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RESPONSE OF *MORINGA OLEIFERA* TO ORGANIC BIOFERTILIZERS AND MINERAL NPK FERTILIZATIONS

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ABSTRACT: This investigation was conducted to investigate the response of *Moringa oleifera* to compost fertilization at four levels (0, 5, 10 and 15 ton/fed) and bio. and/or mineral NPK treatments [(control, 100% NPK, 75% NPK + phosphorein + Minia Azotein, 50% NPK + phosphorein + Minia Azotein and phosphorein + Minia Azotein (Bio)] on vegetative growth traits, yield and pigments.

The obtained results indicate that, plant height, stem diameter, number of branches, number of pods/plant, number of seeds/pod and seed yield/plant, as well as, pigments were gradually increased by increasing the levels of compost fertilizer. All bio. and/or mineral NPK fertilization treatments significantly increased all the previous parameters. Bio. + 75% NPK dose followed by mineral NPK (full dose) treatments were more effective in this concern.

The highest values for vegetative growth traits, yield and yield components and pigments were obtained due to compost at 15 ton/fed in combination with bio. + 75% NPK dose.

Key words: *Moringa oleifera*, compost, fertilization, NPK, biofertilization, phosphorein, Minia Azotein, vegetative growth.

INTRODUCTION

Moringa oleifera is a fast growing tree which belongs to the moringaceae family. It is one of the most importance traditional multipurpose food plants that is produced and used in many African countries (Amaglo, 2007). Moringa has a great potential to become one of the most economically important crops for the tropics and subtropics considering its use in many fields as a medicine (Peixoto *et al.*, 2011), food (Pontual *et al.*, 2012) and fodder plant. The demand for the plant products has been on ascendancy. However, not much work has been done on its cultivation especially in the different ecological zones

Organic materials are added to soils to improve their physical and chemical properties of macro and micro elements, amino acids, organic acids, sugars and organic matter (Abo El-Fadl *et al.*, 1968). Also, they considered useful substrate for several beneficial microorganisms and holding capacity. Dash and Gupta (2009), Imoro *et al*. (2012), Pahla *et al.* (2013) and Umar (2014) on *Moringa oleifera* found that organic manures treatment led to an increase in vegetative growth and pigments content in the fresh leaves of moringa.

Biofertilizers are considered to be low costs, ecofriendly and renewable sources of plant nutrients than supplementing chemical fertilizers in sustainable agricultural systems. Dash and Gupta (2009) and Asaolu *et al.*

(2012) on *Moringa oleifera* concluded that biofertilizers treatments significantly increased plant height, stem diameter and fresh and dry biomass, as well as, pigments compared to control. Similar results were reported by Ravikumar *et al*. (2011) and El-Quesni *et al*. (2013) on *Jatropha curcas*, Abdou and Ashour (2012) on jojoba seedlings and Abdou *et al.* (2014) on *Populus nigra*.

Many authors studied the effects of mineral NPK fertilization on *Moringa oleifera* as Fagbenro *et al.* (2013); Abdullahi *et al*. (2013) and Umar (2014) who found that supplying plant with NPK (15:15:15) increased plant height, stem diameter, leaf production and fresh and dry biomass as compared with non fertilizer (control). Amin (2013) on *Pinus radiata* and *Robinia pseudoacacia* transplants concluded that mineral NPK fertilizers increased plant height, root length, stem diameter and fresh and dry weights of shoots and roots, as well as, chlorophyll a, b and carotenoids contents in the two plants under investigation.

Moringa can grow well under tropical and subtropical areas; however, fertilization needs to be investigated under the Egyptian conditions. This work aimed to investigate the response of *Moringa oleifera* to organic and bio-mineral fertilization in order to enhance and improve their characteristics.

MATERIALS AND METHODS

This investigation was carried out during the two successive seasons of 2013/2014 and 2014/2015 at the Nursery of Ornamental Plants, Faculty of Agricultural, Mina University to figure out the response of *Moringa oleifera* to organic and bio. and/or mineral fertilization treatments.

