Response of Some Physiological, Yield Characters and Seed Quality of Sunflower to Mineral, Organic and Biofertilizers

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ABSTRACT : Two field experiments were carried out at the Experimental Farm of Sakha Agricultural Research Station. Agricultural Reseach Center, Kafr El- Sheikh, Egypt during the two growing seasons 2011 and 2012 to study the response of some physiological, yield characters and seed quality of sunflower "*Helianthus annulus*, L." C.V. Sakha 53 to mineral organic and biofertilizers. The applied experimental design was randomized complete blocks with four replications.

The obtained results could be summarized as follows, (1) The results showed significant differences due to applied 20 kg N/fed + 30 m^3 compost on leaf area/plant, dry matter accumulation/plant at all sampling dates days to full flowering, head diameter, 100- seed weight, seed yield (g)/plant and seed yield (kg)/fed. The highest seed yield/fed viz (2091.29 and 1961.84 kg/fed were obtained by application of 20 kg N/fed + 30 m^3 compost during both seasons (2) Application of 20 kg N/fed + 20 m^3 compost + Cerealine was the best combination to obtain the highest values of plant height at harvest and head diameter compared with fertilized by 10 kg N/fed. However, oil% and oil yield was increased significantly because of application 20 kg N/fed + 30 m^3 compost in both seasons. The present investigation suggests the need for more studies concerning the effect of mineral, organic and bioferlitization as well as applying NPK on sunflower plants under different environmental conditions using different types of soil especially newly reclaimed soil, to reach the optimum combination the achieve to best yield and quality of seed oil content.

Key words: sunflower, mineral (NPK), organic, biofertilizer, yield, oil yield

INTRODUCTION

Sunflower (*Helianthus annuus*, L.) is one of the most important annual crops of the world grown for edible oil. It received considerable attention in Egypt due to its short growing season and it can be grown well under the low fertility soils in the newly reclaimed areas. So, sunflower could be one of the main suggested oil crops to solve edibled vegetable oil shortage in the country. Seeds contain 24-49% oil and cake contains 25- 35% of protein (Henen, 2011).

Nutrition is essential for plant life and yield, therefore mineral fertilization is a common agronomic practice that leads to improve productivity. Mineral fertilization includes several elements, however, nitrogen and phosphorus are among the macro- elements that used on fertilization (Abou- Khadrah *et al*., 2002, Mohamed, 2003).

The organic manure is known to improve the properties of soil by increasing the limited moisture holding capacity. In addition, it can change the chemical properties of soil through lowering pH and extensively their beneficial effects are known for long time. Application of organic matter provide many essential nutrients needed by crop plants. The increase in crop yield due to using of animal manure have been imperative many times as resulted mainly from the nitrogen, phosphorus or potassium or the combination of the three elements (Awad, 2004, Aowad and Mohamed, 2009).

In addition, biofertilization is one of the most important factors used to product free from mineral fertilizer that cause environmental pollution and high rates of it lead to decrease in the potential activity of micro flora and the mobility of organic matters. Hence, the attention has been focused on the researches of bio-fertilization to safe attention for the chemical fertilizers (Namvar *et al*., 2012). Also, bio- fertilizers play vital role for increasing the number of microorganisms and accelerate certain microbial process in the rhizosphere of inoculated soil plants can change the available form of nutrients into plants (Abou- Khadrah *et al*., 2002; Bassal, 2003; El- Temssah, 2008).

Inoculation of Biofertilizers significantly affected plant height and total chlorophyll content. Biofertilizers also, significantly increased yield attributers viz. stem diameter, weight of seeds, filled seed/capitulum and 100- seed weight (g), as well as seed weight, biological yield and oil content. The combined inoculation of phosphate dissolving bacteria (PSB) + vesicular abuser mycoeehyizea (VAM) + Azotobacter recorded higher values of these Parameters as compared to PSB + Azotobacter and VAM + Azotobacter inculcation (Patra *et al*., 2013).

Therefore, the objective of this study is the evaluating the effect of mineral, organic and bio- nitrogen fertilizer treatment on some growth attributes yield and its component of sunflower crop.

