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Response of sunflower cultivars to partial replacement of recommended nitrogen fertilizer by organic and biofertilizers

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Two field experiments were conducted at Wadi El-Rayan, El-Fayoum Governorate, Egypt, during two successive seasons of 2014 and 2015 to study the effect of nitrogen fertilizer, organic and bio fertilizers (Yeast Bread) on growth, yield, yield components and chemical composition of two sunflower cultivars (Vidoc and Euroflor). Vidoc cultivar significantly exceeded Euroflor cultivar in growth, yield and yield components and chemical composition except number of leaves per plant at 60th day. Addition of 15 kg N/fed, 7.5 ton organic fertilizer with yeast increased all growth characters, yield and its components and plant chemical composition compared to the control and other treatments. The interaction between cultivars and nitrogen fertilizer, organic fertilizer and yeast demonstrated that the best treatment for growth, yield and chemical composition was 15 kg N/fed, 7.5 ton organic fertilizer and yeast (Yeast Bread) with Vidoc cultivar.

Keywords: Sunflower, cultivars, nitrogen, bio fertilizer, Yeast Bread, growth, yield.

INTRODUCTION

Sunflower (*Helianthus annuus* L.*)* is one of the most widely cultivated high quality oil seed crop in world, fourth rank after soybean, palm and rape. It can perform well under varying climatic soil conditions. The oil extracted (48- 53%) edible from this crop is used for either human consumption or industrial purposes. Heavy chemical application lead to adverse environmental, agricultural and health consequences, so great efforts are being exerted everywhere to combat the adverse consequences of chemical fertilizer. The Egyptian newly reclaimed sandy soil land is characterized as arid and semi-arid regions with poor soil nutrients, low organic matter, low water holding capacity and high nutrient leaching losses. Yeast Bread is considered as a type of biofertilizer which is usually added to soil or as foliar application to crops(Abbas 2013) because it content of many nutrient elements as well as its role in producing important substances like growth regulators such as gibberellins, auxins (Fathy and Farid 1996). Yeast treatment was suggested to participate beneficial role in improving growth and yield of some crops (Mekki and Ahmed, 2005, Khalil and Ismael, 2010, Dawood et al. 2013 and Marzouk et al. 2014).

Organic matter improves water holding capacity of sandy soil and drainage in clayey soil. Organic manure provides nutrients for the soil micro-organisms, thus increases the activities of microbes in soil, which in turn help to convert unavailable plant nutrients into available form for plant growth promotion.

Increasing sunflower yield per unit area can be achieved by breeding high yielding cultivars. Significant differences in sunflower cultivars have

been shown by many workers Hassanein et al. (2001), Ibrahim et al. (2003), Afifi and Ahmed (2004), Amin et al. (2008), Ahmed et al. (2010) and Ahmed et al. (2016 a and b). Great attention has been directed towards the application of bio-organic farming to avoid the heavy use of agrochemical that result in enormous environmental troubles (Abd-El-Ghany 2007).

The objective of this work is investigate response of growth, yield and its components and some chemical composition of two sunflower cultivars to partial replacement of recommended nitrogen fertilizer by organic and biofertilizer (Yeast bread) at Wadi El-Rayan, El-Fayoum Governorate, Egypt.

MATERIALS AND METHODS

Two field experiments was carried out at Wadi El-Rayan, El-Fayoum Governorate, Egypt, during the two successive seasons of 2014 and 2015 to test the effect of nitrogen chemical fertilizer, organic fertilizer and bio fertilizer (Yeast Bread) on productivity of two sunflower cultivars. At depth of 30cm, soil samples were taken for mechanical and chemical analysis according to the methods described by Chapman and Pratt (1978). Some physical and chemical characters of soil in the site of the experiment (30cm depth) were as follows: sand 73.59%, silt 22.47%, clay 3.45%, pH 8.00, organic matter 0.49%, soluble N 84.0 ppm, soluble P 12.5 ppm, and soluble K 134.0 ppm.

