J. Agric. Sci. Mansoura Univ., 29 (10): 5773 - 5783, 2004

THE PRODUCTIVITY OF JEW'S MALLOW PLANT AS INFLUENCED BY DIFFERENT NK FERTILIZATION

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ABSTRACT

Two field experiments were carried out during the two successive summer seasons of 2002 and 2003 to investigate the effect of 4 levels of nitrogen fertilizer (20, 30, 40, and 50 N unit/fed.) and 4 levels of potassium fertilizer (12, 24, 36 and 48 K unit/fed.) on vegetative growth characters, foliage yield and its some chemical composition of Jew's mallow plant.

The important results could be summarized as follows:

1- Increasing nitrogen fertilizer levels up to 50 N unit/fed. significantly increased vegetative growth and total foliage yield as well as N , P and K contents of its leaves tissue.

2- Increasing the levels of potassium fertilizer addition up to 48 K unit/fed. enhanced vegetative growth characters and total foliage yield as well as increased N, P and K contents in leaves tissue.

3- The vigor vegetative plant growth and the heaviest total foliage yield were associated with the highest nitrogen level (50 N unit/fed.) combined with the highest potassium level (48 K unit/fed.).

INTRODUCTION

Jew's mallow (*Corchorus olitorus* L.) is one of the most popular leafy vegetables grown in Egypt. It is consider a good source of vitamin A and B as well as minerals such as iron, phosphorus, calcium, potassium, sodium and manganese. It is consumed as a fresh vegetable soup, even though, the dried leaves could be used as well.

Nitrogen is highly effective on plant vegetative growth and its yield. However, increasing N-level caused an increase in plant growth of vegetable plants which consequently increased the yield (Shehata et al., 1990 and Ahemd, 2003) on spinach; (Vielemeyer et al., 1991; Walworth et al., 1992 and Ahmed et al., 2004) on Lettuce; (Sharma and Lal, 1991) on radish and (Shawky, 1995) on Jew's mallow .

Moreover, Terashima and Evans (1988); Shawky, (1995) on Jew's mallow.

Moreover, Terashima and Evans (1988) reported that photosynthesis decreased with insufficient nitrogen supply to spinach plants.

As regard to potassium fertilizer, Mengel and Kirkby (1979) mentioned that potassium is considered the third element of major importance in plant growth by affecting the synthesis of simple sugars and starch, the translocation of carbohydrates, the reduction of nitrates and synthesis of protein, particularly in meristemic tissues and the normal cell division. Moreover they stated that potassium not only influences crop

production by enhancing growth and synthetic processes, it is also highly important in raising the disease resistance of many crop species.

Many investigators (Alt, 1987 and Hanafy Ahmed, 1991) pointed out that growth cretirias and yield of spinach plant responded positively to K application.

Agwah and Mahmoud (1994) mentioned that potassium significantly obtained more vigor plant growth and more better yield quality as well as increased the chemical constituents in some vegetables.Silva Junior (1991) and Csizinszky and Schuster (1993) on cabbage, reported that using N+K fertilizers increased both leaves number and the marketable yield.

The aim of present study is to investigate the effect of nitrogen and potassium fertilizers at varied levels on the growth, yield and some chemical composition of Jew's mallow plant.

MATERIALS AND METHODS

Two field experiments were carried out during the two successive summer seasons of 2002 and 2003 at the Experimental Station of the National Research Center, in Shalakan (Kalubia Governorate). The physical and chemical properties of the experimental soil are shown in Table (1).

Table (1): Physical and chemical analysis of the experimental soil (2002 and 2003 seasons).

Physical properties	2002	2003
Soil texture	Clay	Clay
Clay (%)	46.80	48.30
Silt (%)	28.70	28.50
Fine sand (%)	21.50	22.40
Coarse sand (%)	2.68	2.72
Chemical analysis		
Available (K) (mg/100 g soil)	0.61	0.59
Available (P) (mg/100 g soil)	5.82	4.92
Total nitrogen (mg/100 g soil)	138.10	141.80
CL (meq/L.)	1.75	1.83
Co_3 (meq/L.)	4.64	5.15
Na_2Co_3 (meq/L.)	3.75	3.84
$CaCo_3$ (meq/L.)	1.73	1.69
Organic matter (%)	1.87	1.82
So_4 (ppm)	86.30	95.50
EC (mmhos/cm/25°C)	2.58	2.45
PH	7.60	7.70