MATERIALS AND METHODS

Two field Experiments were carried out at the Experimental Farm of Sakha Agricultural Research Station, Agricultural Research Center, Egypt during the two consecutive summer seasons, 2011and 2012. The applied experimental desing was randomized complete blocks with four replicates. The treatments were

1. 10 kg N/fed.
2. 20 kg N/fed.
3. 30 kg N/fed.
4. 10 kg N/fed + 20 m^3 compost.
5. 10 kg N/fed + 30 m^3 compost.
6. 10 kg N/fed + 20 m^2 compost + Cerealine.
7. 10 kg N/fed + 20 m^3 compost + Rizobacterin.
8. 20 kg N/fed + 20 m^3 compost.
9. 20 kg N/fed + 30 m^3 compost.
10. 20 kg N/fed + 20 m^3 compost + Cerealine.
11. 20 kg N/fed + 20 m^3 compost + Rizobacterin.

Analyzis of chemical and physical properties of the experimental soil site (0 to 30 cm depth) is shown in Table (1) and were carried out according to the methods reported by Page *et al*. (1982).

Table (1): Physical and chemical properties of the experimental soil (average of two seasons)

Sand (%)	Silt (%)	Clay (%)	Soil texture	pH	EC (dS/m)	$CaCO_3$ (%)	Total N (%)	Available P(mg/kg)
19.05	37.75	43.20	Clay	8.11	3.90	2.40	0.08	11.00

Table (2): Analysis of the applied organic manure (compost)

pH	EC	C/N	N%	P%	K%	Fe mg/kg	Mn mg/kg	Zn mg/kg
7.5	2.90	1:12.06	1.58	1.49	1.78	4935	435	206

Organic manure (compost) at the two rates was added during soil preparation before planting in both seasons. Analysis of organic manure are presented in Table (2). Prior to sowing seed inoculation was carried out using the biofertilizer with (N2- fixing) i.e Cerealine and Rhizobacterine: An Inoculate for all crops containing of Azospuillum lipofeuim and Bacillus polymx produced by Ministry of Agriculture, Egypt. Inoculation was performed by mixing seeds with the 400g/fed Cerealine and Rhizobacterin rates using Arabic gum (Arabic gum 5%).

Nitrogen fertilizer was applied in the form of urea (46% N) at the rates of (10, 20 and 30 kg N/fed), after the thinning and before the first irrigation after planting. Phosphorus fertilizer was applied in the form of calcium super phosphate (15.5% P_2O_5) as treatments with land preparation.

Each plot consisted of 5 ridges 3m long and 60 cm apart with 30 cm space between plant. The size two rows were used for determing seed yield and its components.

The seed were sown in 7^{th} and 3^{th} of july of the two successive growing seasons 2011 and 2012. In the first and second seasons sunflower was preceded by wheat "*Treticum aestivum,* L.".

Hoeing was practiced before the first and second irrigation. The plant were thinned to secure one plant per hill after 10 days from planting other cultural practices for growing sunflower were conducted as recommended were, growth attributes agronomic characters, yield and its components oil% and oil yield/fed. were recorded from the two middle redges.

A- Growth characters

Five guarded plants, from each plot were taken at 30, 45 and 60 days after sowing (DAS). The following data were recorded for each sample.

1. Leaf area (LA)/plant/(dm^2)
2. Dry matter accumulation (g/plant)
3. Days to full flowering
4. Plant height at harvest (cm)
5. Stem diameter (cm)
6. Head dimater (cm)

B- Yield and yield components

At harvest two guarded plants were taken from the 2nd and 3rd ridges in each plots to determine the following parameters:

1. 100- seed weight (g).
2. Seed yield (g/plant).
3. Seed yield (kg/fed).

D- Oil% and oil yield/fed

Oil percentage was determined using duplicat seed sample each of about two grains. Seed samples were dried in oven at 85 °C to 90°C for 24 hours. After weighting the seed samples were subjected to a constant pressure of 20000 pounds/square inch using a carve laboratory press which was described and used by A. O. A. C. (1980).

Approximately 70% of the oil in the seed was extracted. The crushed seeds were then placed in avail with solvent petroleum ether stopper and allowed to stand a dry at 33°C. Two changes of solvent were applied at 24 hours intervals. Then the seed residue was dried for one hour. Then oven dried for 24 hour at 85°C to 90°C and weighted. The loss in weight of seeds removed by pressing and solvent extraction and oil% was then calculated as follows. In sample was calculated and then content was determined as follows

$$\text{Oil \%} = \frac{\text{Weight of oil}}{\text{Weight of seed}} \times 100$$

Oil yield (kg)/fed: was determined by multiplying seed yield (kg/fed) by seed percentage.

All data collected were subjected to standard statistical analysis according to Gomez and Gomez (1984) using the computer program (IRRISaT). The treatment were compared using. Duncan's multiple range test (L.S.D.).

