RESPONSE OF ONION PRODUCTIVITY TO POTASSIUM FERTILIZER MANAGEMENT METHODS IN CALCAREOUS SOILS

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ABSTRACT

A two-year field experiment was conducted on onion crop (variety Giza 20) at Nubaria agricultural Research Station farm during 2003/2004 and 2004/2005 winter seasons to examine the effect of potassium fertilizer rates and time of application on total and marketable onion bulb yields, yield components and quality parameters in the calcareous soils of Nubaria region. A randomized complete blocks design (RCBD) with four replicates was used to conduct this experiment. The tested potassium treatments were K_1: without K-application (control); K_2 and K_3: 24 and 48kg K_2O/fed applied during land preparation; K_4 and K_5: 24 and 48kg K_2O/fed applied in two equal doses, 2- and 3-month after transplanting; and K_6 and K_7: 24 and 48kg K_2O/fed applied 3 months after transplanting.

The main results could be summarized as follows:

1- *Increasing potassium application rate to 48kg K_2O/fed had a significant effect on the obtained total yield in both seasons.*
2- *The highest total bulb yields of 18.59 and 21.44t/fed were obtained from the highest k-fertilizer rate (48kg K_2O/fed) applied 3-month after transplanting (i.e. K_7 treatment) in the 1st and 2nd seasons, respectively.*
3- *The highest marketable yields of 17.378 and 16.808t/fed, in the 1st season, and 19.398 and 21.283t/fed, in the 2nd season, were obtained from applying high K-fertilizer rate either in two splits (i.e. K_5 treatment) or late in the growing season (i.e. K_7 treatment).*
4- *There were no significant differences among the marketable yields obtained from K_3, K_5 and K_7 treatments in the 2003/2004 season.*
5- *Increasing K-fertilizer rate increased bulb weight, plant height and no. of leaves/plant.*
6- *Increasing K-fertilizer rate decreased no. of days to maturity, increased TSS values and had minor effect on onion storability.*
7- *The results revealed, in general, that applying high K-fertilizer rate (48kg K_2O/fed) resulted in highest marketable yield in the newly reclaimed calcareous soils at Nubaria region.*

Key words: Onion Potassium calcareous

INTRODUCTION

Egypt has an area of about one million square kilometers or 238 million feddans (one feddan = 0.42 ha). The total agricultural land in Egypt amounts to nearly 8.4 million feddans (3.5 million ha) and accounts for around 3.5 percent of the total area. About 420 thousand ha are sandy and calcareous. This land is located mainly on both the east and west sides of the Delta and scattered over various areas in the country. Levels of available phosphorus, potassium and micronutrients are fairly low on calcareous and sandy soils (FAO, 2005). Calcareous soils are soils rich of calcium carbonate. Potential productivity of calcareous soils is high where adequate water and nutrients can be supplied. The management of water and nutrients is the main production challenge. The high pH level in calcareous soils results in unavailability of phosphate (formation of unavailable calcium phosphates as apatite) and sometimes reduced micronutrient availability, e.g., zinc and iron (lime induced chlorosis). There may be also problems of potassium and magnesium nutrition as a result of the nutritional imbalance between these elements and calcium (FAO/AGL, 2000).

In calcareous soils, an imbalance between plant available Mg, Ca, and K ions may lead Mg and/or K deficiencies to crops (Hagin and Tucker, 1982). Marschner (1995) and Obreza et al. (1993) stated that, improved nutritional management is required to grow crops successfully on calcareous soils. Crops fertilizer management on calcareous soils differs from that non-calcareous soil because of the effect of soil pH on soil nutrient availability and chemical reactions that affect the loss or fixation of some nutrients. The presence of $CaCO_3$ directly or indirectly affects the chemistry and availability of nitrogen, phosphorus, magnesium, potassium, manganese, zinc, copper and iron. Marschner (1995) stated that potassium is involved in many aspects of the plant physiology: 1) activates more than 60 enzyme systems, 2) aids in photosynthesis, 3) maintains cell turgor, 4) regulates opening of leaf stomata, 5) promotes water uptake, 6) regulates nutrients translocation in plant, 7) favors carbohydrate transport and storage, 8) enhances N uptake and protein synthesis, and 9) promotes starch synthesis. He indicated also that high Ca levels in calcareous soils suppress Mg and K uptake by crops.

