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EFFECT OF CHEMICAL NITROGEN AND COMPOST RATES ON WHEAT PRODUCTIVITY AND SOIL PROPERTIES

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ABSTRACT: ***Two field experiments were conduct at the Experimental Farm of Water Requirements Research Station, Kafr EL-Sheikh governorate, North Delta, Water Management Research Institute, National Water Research Centre, Egypt,during 2007/2008 and 2008/2009 seasons, to study the effect of chemical nitrogen rate (0,30, 60, 90 kg N/fed.) and compost rates application (0,1.5, 3, 4.5 ton /fed.) and its interaction on productivity of the wheat cultivar Giza 168 and soil properties. Treatments were arranged in split plot design with four replicates (the main plots included chemical nitrogen. while, compost rates were allocated at the sub plots). The obtained results were as follows :***

The results revealed that increasing chemical nitrogen rates from 0 to 90 kg N/fed. signficantly increased plant dry weight/m^2, LAI, plant height, number of tillers and spikes/m^2, number of grains /spike, weight of 1000-grain, grain and straw yield/ fed. and grain protein content in both seasons. Application of 90 kg N/fed. recorded the highest values for all prvious studied traits compared with untreated plants (control treatment) which gave the lowest values, There was no significant difference between 90 and 60 kg N/fed. in dry weight at the first season only.

compost rates recorded significant differences for all studied traits of wheat as plant dry weight/m^2, leaf area index, plant height, number of tillers and spikes/m^2, number of grains/spike, weight of 1000-grains, grain yield, straw yield and grain protein content in both seasons except for dry weight in the first season; The application of 4.5 t/fed. recorded the greatest significant values for all previous studied traits compared with the untreated control treatment which showed the lowest values. The rate of 3 t/fed. did not significantly differed with the rate of 4.5 t/fed in grain protein content in both seasons.

The interaction between chemical nitrogen and compost rates application had a significant effect on plant dry weight/m^2, leaf area index, plant height, number of tillers and spikes/m^2, number of grains /spike, weight of 1000-grains, grain and straw yield in both seasons, with exception of plant dry weight/m^2 in the first season and the grain protein content in both seasons. Application of 90 kg N/fed. + 4.5 or 3 t compost /fed. gave the highest significant values of LAI, plant height, number of tillers and spikes/ m^2, weight of 1000 grain and grain yield/fed. without significant differences between them. The highest significant values of grain yield in both seasons and straw yield in the second season were achieved by 90 kg N/fed. + 4.5 t compost /fed. followed by 60 kg N/fed. + 4.5 t compost /fed. Application of 60 kg N/fed. + 4.5 or 3 t compost /fed. Produced the highest significant values for LAI, weight of 1000-grains in both seasons, straw yield in the first season and number of spikes/m^2 in the second season, However the untreated control recorded the lowest values.

Soil salinity (EC_e) and saturation hydraulic conductivity (K_s) as well as available N, P, and K in the soil were significantly increased with increasing N rates applied generally up to 90 kg N/fed., while soil pH and bulk density (ρ_a) were not significantly affected in the two seasons. Saturation hydraulic conductivity (Ks) as well as available N, P, and K in the soil were significantly increased with increasing compost rate applied generally up to 4.5 ton/fed., while soil salinity, pH and bulk density (ρ_a) were significantly decreased in

the two seasons Finally, adding compost at rate of 4.5 t/fed. resulting in the improvement of soil properties.

From the results and under the conditions of this study, it could be concluded that application of 90 kg N/fed. combined with compost at rate 4.5 or 3 t/fed producing the highest grain and straw yeilds. Also, application of 60 kg N/fed. combined with compost at a rate of 4.5 t/fed found to be the recommended and economic treatment for increasing grain yield of wheat.

Key words: ***wheat, yield, protein, compost, N fertilizer, soil salinity, soil bulk density, hydraulic conductivity.***

INTRODUCTION

Wheat is considered one of the most important strategically crop in Egypt and in the world, increasing wheat productivity is a national target in Egypt to fill the gab between the local consumption and production. There are several ways for increasing the productivity of wheat, one of them is fertilization process, the utilization of chemical fertilizers for several past years without any addition of organic sources resulted in most deficiency of nutrients in soil, which decreased the productivity and quality of crops. Moreover more utilization of mineral fertilizers leads to soil and water pollution. Soil organic matter increases agricultural production by improving soil physical, chemical and biological properties. Application of organic residues could increase soil organic matter, buffer the soil, improve aggregate stability and enhance water retention capacity (Spaccini *et al.,* 2002). Compost (artificial organic manure) is rich source of nutrients with high organic matter content. Physical and chemical properties of soil can be improved by using compost, which may ultimately increase crop yields. Therefore, application of compost is the need of the time. Physical properties like bulk density, porosity, void ratio, water permeability and hydraulic conductivity were significantly improved when FYM (10 t ha-1) was applied in combination with chemical amendments, resulting in enhanced rice and wheat yields in sodic soil (Hussain *et al.,* 2001). Other organic materials like rice straw, wheat straw, rice husk and chopped salt grass also improved these physical properties of a saline sodic soil, which in turn significantly increased tillering, plant height, biomass and paddy yield (Hussain *et al.,* 1998). Moreover, Gong *et al.* (2009), Enke Liu *et al*. (2010) and Yassen *et al.* (2010) reported that growth and yield of wheat was improved by the use of organic fertilizer sources compared with chemical fertilizers, it is quit possible to get higher wheat yield by the integrated use of organic and inorganic fertilizers.

