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ORIGINAL ARTICLES

Effect of Microbine inoculation, Nitrogen fertilizer and organic manure on productivity of sunflower plants

[1]Elham A. Badr, [2]Asal, M. Wali and [2]Gehan A. Amin

[1]Field crops Department, National Research Center, Dokki, Giza, Egypt.
[2]City for Scientific Research and Technology Applications, New Borg ElArab, Egypt.

ABSTRACT

Two field experiments were carried out at the experimental farm of the faculty of Agriculture, Saba Basha, Alexandria University, during 2012 and 2013 seasons to study the effect of mineral and bio-fertilizer(of nitrogen) under application of organic manure on seed and oil yields of sunflower through inoculation with nitrogen fixation (BNF) as bacteria in form of (Microbine inoculation) farm yard manure (FYM)as organic source at rate of zero,10 and 20m3/fed and mineral nitrogen fertilizer zero.40and 60kg/fed. The split-split plot design was used, the main plots were devoted to organic manure, the sub plots were devoted to bio nitrogen and the sub sub plots were the mineral nitrogen. The bio, organic, mineral fertilizer and the combination significantly affected growth analysis and some growth attributes such (dry matter accumulation /plant and leaf area index). Some agronomic characters such (stem diameter, head diameter and plant height) as well as yield and its components such (100 seed weight, seed yield/fed , oil percentage and oil yield) in 2012and 2013 seasons. The results indicated also that organic manure application increased the efficiency available N, available P and water availability percent in the soil.

***Key words**:* Microbine, Mineral nitrogen, organic manure, sunflower.

Introduction

Sunflower (*Helianthus annuus, L.*) is considered one of the major source of edible vegetable oil in the world and in A.R. of Egypt also due o high unsaturated fatty acids content (Leland, 1996). So, there is need to increase the oil yield to enhance food security. The nutrition especially with nitrogen is one of the important factors to increase sunflower seed yield. The nitrogen deficiency in Egyptian soils is one of the most limiting factors for sunflower production, to address issues of crop environment and crop productivity the over all management system of crop culture needs to be improved especially the nutrients management of crops. The application of organic and bio-fertilizers sustain the fertility of the soil for along time. On the other hand, the farmers add rarely sufficient amount of organic manure to the soil against the removal under this condition there in need to explore the possibilities of using the expanding native sources of plant nutrition such as organic and bio-fertilizers. Several investigators showed the effect of mineral and organic fertilizers application on sunflowers as: Abou khadrah *et al*., (2002), Mohamed (2003), Awad (2004) and Mohamed *et al*. (2009). They reported that the application of nitrogen rate up to 45 kgN/fed significantly increased dry matter accumulation, plant height, head diameter, LAI, stem diameter, 100 seed weight and seed yield as well as oil yield/ fed. They reported also that increasing N-Level tended to decreased seed oil content and increasing mineral nitrogen rate with bio and FYM significantly increased dry matter accumulation ,LAI, stem diameter, head diameter, 100-seed weight, seed yield and oil yield. The bio-fertilizers are one of the sources as a part from supplying nutrients for the crops, conserve the environment from pollution as a result of excessive use of N fertilizer. The beneficial effect of bio-fertilizers, viz Azospirillum andAzotobacter inoculation on sunflower has been reported by several investigators(Saleh *et al*. 2004) and Mohamed *et al*., (2009) studied the response of some sunflower cultivars to Rhizobacterien as bio-fertilizers in comparing with mineral nitrogen all studied characters were significantly increased by increasing nitrogen level up to 30 kgN/fed or inoculation of sunflower seed with Rhizobacterien plus application of 20 kgN/fed.

The importance of organic manures in the soil has been recognized for centuries as the key the soil fertility and productivity organic manures, favorable by product of forming and allied industries contribute to plant growth through their favorable affect on physical, chemical and biological properties of soil though information is available on the conjunctive use of organic manures and inorganic fertilizers for improving soil fertility and crop yields.

Corresponding Author: Elham A. Badr, Field crops Department, National Research Center, Dokki, Giza, Egypt.

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Materials and Methods

Two field experiments were carried out in the farm of the faculty of Agriculture, Saba Basha, Alexandria University during the summer season of 2012 and 2013. A split – split plot design with four replicates was used the main plots were arranged to study the effect of organic manure as Zero, $10m^3$ and $20m^3$ FYM/Fed. The sub-plot was devoted to study seed inoculation with microbine(mixed cultures of *Azotobacter chroococcum* and *Asospirillum lipoferem*) is a commercial bio-fertilizer. Sources containing active bio-nitrogen fixing bacteria produced by General Organization for Agriculture equalization, Ministry of Agriculture. The mineral nitrogen fertilization treatments were subjected as split-split plots as follows, zero, 40 and 60 kgN/fed. The plot area was $10.5m^2$ and all plots received to same amount of P_2O_5 as superphosphate (15% P_2O_5) at the rate of 100 kg/fed during land preparation. Nitrogen fertilizer (as the form of urea 46% N) was applied in two equal doses the first applied before the first irrigation while the second dose was applied before the second irrigation. All amounts of farm yard manure containing were added according to the treatments before cultivation.