This work aims to study the effect of nitrogen and potassium fertilizers addition at different levels on the growth and productivity of Jew's mallow plant. Each experiment contained 16 treatments, which were the simple combination between 4 levels of nitrogen (20, 30, 40, and 50 N unit/fed.) and 4 levels of potassium (12, 24, 36 and 48 K unit/fed.). Whereas, nitrogen as ammonium sulphate (20.6%) and potassium as potassium sulphate (48% of K2O) fertilizers were applied to the soil after sowing 3-4 weeks later. Jew's

mallow (*Corchorus olitorus* L.) seeds cv. Balady were sown on the 2nd week of March 2002 and 2003 seasons. The normal agricultural practices took place whenever it was necessary according to the recommendations of the Egyptian Ministry of Agriculture .

The experimental design used in the two successive seasons was split plots design. Whereas, the N levels distributed in main plots, but the K levels occupied the sub-plots. Each sub-plot area was 8.4 m^2 consisted of three ridges, each was 0.7 m in width and 4 m in length. Samples of plants were harvested at 45 days old. Vegetative growth characters, i.e., plant length, leaf number/plant, leaf area/plant, fresh and dry weights of whole plant and its leaves were recorded. Yield and total yield as Kg/m^2 for one cut only or as ton/fed. after 5 cuts of about 4 week intervals were calculated for each treatment . The chemical composition in leaf tissues such as total nitrogen, phosophorus and potassium were analysed in dry matter according to the methods of Black (1983), Troug and Mayer (1939) and Brown and Lilleland (1946), respectively. All the obtained data were statistically analyzed according to Gomez and Gomez (1984).

RESULTS AND DISCUSSION

A- Vegetative growth characters:-

1- Effect of nitrogen fertilizer .

The obtained results in Table (2) showed that vegetative growth of Jew's mallow plant was enhanced by increasing nitrogen fertilizer levels. Plant length, leaf number/plant, leaf area/plant, fresh and dry weight of leaves/plant and whole plant were gradually increased by increasing nitrogen levels up to 50 N units/feddan. Whereas, the highest values of all plant growth characters were obtained with the highest N level .

Table (2): Effect of different levels of nitrogen fertilizer on the vegetative growth characters of Jew's mallow plant during 2002 and 2003 seasons.

Nitrogen levels (unit/fed.)	Plant length (cm)	Leaves/plant				Whole plant	
		Number	Area (cm^2)	Fresh weight (g)	Dry weight (g)	Fresh weight (g)	Dry weight (g)
1st season							
20	33.4	31.8	370.8	14.9	2.6	23.8	8.6
30	37.1	35.4	574.0	20.5	4.3	32.0	14.0
40	41.0	38.4	731.9	27.6	5.1	45.0	15.6
50	44.4	42.9	925.7	32.4	6.9	60.5	19.0
LSD at 5% level	0.1	0.3	23.6	0.7	0.1	0.6	0.2
2nd season							
20	26.7	25.0	210.0	14.3	2.2	21.5	2.9
30	33.1	31.7	341.8	19.0	3.5	27.9	5.9
40	41.1	35.8	514.4	25.4	4.6	43.7	10.6
50	44.1	39.8	660.6	30.0	5.9	58.4	13.6
LSD at 5% level	0.4	0.3	35.7	0.2	0.1	0.3	0.1

The statistical analysis of the obtained data revealed that the differences within different N levels were enough to reach the 5% level. These were true in all plant growth parameters in both two seasons.

It could be concluded that the growth of Jew's mallow plant had a good response to nitrogen fertilization. It is known that increasing the levels of N raise the availability of nutritional elements in the soil solution, which favoured the N, P and K absorption and hence increased plant growth.

Similar trend of the obtained results were reported by Farag and Abdel Aal (1989), Hanafy Ahmed (1991) and El-Gizawy et al. (1992) who found that increasing nitrogen fertilizer levels caused an increase in all vegetative growth parameters of spinach plant. Similarly, Sharma and Lal (1991) and Kolota and Dobromilsk (1985) on radish plant. Salman et al. (2000); Abd El-Rahman et al. (2001); Ahmed (2003) on spinach plant and Ahmed et al. (2004) on lettuce plant. All of them indicated that the values of plant length, leaf number/plant, leaf area/plant, fresh and dry weights of plants were increased with increasing the application of nitrogen fertilizers.