Response of wheat to chemical nitrogen were studied by several authors. In this concern, Sherief *et al.,* (1998) indicated that yield and yield attributes of wheat were significantly respond to nitrogen application up to 75 kg N/ha. Abd El-Maaboud *et al.,* (2006) reported that increasing mineral nitrogen levels increased significantly plant height, number of tiller / plant, yield and yield attributes and protein % of Giza168 and seds1 cultivars. Hussain Iqtidar *et al.,* (2006) showed that maximum plant height, total number of plants/m^2 , number of spikes /m^2 , biological yield and grain protein content were observed at 200 kg N/ha. Hafez (2007) found that dry weight, leaf area index, plant height, number of grains/spike, number of spikelets/spike, number of spikes/m2, weight of 1000-grain, grain yield, straw yield, and grain protein percentage were increased gradually by increasing nitrogen levels from 0 up to 105 kg/fed. Kandil *et al.,* (2011) reported that the highest yield was produced from the N level of 178.5kg /ha (75 kg N/ fed). The combination of mineral fertilizers with

organic manures resulted a significant increase in grain yield of wheat (Kiani *et al,* 2005 and Shah and ahmed 2006). Abd El lattief (2008) found that integrated use of urea and FYM at 75:25 or 50:50 ratio (N basis) had produced maximum yield.

Therefore, the aim of this study was to investigate the effect of nitrogen levels, compost rates, and their interaction on growth, yield, yield components of wheat (Giza 168 cultivar) and some soil properties.

MATERIALS AND METHODS

Two field experiments were carried out at the Experimental Farm of Water Requirements Research Station, Kafr EL-Sheikh governorate, North Delta, Water Management Research Institute, National Water Research Centre, Egypt, during 2007/2008 and 2008/2009 seasons. The experimental design was split plot with four replicates, where the four rates of chemical nitrogen (0, 30, 60, 90 kg N/fed) were distributed in the main plots and four rates of compost (0, 1.5, 3, 4.5 t/fed.) were allocated in the sub plots. The sub plot area was 12 m^2 (3 x 4 m) in both seasons. The chemical nitrogen fertilizers was applied in the form of urea (46.6 % N) in three doses, the first dose (1/5) at sowing, which was incorporated in dry soil, the second dose (2/5) was applied at the first irrigation and the third dose (2/5) at the second irrigation. Before the sowing, the experimental soil was fertilized with 100 kg/fed. of calcium super phosphate (15.5% P_2O_5) during soil preparation. Compost was made from rice straw and animal manure according to the described methods (Abdulla, 2007). Sample of soil was collected from (0-30cm layer) before the soil preparation from the experimental sites in both seasons to determine soil analysis. Soil and compost analysis are prevented in Table (1).

Seeds of the wheat cultivar Giza 168 were sown in the last of November in the first and second seasons respectively. The preceding crop was rice in the two seasons. Seeds were uniformly broadcasted at the rate of 60 kg/fed. The rest of cultural practices were applied as recommended. Surface soil samples (0-30 cm layer) were collected from each plot after harvesting, and then air dried to determine some physical and chemical properties, i.e. particle size distribution which was carried out by the pipette method described by Gee and Bauder(1986), soil bulk density (Pa) and saturated hydraulic conductivity (Ks) as described by Black (1983) in undisturbed samples. Also, chemical properties, i.e. soil pH, electrical conductivity (Ece) and available N, P and K were determined according to the methods described by Page *et al*. (1982).

Table (1): Soil and compost analysis of the experimental soil and compost used.

A: soil analysis.											
Season	EC_e (dS/m)	pH	K_s (cm/hr)	ρ_a (Mg/m^3)	Available (ppm)			Particle size distribution (%)			Texture class
					N	P	K	sand	silt	clay	
1 st	2.03	7.80	0.195	1.16	21.34	11.28	316	20.6	28.1	51.3	clayey
2 nd	1.94	8.10	0.175	1.10	19.60	9.46	354				

B. Compost analysis														
EC_e (dS/m)	pH	O.C (%)	O.M (%)	C/N	Total (%)			ρ_a (Mg/m^3)	Heavy metals and micronutrient (ppm)					
					N	P	K		Cd	Ni	Pb	Mn	Fe	Cu
1.9	7.8	10.8	18.6	11.6	0.931	0.126	0.625	0.66	0.4	0.72	1.1	4.8	9.1	2.8

At heading the following traits were recorded: dry weight of plants (g)/m^2, leaf area index and plant height. At harvest, the following traits were determined: number of tillers/m^2, number of spikes /m^2, number of grains /spike, weight of 1000-grains (g), grain yield (t/fed.) and straw yield (t/fed.). Nitrogen percentage in the grains was determined by using Micro-Kjeldahl method and then multiplied by the factor (5.75) to obtain the grain protein percentage according to A.O.A.C. (1990).

The analysis of variance was carried out according to Gomez and Gomez (1984) for all collected data. Treatment means were compared by Duncan's Multiple Range test according to Duncan (1955). All statistical analysis was performed using analysis of variance technique by means of "MSTATC" computer software package.

RESULTS AND DISCUSSION

A- Growth characters:

Plant dry weight/m^2, leaf area index (LAI), plant height and number of tillers/m^2 of wheat at heading as affected by chemical nitrogen fertilizer and compost in 2007/2008 and 2008/2009 are presented in Table (2).

