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Comparison of nitrogen fertilizer sources and rates on growth and productivity of squash plants

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Abstract : Squash (*Cucurbita pepo*) is an important vegetable crop cultivated in Egypt for local market. Field experiment was carried out at Banha City (Qalubia Governorate) to evaluate the effect of different rates of mineral fertilizers (NPK) and organic fertilizer "chicken manure" on the growth and productivity of squash plants. The rates of mineral fertilizers and/or chicken manure were 100%, 75% and 50%. The study revealed that, the highest plant height, leaf number and dry weight of stems were found with 100 N units with the organic source in the two seasons of study. The highest total yield and fruit length and diameter were found by 100 N units when using mineral fertilizer source in the both seasons of study. Furthermore, the highest fruit weight of squash fruits was recorded by using 100 units organic source of fertilizer. The highest N% was found by using 50 units of mineral nitrogen source and the lowest N% was found by using 100 % unit chemical fertilizer source in two seasons. Furthermore, the highest amount of P% was found by 50 units of nitrogen fertilizer with organic nitrogen source. About K%, the highest amount of K % was recorded by using 100 % unit chemical fertilizer.
Key words: Squash (*Cucurbita pepo*), Mineral fertilizers, Chicken manure, Growth, Yield.

Introduction

Squash (*Cucurbita pepo*) is an important vegetable crops cultivated in Egypt for local market. The consumers require a clean and safe product of vegetable fruits. This means that farmers must increase the use organic manure fertilizers instead of chemical fertilizers.

Therefore, organic fertilization is very important for providing the plants with their nutritional requirements without having any undesirable impacts on the environmental issues. For many years ago, organic fertilization has been used basically as a mean of alleviation of the problem of chemical residues in the export market commodities. Organic manures differ in their element contents depending on its sources.

All organic manures improve the behavior of several elements in soils through the active groups such as (fulvic and humic acids), which have the ability to retain the elements over a period of time and are broken down slowly by soil microorganisms. The extent of availability of such nutrients depends on the type of organic materials and microorganism . Also, organic manure which improves the physical properties of the soil, supplies the plants with many nutrients consequently improves the plant growth .

Nitrogen is considered as one of the essential macronutrients required by the plants for their growth, development and yield. Moreover, nitrogen is the main constituent of all amino acids in proteins and lipids that acting as structural compounds of the chloroplast [1].

Nitrogen (N) fertilizer use has played a significant role in increase of crop yield[2,3,4] with study responses of eggplant to different rates of nitrogen under field conditions have reported that fertilization with 100 Kg/ha nitrogen resulted in the highest average fruit weight and fruit yield. [5] have reported that eggplant fruit yield increased with increase in nitrogen up to 187.5 kg/ha.

Many investigators study the effect of organic manure "Chicken manure" on growth and yield of squash and some other vegetable crops [6,7,8, 9,10].

Therefore, this work was conducted to study the effect of nitrogen fertilizer sources and rates on growth and productivity of squash plants.

Material and Methods

Two field experiments were carried out during the two successive seasons of 2014 and 2015 at Banha City (Qalubia Governorate) to evaluate the effect of different sources and rates of mineral fertilizers (NPK) and organic fertilizer "chicken manure" on the growth and productivity of squash plants. The rates of mineral fertilizers and/or chicken manure were 100%, 75% and 50%. The recommended dose for squash plant is 100 N units/fed. Squash seeds were sown in the second week of April in the two seasons, at distances of 40 cm between hills.

The physical and chemical properties of the experimental soil and poultry manure are presented in **Table (1)**.

Table (1): Chemical analysis of the experimental soil and poultry manure.

Characters	2014		2015	
	Soil	chicken manure	Soil	chicken manure
Ph	7.84	7.71	7.82	7.67
E.c (m.mohs)	1.52	1.06	1.46	1.07
Nitrogen %	0.17	2.64	0.19	2.56
Phosphorus %	0.06	1.45	0.08	1.32
Potassium %	0.12	2.19	0.12	2.19
Fe ppm	5224	2725	5198	2690
Zn ppm	371	284	369	292
Mn ppm	822	331	768	322
Cu ppm	35	7.5	37	7.2
Pb ppm	41.5	112	39.5	109

The design of the experiment was split-plot with four replicates, where the poultry manure rates were distributed in the main plots and the bio-fertilizer treatments were arranged in the sub-plots. The drip irrigation system was used in this experiment. The normal agricultural treatments of the growing squash were practiced as usually followed in the commercial production of squash. Poultry manure was added before sowing.

