ISSN: 0975-833X

Available online at http://www.journalcra.com

SPECIAL ISSUE

International Journal of Current Research
Vol. 3, Issue, 6, pp.295-303, June, 2011

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EFFECT OF MINERAL NITROGEN AND BIOFERTILIZER ON THE PRODUCTIVITY AND QUALITY OF MELON PLANTS IN SOUTH GHOR AREA, JORDAN

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ARTICLE INFO

Article History:
Received 13th March, 2011
Received in revised form
15th April, 2011
Accepted 20th May, 2011
Published online 14th June 2011

Key words:
Biofertilizer,
Cantaloupe,
Melon,
Nitrogen,
Jordan,
Productivity.

ABSTRACT

Two field experiments were conducted at a farm in South Ghor area, Jordan, during the two consecutive summer seasons of 2008 and 2009 to study the effect of nitrogen fertilizer levels, i.e., 0,100 and 200 kg/ha and biofertilizer nitrogen at the rate of 0 and 5.0 kg/ha on growth, productivity and quality of melon (*Cucumis melo* L) cv. Galia especially cultivated under sandy soil conditions and using drip irrigation system in south Ghor area. Results showed that , application of 200 kg/ha of nitrogen significantly increased plant growth i.e., plant length, both number of leaves and branches and leaf area as well as total dry weight for each plant. The uptake of N, P and K by shoots was also increased, early and total yield of fruits/ ha was higher than other levels of nitrogen treatments, while the highest values of TSS in fruits were recorded at 100 kg N/ha. On the other hand, melon plants treated with nitrogen biofertilizer at the rate of 5 kg/ha gave the best results for plant growth and yield and its components as well as fruit quality compared with untreated plants. The interaction between 200 kg/ha and treated plants by nitrogen biofertilizer at 5 kg/ha gave the highest values of total dry weight/ plant , leaf pigments , early and total yield / plant compared to other treatments.

INTRODUCTION

Cantaloupe is an important productive crop in Jordan. The cultivated area has been decreased and become limited because of suddenly wilt disease infection. Cantaloupe (*Cucumis melo* L.) fruit is highly concentrated with excellent levels of beta-carotene, folic acid, potassium, dietary fiber and non-enzymatic antioxidant phytochemicals such as vitamin C. It is also one of the very few fruits that has a high level of vitamin B complex ¾ B1 (thiamine), B3 (niacin), B5 (pantothenic acid), and B6 (pyridoxine) (Lester et al.,1996; Lester *et al.,* 2002).Cantaloupe is also, rich in other human health-bioactive compounds Such as anti-oxidants that can help prevent cancer and heart diseases (Lester, 1997). Nitrogen is one of the major essential element required by vegetables including cantaloupe (*cucumis melo* L). It's a key element attesting plant growth and development. Since it's well known as a major constituents of amino acids, proteins, chlorophylls, nucleic acids and phyotohormones. Many investigators studied the effect of nitrogen levels on plant growth, chemical composition and yield as well as fruit quality of some vegetable crops. The plant growth of squash increased with the increasing in nitrogen rates (Elfstrand *et al.,* 2002; Abd Alla and Knany 2009). The concentrations of Chl. a, Chl. b and carotenes in cucumber leaves increased with increasing rates of N (Lamrani *et al.,* 1996; El-Sayed 1997). Increasing levels up to 148 kg N/ha significantly increased N, P and K contents in cantaloupe plants (Aziz *et al.,* 2002; El-Ashry, 2002; Hasanin, 2007). Average fruit weight, marketable yield and total yield fruit length and fruit diameter of cantaloupe were increase by increasing N rates. (Premalakshmi *et al.,* 1997; Patil *et al.,* 1998) on melon (Akintoye *et al.,* 2002), on cucumber on cucumber (Souza *et al.,*1998; Elfstrand *et al.,*2002; Ferrante *et al.,* 2008; Abd Alla *et al.,* 2009). TSS and flesh thickness were increased by increasing nitrogen levels (Singh *et al.,* 1995; Premalakshmi *et al.,* 1997; Abd Alla *et al.,* 2009).

Biofertlizers have a significant effect on productive traits which are may be due to the effect of using different strain groups as nitrogen fixers, nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted materials and increased levels of extractable N, P, K, Fe, Zn and Mn (El-Karamany *et al.,* 2000; Abdalla *et al.,* 2001; El-Sanafawi 2006; Abd Alla *et al.,* 2009). They found that biofertilizer application improved plant growth parameters (leaf area, leaf dry matter %) , chlorophyll content and N, P and K content in leaf tissue, early yield (weight and number) and total soluble solids%. Therefore, the aim of this study was to evaluate the nitrogen fertilizer and nitrogen biofertilizer on growth, productivity and fruit quality of melon (cantaloupe) plant under sandy soil conditions.