2- Effect of potassium fertilizer.

Data presented in Table (3) indicated that plant length, leaf number, leaf area, fresh and dry weight of whole plant and/or its leaves significantly influenced by increasing potassium levels. The obtained results indicated that potassium fertilizer at the highest level (48 K unit/fed.) gave the highest value of the above mentioned plant growth criterias in both seasons. On the contrary, using potassium fertilizer at 12 K unit/fed. gave the lowest values. These results held good in the two experimental seasons.

The superiority of plant growth under the higher K application may be due to the role of potassium in the enhancement and development the plant tissues by affecting the synthesis of simple sugars and starch, the translocation of carbohydrates, and synthesis the protein. Many workers had a similar trend which supported the obtained data (Alt, 1987) on spinach plant; (Shawky, 1995) on Jew's mallow plant.

Table (3): Effect of different levels of potassium fertilizer on the vegetative growth characters of Jew's mallow plant during 2002 and 2003 seasons.

Potassium levels (unit/fed.)	Plant length (cm)	Leaves/plant				Whole plant	
		Number	Area	Fresh weight	Dry weight	Fresh weight	Dry weight
			(cm^2)	(g)	(g)	(g)	(g)
1st season							
12	37.0	35.6	553.2	21.4	4.2	35.5	13.2
24	38.6	36.6	645.2	23.3	4.5	38.8	13.8
36	39.6	37.6	671.9	24.7	4.9	42.3	14.4
48	40.7	38.6	732.2	25.8	5.4	44.8	15.8
LSD at 5% level	0.3	0.3	16.8	0.3	0.1	0.6	0.2
2nd season							
12	34.2	31.0	372.2	20.1	3.5	33.5	6.7
24	34.8	32.8	389.6	21.3	3.9	36.1	7.8
36	36.4	33.1	440.2	23.2	4.2	39.8	8.7
48	39.6	35.0	524.8	24.2	4.7	42.1	9.7
LSD at 5% level	0.4	0.3	16.8	0.2	0.1	0.2	0.1

3- Effect of the interaction .

As regards to the effect of interaction between nitrogen and potassium levels, results in Table (4) indicated that increasing the level of both nitrogen and potassium fertilizers increased all vegetative growth characters of Jew's mallow plant. Whereas, addition nitrogen fertilizer at 50 N unit/fed. combined with potassium fertilizer at 48 K unit/fed. resulted in the highest values of plant length, leaf number/plant, leaf area/plant, fresh and dry weights of leaves and whole plant.

On the contrary, the lowest values of the above mentioned parameters were recorded with that Jew's mallow plant which supplied with nitrogen fertilizer at 20 N unit/fed. combined with potassium fertilizer at 12 K unit/feddan.

These findings were significant true in both seasons. Similar trend of results were reported by Tremblay and Senecal (1987) , who reported that increasing K rate under high N status enhanced both lettuce leaf area and dry matter accumulation.

Similarly, Silva Junior (1991) and Csizinszky and Schuster (1993) on cabbage, found that fresh weight and yield of plants were increased by increasing N and K levels.

These data demonstrated that the plant response to K application was greater with an abundant N supply. Moreover, it can be suggested that, high physiological activity may occur in the different parts of the plants supplied with high dose of N and K fertilization. This high physiological activity may be important for increasing the ability of roots to supply water and nutrients for long time and maintaining translocation of assimilates and nutrients to the different plant organs.

Table (4): Effect of the interaction between nitrogen and potassium fertilizers at different levels on the vegetative growth characters of Jew's mallow plant during 2002 and 2003 seasons.