Table 1: Chemical composition organic matter (farm yard manure).

E.C. ds/m	pH	Moisture %	O.M.%	Ash %	O.C.%	C/N ratio	Total N %	P_2O_5 %	K_2O %
4.1	6.2	10.55	59.5	30.55	17.9	10.2:1	0.36	0.40	1.20

Soil was directly irrigated after sowing to provide suitable moisture.Soil characteristics of the experimental site are shown in Table 2.

Table 2: Soil characteristics of the experimental site (determined according to Jackson,1967).

Sand (%)	Sit (%)	Clay (%)	Soil texture	pH	E.C. ds/m	O.M. %	$CaCo_3$ %	Available N ppm	Available-P ppm	Available/K ppm
38	19.5	42.5	Clay	7.9	2.3	0.75	7.4	38	8.2	500

Seed of sunflower cultivar Sakha53 were sown during the fist week of May of the two seasons. At harvest; plants were taken at randon from the inner area of each experimental plot to estimate the following characters:-

Plant height(cm),stem diameter (cm), number of leaves/plant,total dry matter accumulation (g/plant), leaf area index (LAI) calculated according towatson (1952) head diameter (cm), seed yield/plant(gm),weight of seed/head , seed index, seed yield/fed (kg).

100seed wt.(gm),stove yield/fed, harvest index and biological yield/fed (total weight of the dry matter of sunflower plants/fed),oil yield/fed (kg) was deterined by multiplying seed yield (kg/fed) by seed oil percentage, and seed quality**.** Seed oil percentage was determined using soxhlet apparatus according to A.O.A.C. (1980).

Protein content: total nitrogen was determined using mciro method described by Egan *et al.* (1981), protein content was calculated as N * 6.25.

Iodine value of the oil was determined using ABBE-refractometer instrument at 20°C.

Total NPK content of leaves to flowering stage was determine by the standard procedures (Champan and Parker, 1981).

The date were subjected to statistical analysis according to Snedecor and Cochian.

Results and Discussion

A) Growth analysis and Growth attributes data cited in Tables (3):

Table 3: Effect of microbine inoculation, nitrogen fertilizer and organic manure on growth parameters of sunflower plant (combined analysis of the two seasons).

Treatment	Plant height (cm)	Stem diameter (cm)	No. of leaves/plant	Leaf area index (LAI)	Total dry matter (g/plant)	Head diameter (cm)
Organic manure:						
Zero (FYM)	145.36c	1.85b	15.22	2.01b	116.9b	15.1c
$10m^3$/fed	158.06b	2.37a	17.92	3.25a	119.4a	16.19b
$20m^3$/fed	169.56a	2.45a	19.20	3.44a	120.2a	17.7a
F test	**	*	NS	*	*	**
Seed uninoculaton:	150.01b	2.16b	15.78b	2.78b	116.54b	15.4b
Inoculated	165.31a	2.39a	19.11a	3.01a	121.12a	17.26a
F. test	**	*	*	*	*	*
N levels kg/fed:						
Zero	129.6c	1.95b	13.16b	2.08b	114.04b	12.9b
40 kg/fed.	165.6b	2.35a	18.91a	2.98a	120.33a	17.3a
60 kg/fed.	179.8a	2.47a	20.25a	3.65a	122.13a	18.8a
F. test	**	*	*	*	*	*

Plant height, head diameter, stem diameter, leaf area index, total dry matter were significantly increased when $20m^3$ FYM and not significant effect of no. of leaves. Further significant increase due to FYM application were obtained for nitrogen, phosphorus and potassium uptake in the leaves. Plants fertilized with the rate of 10 and $20m^3$ farm yard manure having great stem diameter, head diameter and plant height might be due to the improve in translocation as assimilates organic manure that conserving adequate moisture for plant growth and supplying plants with nutrients and therefore the availability of water and nutrient which causes plants growth. The results are in agreement with those obtained. Abou Khadrah *et al*.; (2002), Mohamed, (2003), Awad (2004), Saleh *et al*. (2004), Mohamed *et al*. (2009) and Elham *et al*. (2009).

It can be observed from the collected date (Table 3) that the application of treatment inoculation (Microbine) and treatment (60kg N/fed) gave the highest mean values of all studied characters compared with control (non inoculated and zero Ng/fed.) it could be concluded that N-biofertilizer treatment promote the production of sunflower plants. The roots and seed germination are colonized by N fixing bacteria energetic path ways such as glycolysis and conversion of IAA to active IAA are stimulated also the nitrogen fixing bacteria which may increase the synthesis of the endogenous phytohormones indole acetic acid, gibberellic acid and cytokinene which play an important role in formation of bio active root system that allow more nutrients uptake and therefore may promote photosynthesis and translocation as well as accumulation of dry matter with different plants. Similar results were obtained by El-Khawas (1990), Mohamed (2003), Awad (2004) and Mohamed *et al*. (2009).