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MATERIALS AND METHODS

Two field experiments were conducted at a farm in South Ghor area, Jordan, during the two consecutive summer seasons of 2008 and 2009. This experiment included 6 treatments; they were the interaction between three rates of nitrogen fertilizers and two rates of nitrogen biofertilizer, i.e, 0, 100 and 200 kg N/ha, while nitrogen biofertilizer was at the rate of 0 and 5 kg/ha. Experimental treatments were randomly arranged in a split plot design with three replications for each. Melon cv Galia was used in this experiment. Three germinated seeds were sown in the hill at 50 cm apart on the north side of the ridge at 20th and 28th March in 2008 and 2009, respectively. After emergence, seedlings were thinned to one plant per hill. The area of the experimental unit was 22.5 m². It contains three lines with 5 m length each and 1.2 m between each two dripper's irrigation lines. One dripper line (row) was used for measuring the vegetative growth characters, while the other dripper line was used for measuring the yield and its components. Microbein was mixed with sand and peatmoss, then added (at three cm depth) beside the plants at 10 days after sowing. The mixture of the abovementioned biofertilizer was covered with sand, then plants were irrigated. Microbein contains *Azotobacter* a nitrogen fixing bacteria. The levels of mineral P and K-fertilizers were: 370 kg calcium super phosphate /ha farmyard manure was added during soil preparation and 240 kg potassium sulphate / ha. The amount of ammonium and potassium sulphates were divided in three equal parts three, six and nine weeks after sowing, The other common agricultural practices, i.e., drip irrigation, pests control and weed control of growing melon plants were carried out.

Data recorded

Plant growth, Morphological characters

A random sample of sex plants was taken from each plot at the flowering stage (50 days after sowing) and following data were recorded .Plant length (main stem length) both number of leaves and branches/ plant and leaf area/leaf.

Dry weight

Different plant parts; i.e., roots and shoots were dried at 70 °C till constant weight and the following data were recorded: Dry weight of roots/ plant, dry weight of shoots/ plant and total dry weight / plant (calculated).

Photosynthetic pigments

Fresh leaf samples were taken from the fourth upper leaf of the plant at 50 days after sowing and chlorophyll a, b as well as carotenoids were determined according to the method described by (Wettestein, 1957).

Nitrogen, phosphorus and potassium content %

The dry weights of shoots were finely ground and wet digested with sulfuric acid and perchloric acid (3:1). Nitrogen, phosphorus and potassium were determined as dry weight basis according to the methods described by (Bremner 1996; Olsen *et al.,* 1982; Jackson 1970), respectively.

Yield and its components

The fruits were picked at full ripe stage i.e., 110-115 days after sowing, where the average number of fruits and the average weight of fruits / plant, early yield and total yield of fruits/ fed was also recorded.

Fruit quality

A random sample of ten fruits was obtained from every plot and physical properties of fruits, i.e., fruit length, width and thickness were recorded. Total soluble solids percentage in fruits was determined using the hand refractometer according to the method described by AOAC (1990).

Statistical analysis

Statistical analysis was conducted for all collected data of the experiment. The analysis of variance was calculated according to Snedecor *et al.* (1980), means separation test was done according to LSD at 0.05 levels.

RESULT AND DISCUSSION

Plant growth

Effect of nitrogen levels

Data in (Table 2) show the effect of nitrogen levels on morphological characters of melon plant in 2008 and 2009 seasons. It is obvious from the data in (Table 2) that the application of nitrogen at the rate of 200 kg/ha had significant effect on plant length, number of leaves, branches and leaf area in both growing seasons. The highest values of plant length (157.4 and 164.9), leaf area (20.48 and 17.00 cm^2/leaf) and number of branches per plant (7.90 and 14.31) in the first and second seasons, respectively were detected from those fertilized 200 kg/ha. On the other hand, the lowest ones (90.0 and 101.3 cm), (13.62 and 12.57 cm^2/leaf) and (6.34 and 6.68 branch/plant) were recorded by those without nitrogen fertilizer in both seasons.

Table 1. Some physical and chemical properties of the experimental soil

Parameter	Value
Sand%	86
Silt%	3.74
Clay %	10.16
Texture	Sandy
pH	7.4
$CaCO_3$%	0.54
EC (dS/m)	3.16
Organic c (g/kg soil)	0.74
Total N (g/kg soil)	0.19
Available N (mg/kg soil)	4.79
Available P (mg/kg soil)	4.62

The necessity of nitrogen for melon growth has been demonstrated by many investigators, since nitrogen supply was described for vegetative growth, dry matter accumulation as well as nutrient uptake. The increase in plant growth may be attributed to the beneficial effects of N on stimulating the merstimatic activity for producing more tissues and organic. Since N play major roles in the synthesis of structural protein and other several macromolecules, in addition to its vital

contribution in several biochemical processes in plant growth (Marschner, 1995). Besides, nitrogen is an important constituent of protoplasm. Also, enzymes, the biological catalytic agents, which speed up life processes, have N as their major constituents (Mengel and Kirkby2001). This indicates the great importance of such elements for enhancing plant growth. These results agree with the results obtained by (Hasanin, 2007) on cantaloupe and (Abd Alla and Knany 2009) on cucumber. They found that increasing of mineral nitrogen levels up to 300 kg /ha led to an increase in vegetative growth parameters (such as plant height, leaf area number of leaf/ plant).