The data show that increasing chemical nitrogen rate from 0 to 90 kg N/fed resulted in a significant increase in all mentioned growth traits in both seasons. A significant increase in these traits was accompanied with each increment of applied nitrogen. The data revealed that the level of 90 kg N/fed. gave the greatest values of all mentioned growth traits in both seasons, while the unfertilized treatment recorded that the lowest values. Such effect of nitrogen could be attributed mainly to its role in the stimulation of various physiological process including cell division and cell elongation of internodes resulting in more tillers formation, leaf numbers and photosynthetic area (leaf area), which resulted in more photosynthetic production and consequently increased dry matter accumulation per unit area. The promoting effects of nitrogen on growth of wheat was reported by Eissa (1996), Abd El-Maaboud *et al.,* (2006) and Hafez (2007).

Table (2): Growth characters of wheat plants as affected by chemical nitrogen and compost rates application and their interaction during 2007/2008 and 2007/2009seasons.

Treatments	Dry weight (g/m)		Leaf area index		Plant height (cm)		No. of tillers /m^2	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
(Kg N /fed.)								
0	311.95 c	310.62 d	2.00 d	1.78 d	82.45 d	80.88 d	265.04 d	261.05 d
30	373.99 b	397.97 c	2.83 c	2.53 c	93.5 c	91.72 c	291.4 c	287.97 c
60	473.79 a	472.50 b	3.37 b	3.02 b	98.84 b	96.96 b	297.88 b	293.6 b
90	496.23 a	494.6 a	3.47 a	3.47 a	102.67 a	100.7 a	305.02 a	300.53 a
F-test	**	**	**	**	**	**	**	**
Compost(t/fed.)								
0	395.16	393.90 d	2.69 d	2.40 d	90.67 d	88.94 d	281.24 d	277.1 d
1.5	410.82	409.60 c	2.78 c	2.49 c	93.51 c	91.73 c	287.63 c	283.35 c
3	429.36	428.11 b	3.04 c	2.73 b	96.11 b	94.28 b	294.41 b	290.54 b
4.5	420.61	444.04 a	3.15 a	2.83 a	97.17 a	95.31 a	296.06 a	292.21 a
F-test	Ns	**	**	**	**	**	**	**
Interaction	Ns	**	**	**	**	**	**	**

*, ** and ns indicate p <0.05, <0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range test.

The application of compost resulted in a significant increase in leaf area index, plant height and number of tilles/m^2 in both seasons and dry weight in the second season compared with control treatment (without compost). The rate of 4.5 t compost/fed. recorded the highest significant values more than the other rates for these traits. However, the lowest values were obtained from control treatment (without compost). Such effect of compost might have been resulted from the role of compost in enhancing the soil biological activity which improved nutrient mobilization from organic and chemical fertilizers which is closely related to the amount of absorbed nitrogen and then improve translocation of assimilates and thus improve the growth characters. These results were corresponded with those findings by Millner *et al.,* (1998), khalil and ali (2004), Channabasana Gowda (2007), El- shouny *et al* (2008), Ibrahim *et al* , (2008), Gong *et al* (2009), Enke Liu *et al* (2010) and Yassen *et al* (2010).

With regard to the interaction between chemical nitrogen and compost rates, the data in Table (2) show that there are a significant effect on all studied growth character in both seasons, except dry weight in the first season. Moreover, the data in Table (3) showed that the highest significant values were obtained by the application of 60 kg N/fed. with 3 ton compost /fed. for leaf area index, 90 kgN/fed. with 1.5 ton compost /fed. for number of tillers/m^2 and 90 kg N/fed. with 3 ton compost/fed. for plant height in the two seasons. Moreover, it can be noticed that further more application of either nitrogen or compost rates did not significant increase for all those growth characters in both seasons. Data showed that the untreated control gave the lowest values of leaf area index, plant height and number of tillers/m^2. These results might have been resulted from the quickly chemical nitrogen uptake by wheat roots and the role of compost which lead to enhancing the physical and biological soil properties and then may be caused to improving root growth, slowly released nutrients from organic and chemical fertilizers which increasing the amount of absorbed nitrogen and thus improve the translocation of assimilates which results more vegetative growth in wheat plant. Similar results were obtained by Kiani *et al* (2005), Shah and Ahmed (2006) and Abd El lattif (2008).

Table (3): Leaf area index, Plant height and Number of tillers /m2 as affected by the interaction between mineral nitrogen levels and compost rates application during 2007/2008and 2008/2009 seasons.

Treatments		Leaf area index		Plant height (cm)		No. of tillers (N) /m2	
N	C	1st season	2nd season	1st season	2nd season	1st season	2nd season
0	0	1.65i	1.46j	76.7 L	75.2 L	246.1j	242.00i
	1.5	1.80h	1.6i	82.33k	80.8k	260.5i	256.93h
	3	2.19g	1.95h	85.08j	83.5j	275.63h	271.56g
	4.5	2.37f	2.12g	85.70j	84.1j	277.95h	273.73g
30	0	2.46 f	2.2f	89.98i	88.3i	284.9g	281.78f
	1.5	2.63e	2.36e	92.1h	90.4h	290.5f	286.44e
	3	2.97d	2.66d	94.88g	93.1g	294.75e	296.2c
	4.5	3.25c	2.91c	97.05f	95.2f	295.45e	292.1c
60	0	3.23c	2.9c	97.1f	95.3f	292.55ef	288.02de
	1.5	3.27c	2.94c	98.23ef	96.4ef	295.08e	290.07cd
	3	3.49ab	3.13ab	99.68cd	97.8cd	300.35d	296.20 b
	4.5	3.48ab	3.12ab	100.38bc	98.5bc	303.58bc	300.15a
90	0	3.40b	3.05b	98.9de	97.0de	301.43cd	296.48 b
	1.5	3.43ab	3.08ab	101.4b	99.5b	304.45ab	299.96a
	3	3.53a	3.17a	104.83a	102.8a	306.93a	302.33a
	4.5	3.53a	3.17a	105.55a	103.5a	307.28a	303.34a

***, ** and ns indicate p <0.05, <0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range test...**

B- Yield components :

The results in Tables (4&5) show that mineral nitrogen rates, compost rates and its interaction had a significant effect on the yield components (number of spikes/m², number of grains/spike and weight of 1000 grains) in both seasons.