The treatments were arranged in split plot design with three replications were the sunflower cultivars, i.e. (Vidoc and Euroflor) occupied the main plots, while the eight treatments of nitrogen, organic and biofertilizer (Yeast Bread) were added randomly in the sub-plots. The experiment included sixteen treatments which were the combination of two sunflower cultivars, i.e. Vidoc and Euroflor and eight treatments of nitrogen, organic and biofertilizer (Yeast) as follows:

1- 30 kg N/ feddan
2-15 kg N/ fed + 2.5 ton organic / feddan
3-15 kg N/ fed + 5 ton organic / feddan
4-15 kg N/ fed + 7.5 ton organic / feddan
5-15 kg N/ fed + Yeast
6-15 kg N/ fed + 2.5 ton organic / fed+ Yeast
7-15 kg N/ fed + 5 ton organic / fed+ Yeast
8-15 kg N/ fed + 7.5 ton organic / fed+ Yeast

Organic fertilizer was applied to the soil two weeks before sowing, raked it lightly at a depth of 10-15 cm**.** Yeast (*Saccharo mycescerevisiae*) was dissolved in water followed by adding sugar at a ratio of 1:1 and kept 24 hours in a warm place for reproduction and was sprayed twice at 35 and 45 days after sowing at rate 3 g/L**.** The experimental unit size was 10.5 m^2 (3x3.5m) =1/400 feddan and consisted of five ridges, 3.5 meter long and 60cm apart**.** Seeds sown in 5th May and 10th May in two seasons, in hills 20cm apart. Three seeds were sown in hills. Plants were thinning to one plant per hill was done at 20 days after sowing. Potassium sulphate (48% K2O) and Phosphorus as super phosphate (15.5 % P2O5) were applied during seedbed preparation**.** Other agriculture processes were performed according to normal practice recommended by Oil Crop Research Section, Agricultural Research Centre, Ministry of Agriculture Egypt**.**

The studied characters:

Samples of five guarded plants were collected at random from the middle ridges of each plot for the three replicates to measure growth characters at 60 and 75 days from sowing, where; plant height (cm), number of leaves/plant , total dry weight/ plant (kg)**.** Leaves area/plant (cm^2), was computed as described by Bremner and Taha (1966) and specific leaf area (cm^2/g) was determined according to Abdel-Gawad et al. (1980).

At harvest Samples of five plants were taken from the middle ridges of each plot to determine head diameter (cm), weight of seeds/head (g) and seed index (1000 seeds/g). Furthermore, seed, straw and biological yield (Kg/feddan) were collected from the whole area of each experimental unit and then converted into yield per Fadden. Crude protein percentage was calculated by multiplying the nitrogen % by 6.25 factors according to (Baethgen and Alley, 1989), while the seed oil percentage was determined according A.O.A.C. (1990).

The obtained data were subjected to statistical analysis according to procedure outlined by Gomez and Gomez (1984).Treatments means were compared by L.S.D at 5% level test. Combined analysis was made for the two growing seasons as results followed similar trend.

RESULTS AND DISCUSSION

Growth characters:

A-Effect of cultivar

Data in Table (1) illustrated that there were significant differences between two sunflower cultivars in all growth characters in both seasons except number of leaves/ plant at 60 days after

sowing. Data revealed that Vidoc cultivar significantly surpassed Euroflor cultivar in plant height, total dry weight/ plant, leaf area/ plant and specific leaf area at 75 days from sowing, in addition number of leaves/ plant at 75 days after sowing. Differences between the two sunflower cultivars in growth characters were similar with those reported by Hassanein et al.(2001), Ibrahim et al. (2003), Afifi and Ahmed (2004),Ahmed and Hassanein (2006),Amin et al. (2008), Ahmed et al.(2010) and Ahmed et al.(2016 a and b).

B-Effect of nitrogen fertilizer, organic and biofertilizer (Yeast)

Data in Table (1) indicated that the differences between nitrogen fertilizer, organic and bio fertilizer (Yeast) and the combination between them were significant at 60 and 75 days from sowing in all characters under study. It is clear from data in Table (1) that the best treatment for all growth characters at 60 and 75 days from sowing date was 15 kg N/ fed + 7.5 ton organic / fed+ Yeast, followed by 15 kg N/ fed + 5 ton organic / fed+ Yeast compared with control.

Foliar application of Yeast Bread induced nutrient minerals absorption through general improvement and it due to the ability of Yeast to increase the production of stimulants for plant growth, especially Gibberellins, Auxins and Cytokinins which act to improve the plant cell division. These results are in a good agreement with this obtained by Ahmed et al. (2012) and Ahmed et al. (2015).

C-Effect of the interaction

Data in Table (2) showed that the effect of interaction between cultivars and nitrogen fertilizer, organic and bio fertilizer (Yeast Bread) were significant out at all growth characters i.e. plant height, leaf area/ plant and specific leaf area at 60 and 75 days from sowing, while number of leaves/ plant at 75 days from sowing and total dry weight/ plant at 60 days after sowing only. It is clear from data that the best treatment for plant height and total dry weight at 60 days from sowing, LA and SLA was Vidoc cultivar with 15 kg N/ fed + 7.5 ton organic / fed+ Yeast and the best treatment for number of leaves/ plant was Euroflor cultivar with15 kg N/ fed + 7.5 ton organic / fed+ Yeast.