Effect of biofertilizer

Such data in the same Table show that, treated melon plants with nitrogen biofertilizer significantly increased plant length and leaf area in both growing seasons. Plant length and leaf area/ leaf were the highest values when plants treated with 5 kg nitrogen/ha as compared with untreated plants. The superiority of inoculation with biofertilizer might be due to the vital role of bacteria that present in the applied biofertilizer and capable of contributing some hormone substances, i.e., Gibberellins, Auxins and Cytokinins (Tien *et al.,*1979; Bouton *et al.,*1985; Cacciari *et al.,*1989).

Table 2. Effect of nitrogen levels and biofertilizer nitrogen on morphological characters of melon plants in 2007\2008 to 2008\2009 seasons

Treatments	Plant length (cm)	Number of leaves/ plant	Leaf area/ leaf (cm^2)	Number of branches /plant	Plant length (cm)	Number of leaves/ plant	Leaf area/ leaf (cm^2)	Number of branches /plant
	2008 season				2009 season			
kg/ha	Effect of nitrogen levels							
0	90.0	21.0	13.62	6.34	101.3	18.1	12.57	6.68
100	122.6	29.2	16.08	7.72	132.2	24.4	14.97	10.54
200	157.4	30.3	20.48	7.90	164.9	25.3	17.00	14.31
LSD at 0.05 level	11.1	2.8	2.13	1.15	14.1	3.9	2.17	2.14
	Effect of nitrobein levels							
0	116.7	25.9	15.13	7.36	121.9	22.0	13.74	9.22
5	130.0	27.7	18.32	7.28	143.7	23.2	15.95	11.79
LSD at 0.05 level	9.18	NS	2.17	NS	11.1	NS	1.13	1.28

Table 3. Effect of the interaction between nitrogen levels and biofertilizer nitrogen on morphological characters of melon plants in 2007\2008 to 2008\2009 seasons

]Nitrogen levels (kg/ha)	Treatments Biofertilizer nitrogen (kg/ha)	Plant length (cm)	Number of leaves/ plant	Leaf area (cm^2)	Number of branches /plant	Plant length (cm)	Number of leaves/ plant	Leaf area (cm^2)	Number of branches /plant
		2008 season				2009 season			
0	0	81.51	19.5	12.62	5.90	91.67	15.5	11.58	5.84
	5	98.65	22.6	14.62	6.78	111.11	20.7	13.57	7.53
100	0	118.65	28.3	13.84	7.53	120.57	26.3	14.50	8.28
	5	126.56	30.1	18.33	7.91	143.85	22.6	15.45	12.80
200	0	149.95	30.1	18.95	8.66	153.68	24.4	15.15	13.56
	5	164.98	30.5	22.02	7.15	176.28	26.3	18.85	15.06
LSD at 0.05 level		14.93	NS	2.54	NS	20.27	NS	1.54	NS

Table 4. Effect of nitrogen levels and biofertilizer nitrogen on dry weight of melon plants in 2007\2008 to 2008\2009 seasons

Treatments	Dry weight (gm)				Dry weight (gm)			
	Root	Shoots	Total	Relative dry weight (%)	Root	Shoots	Total	Relative dry weight (%)
	2008 season				2009 season			
(kg/ha)	Effect of nitrogen levels							
0	7.31	93.09	100.4	100.00	8.01	91.63	99.64	100.00
100	9.11	120.57	129.67	129.15	9.82	115.08	124.90	125.35
200	10.45	133.68	144.12	143.55	11.94	138.60	150.53	151.07
LSD at 0.05 level	1.14	6.37	7.85	--	1.38	10.25	7.25	--
	Effect of nitrobein levels							
0	8.45	111.71	120.160	100.00	9.61	107.807	117.410	100.00
5	9.46	119.85	129.307	107.61	10.24	122.397	132.637	112.97
LSD at 0.05 level	0.98	3.18	4.35	--	NS	7.18	4.38	--

Table 5. Effect of interaction between nitrogen levels and biofertilizer nitrogen on dry weight of melon plants in 2007\2008 to 2008\2009 seasons

Treatments		Dry weight (gm)				Dry weight (gm)			
Nitrogen levels (kg/ha)	Biofertilizer nitrogen (kg/ha)	Root	Shoots	Total	Relative dry weight (%)	Root	Shoots	Total	Relative dry weight (%)
		2008 season				2009 season			
0	0	6.79	84.95	91.74	100.00	7.36	81.51	88.86	100.00
	5	7.83	101.24	109.06	118.88	8.67	101.76	110.42	124.26
100	0	8.51	120.68	129.19	140.82	10.61	109.47	120.08	135.13
	5	9.71	120.46	130.16	141.88	9.04	120.68	129.72	145.98
200	0	10.06	129.50	139.55	152.11	10.86	132.44	143.29	161.25
	5	10.84	137.86	148.7	162.09	13.02	144.75	157.77	177.55
LSD at 0.05 level		1.40	14.73	10.74	--	2.12	14.00	11.43	--

Table 6. Effect of nitrogen levels and biofertilizer nitrogen on photosynthetic pigments of melon leaves in 2007\2008 to 2008\2009 seasons