In Egypt, the annual area cultivated by onion varies from 150 to 200 thousand feddans with an average production of 10 t/fed. The newly reclaimed lands at Nubaria region produce about 12% of total onion production. It is expected that this region will be the main production area for onion crop due to the infestation by white rot disease in Upper Egypt and some Delta governorates.

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Geetha et al. (2000) investigated the effect of different rates of farmyard manure (0, 12.5 and 25.0t/ha) and K-fertilizer levels (0, 50, 100 and 200kg/ha) on the yield and nutrition of onion. Their results showed that, FYM and K fertilizers significantly increased the shoot and bulb yields of onion. FYM at 25t/ha and 200kg K/ha, individually or in combinations, gave the highest dry matter production, K uptake and bulb yield. Boyhan and Torrance (2001) indicated that potassium (K) is an important factor in plant water relations, cell wall formation and energy reactions in the plant. However, application of potassium in a concentrated band near the seed or transplant can cause damage and stand reduction. Potassium is also subject to leaching from heavy rainfall or irrigation. Therefore, it is best to split potassium applications by incorporating 30 percent to 50 percent of the recommended potassium before planting and splitting the remainder in one to two side-dress applications. They reported also that, onions are heavy feeders and require more fertilizer than is used in most vegetable crops. Onions respond well to additional fertilizer applied 40 to 60 days after seeding or transplanting. The method of fertilizer application is very important in obtaining maximum use and return. Apply fertilizer in regularly timed applications of small amounts will increase the amount of fertilizer used by the plant and lessen the amount lost from leaching. Sing and Verma (2001) investigated the response of onion to levels, sources and methods of K application. Their results indicated that bulb yield increased significantly with increasing K level up to 120 kg K_2O/ha. They showed also that bulb yield significantly increased with split application of K_2O, being the highest with 3 splits. Yadav et al. (2001) conducted a field experiment to study the effect of four cultivars, three levels of nitrogen (50, 100 and 150kg N/ha) and three levels of potassium (50, 100 and 150kg K/ha) fertilizers on the growth and yield of onion. They concluded that the highest bulb yield and quality were obtained with 150kg N/ha and 150kg K/ha fertilizer levels. Yadav et al. (2003) conducted field experiments to determine the optimum rate of nitrogen (50, 100 and 150kg N/ha) and potassium (50, 100 and 150kg K/ha) to obtain maximum and good quality of onion. Their results indicated that, the highest K rate recorded the highest plant height, leaf number per plant, leaf fresh weight, leaf dry weight, neck thickness, bulb diameter, bulb fresh weight and bulb yield. Shrawan et al. (2004) studied the effect of four nitrogen levels (0, 50, 100 and 150kg N/ha) and four potassium levels (0, 40, 80 and 120kg K/ha) on growth and yield of onion. Results showed that, maximum plant height, fresh weight of leaves, number of leaves, neck thickness, bulb diameter, fresh weight of bulb and bulb yield were highest upon treatment with the highest potassium rate.

The main objective of this research is to examine the effect of potassium fertilizer rates and time of application on total and marketable onion bulb yields, yield components and quality parameters in the calcareous soils of Nubaria region.

MATERIALS AND METHODS

A two-year field experiment was conducted on onion crop (variety Giza 20) at Nubaria Agricultural Research Station farm during 2003/2004 and 2004/2005 winter seasons. Soil samples from the soil of the experimental site were collected from two depths (0-20 and 20-40cm) to determine main soil chemical characters (Page et al., 1982). Results of the analysis are presented in Table 1.

Seedlings of onion crop (var. Giza 20) were transplanted on December 29, 2003 and on December 15th, 2004 in the first and second growing seasons, respectively. The experimental plot size was $7m^2$ (1/600 feddan). Each plot consisted of four ridges, 50cm wide and 3.5m long. Seedlings were planted in both sides of the ridge and spaced at 10cm. The recommended dose of phosphorus fertilizer (45kg P_2O_5/fed) as calcium super phosphate was added during land preparation, while nitrogen fertilizer (90kg N/fed) as ammonium nitrate was added on monthly basis in three equal doses after transplanting. All other cultural practices including irrigation, weed and pest control concerning onion production in the calcareous soils at Nubaria region were followed.