The seeds of *Moringa oleifera* were obtained from the Research Center of Medicinal and Aromatic Plant Section, Giza (Egypt) and were sown, in an unheated glasshouse, on January, 27th for the two experimental seasons in 15 cm diameter pots filled with clay/sand soil (1:1 v/v). Plants were transplanted in the experimental field on the first day of March in both seasons. Plants were thinned twice after one and two weeks from transplanting and left one plant/hill.

The experiment was arranged in a randomized complete block design in a split plot design with three replicates. The main plot (A) included for levels of compost (0, 5, 10 and 15 ton/fed), while, the sub plot (B) included five treatments (control, 100% NPK, 75% NPK + Minia Azotein + phosphorein, 50% NPK + Minia Azotein + phosphorein and Minia Azotein + phosphorein). Therefore, the interaction treatments (A×B) were 20 treatments. The experimental unit (plot) was 4×10 m and each contained 4 rows, 1 m apart. The seedlings were cultivated in hills, 1 m apart, therefore, each plot contained 40 plants. The physical and chemical analysis of the used soil in both seasons are determined according to Jackson (1973) and shown in Table (a).

The used compost (called compost El-Neel) was obtained from the Egyptian Co. for Solid Waste Utilization, New Minia city. Compost was added during preparing the soil to cultivation in the two seasons. Physical and chemical properties of the used compost are shown in Table (b).

Mineral NPK was used as 200 kg ammonium nitrate (33.5% N), 150 kg calcium superphosphate (15.5% P_2O_5) and 75 kg potassium sulphate (48% K_2O)/fed for the treatment of 100% NPK. While, 75% NPK was represented by 150, 112.5 and 56.2 kg/fed. Also, 50% mineral NPK was 100, 75 and 37.5 kg/fed of the above mentioned three fertilizers, respectively.

The amounts of NK were divided to three equal batches and added after 3 weeks from transplanting of seedlings and one month thereafter. All amounts of P were added during preparing the soil to cultivation for each season.

Fresh and active biofertilizers, Minia Azotein (M.A.) (containing N-fixing bacteria) and phosphorein (phos.)

Table a. The physical and chemical analysis of the used soil.

Soil Character	Value	Soil Character		Value
Sand %	28.30	**Available P %**		15.12
Silt %	30.70	**Exch. K^+ (mg/100 g soil)**		2.11
Clay %	41.00	**Exch. Ca^{++} (mg/100 g soil)**		31.74
Soil type	Clayey loam	**Exch. Na^+ (mg/100 g soil)**		2.41
Organic matter %	1.62	**DTPA Ext. ppm**	**Fe**	8.54
$CaCO_3$ %	2.09		**Cu**	2.06
pH (1:2.5)	7.83		**Zn**	2.75
E.C. (mmhos/cm)	1.04		**Mn**	8.26
Total N %	0.08			

Table b. Physical and chemical properties of the used compost.

Properties	Values	Properties	Values
Dry weight of 1 m^3	450 kg	**C/N ratio**	14.1-18.5
Fresh weight of 1 m^3	650-700 kg	**NaCl (%)**	1.1-1.75
Moisture (%)	25-30	**Total P (%)**	0.5-0.75
pH (1:10)	7.5-8	**Total K (%)**	0.8-1.0
E.C. (m mhose/cm)	2-4	**Fe (ppm)**	150-200
Total N %	1-1.4	**Mn (ppm)**	25.56
Organic matter %	32-34	**Cu (ppm)**	75-150
Organic carbon %	18.5-19.7	**Zn (ppm)**	150-225

(containing phosphate dissolving bacteria) were obtained from the Laboratory of Biofertilizers, Department of Genetic, Fac. of Agric., Minia Univ. Biofertilizers were applied three times to the soil beside the plants at the rate of 50 cm^3/hill (1 ml 10^7 cells of bacteria). The first dose, for both M.A. and phos. was added 4 weeks from transplanting date and reported 4 weeks thereafter. All other agricultural practices were performed as usual.