Treatments	(mg/gm dry weight)							
	Chl. a	Chlo. b	Chl. (a+ b)	Carotinoids	Chl. a	Chlo. B	Chl. (a+ b)	Carotinoids
	2008 season				2009 season			
(kg/ha)	Effect of nitrogen levels							
0	0.87	0.45	1.31	0.59	0.76	0.40	0.94	0.54
100	1.04	0.57	1.32	0.95	0.92	0.49	1.38	0.67
200	1.38	0.57	1.88	0.92	1.27	0.62	1.71	0.90
LSD at 0.05 level	0.09	0.06	0.11	0.10	0.10	0.09	0.17	0.09
	Effect of nitrobein levels							
0	1.04	0.50	1.34	0.80	0.92	0.48	1.19	0.69
5	1.15	0.56	1.67	0.84	1.04	0.53	1.50	0.71
LSD at 0.05 level	0.06	NS	0.07	NS	0.06	NS	0.11	NS

Table 7. Effect of interaction between nitrogen levels and biofertilizer nitrogen on photosynthetic pigments of melon leaves in 2007\2008 to 2008\2009 seasons

Treatments		(mg/gm dry weight)							
Nitrogen levels	Biofertilizer	Chl. a	Chlo. b	Chl. (a+ b)	Carotinoids	Chl. a	Chlo. B	Chl. (a+ b)	Carotinoids
(kg/ha)	nitrogen (kg/ha)	2008 season				2009 season			
0	0	0.82	0.45	1.06	0.58	0.81	0.41	0.94	0.54
	5	0.93	0.46	1.57	0.61	0.71	0.40	0.95	0.54
100	0	1.04	0.59	1.38	1.11	0.81	0.47	1.26	0.55
	5	1.05	0.55	1.27	0.79	1.03	0.52	1.51	0.79
200	0	1.27	0.47	1.59	0.72	1.16	0.57	1.38	1.00
	5	1.49	0.68	2.17	1.12	1.38	0.67	2.05	0.81
LSD at 0.05 level		0.12	NS	0.18	0.18	0.14	NS	0.22	0.15

Table 8. Effect of nitrogen levels and biofertilizer nitrogen on mineral contents of melon plants in 2007\2008 to 2008\2009 seasons

Treatments	Mineral contents (%)					
	N	P	K	N	P	K
	2008 season			2009 season		
(kg/ha)	Effect of nitrogen levels					
0	1.29	0.317	3.52	1.28	0.289	3.61
100	1.79	0.334	4.09	1.76	0.338	4.30
200	2.59	0.328	4.09	2.48	0.313	4.31
LSD at 0.05 level	0.17	NS	0.23	0.21	NS	0.36
	Effect of nitrobein levels					
0	1.67	0.335	3.79	1.70	0.322	4.06
5	2.11	0.316	4.02	1.98	0.305	4.08
LSD at 0.05 level	0.11	NS	0.14	0.14	NS	NS

Table 9. Effect of interaction between nitrogen levels and biofertilizer nitrogen on mineral contents of melon plants in 2007\2008 to 2008\2009 seasons

Treatments		Mineral contents (%)					
Nitrogen levels	Biofertilizer	N	P	K	N	P	K
(kg/ha)	nitrogen (kg/ha)	2008 season			2009 season		
0	0	1.141	0.362	3.413	1.187	0.295	3.526
	5	1.441	0.271	3.627	1.375	0.283	3.684
100	0	1.593	0.339	4.000	1.582	0.342	4.441
	5	1.992	0.328	4.192	1.952	0.334	4.158
200	0	2.276	0.305	3.944	2.353	0.328	4.226
	5	2.921	0.350	4.238	2.621	0.297	4.407
LSD at 0.05 level		0.23	NS	0.36	0.30	NS	0.54

Table 10. Effect of nitrogen levels and biofertilizer nitrogen on mineral uptake of melon plants in the two seasons

Treatments	Mineral uptake mg/plant					
	N	P	K	N	P	K
	2008 season			2009 season		
(kg/ha)	Effect of nitrogen levels					
0	1309.15	313.83	3543.35	1286.52	287.31	3600.54
100	2325.39	432.44	5311.95	2215.90	421.97	5363.26
200	3759.84	473.04	5902.88	3753.38	469.28	6504.18
LSD at 0.05 level	223.12	54.18	323.18	298.14	58.19	425.14
	Effect of nitrogen levels					
0	2093.64	398.56	4600.85	2108.68	380.93	4840.46
5	2835.96	414.31	5237.94	2728.52	404.78	5471.52
LSD at 0.05 level	197.14	38.14	298.14	217.58	14.92	318.29

These phytohormones may stimulate the cell elongation and development and hence plant growth (Paleg, 1985). Moreover, the activity of these bacteria in the absorption zone of plant roots might improve soil fertility and consequently plant development by N_2–fixation and due to releasing of certain other nutrients; i.e., Fe, Zn and Mn (Bhonde

Table 11. Effect of interaction between nitrogen levels and biofertilizer nitrogen on mineral uptake of melon plants in the two seasons