1st season								
Nitrogen levels (unit/fed.)	Potassium levels (unit/fed.)	Plant length (cm)	Leaves/plant				Whole plant	
			Number	Area	Fresh weight	Dry weight	Fresh weight	Dry weight
				(cm^2)	(g)	(g)	(g)	(g)
	12	30.3	30.0	275.3	13.2	1.8	20.9	7.5
	24	33.8	31.3	386.3	14.8	2.6	22.9	7.9
20	36	34.2	32.3	399.6	15.5	2.7	24.8	8.1
	48	35.3	33.3	421.9	16.2	3.3	26.5	11.0
	12	36.5	34.0	436.0	17.4	4.0	28.6	12.3
	24	36.5	35.7	594.6	19.5	4.3	31.0	14.3
30	36	37.0	35.8	599.4	21.5	4.4	33.0	14.6
	48	38.2	36.0	666.0	23.2	4.6	35.3	14.9
	12	38.7	37.0	701.6	25.0	4.9	40.3	15.0
40	24	40.7	37.6	715.8	27.2	5.0	45.4	15.1
	36	42.2	38.5	722.2	28.5	5.1	46.2	15.6
	48	42.3	40.3	788.2	29.6	5.3	48.2	16.7
	12	42.4	41.3	799.7	30.1	6.0	52.3	17.9
	24	43.3	42.0	884.1	31.8	6.0	55.8	18.0
50	36	45.0	43.7	966.4	33.4	7.3	65.0	19.5
	48	46.8	44.7	1052.7	34.1	8.3	69.0	20.7
LSD at 5% level		0.6	0.6	33.6	0.7	0.2	1.3	0.3

Table (4) Cont'd

2nd season								
	12	24.2	20.8	174.8	12.8	1.2	17.9	2.0
	24	25.1	25.3	194.5	14.1	2.3	21.1	3.0
20	36	27.7	26.0	225.2	15.2	2.5	22.5	3.0
	48	29.8	27.7	245.6	15.3	2.8	24.3	3.4
	12	29.8	30.7	270.5	15.7	3.0	25.2	3.7
	24	30.3	31.3	274.5	18.1	3.2	26.7	4.4
30	36	33.0	32.0	385.8	20.6	3.7	28.5	6.5
	48	39.5	32.7	436.5	21.8	4.2	31.2	8.9
	12	39.9	34.7	474.1	23.8	4.4	39.7	9.7
40	24	40.6	35.3	508.7	24.9	4.5	43.4	10.7
	36	41.2	36.0	515.8	25.9	4.7	44.1	11.0
	48	42.7	37.3	558.8	27.0	4.9	47.5	11.1
	12	43.0	37.7	569.4	28.0	5.3	51.0	11.5
	24	43.3	39.0	580.7	28.2	5.7	53.2	13.2
50	36	43.8	40.3	633.9	31.2	6.0	64.0	14.2
	48	46.3	42.3	858.3	32.6	6.8	65.5	15.4
LSD at 5% level		0.8	0.6	33.5	0.5	0.1	0.5	0.2

Yield and its some chemical composition .

1- Effect of nitrogen fertilizer .

The obtained results in Table (5) showed that increasing nitrogen fertilizer levels had a great increase in the yield as kg/m^2 and or ton/fed.

However, the highest values of yield were recorded with the highest level of nitrogen application (50 N unit/fed.) in both seasons. Whereas, plants yielded 29.027 and 24.925 ton/fed. in the 1st and 2nd seasons respectively. On the other hand, plants which received N fertilizer at 20 N unit/fed. yielded 15.533 and 13.881 ton/fed. for the same respectively.

Moreover, the statistical analysis of the obtained data showed that the differences within levels of nitrogen were significant at 5% levels in both seasons.

Table (5): Effect of different levels of nitrogen fertilizer on the foliage yield and its some chemical composition of Jew's mallow plant during 2002 and 2003 seasons.

Nitrogen levels (unit/fed.)	Foliage Yield		%		
	(kg/m^2)	(ton/fed.)	N	P	K
1st season					
20	0.971	15.533	2.632	1.094	2.752
30	1.297	20.747	3.040	1.331	3.045
40	1.449	23.187	3.344	1.420	3.180
50	1.814	29.027	3.937	1.699	3.308
LSD at 5% level	0.035	0.599	0.012	0.041	0.008
2nd season					
20	0.868	13.881	2.652	1.135	2.740
30	1.121	17.935	3.068	1.312	3.012
40	1.346	21.533	3.448	1.432	3.188
50	1.558	24.925	4.119	1.581	3.281
LSD at 5% level	0.030	0.270	0.020	0.026	0.022

These results are in harmony with those reported by several investigators (Abd El-Fattah and Sorial, 1988) on lettuce; (El-Gizawy et al.,

1992) on spinach; (Abd El-Rahman et al., 2001) on spinach; (Ahmed, 2003) on spinach; (Ahmed et al., 2004) on lettuce .