A randomized complete blocks design (RCBD) with four replicates was used to conduct this experiment. The tested potassium treatments were as follows:

1. K_1: without K-application (control).
2. K_2: 24kg K_2O/fed were applied during land preparation.
3. K_3: 48kg K_2O/fed were applied during land preparation.
4. K_4: 24kg K_2O/fed were applied in two equal doses, 2- and 3-month after transplanting.
5. K_5: 48kg K_2O/fed were applied in two equal doses, 2- and 3-month after transplanting.
6. K_6: 24kg K_2O/fed were applied 3 months after transplanting.
7. K_7: 48kg K_2O/fed were applied 3 months after transplanting.

During the two seasons, the following data were recorded:

1- Vegetative growth characters:

After 120 days from transplanting, 15 plants were selected from each experimental plot for plant height and number of tubular leaves per plant measurements.

2- Days to maturity:

Number of days from transplanting to maturity was recorded. Maturity was determined by both neck softening and 50% top down.

3- Yield and its components:

At harvest time, all plants in the experimental plot were uprooted and the following data were recorded:

a) Total yield (t/fed).
b) Marketable yield (t/fed): represents the weight of single bulbs.
c) Onion bulb weight (g)

4- Total soluble solids (TSS, %):

It includes mainly soluble sugars, amino acids and soluble minerals. It was determined using the hand refractometer.

5- Storability:

It measures the percentage of sprouted bulbs after six months from harvest under the normal storage conditions.

Statistical analysis:

The obtained data were analyzed using the CoHort Software (1986) statistical package. Average values from the four replicates of each treatment were interpreted using the analysis of variance (ANOVA). The Duncan's Test was used for comparisons between means as advised by Steel and Torrie (1980).

Table 1: Some chemical properties of the soil at the experimental site.

Soil character	2003/2004		2004/2005	
Soil depth (cm)	0 - 20	20 - 40	0 – 20	20 - 40
Soil pH (1:2.5)	8.20	8.23	8.48	8.25
EC, dS/m	1.84	1.96	3.86	4.58
Soil texture	Sandy loam		Sandy loam	
$CaCO_3$ (%)	24.31	26.52	25.85	24.91
O.M. (%)	0.38	0.27	0.24	0.26
Available macro nutrients:				
N (ppm)	52.71	41.16	46.38	33.72
P (ppm)	4.42	3.74	4.14	3.65
K (ppm)	102.26	89.24	91.36	84.31
Available micro nutrients:				
Zn (ppm)	0.24	0.16	0.21	0.17
Fe (ppm)	4.10	2.80	3.40	2.60
Mn (ppm)	1.10	0.87	0.94	0.83
Soluble cations:				
Ca (meq/l)	6.68	7.17	9.62	12.8
Mg (meq/l)	1.85	2.11	5.10	5.44
Na (meq/l)	7.98	8.34	29.8	36.7
K (meq/l)	1.89	1.98	5.19	5.45
Soluble anions:				
CO_3	----	----	----	----
HCO_3	3.25	3.62	11.1	15.9
Cl	9.16	9.85	30.1	38.7
SO_4	5.99	6.13	7.7	5.8

RESULTS AND DISCUSSION

1- Vegetative growth characters:

Results revealed that average plant height values were significantly affected by the tested potassium fertilizer treatments in the two growing seasons (Table 2). It is clear from the results that, increasing K-fertilizer application rate increased plant height. The highest averages of 69.6 and 67.4cm were recorded for K_5 (48kg K_2O/fed, applied in two equal doses after 2- and 3-month from transplanting) treatment in the 1st and 2nd seasons, respectively. The obtained values were 13.3 and 12.1% higher than average plant height values of the control treatment. The obtained results were in agreement with the results of Yadav et al. (2003) and Sharwan et al. (2004).