Data recorded:

Samples of four plants were taken at 60 days after sowing and the plant length, number of leaves and stem and fresh weight of leaves, stems and roots were recorded.

Squash fruits were harvested twice every week. At harvest time, the fruit length, diameter and weight, and total weight of fruits in each experimental plot were recorded and the total yield was accounted. Samples of leaves were oven dried at 70 ^{o}C, then fine grounded and wet digested. Total nitrogen, phosphorus and potassium concentration in the tissues of plant leaves were determined according to the methods described by [11,12 ,13] respectively. All the obtained data were subjected to statistical analysis of variance according to the procedure outlined by [14]**.**

Results and Discussion

Vegetative growth characters:

Effect of nitrogen fertilizer rates:

Data in Table (2) show clearly that increasing nitrogen fertilizer rate increased vegetative growth characters (plant length, leaf and stem number , fresh and dry weight of leaves , stems and whole pant). The highest vegetative growth characters were recorded by 100 N units. Meanwhile, the lowest vegetative growth

characters were recorded by 50 N unit poultry manure. These results were true in the two seasons of study. In addition, the stem number was not significantly affected by different Nitrogen fertilizer rates in the first season. Similar result was found by [2,3,15]**.**

Effect of nitrogen fertilizer sources:

As shown in Table (2) using mineral fertilizer source increased significantly the vegetative growth characters (stem number, fresh and dry weight of total plant) except for the plant height in the first season and dry weight of stems in the second one. These results were true in both seasons. These results were coincided with those reported by [5, 16].

Table (2).Effect of nitrogen fertilizer source and rate on vegetative growth characters of squash plants in 2014 and 2015 seasons.

First season

Treatments		Plant length (cm)	Leaf number/ plant	Stem number (cm)	Fresh weight (g)			Dry weight (g)		
					Leaves	Stems	Plant	Leaves	Stems	plant
First season										
Nitrogen fertilizer rate										
100N unit		61.50	30.00	2.05	507.70	90.33	598.03	9.10	6.46	15.56
75 N unit		53.60	26.00	2.00	469.03	75.30	544.33	8.47	5.62	14.09
50 N unit		47.60	22.00	2.05	385.67	66.47	452.14	8.23	4.73	12.95
L.S.D		4.71	3.15	NS	21.87	7.94	36.41	0.42	0.66	1.03
Nitrogen fertilizer source										
Mineral		53.47	25.67	2.13	463.23	77.43	540.66	8.80	5.52	14.32
Organic		55.00	26.33	1.93	445.04	77.30	522.34	8.39	5.69	14.08
L.S.D		1.21	0.67	NS	12.64	NS	11.65	0.26	NS	0.17
Interaction										
100 N unit	**Mineral**	60.00	29.00	2.00	521.63	84.72	606.35	9.40	6.44	15.84
	Organic	63.00	31.00	2.10	493.77	95.94	589.71	8.79	6.48	15.27
75 N unit	**Mineral**	53.20	26.00	2.20	475.65	83.23	558.88	8.50	5.64	14.14
	Organic	54.00	26.00	1.80	462.40	67.37	529.77	8.43	5.60	14.03
50 N unit	**Mineral**	47.20	22.00	2.20	392.40	64.34	456.74	8.50	4.47	12.97
	Organic	48.00	22.00	1.90	378.94	68.60	447.54	7.95	4.98	12.93
L.S.D		3.56	2.14	NS	17.12	5.47	15.59	0.37	0.58	0.76
Second season										
Nitrogen fertilizer rate										
100N unit		62.32	30.83	2.23	520.29	96.62	616.92	9.69	6.56	16.25
75 N unit		52.91	27.13	2.17	474.27	78.74	553.01	8.94	5.56	14.50
50 N unit		45.77	22.48	2.23	395.08	68.23	463.31	8.38	4.86	13.24
L.S.D		5.14	3.01	NS	15.87	9.13	37.18	0.22	0.49	1.02
Nitrogen fertilizer source										
Mineral		52.76	27.16	2.33	474.04	81.27	555.31	9.16	5.68	14.84
Organic		54.58	26.47	2.09	452.39	81.12	533.51	8.85	5.64	14.49
L.S.D		1.11	0.37	NS	17.54	NS	13.68	0.17	NS	NS
Interaction										
100 N unit	**Mineral**	60.53	29.64	2.17	536.87	89.95	626.82	10.06	6.53	16.59
	Organic	64.10	32.02	2.29	503.72	103.30	607.01	9.33	6.58	15.91
75 N unit	**Mineral**	52.44	28.19	2.41	482.15	88.17	570.33	8.99	5.58	14.57
	Organic	53.39	26.07	1.93	466.39	69.30	535.69	8.90	5.53	14.44
50 N unit	**Mineral**	45.30	23.65	2.41	403.09	65.69	468.78	8.43	4.93	13.36
	Organic	46.25	21.31	2.05	387.07	70.76	457.83	8.33	4.80	13.13
L.S.D		6.63	4.15	NS	21.34	4.36	18.19	0.69	0.44	1.09