For respect to the content of N, P and K of leaves tissues the presented data (Table 5) shows that, their contents were significantly increased by increasing nitrogen fertilizer levels up to 50 N unit/fed. in both seasons. These increments might be attributed to increasing the availability of N and K in soil solution which consequently increased NPK uptake.

The obtained results are in harmony with those reported by (Shafashak and Abo-Sedra, 1990) on lettuce; (Nieuwhof and Jansen, 1993) on radish; (Bakr and Gawaish, 1997) on some leafy vegetables; (Ansary, 1998) on lettuce; (Abd El-Rahman et al., 2001) on spinach; (Ahmed, 2003) on spinach and (Ahmed et al., 2004) on lettuce. All of them found that there was a consistant increase in the concentration of the mineral elements by increasing nitrogen fertilizer rates.

2- Effect of potassium fertilizer .

Data presented in Table (6) indicated that yield as kg/m^2 or as ton/fed. of Jew's mallow were increased with increasing potassium levels up to 48 K unit/fed. in both seasons. Also, content of N, P and K of leaves tissue were increased with increasing potassium levels. These were true in both seasons. These increases were significantly in both seasons. Whereas, the highest foliage yield as well as the highest values of N, P and K in leaf tissues were obtained with potassium addition at level of 48 K unit/fed.

Table (6): Effect of different levels of potassium fertilizer on the foliage yield and its some chemical composition of Jew's mallow plant during 2002 and 2003 seasons.

Potassium levels (unit/fed.)	Foliage Yield		%		
	(kg/m^2)	(ton/fed.)	N	P	K
1st season					
12	1.231	19.693	2.991	1.286	2.952
24	1.324	21.187	3.183	1.346	3.042
36	1.426	22.813	3.294	1.398	3.137
48	1.550	24.800	3.486	1.515	3.157
LSD at 5% level	0.032	0.402	0.012	0.025	0.013
2nd season					
12	1.154	18.456	3.176	1.306	2.973
24	1.179	18.869	3.231	1.342	3.023
36	1.221	19.540	3.406	1.384	3.101
48	1.338	21.409	3.474	1.428	3.124
LSD at 5% level	0.036	0.316	0.016	0.018	0.025

It could be concluded that, the higher content of minerals in leaf tissues may be attributed to that potassium fertilizer enhanced the accumulation of photosynthetic products for increasing the potentiality of plants to accumulate more dry matter. The obtained results are in harmony with those reported by Shawky (1995).

3- Effect of the interaction .

It is clear from the data in Table (7) that increasing both N and K fertilizer levels significantly increased the foliage yield as kg/m^2 or as ton/fed. as well as N, P and K contents of leaves tissue. Whereas, that Jew's mallow plants which received 50 N unit/fed. combined with 48 K unit/fed. recorded the heaviest foliage yield and the highest N, P and K values in leaves tissues.

On the contrary, the poorest foliage yield and the lowest N, P and K content of leaves were recorded with that Jew's mallow plants which supplied the lowest of N and/or K as NK fertilizer. The statistical analysis of the obtained results revealed that the differences among the different interaction treatments concerning the foliage yield, N, P and K contents of leaves tissues were great enough to be significant at 5% levels. These findings were similar in the two experimental seasons and in harmony with those reported by Shawky (1995).

Also, many workers had a similar results which supported that obtained in this script Tremblay and Senecal, 1987; Silva Junior (1991) and Csizinszky and Schuster (1993).

Table (7): Effect of the interaction between nitrogen and potassium fertilizers at different levels on the foliage yield and its some chemical composition of Jew's mallow plant during 2002 and 2003 seasons.

1st season						
Treatments		Foliage Yield		%		
Nitrogen levels (unit/fed.)	Potassium levels (unit/fed.)	(kg/m^2)	(ton/fed.)	N	P	K
	12	0.680	10.880	2.177	0.968	2.412
	24	0.907	14.507	2.567	1.033	2.665
20	36	1.073	17.173	2.860	1.184	2.951
	48	1.223	19.573	2.925	1.188	2.981
	12	1.247	19.947	2.930	1.250	3.011
	24	1.267	20.267	2.951	1.339	3.041
30	36	1.297	20.747	3.042	1.351	3.052
	48	1.377	22.027	3.237	1.384	3.086
	12	1.397	22.347	3.269	1.401	3.162
	24	1.417	22.667	3.302	1.409	3.177
40	36	1.450	23.200	3.334	1.429	3.187
	48	1.533	24.533	3.471	1.441	3.192
	12	1.600	25.600	3.587	1.523	3.222
	24	1.707	27.307	3.913	1.601	3.282
50	36	1.883	30.133	3.939	1.625	3.357
	48	2.067	33.067	4.309	2.046	3.368
LSD at 5% level		0.064	0.805	0.024	0.051	0.025

Table (7) Cont'd.