B) Yield and its components:

Table 4: Effect of microbine inoculation, nitrogen fertilizer and organic manure on yield characters of sunflower plant (combined analysis of the two seasons).

Treatment	Seed yield/ Plant (gm)	Seed yield kg/fed	100. seed wt(gm)	Seed Index (gm)	Stove yield (ton/fed)	Harvest index	Biological yield (ton/fed)
Organic manure:							
Zero (FYM)	45.25b	663.5c	5.22b	4.85b	4.57	15.25	5.23
$10m^3$/fed	49.12a	774.6b	5.51a	6.28a	5.01	15.58	5.78
$20m^3$/fed	55.20a	804.9a	5.72a	6.62a	5.71	16.33	6.51
F test	*	*	*	*	NS	NS	NS
Seed uninoculaton:	48.32b	719.46b	53.26b	5.76	4.98	15.46	5.69
Inoculated	51.39a	775.80a	56.47a	6.07	5.21	15.99	5.98
F. test	**	*	*	NS	NS	NS	NS
N levels kg/fed:							
Zero	30.71c	341.93c	44.50c	4.99b	4.33b	15.66	4.67
40 kg/fed.	49.48b	821.93b	57.81c	5.98a	5.16a	15.30	5.98
60 kg/fed.	69.38a	1079.13a	62.31a	6.77a	5.78a	16.20	6.85
F. test	**	**	*	*	*	NS	NS

The Data in Table (4) show that seed yield/plant (g), seed yield kg/fed, 100 seed weight and seed Index were significantly influenced by the bio, organic, mineral fertilizers. These significant increases in 100 seed weight and seed yield/fed. may be due to improvement in translocation of assimilates. The great values of 100 seed weight and seed yield were produced from sunflower plants received the mineral nitrogen at the recommended rate (60 kgN/fed) alone or the same rate $20m^3$ farm yard manure. The beneficial effect of organic manure to sunflower yield and its components could be attributed mainly to available NPK in the soil over initial as well as increasing activity of a symbiotic nitrogen fixation as a result of increasing the availability of carbon and energy source. Also application of FYM influenced the physical and chemical properties of the soil and subsequently increased the fertility available water and productivity of the soil.

Similar results were reported by Mohamed (1997), Keshta and El-Kholy (1999), Gorttappeh *et al*.(2000), Sharief *et al*. (2000), Abou khadrah *et al*. (2000),and Metwally (2010).

c) Chemical analysis of seed:

Data in Table (5) show seed oil content and oil yield of sunflower cv. Sakha 53 were significantly affected by bio, organic, mineral fertilizers. This significant increase in oil yield may be due to the increase in seed yield and oil percentage and so the improvement in translocation of assimilates. The highest values of seed oil content and oil yield were produced from sunflower plants received the mineral nitrogen at the recommended rate (60 kgN./fed) and $20m^3$ farm yard manure.

Application of farm yard manure at rate $20m^3$ was less effective on seed oil content and oil yield than applying mineral nitrogen. Such increase in seed oil content and oil yield from applying mineral nitrogen might be due to the fact that nitrogen composes protoplasmic protein, which required for increasing the growth and the increasing the seed oil content and oil content and oil yield similar results were reported by Mohamed (1997), Gorttappeh *et al*. (2000) Abou-Ghazala *et al*. (2001), The date show also that organic manure gave the highest

iodine and refractive index. The results are similar with those obtained by EL-Afendy et al.(2000)Sunflower seed content of protein was 24% No significant increase was found in protein content.

Table 5: Effect of microbine inoculation, nitrogen fertilizer and organic manure on chemical analysis of seed yield of sunflower plant (combined analysis of the two seasons).

Treatment	Oil yield (kg/fed)	Seed oil %	Seed Protein %	Iodine value	Refractive index	N %	P %	K%
Organic manure:								
Zero (FYM)	359.3c	37.54b	24.18	131.50	1.4760	1.95b	0.341b	2.06b
$10m^3$/fed	437.0b	38.61a	24.23	135.11	1.4736	1.97b	0.354b	2.10a
$20m^3$/fed	460.0a	39.89a	24.37	137.2	1.4742	2.53a	0.424a	2.32a
F test	*	*	N.S	N.S	N.S	*	*	*
Seed uninoculaton:	413.72	37.41b	24.22	134.51	1.4734	1.94	0.375	2.10
Inoculated	423.81a	39.96a	24.31	134.70	1.4736	2.36	0.369	2.12
F. test	*	*	N.S	N.S	N.S	N.S	N.S	N.S
N levels kg/fed:								
Zero	351.38c	38.11	24.05	133.25	1.9739	1.98	0.364	2.07b
40 kg/fed.	412.39b	38.91	24.15	134.86	1.4743	2.08	0.378	2.10a
60 kg/fed.	492.51a	39.01	24.60	135.67	1.4746	2.39	0.384	2.18a
F. test	*	N.S.	N.S.	N.S.	N.S.	N.S.	*	*

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