Table (1): Effect of cultivars and nitrogen fertilizer, organic and biofertilizer (yeast) on growth characters of sunflower plant at 60 and 75 days after sowing. (Average of 2014 and 2015 seasons).

Characters / Treatments	Plant height(cm)		Number of leaves /plant		Total dry weight/plant (kg)		LA (cm^2)		SLA(cm^2 /g)	
	60	75	60	75	60	75	60	75	60	75
Cultivars										
Vidoc	306.13	353.50	33.65	28.05	2.750	3.157	1358.76	1370.54	210.38	237.75
Euroflor	297.96	325.02	32.45	25.87	2.579	2.847	1343.20	1356.90	182.75	203.09
L.S.D at 5%	1.09	0.60	n.s	0.94	0.012	0.022	1.19	0.90	0.46	0.61
Nitrogen fertilizer + Organic and biofertilizer (Yeast)										
30 kg N/fed.	273.04	312.71	25.35	21.42	2.467	2.813	1335.51	1349.57	174.74	200.31
15kg N +2.5 ton organic/fed	290.14	328.01	28.55	23.92	2.555	2.863	1342.37	1359.07	182.16	206.25
15kg N +5 ton organic/fed	299.39	339.50	32.24	26.25	2.605	3.027	1346.56	1365.36	190.64	212.75
15kgN+7.5ton organic/fed	317.72	353.92	35.89	29.03	2.773	3.083	1353.96	1371.48	194.14	218.22
15kg N +Yeast	281.69	319.83	28.49	23.19	2.560	2.927	1342.83	1354.88	193.87	218.10
15kg N +2.5 ton organic/fed+ Yeast	300.95	337.07	33.55	27.90	2.652	3.023	1353.97	1360.99	204.71	227.33
15kg N +5 ton organic/fed+ Yeast	320.32	355.63	37.71	30.84	2.788	3.105	1361.98	1370.34	213.67	236.13
15kg N +7.5 ton organic/fed+ Yeast	333.12	367.40	42.63	33.10	2.915	3.175	1370.66	1378.05	218.58	244.27
L.S.D. at 5%	1.82	1.57	1.86	1.00	0.018	0.033	1.87	1.53	1.56	1.59

Table (2): Effect of interaction between cultivars and nitrogen fertilizer, organic and biofertilizer (yeast) on growth characters of sunflower plant at 60 and 75 days after sowing. (Average of 2014 and 2015 seasons).

Characters / Treatments		Plant height(cm)		Number of leaves /plant		Total dry weight /plant (kg)		LA (cm^2)		SLA(cm^2 /g)	
		60	75	60	75	60	75	60	75	60	75
Cultivars x Nitrogen fertilizer + Organic and bio fertilizer (Yeast)											
Vidoc	30 kg N/fed.	281.51	328.04	26.88	23.50	2.513	2.930	1342.48	1355.02	185.22	212.00
	15kg N +2.5 ton Organic/fed	295.79	342.01	29.49	25.78	2.627	2.987	1347.21	1361.08	191.95	219.08
	15kg N +5 ton Organic/fed	300.65	350.56	32.81	27.92	2.707	3.207	1351.39	1369.28	199.49	226.17
	15kgN +7.5ton Organic/fed	318.41	364.71	36.75	30.60	2.877	3.233	1359.05	1373.50	202.18	235.45
	15kg N +Yeast	290.31	337.45	29.81	25.05	2.633	3.110	1352.91	1360.73	214.29	241.14
	15kg N +2.5 ton Organic/fed+ Yeast	303.50	350.61	34.61	29.37	2.783	3.203	1361.91	1370.56	222.74	250.65
	15kg N +5 ton Organic/fed+ Yeast	326.29	372.51	36.25	30.59	2.887	3.263	1372.12	1382.96	230.67	255.60
	15kg N +7.5 ton Organic/fed+ Yeast	332.54	382.09	42.59	31.57	2.973	3.323	1383.02	1391.16	236.49	261.88
Euroflor	30 kg N/fed.	264.56	297.38	23.83	19.34	2.420	2.697	1328.53	1344.11	164.27	188.62
	15kg N +2.5 ton Organic/fed	284.48	314.01	27.61	22.07	2.483	2.740	1337.53	1357.06	172.36	193.41
	15kg N +5 ton Organic/fed	298.13	328.43	31.66	24.58	2.503	2.847	1341.72	1361.44	181.78	199.32
	15kgN +7.5ton Organic/fed	317.03	343.12	35.04	27.46	2.670	2.933	1348.86	1369.46	186.10	201.00
	15kg N +Yeast	273.07	302.22	27.16	21.33	2.487	2.743	1332.76	1349.03	173.45	195.06
	15kg N +2.5 ton Organic/fed+ Yeast	289.39	323.53	32.49	26.43	2.520	2.843	1346.04	1351.43	186.67	204.00
	15kg N +5 ton Organic/fed+ Yeast	314.35	338.75	39.16	31.08	2.690	2.947	1351.83	1357.72	196.67	216.67
	15kg N +7.5 ton Organic/fed+ Yeast	333.69	352.72	42.66	34.63	2.857	3.027	1358.31	1364.94	200.67	226.67
L.S.D. at 5%		2.58	2.21	n.s	1.41	0.025	n.s	2.65	2.17	2.20	2.26