Results in Table 2 indicated, in general, that increasing K-fertilizer rate increased average no. of leaves/plant in the two seasons. Average no. of leaves/plant of the high K-fertilizer treatments (i.e. K_3, K_5 and K_7) were 2.5, 6.5 and 11.6%, respectively, higher than those of the control treatment in the 1st season. While, the same respective values were 8.7, 16.3 and 14.8% higher than average no. of leaves/plant of the control treatment in the 2nd season. The obtained results agreed with those of Geetha et al. (2001), Yadav et al. (2003) and Sharwan et al. (2004).

2- Yield components:

The effect of potassium treatments on average bulb weight, plant height and number of leaves per plant is presented in Table 2. Results showed significant effect of the tested K-treatments on average bulb weight. Results indicated that increasing potassium rate up to 48kg K_2O/fed increased bulb weight. In the 1st growing season, average bulb

weights of the K_7, K_5 and K_3 (48kg K_2O/fed) treatments were 14.4, 8.2 and 10% higher than those of K_6, K_4 and K_2 (24kg K_2O/fed) treatments, respectively, as well as 21.3, 16.7 and 11.8% higher than average bulb weight of the K_1 (control) treatment. In the 2nd season, average bulb weights of the K_7, K_5 and K_3 treatments were 16.6, 18.3 and 0.8% more than those of K_6, K_4 and K_2 treatments, respectively, and were 41.2, 32.3 and 13.7% more than average bulb weight of the K_1 (control) treatment. From the obtained results it could be concluded that the application of high K-fertilizer rate, especially late in the growing season, will increase onion bulb weight. The obtained results agreed with those reported by Yadav et al. (2003) and Sharwan et al. (2004).

Table 2. Effect of potassium treatments on average bulb weight, plant height, and number of leaves per plant in the two seasons.

K-treatments	Bulb weight (g)		Plant height (cm)		No. leaves/plant	
	2003/04	2004/05	2003/04	2004/05	2003/04	2004/05
K_1 - without K	107.75c*	82.00d	61.45c	60.15b	6.93b	6.60c
K_2 - 24kg at land prepare.	109.50c	92.50cd	61.65bc	62.20ab	7.03a	6.90bc
K_3 - 48kg at land prepare.	120.50abc	93.25cd	63.95abc	63.55ab	7.10a	7.18abc
K_4 - 12 + 12kg in two splits	116.25abc	91.75cd	65.55abc	63.00ab	7.48a	7.30ab
K_5 - 24 + 24kg in two splits	125.75ab	108.50ab	69.60a	67.40a	7.38a	7.68a
K_6 - 24kg after 3 months	114.25bc	99.25bc	67.15abc	65.53ab	7.53a	7.35ab
K_7 - 48kg after 3 months	130.75a	115.75a	68.00ab	67.05a	7.73a	7.58ab
LSD0.05	13.757	13.967	5.798	6.093	0.708	0.627

*numbers followed by the same letter(s) are not significant at 0.05 probability level.

3- Total and marketable yields (t/fed):

The effect of potassium treatments on average total and marketable yields for the two growing seasons is presented in Table 3. Results indicated, in general, that there was a significant effect of the tested variables on both total and marketable yields in the two seasons. Results showed that increasing potassium application rate to 48 kg K_2O/fed had a significant effect on the obtained total yield in both seasons. In the first growing season, average total bulb yields of 18.59 and 17.54t/fed for the K_7 and K_5 treatments were significantly higher than those of K_6 (17.068t/fed) and K_4 (16.303t/fed) treatments, respectively. In the second season, average bulb yields for the same treatments (K_7 = 21.443 and K_5 = 19.473 t/fed) were significantly higher than total bulb yield of K_6 (17.81t/fed) and K_4 (16.908t/fed) treatments. The obtained results were in agreement with those reported by Sing and Verma (2001).

Results indicated also that average total bulb yields for K_3 treatments were 6.9 and 6.0% higher than those of K_2 treatment in the 1st and 2nd growing seasons, respectively. The non significant differences between the yields of the two treatments could be due to leaching the potassium fertilizer by surface irrigation.