2nd season						
Treatments		Foliage Yield		%		
Nitrogen levels (unit/fed.)	Potassium levels (unit/fed.)	(kg/m²)	(ton/fed.)	N	P	K
20	12	0.830	13.280	2.467	1.056	2.635
	24	0.867	13.867	2.480	1.068	2.643
	36	0.881	14.096	2.789	1.193	2.816
	48	0.893	14.283	2.873	1.223	2.866
30	12	1.084	17.344	2.990	1.272	2.896
	24	1.098	17.573	3.055	1.295	2.996
	36	1.136	18.171	3.094	1.319	3.069
	48	1.166	18.651	3.133	1.362	3.087
40	12	1.307	20.912	3.312	1.415	3.107
	24	1.321	21.141	3.312	1.432	3.177
	36	1.364	21.824	3.530	1.435	3.230
	48	1.391	22.256	3.640	1.446	3.237
50	12	1.393	22.288	3.936	1.481	3.253
	24	1.431	22.896	4.079	1.573	3.275
	36	1.504	24.069	4.212	1.589	3.290
	48	1.903	30.448	4.251	1.681	3.305
LSD at 5% level		0.072	0.633	0.031	0.035	0.051

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تأثير إضافة مستويات مختلفة من الأسمدة النيتروجينية والبوتاسية على إنتاجية نبات الملوخية

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أجريت تجربتان حقليتان بمزرعة المركز القومى للبحوث بشلقان – محافظة القليوبية فى عامين متتاليين ٢٠٠٢ ، ٢٠٠٣ لدراسة استجابة نبات الملوخية لإضافة كلا من التسميد النيتروجينى (٢٠، ٣٠، ٤٠، ٥٠ وحدة نيتروجين/فدان) والتسميد البوتاسى (١٢، ٢٤، ٣٦، ٤٨ وحدة بوتاسيوم/فدان) على صفات النمو والمحصول البيولوجى وبعض الصفات الكيميائية (نيتروجين، فوسفور ، بوتاسيوم) لنبات الملوخية.

وتضمنت أهم النتائج مايلى :-

١-أدت زيادة مستويات التسميد النيتروجينى المضافة إلى تحسن ملحوظ فى صفات النمو الخضرى لنبات الملوخية معبراً عنه بطول النبات، عدد الأوراق/ نبات ، مساحة الأوراق /نبات، الوزن الغض والجاف لكلا من الأوراق /نبات، والنبات الكلى وكذا المحصول البيولوجى (محصول الأوراق والمحصول الكلى).

٢-زاد محتوى الأوراق من النيتروجين والفوسفور والبوتاسيوم مع زيادة مستويات التسميد الأزوتى المضافة.

٣-أدت زيادة مستويات التسميد البوتاسى إلى تحسن واضح فى صفات النمو الخضرى لنبات الملوخية متمثلة فى طول النبات ، عدد الأوراق/نبات ، مساحة الأوراق/ نبات، الوزن الغض والجاف لكلا من الأوراق /نبات والنبات الكلى وكذلك المحصول البيولوجى بالاضافة إلى زيادة محتوى أوراق النبات من النيتروجين والفوسفور والبوتاسيوم.

٤-أدى استخدام التسميد النيتروجينى بمستوى ٥٠ وحدة نيتروجين / فدان مضافاً معه التسميد البوتاسى بمستوى ٤٨ وحدة بوتاسيوم/فدان إلى الحصول على أفضل النتائج فى صفات النمو الخضرى والمحصول وكذلك محتوى الأوراق من النيتروجين والفوسفور والبوتاسيوم مقارنة بالتسميد النيتروجينى بمستوى ٢٠ وحدة نيتروجين/فدان مضافاً معه التسميد البوتاسى بمستوى ١٢ وحدة بوتاسيوم /فدان.