Data recorded:

1- **Vegetative growth parameters**:

The following data were recorded on the first week of November in both seasons: plant height (cm), number of branches/plant, stem diameter (cm), leaves fresh weight/plant (kg) and leaves dry weight per plant (g).

2-**Yield and yield components**:

All characters were recorded and calculated in first week of April (2014 and 2015) for each season: number of pods/plant, number of seeds/pod and seed weight/plant (g).

3- Photosynthetic pigments:

The three pigments namely, chlorophyll a, b and carotenoids were determined in the fresh leaves at the middle of branches, during the July, 21^{st} in the two seasons 2014 and 2015 as mg/g f.w. according to Moran (1982).

Statistical analysis: all data were tabulated and statistically analyzed according to MSTAT-C (1986) and the L.S.D. test at 5% was followed to compared between the means.

RESULTS AND DISCUSSION

1-Vegetative growth characters:

Data presented in Tables (1 and 2) show that plant height, stem diameter, number of branches/plant and leaves fresh and dry weights/plant were significantly increased in both seasons due to the use of compost at 5, 10 and 15 ton/fed in comparison with those of control. The increase was gradual by the gradual increase in compost fertilizer levels. The increase in vegetative growth traits due to low, medium and high level of compost over the control reached 9.87, 15.45 and 23.18% for plant height, 6.38, 13.15 and 20.50% for stem diameter, 17.04, 34.07 and 46.90% for number of branches, 10.37, 15.66 and 23.48% for leaves fresh weight/plant and 10.21, 15.44 and 23.17% for leaves dry weight/plant, respectively, in the first season. The results in the second season took similar trend. Similar results were found by Dash and Gupta (2009), Imoro *et al*. (2012), Pahla *et al*. (2013) and Umar (2014) on moringa.

Data presented in Tables (1 and 2) indicate that plant height, stem diameter, number of branches/plant, fresh and dry weights/plant were significantly increased, in both seasons, due to the used of all treatments of bio. and/or mineral NPK fertilization in comparison with unfertilized control. The treatments of mixture biofertilizers (phosphorein + Minia Azotein) + 75% NPK dose followed by mineral NPK (100%) seemed to be more effective than other two treatments. However, significant differences were detected between such two superior treatments for the five vegetative growth characters in the two seasons. These findings go parallel with those of Dash and Gupta (2009) and Asaolu *et al.* (2012) on moringa; Ravikumar *et al*. (2011) on *Jatropha curcas* and Abdou and Ashour (2012) on jojoba regarding the effect of biofertilizers, meantime, Fagbenro *et al.* (2013); Abdullahi *et al.* (2013) and Umar (2014) on moringa, found that NPK treatments increased plant height, stem diameter and fresh and dry biomass.

The interaction between compost and bio. and/or mineral NPK fertilization treatments was significant, in the two seasons for the five characters. The highest values were obtained due to supplying *Moringa oleifera* with compost at 15 ton/fed in combination with bio. + 75% NPK dose or mineral NPK (100%).

2-Yield and yield components:

Data presented in Table (3) during both seasons reveal that the used of compost treatments has pronounced significant effects on number of pods/plant, number of seeds/pod and yield of seeds/plant when compared with untreated ones in the two growing seasons. The highest values of the three parameters resulted from the treatment of 15 ton/fed followed by 10 ton/fed then 5 ton/fed of compost. Similar, results were obtained by Ugbaja (1996) on castor oil, Kayina *et al.* (2012) on senna and Dahmardeh (2012) on roselle plants.

The stimulatory effect of compost treatments on vegetative growth traits and yield of plant may be due to organic manure which gave availability of most nutrients, such stimulation on the uptake of nutrients leads to enhancing the biosynthesis of organic foods and cell division, more carbohydrates and dry matter accumulation (Nijjar, 1985).