Effect of interaction:

The data found that the interaction between nitrogen sources and rates (Table 2) significantly affected all vegetative growth characters except for stem number in both seasons of study. The highest plant height, leaf number and dry weight of stems were recorded with 100 N unit combined with organic source in both seasons. The heaviest fresh and dry weights of leaves were recorded with 100 N units with mineral fertilizer in the both seasons of study. Moreover, the lowest values of all vegetative growth characters were recorded by 50 N units with mineral and organic sources of fertilizers in the first season and second seasons.

Total yield and quality.

Effect of nitrogen fertilizer rates:

Data in Table (3) there were significant differences in the total yield and quality, among different rates of nitrogen fertilizer rates in the two seasons of study except for fruit length and diameter which failed to reach the 5% level of significance in the two seasons. The highest total yield and quality of squash fruits were produced by 100 N unit treatments in the two seasons. On the contrary, the lowest total yield and quality of squash fruits plants were produced by 50 N unit of nitrogen fertilizer in the two seasons. These findings held good in both experimental seasons. The results are in agreement with those obtained by [2,3].

Effect of nitrogen fertilizer sources:

Data presented in Table (3) indicated that using mineral and organic nitrogen fertilizer sources increased the total yield and quality of squash fruits. The highest total yield and quality (fruit length, diameter and fruit weight) with using nitrogen chemical fertilizer. However, the lowest value of total yield and quality of squash fruit were found by using organic nitrogen fertilizer. These findings held good in both experimental seasons similar reports were recorded by [5].

Table (3).Effect of nitrogen fertilizer source and rate on yield and quality of squash plants in 2014 and 2015 seasons.

Treatments		Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Total yield (ton/fed)	Fruit length (cm)	Fruit diameter (cm)	Fruit weight (g)	Total yield (ton/fed)
		2014				2015			
Nitrogen fertilizer rate									
100N unit		15.16	3.78	137.62	8.39	14.91	3.47	140.63	8.43
75 N unit		14.59	3.56	131.76	8.06	14.23	3.29	133.66	8.04
50 N unit		14.16	3.49	125.42	7.62	13.71	3.24	126.11	7.51
L.S.D		NS	NS	2.65	0.17	NS	NS	3.87	0.23
Nitrogen fertilizer source									
Mineral		14.75	3.72	131.77	8.11	14.43	3.46	133.68	8.10
Organic		14.51	3.49	131.42	7.93	14.14	3.21	133.26	7.88
L.S.D		NS	NS	NS	0.12	NS	NS	0.37	0.15
Interaction									
100 N unit	**Mineral**	15.56	3.89	137.15	8.54	15.39	3.60	140.08	8.61
	Organic	14.76	3.67	138.08	8.23	14.43	3.34	141.19	8.24
75 N unit	**Mineral**	14.38	3.66	132.45	8.21	13.98	3.51	134.49	8.22
	Organic	14.79	3.45	131.06	7.9	14.47	3.08	132.83	7.85
50 N unit	**Mineral**	14.32	3.61	125.71	7.58	13.91	3.27	126.46	7.47
	Organic	13.99	3.36	125.12	7.65	13.52	3.22	125.76	7.55
L.S.D		NS	NS	3.69	0.43	NS	NS	2.74	0.36