Treatments		Mineral uptake mg/plant					
Nitrogen levels (kg/ha))	Biofertilizer nitrogen (kg/ha)	N	P	K	N	P	K
		2008 season			2009 season		
0	0	1046.753	332.10	3131.09	1054.768	262.14	3133.20
	5	1571.555	295.55	3955.61	1518.275	312.49	4067.87
100	0	2057.997	437.95	5167.60	1899.666	410.67	5332.75
	5	2592.787	426.92	5456.31	2532.134	433.26	5393.76
200	0	3176.158	425.63	5503.85	3371.614	469.99	6055.44
	5	4343.527	520.45	6301.91	4135.152	468.58	6952.92
LSD at 0.05 level		347.2	64.41	591.3	327.9	86.88	792.1

Table 12. Effect of nitrogen levels and biofertilizer nitrogen on fruit quality of melon in 2007\2008 to 2008\2009 seasons

Treatments	Average fruit weight (kg)	Yield / plant (kg)	Early yield (ton/ha)	Total yield (ton /ha)	Relative yield (%)	Average fruit weight (kg)	Yield / plant (kg)	Early yield (ton/ha)	Total yield (ton /ha)	Relative yield (%)
	2008 season					2009 season				
(Kg/ha)	Effect of nitrogen levels									
0	0.600	0.751	2.108	5.925	100.00	0.600	0.751	2.252	14.125	100.00
100	0.732	0.955	2.724	7.401	124.91	0.741	0.937	2.739	18.150	130.37
200	0.842	1.347	3.655	9.895	167.00	0.839	1.319	3.596	24.213	171.41
LSD at 0.05 level	0.076	0.174	0.194	1.115		0.089	0.114	0.113	0.651	--
	Effect of nitrogen levels									
0	0.693	0.953	2.600	17.722	100.00	0.679	0.924	2.700	17.500	100.00
5	0.757	1.083	3.063	20.515	115.76	0.775	1.082	3.025	20.370	116.52
LSD at 0.05 level	0.032	0.125	0.089	0.970	--	0.064	0.097	0.086	0.418	--

Table 13. Effect of interaction between nitrogen levels and biofertilizer nitrogen on fruit quality of melon in 2007\2008 to 2008\2009 seasons

Treatments		Average fruit weight (kg)	Yield / plant (kg)	Early yield (ton/ha)	Total yield (ton/ha)	Relative yield (%)	Average fruit weight (kg)	Yield / plant (kg)	Early yield (ton/ha)	Total yield (ton /ha)	Relative yield (%)
Nitrogen levels (kg/ha)	Biofertilizer nitrogen (kg/ha)	2008 season					2009 season				
0	0	0.584	0.697	1.832	13.200	100.00	0.577	0.693	3.100	12.147	100.00
	5	0.616	0.806	2.381	16.067	121.70	0.623	0.809	2.410	16.105	132.57
100	0	0.707	0.899	2.511	17.000	128.27	0.701	0.866	2.540	17.052	140.38
	5	0.758	1.011	2.100	19.630	148.68	0.781	1.009	2.900	19.800	162.83
200	0	0.788	1.262	3.440	23.027	174.42	0.759	1.212	3.460	23.222	191.18
	5	0.896	1.432	3.900	26.000	195.83	0.920	1.427	3.732	25.200	207.48
LSD at 0.05 level		0.094	0.212	0.250	1.680	--	0.116	0.163	0.150	0.941	--

Table 14. Effect of nitrogen levels and biofertilizer nitrogen on fruit quality of melon in 2007\2008 to 2008\2009 seasons

Treatments	Fruit length	Fruit width	Thickness (cm)	TSS	Fruit length	Fruit width	Thickness (cm)	TSS
		2008 season			2009 season			
(kg/ha)		Effect of nitrogen levels						
0	9.41	7.88	2.26	11.21	9.35	9.34	2.32	10.83
100	12.01	10.54	2.78	14.69	11.49	11.48	2.80	14.88
200	12.67	12.80	3.80	13.56	12.34	12.89	3.74	13.56
LSD at 0.05 level	0.54	0.63	0.18	0.56	1.17	0.31	0.17	0.54
		Effect of nitrogen levels						
0	11.04	9.72	2.83	13.00	10.77	10.96	2.84	12.75
5	11.69	11.10	3.06	13.30	11.36	11.52	3.07	13.43
LSD at 0.05 level	NS	0.31	NS	0.21	NS	0.21	NS	0.11

Table 15. Effect of interaction between nitrogen levels and biofertilizer nitrogen on fruit quality of melon in 2007\2008 to 2008\2009 seasons

Treatments		Fruit length	Fruit width	Thickness (cm)	TSS	Fruit length	Fruit width	Thickness (cm)	TSS
Nitrogen levels (kg/ha)	Biofertilizer nitrogen (kg/ha)	2008 season				2009 season			
0	0	9.16	6.95	2.26	11.13	9.04	9.16	2.39	10.37
	5	9.67	8.81	2.26	11.30	9.67	9.52	2.26	11.30
100	0	11.56	9.60	2.59	14.31	11.49	11.30	2.59	14.31
	5	12.46	11.49	2.97	15.06	11.50	11.67	3.00	15.44
200	0	12.39	12.62	3.65	13.56	11.78	12.43	3.53	13.56
	5	12.96	12.99	3.95	13.56	12.90	13.36	3.95	13.56
LSD at 0.05 level		0.82	0.84	NS	0.85	1.55	0.47	NS	0.81

*et al.,*1997) through the break down of organic materials in the soil and make these elements in available forms. These results were in agreement with those reported by (El-Karamany *et al.,* 2000; Rizk *et al.,* 2000; Adam 2002; El-Sanafawi 2006; Abd Alla *et al.,* 2009).