The data in Table (4) revealed that the greatest values of such components were obtained from the application of 90 kg N/fed., but the lowest values of those components were recorded by the untreated plants (control treatment). Such favorable effect of mineral nitrogen on yield components might have been resulted from the quickly mineral nitrogen uptake by plant roots, which increased vegetative growth, photosynthetic area, which resulted in more assimilates products and consequently increased dry matter accumulation and translocation of more photosynthesis to grain. These results are in harmony with those obtained by Sherief *et al*., (1998), Abd El-Maaboud *et al*., (2006), Hussain Iqtidar *et al*., (2006) and Hafez (2007).

There are significant differences in yield components (number of Spikes/m^2, number of grains /spike and weight of 1000 grains) due to the application of compost rates in both seasons. Increasing compost rates from zero up to 4.5 ton/fed. caused a significant increases for all yield components studied. The highest values were recorded from 4.5 ton/fed. followed by 3 ton/fed treatments without significant differences between them in 1000 grain weight in the first season only. Howevere, the lowest values were obtained from the untreated plants (control treatment). These results are confirmed with those obtained by Millner *et al*., (1998), khalil and Ali (2004), Channabasana Gowda (2007), El- shouny *et al* (2008), Ibrahim *et al* , (2008), Gong *et al* (2009), Enke Liu *et al* (2010) and Yassen *et al* (2010).

Table (4): Number of spikes/m^2, number of grains/spike and weight of 1000 grains as affected by chemical nitrogen levels, compost rates application and their interaction during 2007/2008 and 2008/2009 seasons.

Treatments	No. of spikes/m^2		No. of grains		1000 grain weight (g)	
	1st	2nd	1st	2nd	1st	2nd
Kg N /fed.						
0	264.3 d	258.42 d	51.66 d	50.53 d	38.36 d	37.86 d
30	290.8 c	284.12 c	61.09 c	60.02 c	42.87 c	42.65 c
60	296.9 b	290.44 b	63.80 b	63.13 b	46.60 b	45.31 b
90	303.5 a	297.39 a	65.18 a	64.59 a	46.27 a	45.85 a
F-test	**	**	**	**	**	**
Compost (t/fed.)						
0	280.24 d	274.21 d	58.08 d	57.41 d	41.49 c	41.26 d
1.5	286.7 c	280.44 c	59.44 c	58.66 c	42.58 b	42.33 c
3	293.13 b	287.1 b	61.64 b	60.62 b	44.45 a	43.88 b
4.5	295.33 a	288.66 a	62.55 a	61.76 a	44.57 a	44.21 a
F-test	**	**	**	**	**	**
Interaction	**	**	**	**	**	**

*, ** and ns indicate p <0.05, <0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range tests.

Table (5): Number of spikes/m^2, number of grains /spike and weight of 1000 grains as affected by the interaction between chemical nitrogen levels and compost rates application during 2007/2008 and 2008/2009 seasons.

Treatments		No. of spikes /m2		No. of grain /spike		1000 grain weight (g)	
N	C	1st season	2nd season	1st season	2nd season	1st season	2nd season
0	0	245.4j	240.0j	46.99K	46.12k	36.59i	35.95j
	1.5	259.8i	254.0i	50.19J	48.86j	37.69h	37.13i
	3	274.6h	269.0n	53.99I	52.59i	39.04g	38.64h
	4.5	277.3h	271.0n	55.47h	54.54h	40.07f	39.72g
30	0	284.4g	277.8g	58.14g	57.15g	38.92g	39.2gh
	1.5	289.8f	283.2f	59.67f	58.93f	41.89e	41.77f
	3	294.3d	287.9ef	62.89e	61.91e	45.62bcd	44.94de
	4.5	294.8d	288.1e	63.67cde	62.91cde	45.04d	44.7e
60	0	291.4ef	285.2ef	62.99e	62.51de	44.99d	44.67e
	1.5	293.7de	287.7e	63.17de	62.68de	44.97d	45.01de
	3	299.3c	292.8d	64.47bc	63.54bcd	46.14bc	45.64bcd
	4.5	303.1b	296.00bc	64.57bc	63.81bcd	46.32ab	45.94abc
90	0	299.9c	293.9cd	64.22bcd	63.95bcd	45.47cd	45.23de
	1.5	303.5ab	296.8 ab	64.77 bc	64.20bc	45.79bc	45.39cde
	3	304.4ab	299.3a	65.22b	6.4.44b	46.99a	46.29ab
	4.5	306.3a	299.6a	66.52a	65.78a	46.84a	46.48a

*, ** and ns indicate p <0.05, <0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range test.

The interaction between the chemical nitrogen and compost rates had highly significant effect on yield components studied. The application of 90 kg N/fed. combined with 4.5 ton compost/fed. produced the highest significant values of all yield components studied in the two seasons without significant differences with the treatments of 90 kg N/fed. combined with 1.5 or 3 ton/fed. compost in the two seasons and the treatment of 60 kg N/fed combined with 4.5 ton/fed compost in the second season for number of spikes/m2 as well as the treatments of 90 kg N/fed. combined with 3 ton compost/fed. or 60 kg N/fed. combined with 4.5 ton compost /fed. in both seasons for 1000 grain weight. On the other hand, the untreated plants gave the lowest values at all yield components studied in both seasons.