Data in Table (3) show that all used fertilization treatments significantly increased in number of pods/plant, number of seeds/pod and seed yield/plant over the control in both seasons. The highest values of number of pods/plant, number of seeds/pod and seed yield/plant were resulted from the treatments of bio. + 75% NPK dose.

The stimulatory effect of biofertilizers and/or mineral NPK may be attributed to the role of NPK on plant physiological processes (Devlin, 1975), also, biofertilizers increase soil available N and P, as well as, other

Table 1. Effect of compost, NPK and biofertilization treatments on plant height (cm), stem diameter (cm) and number of branches/plant of moringa (*Moringa oleifera*, L.) plants, during 2013/2014 and 2014/2015 seasons.

NPK and biofertilization treatments (B)	Compost levels (ton/fed) (A)									
	1st season					2nd season				
	0	5	10	15	Mean (B)	0	5	10	15	Mean (B)
Plant height (cm)										
Control	180	196	204	217	199	198	216	245	260	230
100% NPK	250	275	290	309	281	275	303	348	371	324
Bio. + 75% NPK	268	297	311	334	303	295	327	373	401	349
Bio. + 50% NPK	245	272	285	306	277	270	299	342	367	320
Bio.	220	242	253	269	246	242	266	304	323	284
Mean (A)	233	256	269	287		256	282	322	344	
L.S.D. at 5%	A: 8.68		B: 11.27		AB:22.55	A: 9.98		B: 12.96		AB: 25.92
Stem diameter (cm)										
Control	4.38	4.69	4.98	5.28	4.83	5.69	6.11	647	6.86	6.28
100% NPK	5.06	5.45	5.86	6.31	5.67	7.08	7.63	8.20	8.83	7.94
Bio. + 75% NPK	6.40	6.79	7.21	7.68	7.02	8.96	9.51	10.09	10.75	9.83
Bio. + 50% NPK	5.03	5.31	5.66	5.99	5.50	7.04	7.43	7.92	8.39	7.70
Bio.	4.98	5.26	5.56	5.89	5.42	6.97	7.28	7.78	8.25	7.57
Mean (A)	5.17	5.50	5.85	6.23		7.15	7.59	8.09	8.62	
L.S.D. at 5%	A: 0.11		B: 0.13		AB: 0.26	A: 0.15		B: 0.18		AB: 0.36
Number of branches/plant										
Control	4.03	4.73	5.53	6.17	5.12	4.19	4.92	5.75	6.42	5.32
100% NPK	4.73	5.53	6.23	6.77	5.82	4.97	5.81	6.54	7.11	6.11
Bio. + 75% NPK	4.90	5.83	6.37	7.10	6.05	5.15	6.12	6.69	7.46	6.36
Bio. + 50% NPK	4.53	5.27	6.17	6.67	5.66	4.76	5.53	6.48	7.00	5.94
Bio.	4.40	5.10	6.00	6.50	5.50	4.62	5.36	6.30	6.83	5.78
Mean (A)	4.52	5.29	6.06	6.64		4.74	5.55	6.35	6.96	
L.S.D. at 5%	A: 0.36		B: 0.22		AB: N.S.	A: 0.38		B: 0.23		AB: 0.46

Bio. = Phosphorein + Minia Azotein

Table 2. Effect of compost, NPK and biofertilization treatments on leaves fresh weight/plant (kg) and leaves dry weight/plant (g) of moringa (*Moringa oleifera*, L.) plants, during 2013/2014 and 2014/2015 seasons.