Interaction effect

Data in (Table 3) show that the interaction between nitrogen fertilizer levels and biofertilizer nitrogen had significant effect on plant length and leaf area/ leaf, while number of leaves and branches had insignificant affected by interaction treatments in both seasons. The interaction between 200 kg N/ha and plants treated with 5 kg nitrogen / ha gave the highest values of plane length and leaf area/ leaf. On the other hand, the lowest values in this respect were obtained in the control plant treatment. Similar results were observed by (Adam *et al.,* 2002; Abd Alla *et al.,* 2009). They found that, the combination between nitrogen fertilizer and biofertilizer treatment significantly affects the vegetative growth.

Dry weight

Effect of nitrogen level

Data in (Table 4) indicate that the effect of nitrogen fertilizer on dry weight of roots shoots and total dry weight/ plant in both seasons. Dry weight of roots, shoots and total/ plant were significantly increased by increasing nitrogen rates up to 100 kg N/ha, and was insignificantly increased when the rate of nitrogen was increased from 100 to 200 kg/ha, in the first season, with respect to roots dry weight. Total dry weight was increased by about 43.55 and 51.07 % at the rate of 100 kg nitrogen /ha and 29.15 and 25.35 % for nitrogen treatment at 100 m^3/ha compared to the control group in the first and second season, respectively. The stimulative effect of N on the dry weight of plant may be due to physiological role of N which is considered an essential element for building up protoplasm, amino acids and proteins that induce cell division and initiate merestimatic activity (Mengel *et al.,* 2001). These results agree with that's obtained by (Barakat *et al.,* 1998; El-Robae 2002) on tomato (Hasanin, 2007). They found that dry weight of plant significantly increased by application of 300 kg N /ha as compared with the other treatments of 200 and 400 kg N/ha.

Effect of biofertilizer

Data in (Table 4) also, show that fertilization of melon plants with 5 kg nitrogen/ ha significantly increased dry weight of roots, shoots and total dry weight/ plant, except roots dry weight in the second season. The increases of total dry weight were about 7.61 and 12.97 % more than control in the first and second season, respectively. These results agree with those reported by (Barakat *et al.,*1998; Abd Alla *et al.,* 2009).

Interaction effect

Data in (Table 5) show that the interaction between nitrogen fertilizer at 200 /ha and nitrogen at 5 kg/ha significantly increased dry weight of roots, shoots and total dry weight in the two season, without significant differences between 200 kg N (without nitrogen biofertilizer). The increases in total dry weight were about 62.09 and 77.55 % for the interaction between 200 kg N/ha combined with 5 kg Nitrogen /ha more than control treatment in the first and second season, respectively .These results are in harmony with those reported by (Ali *et al.,* 1996; Abd El-Hakeem, 2003) who found that the interaction between bio and mineral fertilizers increased dry weight plant of tomato or pepper plants.

Photosynthetic pigments

Effect of nitrogen fertilizer

(Table 6) illustrates the effect of the nitrogen fertilizer on Photosynthetic pigments during both seasons. Nitrogen rates had significant effect on leaf pigments such as, chlorophyll a, chlorophyll b, total (a+b) and carotenoides in both seasons. The highest values of chlorophyll a, b (a+b) and carotenides were obtained by fertilized melon plants with 200 kg/ha without significant differences between 100kg N/ha with respect chlorophyll b and carotenides in the first season only. It could be suggested that the enhancing effect of nitrogen dose on photosynthetic pigments might be owe much to that it is a constituent molecule of chlorophyll .Moreover , nitrogen is the main constituent of all amino acids and hence of proteins and lipids as glactolipids, acting as a structural components of chloroplast. Correspondingly, an enhancement of protein synthesis and chloroplast formation leads to an increase in chlorophyll and carotene (Marschner, 1995). These results are in harmony with those obtained by (Lamrani *et al.,*1996; El-Sayed 1997) on cucumber (Barakat *et al.,* 1998; El-Robae 2002) who found that concentration of chlorophyll a, b, total (a+b) and carotenoids in leaf tissues of tomato increased with increasing N up to the highest levels (400 kg N/ha *)*.

Effect of nitrogen biofertilizer

As for the effect of nitrogen biofertilizer on photosynthetic pigments data in such Table also show that, melon plants treated with nitrogen had a significant effect on chlorophyll a and total (a+b) in both seasons, while chlorophyll b and carotenides did not affected by nitrogen biofertilizer in both seasons. Application of 5kg/ha Nitrogen recorded maximum values of chlorophyll a and total (a+b) in both seasons. On the other hand, the minimum values in this respect were obtained by untreated plants in both seasons. These results agree with those reported by (Barakat *et al.,* 1998) on tomato, (El-Sanafawi 2006; Abd Alla *et al.,* 2009) who found that, cucumber treated with a biofertilizer produced higher chlorophyll content in its leaves.