Table (3): Effect of cultivars and nitrogen fertilizer, organic and biofertilizer (yeast) on yield, its components and chemical constituent of sunflower. (Average of 2014 and 2015 seasons)

Characters / Treatments	Head diameter (cm)	Weight of seeds /head(g)	Seed index (g)	Seed yield(kg) /feddan	Straw yield(k) /feddan	Biological yield (kg) /feddan	Protein %	Oil%
Cultivars								
Vidoc	35.36	207.61	103.15	1237.78	4723.76	5961.75	17.796	33.479
Euroflor	33.10	196.55	92.44	1109.32	4623.29	5734.70	17.305	32.553
L.S.D at 5%	0.63	1.61	1.48	17.65	22.57	43.60	0.017	0.009
Nitrogen fertilizer + Organic and biofertilizer (Yeast)								
30 kg N/fed.	25.38	183.12	82.50	990.00	4457.32	5447.32	17.303	32.797
15kg N +2.5 ton Organic/fed	30.37	192.20	88.01	1056.10	4550.78	5606.88	17.475	32.915
15kg N +5 ton Organic/fed	33.43	199.64	95.80	1149.54	4648.30	5797.84	17.550	32.987
15kgN +7.5ton Organic/fed	39.28	212.64	105.46	1265.63	4780.53	6054.50	17.638	33.092
15kg N +Yeast	29.82	192.11	87.30	1047.64	4551.14	5598.78	17.392	32.910
15kg N +2.5 ton Organic/fed+ Yeast	34.31	201.71	97.02	1164.26	4674.80	5839.90	17.592	33.027
15kg N +5 ton Organic/fed+ Yeast	38.65	212.71	107.04	1284.50	4796.47	6080.97	17.697	33.118
15kg N +7.5 ton Organic/fed+ Yeast	42.60	222.51	119.23	1430.74	4928.86	6359.60	17.757	33.283
L.S.D. at 5%	1.04	1.57	1.29	15.45	18.50	26.57	0.029	0.018

2-Yield, yield components and chemical composition:

A-Effect of cultivar

It is clear from data Table (3) that yield, yield components and chemical composition of the two sunflower cultivars were significantly different for all characters under study in both seasons. Vidoc cultivar was superior in its yield, yield components and chemical composition compared with Euroflor cultivar**.** The superiority of seed, straw and biological yield kg/ feddan in Vidoc cultivar mainly due to the increase in some yield components**.** The differences between cultivars may be due to the differences in genetic structure between the two sunflower cultivars, to the differences in growth characters and in glucose required for synthesis of different chemical constituents at different plant organs, in carbon equivalent and to the differences in photosynthesis partitioning that previously indicated Afifi and Ahmed (2004).These results are in a harmony with those obtained by Ahmed et al. (2010) and Ahmed et al. (2016 a and b).

B-Effect of nitrogen fertilizer, organic and biofertilizer (Yeast)

Data in Table (3) observed that yield and yield components of sunflower plants significantly affected by fertilizer treatments. Data revealed the highest value were recorded by the plants treated with 15 kg N/ fed + 7.5 ton organic / fed+ Yeast. The effect of Yeast Bread were reported by many investigators on different crop, Mekki and Ahmed (2005), Ahmed et al. (2010), Khalil and Ismael (2010), Abbas (2013), Ahmed et al. (2015) and Ahmed et al. (2016 a). These results may be due to Yeast's Cytokinins content, and the high content of vitamin B5 and minerals, Yeast composition might be play a considerable role in orientation and translocation of metabolites from leaves to the productive organs. Similar studies confirmed our results Ahmed et al. (2015).