RESULTS AND DISCUSSION

A- Growth Characters:

The data of leaf area/plant and dry matter accumulation g/plant at the three sampling dates of sunflower as affected by bio- organic and mineral nitrogen are presented in Table (2).

The data indicated that a significant effect of all sampling dates in both seasons. The highest values of leaf area/plant and dry matter accumulation produced from 20 kg N/fed + 30 m^3 compost in the two seasons. In addition effect on the dry matter/plant in the first simple for both seasons. Applying 10 kg N/fed, alone gave the lowest values for these characters. Also, the results revealed that nitrogen is necessary to more vegetative growth, hence the leaf area/plant and dry matter of sunflower continued to increase as the plant advanced in age until the last sampling data. These results may be due to the fact that nitrogen fertilizer is an essential element, which plays a prominent role in building newliving staff, increase in size of successive leaves which improved translocation of assimilates. The role of nitrogen fertilizer on structure of protein molecule, which necessary for biological activity and improvement of plant metabolism as well as growth of stem

and leaves. In addition to compost intended to serve as soil amendment is applied in order to improve soil fertility (Namvar *et al*., 2010). Similar results were reported by Abou- Khadrah *et al*. (2002) and Aowas and Mohamed (2009).

Also, results presented in Table (3) show a significant response to bio-organic and mineral nitrogen fertilizer on (number of days to full flowering, plant height at harvest, stem and head diameter). Application of 20 kg N/fed + 20 m^3 compost + Cerealine recorded the highest plant height and stem diameter, as well as application 20 kg N/fed + 30 m^3 compost gave the highest values for days to full flowering and head diameter is in both seasons, while applying 10 kg N/fed, gave the lowest values of all the characters. Such increase in this characters due to apart of recommended mineral nitrogen + compost with biofertilizer synergistic effect on subsequent plant growth and cause bacterial development as Cerealine inoculants to gave biological N2- fixation, which improve plant growth and head diameter. Similar results were reported by Bassal (2003) and Dhanasekar and Dhandapani (2012).

B- Yield and its components:

Application of mixture of 20 kg N/fed + 30 m^3 compost were significantly increased all these characters i.e. 100- seed weight, seed yield, g/plant and seed yield, kg/fed during both seasons in comparison with the 10 kg N/fed, Table (4). It could be concluded that the lowest values come from fertilization with 10 kg N/fed. These findings might be the attributed to more adsorption of nutrition with reflect more growth substance more cell division and enlargement more of tissues and organs and plant elongation. Also, the nitrogen and compost may be increase the synthesis of endogenous photohormones which plays in formation of a big active root system allow more nutrients uptake. The previous results agree, more or less, with the finding of Abou- Khadrah *et al.* (2002), Bassal (2003) and El- Sadek (2005).

D- Seed oil and oil yield/fed:

Data presented in Table (4) showed that there were significant differences, due all these treatments. The highest oil % and oil yield/fed were produced by applying 20 kg N/fed + 30 m^3 compost in both seasons while the lowest oil % obtained by 30 kg N/fed and oil yield/fed obtained by 10 kg N/fed respectively. This may be due to the increased of oil and oil yield. It was noted that the application of higher doses of nitrogen decrease oil yield/fed, the seed yield was increase to a level that may compensate for the reduction and oil content. Similar results were reported by Mohamed (2003) and zadah (2010).

CONCLUSION

High quantity and quality production of sunflower: *Hehanthus annuus,* L. cv. Sakha 53 were obtained at the applying of 20 kg N/fed + 30 m^3 compost and 20 kg N/fed + 20 m^3 compost + Cerealine. Sunflower "*Helianthus annuus*, L. cv. Sakha 53, can be grown under these treatments for their high seed yield and oil content under conditions of Sakha Agricultural Research Center or in other similar areas.

Table (2) : Leaf area/dm2 plant, dry matter accumulation (g/plant) as influenced by mineral organic and biofertilization in 2011 and 2012 seasons