NPK and biofertilization treatments (B)	Compost levels (ton/fed) (A) 1st season					2nd season				
	0	5	10	15	Mean (B)	0	5	10	15	Mean (B)
					Leaves fresh weight/plant (kg)					
Control	3.61	3.93	4.09	4.34	3.99	4.96	5.50	5.73	6.00	5.55
100% NPK	5.51	6.05	6.38	6.80	6.19	7.71	6.29	8.93	9.52	8.11
Bio. + 75% NPK	6.43	7.13	7.47	8.02	7.26	9.00	9.98	10.46	11.23	10.17
Bio. + 50% NPK	5.39	5.99	6.28	6.74	6.10	7.50	8.39	8.79	9.44	8.53
Bio.	4.62	5.09	5.32	5.64	5.17	6.40	7.13	7.45	7.90	7.22
Mean (A)	5.11	5.64	5.91	6.31		7.11	7.46	8.27	8.82	
L.S.D. at 5%	A: 0.15		B: 0.24		AB: 0.49	A: 0.21		B: 0.34		AB: 0.68
					Leaves dry weight/plant (g)					
Control	396.7	431.8	449.8	477.5	439.0	535.5	626.1	652.2	692.0	626.5
100% NPK	550.7	605.1	638.1	679.4	618.3	798.5	877.3	925.3	985.0	896.5
Bio. + 75% NPK	642.6	7.12.2	744.9	798.8	724.6	931.8	1032.7	1080.1	1158.3	1050.7
Bio. + 50% NPK	538.5	597.2	626.7	672.8	608.8	780.0	865.9	908.7	975.6	882.6
Bio.	462.5	509.0	531.6	562.8	516.5	670.6	738.1	770.8	816.1	748.9
Mean (A)	518.2	571.1	598.2	638.3		743.3	828.0	867.4	925.4	
L.S.D. at 5%	A: 15.0		B: 24.8		AB: 49.6	A: 21.8		B: 36.0		AB: 72.0

Bio. = Phosphorein + Minia Azotein

nutrient elements, consequently increase formation of metabolites which encourage the plant vegetative growth and yield or gibberellin and auxins which as a result from inoculation of biofertilizers that encourage the cell division and cell enlargement that increase the biosynthesis and metabolites which consequently increased carbohydrates accumulation in the seeds (Spernat, 1990 and Hauka, 2000).

The interaction between main and sub plot treatments was significant for number of pods/plant, number of seeds/pod and seed weight/plant in both seasons. The highest number of pods/plant (32.73 and 39.28 in both seasons), number of seeds/pod (33.08 and 36.39 in both seasons) and heaviest weight of seeds/plant (148.01 and 205.12 g/plant in both seasons) were obtained by adding compost (15 ton/fed) in combination with bio. + 75% NPK dose as cleared shown in Table (3).

3- Photosynthetic pigments:

The contents of chlorophyll a, b and carotenoids were significantly promoted due to compost treatments, in the two seasons, in comparison with those of untreated plants as shown in Table (4). Compost at 15 ton/fed gave the highest values for chlorophyll a, b and carotenoids followed by compost (10 ton/fed) and then compost (5 ton/fed) in both seasons. These results may be attributed to the increase nutrient elements and/or positive role of Mg that reflect on the chlorophyll content.

In harmony with these results regarding organic fertilization treatments were reported by Abass (2003) on *Rosa hybrida*, Sakr (2005) on senna plants, El-Khateeb *et al.* (2006) and Abdou *et al.* (2007) on *Ficus spp*.

Table 3. Effect of compost, NPK and biofertilization treatments on number of pods/plant, number of seeds/pod and seed weight/plant (g) of moringa (*Moringa oleifera*, L.) plants, during 2013/2014 and 2014/2015 seasons.