Interaction effect

Data in (Table7) show the effect of interaction between nitrogen fertilizer and nitrogen biofertilizer on photosynthetic pigments during both seasons. The interaction between two factors had significant effect on chlorophyll a, total (a+b) and carotenides in both seasons. Fertilized melon plants with 200 kg N/ha and plants treated with 5 kg/ha nitrogen recorded the maximum values of chlorophyll a, total (a+b) and carotenides. On the other hand, the lowest values in this respect were obtained by control plants in both seasons.

Mineral contents

Effect of nitrogen biofertilizer

It is clear from results shown in Table 8 that melon plants treated with nitrogen fertilizer significantly increased nitrogen and potassium content of shoots during two seasons. The highest values of N and K (%) in shoots were obtained by application of 200 kg N/ha in both seasons. However, the tested nitrogen treatments had no affect on phosphorus

content in shoots. On the other hand, the lowest values of these parameters were obtained by unfertilized plants in both seasons. These results agree with those reported by (Soares *et al.,*1985; Midan *et al.,*1986) on tomato plants, who found that N content in leaves increased with increasing N up to the highest used N level.

Effect of nitrogen biofertilizer

With regard the effect of nitrogen biofertilizer on mineral content in shoots, data in such Table show that, application of nitrogen biofertilizer to melon plants had significantly increased N and K% in both seasons, while phosphorus contents in shoot did not affect by nitrogen biofertilizer in both seasons. Nitrogen and potassium percentage were the highest values by treated melon plants with 5 kg nitrogen/ha in both seasons. On the other hand, the lowest values in this respect were obtained from control nitrogen biofertilizer plant treatment in both seasons. The favorable effect of biofertilizer on chemical contents of tomato plant may be due to the fact that non- symbiotic bacteria have the ability to supply the plants with N, certain micronutrients and phytohormones that could stimulate nutrients absorption and photosynthesis and there by increase chemical contents in different plant tissues (Bashan *et al.,* 1997). These results are in harmony with those reported by (Ali *et al.,* 1996; Barakat *et al.,* 1998). They found that inoculation of tomato with Azotobacter, Azosperillum recorded maximum values of N content in leaves.

Interaction effect

The interaction between nitrogen fertilizer and nitrogen biofertilizer had a significant effect on mineral contents in shoot, except phosphors contents in both seasons (Table 9). The results clearly indicate that the combination between 200 kg nitrogen /ha and melon plants treated with 5 kg/ha gave the highest values of nitrogen and potassium percentage in both seasons. While the lowest values were obtained by the control treatments in both seasons. These results are in agreement with those reported by (Ali *et al.,* 1996) on tomato. Who found that fertilization with biofertilizer combined with chemical fertilizers increased N, P and K contents in roots and leaves of tomato.

Nitrogen, phosphorus and potassium uptake
Effect of nitrogen biofertilizer

Data in (Table 10) indicate that fertilization melon plants with nitrogen fertilizer significantly increased N, P and K uptake by shoots during two seasons. Application of 200 kg nitrogen /ha recorded the maximum values of N , P and K uptake by shoots in both seasons without significant differences between 100 kg/ha with respect to phosphorus uptake in both seasons. While, the lowest values of this parameters were obtained by unfertilized plants in both seasons. In this regard,(El-Robae,2002) indicated that N,P and K uptake by roots, stems and leaves of tomato plants increased by increasing N up to the highest levels of 400 kg/ ha.

Effect of nitrogen biofertilizer

As for the effect of nitrogen biofertilizer on NP and K uptake by shoots, the same data in such Table show that, application of nitrogen biofertilizer to melon plants had significantly increased N, P and K uptake in both seasons. Nitrogen, phosphorus and potassium uptake by shoots were the highest values by treated melon plants with 5 kg nitrogen/ha in both seasons. On the other hand the lowest values in this respect were obtained from untreated control plants in both seasons. Biofertlizers have a significant effect may be due to the effect of using different strain groups as nitrogen fixers, nutrients mobilizing microorganisms which help in availability of metals and their forms in the composted materials and increased levels of extractable N, P, K, Fe, Zn and Mn (El-Karamany et al.,2000). These results agreed with those obtained by Hasanin (2007) on melon. He found that addition of nitrogen at the rate of 300 Kg N/ha significantly increased leaf content of N,P and K over any treatments, while the lowest nutrient elements content were found in the control plants. Similar results were obtained by (Aziz and El-Ashary, 2002) on cantaloupe.

Interaction effect

The interaction between nitrogen fertilizer and nitrogen biofertilizer had a significant effect on mineral uptake by shoot in both seasons (Table 11). The results clearly indicate that the interaction between 200 kg nitrogen /ha and melon plants treated with 5 kg/ha recorded the maximum values of nitrogen, phosphorus and potassium uptake in both seasons. While the lowest values in this respect were obtained by the control treatments in both seasons.