Treatments	Leaf area Days after sowing						Dry matter accumulation Days after sowing					
	2011			2012			2011			2012		
	30	45	60	30	45	60	30	45	60	30	45	60
F1:10Kg N/fed	14.42i	25.29b	53.58i	11.36b	21.74f	52.71i	22.69f	70.38b	113.97i	20.82g	69.29h	104.39i
F2: 20kg N/fed	17.49ef	32.98.d	65.28e	15.28d	30.06e	63.52e	30.16c	81.11e	124.24f	27.56e	76.24e	119.86e
F3:30kg N/fed	22.05b	37.75be	71.59b	19.89b	36.89b	69.98b	38.69a	86.48b	137.07b	35.17f	84.08ab	128.58b
F4: 10kg N/fed+ 20m^3 compost	15.93b	27.84g	55.69h	12.81g	24.13b	55.72b	24.21f	74.38g	119.06b	22.90ef	71.27g	108.93h
F5: 10kg N/fed+ 30m^3 compost	17.76e	30.31e	59.76f	14.36c	27.48f	58.65f	26.63d	77.24f	122.81g	24.95d	74.21f	112.66f
F6: 10kg N/fed+ 20m^3 compost+ Cerealine	17.19f	28.47f	57.32g	13.54f	25.33g	57.34g	25.43de	74.25g	120.37b	24.22de	72.24g	110.99g
F7: 10kg N/fed+ 20m^3 compost + hizobacterine	16.67g	28.44f	56.21h	12.91g	24.84gh	56.79g	24.34ef	74.46g	119.43h	22.79f	71.27s	108.93h
F8: 20kg N/fed+ 20m^3 compost	19.46d	37.63c	68.41d	17.98c	33.54d	68.47cd	34.15b	83.22d	129.59c	31.29b	80.26d	123.28d
F9: 20kg N/fed+ 30m^3 compost	22.66a	41.59a	76.46a	20.95a	39.56a	73.89a	40.32a	89.46a	140.21a	36.04a	85.50a	131.38a
F10: 20kg N/fed+ 20m^3 compost+ Cerealine	20.63c	38.59b	71.20b	19.99b	35.62c	69.37bc	35.29b	84.61c	135.44c	32.52d	83.05bc	125.95c
F11: 20kg N/fed+ 20m^3 compost+ Rhizobacterine	20.22c	37.54c	69.29c	19.76b	33.83d	68.16d	34.78b	83.81c	133.01d	31.76b	81.65bc	123.65d
F test	*	*	*	*	*	*	*	*	*	*	*	*

*** indicate P < 0.05 Means designated by the same letter within columns are not significant differences at 5% level according to Duncan's multiple range test.**

Table (3) : Number of days to full flowers, plant height, stem and head diameter as influenced by mineral, organic and biofertilization in 2011 and 2012 seasons

Treatments	Number of days to Full flowering		Plant height at Harvest (cm)		Stem diameter (cm)		Head diameter (cm)	
	2011	2012	2011	2012	2011	2012	2011	2012
F1:10Kg N/fed	55.00de	55.25d	177j	175.50j	2.20f	2.03b	17.65g	18.45f
F2: 20kg N/fed	56.50c	56.50c	194.33f	189.71e	2.80d	2.68e	21.80d	22.15de
F3:30kg N/fed	58.00ab	58.25ab	200.57b	195.53c	3.60ab	3.80ab	23.25ab	23.08ab
F4: 10kg N/fed+ 20m^3 compost	55.50d	55.75d	179.83i	177.80i	2.43e	2.25g	20.98f	21.68e
F5: 10kg N/fed+ 30m^3 compost	56.50c	56.50c	182.10i	178.80b	2.70d	2.48f	21.55de	21.75e
F6: 10kg N/fed+ 20m^3 compost+ Cerealine	55.75cd	56.00cd	184.57g	181.13f	2.63d	2.73e	21.45e	22.55cd
F7: 10kg N/fed+ 20m^3 compost + Rhizobacterine	56.00cd	56.25c	183.13b	179.83g	2.63d	2.52f	21.33e	22.00c
F8: 20kg N/fed+ 20m^3 compost	57.25bc	57.50b	196.97d	195.57c	2.98c	2.93d	22.13e	22.70bc
F9: 20kg N/fed+ 30m^3 compost	58.50a	58.50a	195.27c	192.93d	3.45b	3.55c	23.52a	23.35a
F10: 20kg N/fed+ 20m^3 compost+ Cerealine	57.50b	57.75b	201.60a	198.47a	3.70a	3.85a	23.25ab	23.15ab
F11: 20kg N/fed+ 20m^3 compost+ Rhizobacterine	57.75b	58.00ab	198.63c	196.60b	3.50b	3.68c	23.05b	23.23a
F test	**	**	**	**	**	**	**	**

***** indicate P < 0.05 Means designated by the same letter within columns are not significant differences at 5% level according to Duncan's multiple range test.