NPK and biofertilization treatments (B)	Compost levels (ton/fed) (A)									
	1st season					2nd season				
	0	5	10	15	Mean (B)	0	5	10	15	Mean (B)
	Number of pods/plant									
Control	11.73	15.13	18.21	21.24	16.58	12.90	16.64	20.03	23.36	18.23
100% NPK	20.44	23.46	25.39	28.47	24.44	24.53	28.15	30.47	34.16	29.33
Bio. + 75% NPK	22.59	26.24	29.15	32.73	27.68	27.11	31.49	34.98	39.28	33.22
Bio. + 50% NPK	17.99	21.93	24.95	28.55	23.36	21.59	26.32	29.94	34.26	28.03
Bio.	14.83	18.39	21.44	25.07	19.93	17.80	22.07	25.73	30.08	23.92
Mean (A)	17.52	21.03	23.83	29.21		20.79	24.93	28.23	32.23	
L.S.D. at 5%	A: 0.55		B: 0.46		AB: 0.92	A: 0.66		B: 0.55		AB: 1.10
	Number of seeds/pod									
Control	20.74	22.10	23.46	25.26	22.89	21.81	24.31	25.81	27.79	24.93
100% NPK	24.82	26.52	28.56	30.70	27.65	27.30	29.17	31.42	33.77	30.42
Bio. + 75% NPK	25.84	28.22	29.22	33.08	29.27	28.42	31.04	32.14	36.39	32.00
Bio. + 50% NPK	23.46	25.16	26.86	29.00	26.12	25.81	27.68	29.55	31.90	28.74
Bio.	22.44	24.14	25.50	27.64	24.93	24.68	26.55	28.05	30.40	27.42
Mean (A)	23.46	25.23	26.72	29.14		25.60	27.75	29.39	32.05	
L.S.D. at 5%	A: 0.60		B: 0.99		AB: 1.98	A: 0.66		B: 1.09		AB: 2.18
	Seed weight/plant (g)									
Control	24.89	36.95	47.63	63.10	43.14	30.22	46.92	60.54	80.17	54.46
100% NPK	57.43	76.03	89.49	113.71	84.17	79.62	105.35	124.08	157.58	116.66
Bio. + 75% NPK	69.41	94.19	110.39	148.01	105.50	96.23	130.59	153.01	205.12	146.24
Bio. + 50% NPK	46.85	64.94	81.09	105.65	74.63	64.97	90.05	112.45	146.45	103.48
Bio.	36.61	51.76	65.55	87.66	60.40	50.30	71.72	90.87	121.44	83.58
Mean (A)	47.04	64.77	78.83	103.63		64.27	88.93	108.19	142.15	
L.S.D. at 5%	A: 5.58		B: 4.53		AB: 9.06	A: 6.15		B: 4.98		AB: 9.96

Bio. = Phosphorein + Minia Azotein

Table 4. Effect of compost, NPK and biofertilization treatments on chlorophyll a, b and carotenoids (mg/g f.w.) of moringa (*Moringa oleifera*, L.) plants, during 2013/2014 and 2014/2015 seasons.