From these results, it can be concluded generally that the highest rate of compost can be improve the yield components This may be attributed to the effect quickly chemical nitrogen uptake by wheat roots and the role of compost which lead to increasing the amount of absorbed nitrogen and thus improve vegetative growth in wheat plant which positively reflect on increasing yield components. These results are in harmony with those obtained by by Sherief *et al*., (1998), Abd El-Maaboud *et al*., (2006), Hussain Iqtidar *et al*., (2006) and Hafez (2007).

C- Grain and Straw yields /fed.

It noticed from the data in Tables (6&7) that the grain and straw yields/fed. had a significant effect by the application of different chemical nitrogen fertilizer and compost rates as well as its interaction in both seasons.

Table (6): Grain and straw yield /fed and protein content as affected by the interaction between chemical nitrogen levels and compost rates application during 2007/2008 and 2008/2009 seasons.

Treatments	Grain Yield (t/fed.)		Straw Yield (t/fed)		Protein content (%)	
	1st season	2nd season	1st season	2nd season	1st season	2ndseason
(Kg N/fed.)						
0	1.77 d	1.75 d	2.74 d	2.81 d	9.39 d	9.42 d
30	2.28 c	2.25 c	3.35 c	3.61 c	10.28 c	10.34 c
60	2.60 b	2.56 b	3.74 b	4.3 b	11.09 b	11.1 b
90	2.77 a	2.72 a	3.81 a	4.28 a	12.02 a	12.00a
F-test	**	**	**	**	**	**
Compost (t/fed.)						
0	2.17 d	2.14 d	3.21 d	3.41 d	9.95 c	9.96 c
1.5	2.29 c	2.26 c	3.33 c	3.62 c	10.56 b	10.59 b
3	2.44 b	2.39 b	3.52 b	3.76 b	11.07 a	11.10 a
4.5	2.53 a	2.49 a	3.58 a	3.96 a	11.20 a	11.22 a
F-test	**	**	**	**	**	**
Interaction	**	**	**	**	Ns	Ns

*, ** and ns indicate $p < 0.05$, < 0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range tests.

Table (7): Grain and straw yields /fed as affected by the interaction between mineral nitrogen levels and compost rates application during 2007/2008 and 2008/2009 seasons.

Treatments		Grain yield (t/fed)		Straw yield (t/fed)	
N	C	1st season	2nd season	1st season	2nd season
0	0	1.43k	1.43k	2.4n	2.28m
	1.5	1.66j	1.66j	2.62m	2.72l
	3	1.84i	1.84i	2.90l	2.91k
	4.5	2.66h	2.66h	3.05k	3.34i
30	0	2.13gh	2.13gh	3.14j	3.45ij
	1.5	2.19g	2.19g	3.17i	3.59hi
	3	2.32f	2.32f	3.47h	3.71gh
	4.5	2.38ef	2.38ef	3.60f	3.78fg
60	0	2.44e	2.44e	3.57g	3.86ef
	1.5	2.52d	2.52d	3.70e	3.95de
	3	2.61bc	2.61bc	3.87a	4.05d
	4.5	2.68b	2.68b	3.82c	4.26bc
90	0	2.58cd	2.58cd	3.73d	4.03d
	1.5	2.69b	2.69b	3.82c	4.22c
	3	2.79a	2.79a	3.84b	4.38ab
	4.5	2.84a	2.84a	3.84b	4.49a

*, ** and ns indicate $p < 0.05$, < 0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range test.

Data presented in Table (6) revealed that the grain and straw yields/fed. were significantly increased with increasing nitrogen rates up to 90 kg N/fed., while the lowest values were obtained by the untreated plants (control). The superiority of grain yield/fed. with increasing N fertilizer rates may be due to the increase of no. of spikes/m^2, no.of grains/spike and 1000 grain weight as recorded in Table (4). Increase of plants dry weight/m^2 associated with increasing N rates may be lead to the increase in straw yield/fed. Similar results were obtained by Sherief *et al*., (1998), Abd El-Maaboud *et al*., (2006), Hussain Iqtidar *et al*., (2006), Hafez (2007), Shaban and Abd El-Rhman (2007) and Kandil *et al*., (2011).

Data in Table (6) revealed that a significant effect was recorded on the grain and straw yield/fed by applying compost rates in the two growing seasons. The greatest value of grain and straw yields/fed. were obtained by applying 4.5 ton compost /fed. followed by 3 and 1.5 ton/fed. in a descending order in both seasons. However, the untreated plants (control) produced the lowest values of the two treats in both seasons. The superior effect of organic compost on grain and straw yields/fed. might be attributed to its beneficial effects on soil physical, chemical and biological properties which caused improving of nutrient availability from both organic and chemical fertilizers which lead to a lot of absorbed nitrogen and this in turn improve the growth, grains and straw attributes and translocation of assimilates to sink organs. These results were confirmed by khalil and Ali (2004), Channabasana Gowda (2007), Abd El lattief (2008), El-shouny *et al* (2008), Ibrahim *et al*, (2008), Gong *et al* (2009), Enke Liu *et al* (2010) and Yassen *et al* (2010).

With regard to the interaction between chemical nitrogen and compost rates on grain and straw yield in both seasons, the data in table (7) show that the wheat plants received the combination of 90 kg N/fed and 3 or 4.5 ton compost /fed. gave the highest values of grain yield in both seasons as well as straw yield/fed. in the second season. However, the application of 60 kg N/fed. combined with 3 ton compost/fed gave the greatest values of straw yield/fed. in the first season. Moreover, it can be noticed that the combination of 60 kg/fed. + compost at rate 4.5 t/fed. have been taken the second place for high productivity of wheat grains, saving about 30 kg N/fed. compared with the combination of 90 kg N/fed +4.5 t/fed. as well as the reduction of environmental pollution of nitrogen. Similar results were obtained by Kiani *et al* (2005), Shah and ahmed (2006) and abd El lattif (2008).