Table (4) : 100 seed weight (g), seed yield (g), seed yield (kg/fed), oil% and oil yield (kg/fed) as influenced by mineral, organic and biofertilization in 2011 and 2012 seasons

Treatments	100 seed weight (g)		Seed yield g/plant		Seed yield (kg/fed)		Oil%		Oil yield (kg/fed)	
	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
F1:10Kg N/fed	6.99e	6.47f	37.48h	36.20f	1311.10h	1266.49f	45.72b	44.25b	599.98b	560.42h
F2: 20kg N/fed	7.55de	7.39c	45.00f	43.60d	1574.37f	1525.39d	45.36b	43.40c	714.13f	662.02g
F3:30kg N/fed	8.61b	8.83b	54.70c	54.08c	1808.78c	1891.86c	42.25d	40.62e	773.25d	778.70
F4: 10kg N/fed+ 20m^3 compost	7.64de	7.41e	44.58fg	41.68e	1539.38fg	1458.22e	44.25c	44.20b	681.18g	644.54b
F5: 10kg N/fed+ 30m^3 compost	7.81d	7.95d	46.42e	43.93d	1624.05e	1536.96d	45.95b	44.28b	746.25e	680.55f
F6: 10kg N/fed+ 20m^3 compost+ Cerealine	8.61b	8.14d	46.28e	41.00d	1619.35e	1504.39d	44.28c	43.11c	716.96f	648.54gh
F7: 10kg N/fed+ 20m^3 compost + Rhizobacterine	8.64b	8.47c	45.53ef	42.68e	1592.91ef	1493.20e	45.39b	44.06bc	725.02ef	658.35g
F8: 20kg N/fed+ 20m^3 compost	7.93ed	8.51bc	50.50d	53.70c	1766.76d	1877.75c	44.16c	42.35d	784.23d	795.65d
F9: 20kg N/fed+ 30m^3 compost	9.88a	9.95a	59.78a	56.08a	2091.29a	1961.84a	47.46a	45.12a	953.15a	873.92
F10: 20kg N/fed+ 20m^3 compost+ Cerealine	9.05b	8.78bc	57.27b	55.38b	2003.82b	1937.35b	44.27c	42.29d	925.23b	832.99c
F11: 20kg N/fed+ 20m^3 compost+ Rhizobacterine	8.49bc	8.68bc	57.45b	55.08b	1999.45b	1926.85b	45.09c	44.20b	901.93c	850.51b
F test	**	**	**	**	**	**	**	**	**	**

* indicate P < 0.05 Means designated by the same letter within columns are not significant differences at 5% level according to Duncan's multiple range test.

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الملخص العربي

استجابة بعض الصفات الفسيولوجية والمحصولية وجودة البذور في عباد الشمس للأسمدة المعدنية والعضوية والحيوية

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أجريت تجربتان حقليتان بالمزرعة البحثية بسخا – مركز البحوث الزراعية خلال عامي 2011، 2012 لدراسة استجابة بعض صفات النمو والمحصول ونسبة ومحصول الزيت في عباد الشمس صنف سخا 53 للأسمدة المعدنية والعضوية والحيوية حيث صممت التجربة بالقطاعات العشوائية الكاملة مع أربع مكررات.

وأوضحت النتائج المتحصل عليها كما يلي:

– أوضحت النتائج اختلافات معنوية لإضافة 20 كجم نتروجين + 20م^3 سماد كمبوست على المساحة الورقية/نبات وتراكم المادة الجافة عند جميع بيانات العينات، عدد الأيام حتى اكتمال التزهير قطر الساق، وزن 100 بذرة، محصول البذور (جم)/ نبات ومحصول البذور(كجم)/فدان. ارتفاع محصول البذور كانت (2091–1961.82كجم/فدان) نتجت بواسطة إضافة 20 كجم نتروجين + 30م3 سماد الكموست خلال الموسمين.

– إضافة 20 كجم نتروجين/ فدان + 20م3 كمبوست + السيريالين أعطت أفضل تداخل أدى إلى ارتفاع قيم كلاً من ارتفاع النبات عند الحصاد وقطر الرأس مقارنة بالتسميد بـ 10 كجم نتروجين/فدان كما أن النسبة المئوية للزيت ومحصول الزيت زادت معنوياً بسبب إضافة 20 كجم نتروجين/فدان + 30م^3 كمبوست في كلا الموسمين.

– يقترح البحث الحالي الحاجة إلى دراسات متعددة لتأثير الأسمدة المعدنية، العضوية والحيوية مع إضافة النتروجين والفوسفور والبوتاسيوم تحت شروط بيئية مختلفة باستخدام أنواع مختلفة من الأراضي خاصة الأراضي الجديدة المستصلحة للحصول على التداخل الأعظم للحصول على أفضل محصول وجودة محتوى الزيت للبذور.