Results revealed also that applying potassium fertilizer late in the season (i.e. K_6 and K_7 treatments) and splitting K-doses (i.e. K_4 and K_5 treatments) resulted in increasing total bulb yields. It is clear from the results that applying 48kg K_2O/fed after three months from transplanting (K_7 treatment) resulted in 9.9 and 23.2% yield increase more than that obtained from applying the same amount at land preparation (K_3 treatment) in the 1st and 2nd growing seasons, respectively. The obtained results agreed well with those of Saimbhi and Randhawa (1983). They concluded that, 50% of uptake of the three major nutrients by onion crop occurs during the last month before harvesting. They indicated also that, high nutrient availability is important during bulbification, in this phase a high K:N ratio is required.

Results revealed that splitting the application of 48kg K_2O/fed in two equal doses resulted in total bulb yields of 17.543 and 19.473t/fed that are comparable to the yields (18.59 and 21.443t/fed) obtained from applying the same amount late in the 1st and 2nd seasons, respectively. The obtained results agreed with those of Boyhan and Torrence (2001) and Sing and Verma (2001).

Results in Table 3 indicated that average marketable yields of the high potassium level (48kg K_2O/fed) treatments were significantly higher than those without K-applications in the two growing seasons. Results revealed also that, the highest marketable yields of 17.378 and 16.808t/fed, in the 1st season, and 21.283 and 19.398t/fed, in the 2nd season, were obtained from applying high K-fertilizer rate either in two splits (i.e. K_5 treatment) or late in the growing season (i.e. K_7 treatment). The obtained results agreed with those of Yadav et al. (2001 and 2003).

Table 3. Effect of potassium treatments on average total and marketable bulb yields.

K-treatments	Total yield (t/fed)		Marketable yield (t/fed)	
	2003/2004	2004/2005	2003/2004	2004/2005
K_1 - without K	14.588e*	13.958d	14.073c	13.898d
K_2 – 24kg at land prepare.	15.823d	16.415c	15.040bc	16.348c
K_3 – 48kg at land prepare.	16.915bcd	17.403bc	15.975ab	17.260bc
K_4 – 12 + 12kg in two splits	16.303cd	16.908c	15.820ab	16.638c
K_5 – 24 + 24kg in two splits	17.543ab	19.473ab	17.378a	19.398ab
K_6 – 24kg after 3 months	17.068bc	17.810bc	16.513ab	17.718bc
K_7 – 48kg after 3 months	18.590a	21.443a	16.808a	21.283a
LSD0.05	1.093	2.119	1.510	2.136

*numbers followed by the same letter(s) are not significant at 0.05 probability level.

4- Quality parameters:

The effect of potassium treatments on number of days to maturity, total soluble solids (TSS) and storability of onion in the two seasons is given in Table 4.

Results indicated, in general, that increasing the rate of potassium fertilizer decreased number of days to bulb maturity. Results showed that the application of 48kg K_2O in two splits (i.e. K_5 treatment) resulted in the earliest bulb maturity in both growing seasons as compared with the other treatments. In the 1st growing season, results indicated no significant effect of the tested K-fertilizer treatments on no. of days to maturity. Average no. of days to maturity for the control treatment (K_1) of 142 days was the highest among all treatments. In the 2nd season, the same trend was noticed with average no. of days to maturity that varied from 158.25 (K_5) to 164.25 days (K_1).

Results showed significant effect of the tested K-fertilizer treatments on total soluble solids (%). Increasing K-fertilizer rate resulted in increasing TSS values. In the 1st season, results indicated that average TSS values for the high K-fertilizer rate treatments (i.e. K_3, K_5 and K_7) were 3.04, 11.6 and 10.5% higher than those of the low K-fertilizer treatments (i.e. K_2, K_4 and K_6), respectively. In the 2nd season, the same trend was obtained. Average TSS values for the K_3, K_5 and K_7 treatments were 9.3, 10.5 and 9.6% higher than those obtained from K_2, K_4 and K_6 treatments, respectively. Results indicated also that, average TSS values for the 48kg K_2O/fed treatments were significantly higher than those of the control treatment in both growing seasons. Also, average TSS values under the application of potassium fertilizer in two splits or late in the growing season were higher than TSS values obtained under the application of K-fertilizer at land preparation. The obtained results were in agreement with those of Yadav et al. (2003).