D- protein content :-

Data presented in Table (6) showed the effect of chemical nitrogen and compost rates on protein content. Nitrogen rates had highly significant effect on protein content in both seasons. Increasing nitrogen rate from 0 to 90 kg N/fed. caused a significant increase in protein content. However the lowest values were observed from the untreated wheat plants (control) in the two seasons. These results may be due to the role of nitrogen element absorbed in increasing the nitrogen compounds translocated to the grains which positively increase the protein grain. These results are in agreement with those obtained by other investigators who reported that wheat grain protein content was increased with increasing nitrogen fertilization levels up to 90 kg N/fed. (Allam 2005 and Gafaar 2007).

Concerning the effect of different compost rates on protein content, the data in table (6) showed that the application of 3 or 4.5 t compost /fed gave the highest protein content in the grains without significant differences between them in both seasons. However, the control treatment registered the lowest values of grains protein content in both seasons. These results may be due to the effect of compost in improving nitrogen availability which lead to a lot of

nitrogen absorption and translocation to grains which positively reflect on grain protein. These results were harmony with those obtained by khalil and aly (2004), Channabasana Gowda (2007), abd El lattif (2008), El- shouny *et al* (2008), Ibrahim *et al* , (2008), Gong *et al* (2009), Enke Liu *et al* (2010) and Yassen *et al* (2010).

Regarding to the interaction between the chemical nitrogen and compost rates on the protein content, the data show insignificant effect in both seasons, therefore the data were excluded.

E. Soil characters:

Data in Table 8 indicated that soil salinity (ECe) was significantly increased by increasing nitrogen levels applied up to 90 kg N/fed. but was significantly decreased by increasing compost rates applied up to 4.5 ton/fad. in the two seasons. Also, the interaction between two factors (Table, 9) seemed to be significant in 1st season but non significant in 2nd season. The highest values of ECe (3.32 & 3.20 dS/m) were found when 90 kg N/fed. was applied with 4.5 ton compost/ fed. in 1st and 2nd season, respectively. However, the lowest values of ECe (2.06 &1.90 dS/m) were found with the application of 4.5 ton compost/fed. without nitrogen fertilization (N_0) in 1st and 2nd season, respectively.

Table (8): Some soil properties (0-30cm) as affected by mineral nitrogen level (N), compost rate applied (C) and interaction between them after harvest of wheat crop during 2007/2008 and 2008/2009 seasons.

Treatments		EC_e (dS/m)	PH	Ks (cm./hr)	ρ_a (Mg/m^3)	Available (ppm)		
						N	P	K
1st season								
N	0	2.20 d	7.92	0.379 d	1.26	35.25 d	12.60 d	352.25 d
	30	2.39 c	7.98	0.403 c	1.23	41.70 c	13.18 c	355.75 c
	60	2.65 b	7.89	0.503 b	1.20	44.40 b	13.90 b	373.00 b
	90	3.00 a	7.89	0.555 a	1.02	54.38 a	14.55 a	409.50 a
F-Test		**	ns	**	ns	**	**	**
C	0	2.73 a	8.02 a	0.271 d	1.24 a	33.70 d	12.09 d	364.00 d
	1.5	2.64 a	7.96 a	0.378 c	1.20 ab	42.43 c	12.66 c	369.75 c
	3.0	2.53 b	7.85 b	0.520 b	1.15 bc	46.30 b	13.94 b	375.25 b
	4.5	2.35 c	7.84 b	0.670 a	1.12 c	53.30 a	15.54 a	381.50 a
F-Test		**	**	**	**	**	**	**
Interaction		*	ns	**	*	**	**	**
2nd season								
N	0	2.05 d	7.73	0.348 c	1.29	32.15 d	9.89 d	404.75 d
	30	2.28 c	7.76	0.348 c	1.27	32.65 c	10.96 c	414.25 c
	60	2.59 b	7.81	0.418 b	1.24	37.18 b	12.65 a	431.50 b
	90	2.99 a	7.84	0.438 a	1.19	44.50 a	12.43 b	445.75 a
F-Test		**	ns	**	ns	**	**	**
C	0	2.64 a	7.89 a	0.240 d	1.31	28.50 d	10.63 d	409.75 d
	1.5	2.54 a	7.85 a	0.325 c	1.28	33.80 c	11.23 c	418.25 c
	3.0	2.43 b	7.72 b	0.445 b	1.23	39.73 b	11.75 b	427.25 b
	4.5	2.31 c	7.69 b	0.540 a	1.18	44.45 a	12.33 a	441.00 a
F-Test		**	**	**	ns	**	**	**
Interaction		ns	ns	**	ns	**	**	**

*, ** and ns indicate p <0.05, <0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range test.