Effect of the interaction

The interaction between Nitrogen sources and rates (Table 3) had significant effects on total yield and quality of squash fruits except for fruit length and diameter failed to reach the 5% level of significance in the

two seasons. The highest total yield was found by 100 N unit Nitrogen fertilizer with using mineral fertilizer source in the both seasons of study. Furthermore, the highest fruit weight of squash fruits was recorded by using 100 nitrogen fertilizer units by organic source of fertilizer. On the other hand, the lowest total yield was found by using 50 Nitrogen units with using mineral fertilizer. Moreover, the lowest quality of squash fruit was found by 50 Nitrogen units with using organic source of fertilizer. These findings held good in both experimental seasons.

Chemical composition of squash fruits.

Effect of nitrogen fertilizer rates:

As presented in Table (4) show that, there were a significant differences in the N, P and K %, among different rates of nitrogen fertilizer rates in both seasons except for P and K% in the first season which failed to reach the 5% level of significance in the first season. The highest N and P % were produced by 50 N unit treatments in the both seasons. On the other hand, the lowest N and P % were produced by 100 N unit of nitrogen fertilizer in the two seasons. Furthermore, the highest amount of K % was found by using 100 units of nitrogen. On the other hand, the lowest value of K% was recorded by using 50 units of nitrogen fertilizer. These findings held good in both experimental seasons. The results are in the similar by [2, 3,17].

Effect of nitrogen fertilizer sources:

Data presented in Table (4) indicated that using mineral and organic nitrogen fertilizer sources had no significant differences on chemical composition of squash fruits except for K% in both seasons of study. The highest value of K% was found by using chemical fertilizer source. However, the lowest value of K% was found by using organic Nitrogen fertilizer sources. These findings held good in both experimental seasons. Similar reports were recorded by [5,18].

Effect of interaction:

Interaction between nitrogen sources and rates (Table 4) had significant effects on chemical content (%) expect for P% in both seasons. The highest N% was found by using 50 units of nitrogen fertilizers by mineral nitrogen source and the lowest N% was found by using 100 % nitrogen fertilizers unit by chemical fertilizer source in both seasons of study. About K%, the highest amount of K % was found by using 100 % nitrogen fertilizers unit by chemical fertilizer. On the contrary, the lowest amount of K % was found by using 50 units of nitrogen fertilizer with organic nitrogen source. These findings held good in both seasons.

Table (4): Effect of nitrogen fertilizer source and rate on chemical analysis of squash plants in 2014 and 2015 seasons.

K%	P%	N%	K%	P%	N%	**Treatments**	
2015			2014				
Nitrogen fertilizer rate							
1.65	0.51	1.44	1.70	0.54	1.44	**100N unit**	
1.55	0.55	1.70	1.62	0.57	1.66	**75 N unit**	
1.54	0.63	1.79	1.61	0.64	1.74	**50 N unit**	
0.07	0.04	0.13	NS	NS	0.11	**L.S.D**	
Nitrogen fertilizer rate							
1.61	0.55	1.63	1.66	0.57	1.60	**Mineral**	
1.55	0.57	1.66	1.61	0.59	1.62	**Organic**	
0.02	NS	NS	0.03	NS	NS	**L.S.D**	
Interaction							
1.68	0.50	1.32	1.72	0.53	1.34	**Mineral**	**100 N unit**
1.62	0.51	1.55	1.67	0.54	1.53	**Organic**	
1.58	0.56	1.72	1.64	0.58	1.67	**Mineral**	**75 N unit**
1.52	0.54	1.68	1.59	0.56	1.64	**Organic**	
1.57	0.60	1.85	1.63	0.61	1.78	**Mineral**	**50 N unit**
1.51	0.66	1.74	1.58	0.66	1.69	**Organic**	
0.06	NS	0.20	0.09	NS	0.06	**L.S.D**	

Conclusion

It could be recommended that, the highest total yield and fruit length and diameter were reported by 100 N unit nitrogen fertilizer with using chemical fertilizer source in the both seasons of study. Furthermore, the highest fruit weight of squash fruits was found by using 100 nitrogen fertilizer units by organic source of fertilizer.

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