Fruit yield

Effect of nitrogen biofertilizer

The results presented in (Table 12) show that average fruit weight, yield / plant, early and total yield /ha significantly increased with the increase of nitrogen fertilization rate. The highest values resulted from the plants fertilized with 200 kg N/ha in both seasons. On the other hand, the lowest values were obtained by plants grown in the control group during 2008 and 2009 seasons. The increases in total yield were about 24.91 and 30.37 % for N at 100 kg/ ha and 67.0 and 71.41 for 200 kg N/ha over the control treatment in the first and second season, respectively. The increase in the average weight of fruits per plant by nitrogen treatments might be attributed to the increase in the growth parameters shown in (Table 2) by nitrogen fertilization. These results agree with the results obtained by Aziz et al. (2002), Hasanin (2007) and Abd Alla et al. (2009) on cantaloupe. They found that fruit weight, fruit number, early and total yield were significantly affected by application of 300 kg N /ha as compared with the other treatments 200 and 400 kg N/ha**.**

Effect of nitrogen biofertilizer

With regard to the effect of nitrogen biofertilizer, data in such Table also show that, nitrogen biofertilizer had significant effect on yield and its components in 2008 and 2009 seasons. Treated melon plants with 5kg nitrogen/ha recorded the maximum values of average fruit weight, yield / plant, early and total yield / ha in two growing seasons. On the other hand, the lowest values were recorded in control plant group. The increases in total yield were about 15.76 and 16.52 % for nitrogen biofertilizer at 5kg nitrogen/ha over the control

treatment in the first and second season, respectively. The positive effects of biofertilizer application on melon fruit yield directly correlated with improving plant growth as dry matter production. These results were in agreement with the results obtained by other researchers on tomato (Moustafa *et al.,* 1990; Terry *et al.,* 1998; Adam *et al.,* 2002; Abd Alla *et al.,* 2009).

Interaction effect

Data in (Table 13) show the effect of interaction between two factors on yield and its components during both seasons. The interaction between nitrogen fertilizer and nitrogen biofertilizer had significant effect on average fruit weight, yield / plant, early and total yield /ha in both growing seasons. The maximum values of average fruit weight, yield / plant, early and total yield/ ha in two growing seasons were obtained by application of 200kg N/ha and melon plants treated with 5 kg/ha nitrogen. On the other hand, the lowest values in this respect were obtained by plants grown in the control group in both seasons. The increases in total yield were about 95.83 and 107.48 % for the interaction between 200 kg N/ha and nitrogen biofertilizer at 5 kg/ha over the control treatment in the first and second season, respectively. These results are in harmony with those reported by (Abd El-Rahman *et al.,* 2001; Adam *et al.,* 2002; Abd Alla *et al.,* 2009).

Fruit quality

Effect of nitrogen level

It is clear from results shown in (Table 14) that adding nitrogen fertilizer significantly increased average fruit length, fruit width, flesh thickness, and TSS (%) compared with zero level of nitrogen in the two seasons. The highest values of average fruit length, fruit width and flesh thickness were obtained by application of 200kg N/ha in both seasons, the best TSS in fruits was recorded by the second rates of nitrogen (100 kg N/ha) in both seasons. On the contrary, the lowest values of these parameters were obtained by unfertilized plants in both seasons. These results agree with obtained by (Aziz *et al.,* 2002; Hasanin, 2007) on cantaloupe (Abd Alla *et al.,* 2009) on cucumber. They found that fruit length, fruit diameter, flesh thickness and TSS significantly increased by application of 300 kg N /ha as compared with the other treatments of 200 and 400 kg N/ha.

Effect of nitrogen biofertilizer

As for the effect of nitrogen biofertilizer on fruit quality after harvesting date, data in Table 14 show that, application of nitrogen biofertilizer had significantly increased fruit width and TSS (%) in both seasons, while fruit length and flesh thickness had no affected by nitrogen biofertilizer in both seasons. Fruit width and TSS were the highest by treated melon plants with 5 kg nitrogen/ ha in both seasons. On the other hand the lowest values in this respect were obtained under zero nitrogen biofertilizer in both seasons. These results are agree with those obtained by Abd Alla et al.(2009) who found that in cucumber, inoculated cucumber plants with biofertilizer produced higher total soluble solids%.

Interaction effect

The interaction between nitrogen fertilizer and nitrogen biofertilizer had a significant effect on quality of fruits such as fruit length, fruit width, and TSS (%). Flesh thickness of fruits did not affect by the combination treatments (Table 15). The results clearly indicate that the combination between 200 kg nitrogen /ha and melon plants treated with 5 kg/ha gave the highest values of fruit length, fruit width, and TSS in both seasons. While the lowest values in this respect were obtained by the control treatments in both seasons. These results are in harmony with those reported by (Abd-El-Rahman 2001; Adam *et al.,* 2002) on cantaloupe who reported that biofertilizer with mineral fertilizers increased TSS and ascorbic acid in melon fruits. Thus, it could be concluded that fertilization of melon plants with 200 kg N/ha combined with biofertilizer nitrogen at 5 kg/ha would be the most promising treatment for increasing productivity and quality under the same conditions.

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