Table (9): Some soil properties (0-30cm) as affected by interaction between chemical nitrogen level and compost rate applied after harvest of wheat crop during 2007/2008 and 2008/2009 seasons

Treatments		EC_e (dS/m)	PH	Ks (cm./hr)	ρa (Mg/m^3)	Available (ppm)		
N	C					N	P	K
1st season								
0	0	2.31 fg	8.00	0.225 k	1.32 ab	24.50 n	10.55 i	344 o
	1.5	2.28 fg	7.97	0.331 i	1.28 ab	35.30 l	11.12 h	354 e
	3.0	2.15 gh	7.90	0.440 g	1.25 b	39.00 k	13.55 d	355 k
	4.5	2.06 h	7.80	0.520 e	1.18 bc	42.20 i	15.17 b	356 j
30	0	2.50 def	8.2	0.240 k	1.29 ab	30.10 m	12.00 g	350 n
	1.5	2.45 ef	8.10	0.320 ij	1.25 b	40.20 j	12.50 f	352 m
	3.0	2.30 fg	7.80	0.470 f	1.19 bc	45.80 f	13.20 e	359 i
	4.5	2.29 fg	7.80	0.580 cd	1.17 bc	50.70 e	15.00 b	362 h
60	0	2.78 c	7.94	0.300 j	1.22 b	35.20 l	12.60 f	362 h
	1.5	2.70 cd	7.90	0.380 h	1.20 bc	39.00 k	13.00 e	370 g
	3.0	2.62 cde	7.86	0.570 d	1.19 bc	43.40 h	14.00 c	375 f
	4.5	2.50 def	7.85	0.760 b	1.18 bc	60.00 b	16.00 a	385 e
90	0	3.32 a	7.93	0.320 ij	1.12 bcd	45.00 g	13.20 e	400 d
	1.5	3.11 b	7.87	0.480 f	1.05 cd	55.20 d	14.00 c	403 c
	3.0	3.03 b	7.85	0.600 c	0.98 cd	57.00 c	15.00 b	412 b
	4.5	2.55 de	7.89	0.820 a	0.94 d	60.30 a	16.00 a	423 a
2nd season								
0	0	2.20	7.86	0.200 h	1.35	22.30 k	9.75 k	396 n
	1.5	2.11	7.77	0.310 e	1.32	30.20 i	9.83 k	402 m
	3.0	2.00	7.67	0.400 d	1.28	35.00 g	9.93 jk	409 k
	4.5	1.90	7.63	0.480 bc	1.20	40.10 d	10.05 j	412 j
30	0	2.43	7.90	0.230 g	1.32	25.00 j	10.38 i	407 l
	1.5	2.33	7.86	0.290 ef	1.30	30.00 i	10.84 h	412 j
	3.0	2.25	7.66	0.400 d	1.27	35.40 f	11.05 g	415 i
	4.5	2.12	7.63	0.470 c	1.20	40.20 d	11.57 f	423 g
60	0	2.73	7.86	0.250 g	1.30	30.10 i	11.17 g	415 i
	1.5	2.67	7.83	0.310 e	1.26	34.70 h	12.23 d	425 f
	3.0	2.53	7.79	0.500 b	1.20	38.70 e	13.00 c	433 e
	4.5	2.44	7.75	0.610 a	1.20	45.20 c	14.20 a	453 b
90	0	3.20	7.94	0.280 f	1.25	35.60 f	11.20 g	421 h
	1.5	3.05	7.92	0.390 d	1.22	40.30 d	12.00 e	434 d
	3.0	2.92	7.75	0.480 bc	1.18	49.80 b	13.00 c	452 c
	4.5	2.80	7.73	0.600 a	1.11	52.30 a	13.50 b	476 a

***, ** and ns indicate $p < 0.05$, < 0.01 and not significant, respectively. Means of each treatment followed by the same letter are not significantly different at 5% level, according to Duncan's multiple range test.**

The data in Table (8) indicated that the soil pH values were significantly decreased by increasing compost rate up to 4.5 ton/fed., while insignificantly affected by nitrogen levels applied and the interaction between nitrogen and compost in both seasons.

Saturation hydraulic conductivity (Ks) was significantly affected by the application of nitrogen, compost rates and their interaction in the two seasons. The values of Ks were increased by increasing the rates of nitrogen and compost. This increase was higher for compost than for nitrogen rates. These results are to be expected because the role of organic matter in the compost which modified the soil structure and aggregates. The highest values of Ks (0.820 & 0.600 cm/hr) were obtained using the treatments of 90 kg N/fed. and 4.5 ton compost/fed. in 1st and 2nd season, respectively. However, the lowest values Ks (0.225 &0.200 cm/hr) were found by non application of either nitrogen (N0C0) in 1st and 2nd season, respectively, (Table 9). From these results, it can be concluded that, Saturation hydraulic conductivity(Ks) has negatively related with soil bulk density (ρa) and positively with soil salinity ECe.

Soil bulk density (ρa) was significantly decreased by increasing nitrogen levels in the two seasons. However, the application of compost had a significantly on (ρa) in 1st season only. The lowest values were obtained by the application of 90 kg N/fed and 4.5 t compost/fed. in the two seasons.

The data in Tables 8 and 9 showed that the values of available N, P and K content were significantly increased by increasing nitrogen and compost rate applied. The improvement of plant growth and yield due to organic fertilizers could be attributed to the enrichment of soil with organic matter and therefore, improving soil quality. Similar results were reported by Awad and Griesh (1992). Organic amendments geared towards maintenance of soil organic matter content and fertility (Van Bruggen and Termorshuizen 2003).

