1	V2	χ	V1	V2	χ
T1	55	60	٥٨	40	43	٤٢	60	69	٦٥	53	49	٥١
T2	144	155	١٥٠	89	92	٩١	153	163	١٥٨	62	101	٨٢
T3	120	134	١٢٧	70	78	٧٤	134	140	١٣٧	50	107	٧٩
T4	140	157	١٤٩	85	93	٨٩	159	166	١٦٣	72	102	٨٧
T5	150	162	١٥٦	43	102	٧٣	163	169	١٦٦	83	119	١٠١
T6	160	169	١٦٥	100	104	١٠٢	172	182	١٧٧	79	78	٧٨
T7	135	140	١٣٨	76	82	٧٩	159	163	١٦١	84	89	٨٧
T8	150	159	١٥٥	90	101	٩٦	164	180	١٧٣	99	120	١١٠
χ	١٣٢	١٤٢	١٣٧	٧٤	٨٧	٨١	١٤٦	١٥٤	١٥٠	٧٣	٩٧	٨٥
L.S.D $_{.0.05}$	٢٣.7	٢٠.7	—	١٧.8	١٤.7	—	١٢.6	٢٤.3	—	١٨.9	٢١.7	—

Table 7: Nitrogenas and dehydrogenase of sunflower rhizosphere soil treatments at 45 and 120 DAP on 2010 and 2011 seasons:

Parameters	Nitrogenas (mmol C2 H4/hr)						Dehydrogenas (mgTPF/ g dry soil / day)					
	45 DAP			120 DAP			45 DAP			120 DAP		
Treatments	V1	V2	$\bar{x}$	V1	V2	$\bar{x}$	V1	V2	$\bar{x}$	V1	V2	$\bar{x}$
2010 Season												
T1	33.4	90.3	٦١.9	30.15	80.4	55.3	11.4	13.4	١٢.4	12.2	13.0	١٢.6
T2	130.4	140.5	١٣٥.5	110.2	115.3	١١٢.8	20.5	22.5	21.5	19.4	20.3	١٩.9
T3	150.5	170.6	١٦٠.6	100.5	109.2	104.9	23.6	24.3	23.9	20.3	19.4	٢١.5
T4	250.6	233.4	٢٤٢.	190.7	200.3	195.5	22.7	23.2	٢٢.9	17.5	20.3	18.9
T5	270.4	250.2	260.3	180.4	180.7	١٨٠.6	23.7	25.4	24.6	18.3	21.4	19.9
T6	290.6	299.5	295.1	170.5	210.4	190.3	٢٨.2	٢٧.8	28.0	٢٣.2	٢٣.2	٢٣.2
T7	192.3	180.2	١٨٦.3	160.7	160.5	١٦٠.6	21.7	22.5	22.1	19.9	19.2	19.6
T8	280.7	290.5	285.6	193.7	213.4	203.6	25.4	27.2	٢٦.3	21.2	19.8	20.5
$\bar{x}$	١٩٩.7	٢٠٦.9	203.3	١٤٢.1	١٥٨.8	١٥٠.5	٢٢.2	23.3	٢٢.7	19.0	١٩.6	١٩.3
L.S.D $_{.0.05}$	٢٧.3	٢٤.5	—	١٣.8	١٥.9	—	١.2	٠.91	—	٠.85	0.43	—
2011 Season												
T1	62.3	70.4	٦٦.4	40.7	60.3	٥٠.5	12.5	14.2	13.4	10.2	15.2	١٢.7
T2	140.7	150.3	١٤٥.5	40.8	100.4	٧٠.6	22.3	20.4	21.4	18.3	18.5	١٨.4
T3	160.4	166.4	١٦٣.4	120.2	150.3	١٣٥.3	20.5	23.7	٢٢.1	17.4	21.2	١٩.3
T4	240.5	250.3	245.4	200.1	190.4	295.3	23.7	24.8	٢٤.3	20.5	23.6	٢٢.1
T5	260.3	270.4	٢٦٥.4	210.3	220.5	٢١٥.4	24.8	26.2	٢٥.5	21.2	24.8	٢٣.0
T6	297.2	280.5	٢٨٨.9	230.4	240.4	٢٣٥.4	27.9	٢٩.2	28.6	٢٤.8	٢٥.4	25.1
T7	210.5	220.4	٢١٥.5	189.5	200.8	١٩٥.2	23.4	25.3	٢٤.4	20.7	23.2	21.9
T8	270.4	260.8	٢٦٥.6	211.4	230.4	٢٢١.2	26.5	28.9	٢٧.7	23.5	26.4	٢٤.9
$\bar{x}$	٢٠٥.3	208.7	207.0	١٥٥.4	١٧٤.2	١٦٤.8	٢٢.7	24.1	٢٣.4	19.6	٢٢.3	20.9
L.S.D $_{.0.05}$	٢٤.3	٢١.7	—	١٧.6	٢١.7	—	٠.73	0.81	—	1.73	٠.93	—