NPK and biofertilization treatments (B)	Compost levels (ton/fed) (A)									
	1st season					2nd season				
	0	5	10	15	Mean (B)	0	5	10	15	Mean (B)
	Chlorophyll a (mg/g f.w.)									
Control	2.891	3.036	3.188	3.347	3.116	2.920	3.066	3.220	3.380	3.147
100% NPK	3.158	3.315	3.480	3.654	3.402	3.190	3.348	3.515	3.691	3.436
Bio. + 75% NPK	3.189	3.349	3.516	3.692	3.437	3.221	3.382	3.551	3.729	3.471
Bio. + 50% NPK	3.037	3.188	3.347	3.514	3.272	3.067	3.220	3.380	3.549	3.305
Bio.	2.920	3.066	3.219	3.379	3.146	2.949	3.097	3.251	3.413	3.177
Mean (A)	3.039	3.191	3.350	3.517		3.069	3.223	3.384	3.552	
L.S.D. at 5%	A: 0.111		B: 0.028		AB: 0.056	A: 0.116		B: 0.031		AB: 0.062
	Chlorophyll b (mg/g f.w.)									
Control	0.934	0.982	1.033	1.085	1.009	0.943	0.992	1.043	1.096	1.019
100% NPK	1.032	1.105	1.130	1.188	1.114	1.042	1.116	1.141	1.200	1.125
Bio. + 75% NPK	1.033	1.116	1.170	1.231	1.138	1.043	1.127	1.182	1.243	1.149
Bio. + 50% NPK	0.982	1.033	1.086	1.141	1.061	0.992	1.043	1.097	1.152	1.072
Bio.	0.943	0.992	1.045	1.095	1.019	0.952	1.002	1.055	1.106	1.029
Mean (A)	0.985	1.046	1.093	1.148		0.995	1.056	1.104	1.159	
L.S.D. at 5%	A: 0.038		B: 0.008		AB: 0.016	A: 0.040		B: 0.012		AB: 0.024
	Carotenoids (mg/g f.w.)									
Control	0.993	1.041	1.092	1.146	1.068	1.003	1.051	1.103	1.157	1.079
100% NPK	1.112	1.165	1.191	1.248	1.179	1.123	1.177	1.203	1.260	1.191
Bio. + 75% NPK	1.121	1.172	1.232	1.291	1.204	1.132	1.184	1.244	1.304	1.216
Bio. + 50% NPK	1.042	1.092	1.146	1.201	1.120	1.052	1.103	1.157	1.213	1.131
Bio.	1.003	1.052	1.103	1.156	1.079	1.013	1.063	1.114	1.168	1.090
Mean (A)	1.054	1.104	1.153	1.208		1.065	1.115	1.165	1.220	
L.S.D. at 5%	A: 0.042		B: 0.010		AB: 0.020	A: 0.045		B: 0.009		AB: 0.018

Bio. = Phosphorein + Minia Azotein

In relation to the influence of different biofertilizers and/or mineral NPK treatments, chlorophyll a, b and carotenoids contents was promoted in the two seasons (Table, 4). Obtained data showed that fertilization treatment and control were statistically significant. The highest contents were obtained due to the treatment of bio. + 75% NPK dose. These results may be attributed to the increase in nutrient elements which came as a result from adding NPK or inoculated with bacteria that reflect on chlorophyll content. Similar results were obtained by Ashour (2010) on jojoba and Abdou *et al.* (2014) on *Populus nigra*.

The interaction between compost and bio. and/or mineral NPK fertilization treatments was significant, in both seasons, for chlorophyll a, b and carotenoids contents.

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استجابة المورنجا اوليفيرا للتسميد العضوي والحيوي والمعدني النتروجيني الفوسفوري البوتاسي

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تم إجراء هذا البحث بغرض استقصاء مدى استجابة المورنجا للتسميد بالكمبوست بأربع مستويات (صفر ، ٥ ، ١٠ ، ١٥ طن للفدان) وكذلك التسميد الحيوي و/أو المعدني [(كنترول، ١٠٠ % ن فو بو، الفوسفورين + المنيا أزوتين + ٧٥ % ن فو بو، الفوسفورين + المنيا أزوتين + ٥٠ % ن فو بو، الفوسفورين + المنيا أزوتين (حيوي)].

أوضحت النتائج أن إرتفاع النبات وسمك الساق وعدد الفروع وعدد القرون للنبات وعدد البذور لكل قرن ومحصول البذور للنبات وكذلك الصبغات زاد تدريجياً مع زيادة مستويات سماد الكمبوست.

كل معاملات التسميد الحيوي و/أو المعدني زاد معنوياً كل الصفات السابقة معاملة الحيوي + ٧٥ % ن فو بو متبوعة بمعاملة ١٠٠ % ن فو بو كانتا أكثر تأثيراً في هذا الشأن.

أحسن القيم لصفات النمو الخضري والمحصول ومكوناتة والصبغات تم الحصول عليها من استخدام سماد الكمبوست عند ١٥ طن للفدان مع خليط التسميد الحيوي + ٧٥ % من السماد المعدني.