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تأثير مستويات السماد النيتروجينى المعدنى ومعدلات الكمبوست على إنتاجية القمح وصفات التربة

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الملخص العربى

أجريت تجربتان حقليتان بالمزرعة البحثية بمحطة بحوث الاحتياجات المائية بكفر الشيخ – معهد بحوث إدارة المياه بشمال الدلتا – المركز القومى لبحوث المياه خلال موسمى ٢٠٠٧/ ٢٠٠٨ ، ٢٠٠٨/ ٢٠٠٩ لدراسة تأثير أربع مستويات من السماد النيتروجينى (صفر،٣٠ ،٦٠ ، ٩٠ كجم أزوت/فدان) و ٤ معدلات من الكمبوست (صفر، ١.٥ ،٣ ،٤.٥ طن/فدان) والتفاعل بينهما على انتاجية صنف القمح جيزة ١٦٨ وقد وزعت المعاملات فى تصميم القطع المنشقه فى أربع مكررات حيث اشتملت القطع الرئسية على مستويات النيتروجين المعدنى بينما أضيفت معدلات الكمبوست فى القطع الشقيه ، وكانت النتائج المتحصل عليها كما يلى :–

١) اظهرت النتائج ان زيادة مستويات النيتروجين من صفر الى٩٠ كجم ن/ فدان ادت الى زيادة معنوية فى صفات الوزن الجاف للنباتات/م٢ ، دليل مساحة الاوراق ، ارتفاع النبات ، عدد الفروع /م² ، عد السنابل/م² ، عدد الحبوب/ سنبله ،وزن الالف حبه ،محصول الحبوب ، محصول القش و محتوى الحبوب من البروتين (%) فى كلا الموسمين . هذا وقد اظهر مستوى ٩٠ كجم ن/فدان اعلى القيم لكل الصفات المدروسه السابقه بالمقارنه بمعاملة الكنترول التى سجلت القيم الدنيا ، فى حين لم يختلف كلا من مستوى ٩٠ ، ٦٠ كجم ن/فدان فى الوزن الجاف فى الموسم الاول فقط معنويا .

٢) سجلت إضافة معدلات الكمبوست اختلافات معنوية فى كل الصفات المدروسة من القمح مثل الوزن الجاف للنباتات/م٢ ، ودليل مساحة الأوراق ، ارتفاع النبات ، عدد الفروع/م² ، عدد السنابل/م² ، عدد الحبوب/سنبله ،وزن الألف حبة ، محصول الحبوب ، محصول القش ومحتوى البروتين فى الحبة (%) فى كلا الموسمين فيما عدا الوزن الجاف فى الموسم الاول . هذا وقد أعطى إضافة الكمبوست بمعدل ٤.٥ طن/ فدان أعلى القيم معنوية فى كل الصفات السابقة المدروسة مقارنة بمعاملة الكنترول الذى أظهرت القيم الدنيا فى حين لم يختلف معدل ٣ طن/فدان معنويا مع معدل ٤.٥ طن/فدان فى محتوى البروتين فى الحبة (%).

٣) اظهر التفاعل بين مستويات السماد النيتروجينى ومعدلات الكمبوست المضافة تأثيرا معنويا فى الوزن الجاف للنباتات/م٢ ، ودليل مساحة الأوراق ، ارتفاع النبات ، عدد الفروع/م² عدد الحبوب/ سنبلة ، وزن الألف حبة ، محصول الحبوب ومحصول القش فى كلا الموسمين فيما عدا صفة الوزن الجاف للنباتات/م٢ فى الموسم الاول ومحتوى البروتين فى الحبة فى كلا الموسمين التى لم تتاثر معنويا بالتفاعل بين مستويات النيتروجين و معدلات الكمبوست.

٤) لم تختلف معنويا إضافة التسميد الازوتى بمعدل ٩٠ كجم ن/فدان مع معدلات اضافة الكمبوست سواء ٣ او ٤.٥ طن/فدان حيث أعطت القيم الأعلى معنوية فى دليل مساحة الأوراق ، ارتفاع النبات ، عدد الفروع /م² ، عدد السنابل/م² ، وزن الألف حبه ومحصول الحبوب/فدان هذا وقد سجلت معامله ٩٠ كجم ن/فدان + معدل كمبوست ٤.٥ طن/فدان أعلى القيم المعنوية فى عدد الحبوب/سنبله فى كلا الموسمين و محصول القش فى الموسم الثانى بينما سجلت معاملة ٦٠ كجم ن/فدان +٣ طن كمبوست أعلى القيم المعنوية لمحصول القش فى الموسم الاول يليها معاملة ٦٠ كجم + ٤.٥ طن كمبوست/فدان والتى اعطت أعلى القيم لمحصول الحبوب فى الموسمين ومحصول القش فى الموسم الثانى .

٥) ادى زيادة معدل التسميد الازوتى حتى ٩٠ كجم ن/ فدان الى زيادة كل من ملوحة التربة والتوصيل الهيدروليكى المشبع والنسبة المئوية للنيتروجين والفسفور والبوتاسيوم الميسرين فى التربة ، بينما لم تتأثر معنويا كل من كثافة التربة الظاهرية ورقم تفاعل التربة فى كل من الموسمين بزيادة مستوى النيتروجين المضاف. هذا وقد ازداد معنويا التوصيل الهيدروليكى المشبع وكذلك النيتروجين والفسفور والبوتاسيوم الميسرين ، بينما انخفضت معنويا كل من ملوحة التربة ورقم تفاعل التربة والكثافة الظاهرية مع زيادة معدل الإضافة من الكمبوست حتى ٤.٥ طن للفدان فى كل من الموسمين. مما يشير الى ان إضافة الكمبوست بمعدل ٤.٥ طن /فدان يعمل على تحسين خواص التربة .

٦) من النتائج السابقة يمكن التوصية بإضافة ٩٠ كجم ن/فدان مع ٣ طن أو بإضافة ٦٠ كجم ن/فدان مع ٤.٥ طن كمبوست /فدان للحصول على اعلى إنتاجية من محصول القمح (صنف جيزة ١٦٨) وذلك تحت ظروف هذه الدراسة.