Also results in (Table 3) show that plants treated with 15 kg N/ fed + 7.5 ton organic / fed+ Yeast Bread were much superior in seed content of protein and oil % compared with other treatments. These results may be due to increase of growth and yield which in turn reflected positively on chemical composition (Ahmed et al, 2015).

Table (4): Effect of interaction between cultivars and nitrogen fertilizer, organic and biofertilizer (yeast) on yield, its components and chemical constituent of sunflower. (Average of 2014 and 2015 seasons)

Characters / Treatments		Head diameter (cm)	Weight ofseeds /head (g))	Seed index (g)	Seed yield (kg) /feddan	Straw yield (kg) /feddan	Biological yield (kg) /feddan	Protein %	Oil %
Cultivars x Nitrogen fertilizer + Organic and bio fertilizer (Yeast)									
Vidoc	30 kg N/fed.	27.24	190.84	89.10	1069.48	4530.16	5599.32	17.567	33.247
	15kg N +2.5 ton Organic/fed	31.69	197.45	95.31	1143.68	4622.84	5766.52	17.780	33.370
	15kg N +5 ton Organic/fed	34.47	205.02	100.03	1200.32	4721.48	5921.80	17.840	33.433
	15kgN +7.5ton Organic/fed	40.28	218.39	111.53	1338.55	4801.24	6139.79	17.930	33.537
	15kg N +Yeast	30.59	199.21	91.79	1101.52	4597.92	5699.44	17.523	33.403
	15kg N +2.5 ton Organic/fed+ Yeast	35.11	206.66	100.43	1205.20	4701.60	5908.48	17.820	33.530
	15kg N +5 ton Organic/fed+ Yeast	39.88	216.98	113.72	1364.68	4824.00	6188.68	17.923	33.610
	15kg N +7.5 ton Organic/fed+ Yeast	43.62	226.31	123.26	1479.16	4990.80	6469.96	17.983	33.703
Euroflor	30 kg N/fed.	23.52	175.40	75.90	910.84	4384.48	5295.32	17.040	32.347
	15kg N +2.5 ton Organic/fed	29.06	186.95	80.71	968.52	4478.72	5447.24	17.170	32.460
	15kg N +5 ton Organic/fed	32.38	194.26	91.56	1098.76	4575.12	5673.88	17.260	32.540
	15kgN +7.5ton Organic/fed	38.27	206.88	99.39	1192.72	4759.81	5969.20	17.347	32.647
	15kg N +Yeast	29.04	185.02	82.81	993.76	4504.36	5498.12	17.260	32.417
	15kg N +2.5 ton Organic/fed+ Yeast	33.51	196.75	93.61	1123.32	4648.00	5771.32	17.363	32.523
	15kg N +5 ton Organic/fed+ Yeast	37.42	208.44	100.36	1204.32	4768.93	5973.25	17.470	32.627
	15kg N +7.5 ton Organic/fed+ Yeast	41.57	218.72	115.19	1382.32	4866.92	6249.24	17.530	32.863
L.S.D. at 5%		n.s	2.22	1.82	21.85	26.16	37.58	0.041	0.025

C-Effect of the interaction

Data in Table (4) revealed that the inter action between sunflower cultivars and nitrogen fertilizer, organic and bio fertilizer (Yeast Bread) was significant at all character under study i.e.(weight of seeds/head (g) and seed index (g), seed, straw and biological yields (Kg/feddan),protein and oil percentage) except head diameter. Data illustrated that Vidoc cultivar with 15 kg N/ fed + 7.5 ton organic / fed+ Yeast Bread gave the highest value of yield, yield components and chemical composition of sunflower.

CONCLUSION

The results of this work revealed that high productivity of sunflower could be obtained by growing with Vidoc cultivar with 15 kg N/ fed + 7.5 ton organic / fed+ Yeast Bread at environmental conditions of Wadi El-Rayan, El-Fayoum Governorate, Egypt.

CONFLICT OF INTEREST

The present study was performed in absence of any conflict of interest.

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AUTHOR CONTRIBUTIONS

Hassanein, M.S., design of the work, Data analysis and interpretation, Amal, G. Ahmed, Data collection, Nabila, M. Zaki, Final approval of the

version to be published

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