Results revealed that there was no significant effect of the tested K-fertilizer treatments on onion storability. Results showed minor effect of increasing K-fertilizer rate on number of sprouted bulbs stored for 6 months after harvest. The obtained results could be related to the high potential ability of Giza 20 cultivar to resist sprouting under the local storage conditions.

Table 4. Effect of potassium treatments on average no. of days to maturity, TSS (%), and storability in the two seasons.

K-treatments	Days to maturity		TSS (%)		Storability	
	2003/04	2004/05	2003/04	2004/05	2003/04	2004/05
K_1 - without K	142.00a*	164.25a	10.50c	9.55d	0.0025	0.0025
K_2 - 24kg at land prepare.	140.75a	164.00a	11.50bc	9.68cd	0.0025	0.0025
K_3 - 48kg at land prepare.	138.75a	161.75ab	11.85ab	10.58abc	0.0	0.0
K_4 - 12 + 12kg in two splits	140.50a	163.00a	11.38bc	9.98cd	0.0025	0.0025
K_5 - 24 + 24kg in two splits	138.50a	158.25b	12.70a	11.03ab	0.0	0.0
K_6 - 24kg after 3 months	140.25a	163.00a	11.70abc	10.43bcd	0.0025	0.0
K_7 - 48kg after 3 months	138.75a	161.50ab	12.93a	11.43a	0.0	0.0
LSD0.05	5.173	4.185	1.14	0.903	NS**	NS

*Numbers followed by the same letter(s) are not significant at 0.05 probability level.
** Not significant at 0.05 probability level.

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الملخص العربى

إستجابة إنتاجية محصول البصل لطرق إدارة السماد البوتاسي في الأراضي الجيرية

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نفذت تجربة حقلية في الأراضي الجيرية حديثة الإستصلاح بمزرعة محطة بحوث النوبارية خلال موسمي الزراعة ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٥. يهدف البحث إلي دراسة تأثير معدلات ومواعيد إضافة السماد البوتاسي علي إنتاجية محصول البصل (صنف جيزة ٢٠) وعلي مكونات المحصول وصفات الجودة. استخدمت طريقة القطاعات العشوائية الكاملة وأربعة مكررات لتنفيذ هذه الدراسة. والمعاملات تحت الدراسة هي:

بو ١ - بدون إضافة سماد بوتاسي (مقارنة).

بو ٢ - إضافة ٢٤ وحدة بو٢أ/فدان مع عملية خدمة الأرض.

بو ٣ - إضافة ٤٨ وحدة بو٢أ/فدان مع عملية خدمة الأرض.

بو ٤ - إضافة ١٢ وحدة بو٢أ/فدان بعد شهرين + ١٢ وحدة بو٢أ/فدان بعد ٣ أشهر من الشتل.

بو ٥ - إضافة ٢٤ وحدة بو٢أ/فدان بعد شهرين + ٢٤ وحدة بو٢أ/فدان بعد ٣ أشهر من الشتل.

بو ٦ - إضافة ٢٤ وحدة بو٢أ/فدان بعد ٣ أشهر من الشتل.

بو ٧ - إضافة ٤٨ وحدة بو٢أ/فدان بعد ٣ أشهر من الشتل.

ويمكن تلخيص أهم النتائج في النقاط الآتية:

١- كان لزيادة معدل إضافة السماد البوتاسي إلي ٤٨ وحدة بو٢أ/فدان تأثير معنوي علي إنتاجية محصول البصل في موسمي الزراعة.

٢- تحقق أعلي محصول كلي للأبصال وقدرة ١٨,٥٩ و ٢١,٤٤ طن/فدان من إضافة ٤٨ وحدة بو٢أ/فدان بعد ٣ أشهر من شتل البصل (معاملة بو ٧) لموسمي الزراعة ٢٠٠٣/٢٠٠٤ و ٢٠٠٤/٢٠٠٥ علي الترتيب.

٣- تحقق أعلي محصول قابل للتسويق مقدارة ١٧,٣٧٨ و ١٦,٨٠٨ طن/فدان في موسم ٢٠٠٣/٢٠٠٤ و ١٩,٣٩٨ و ٢١,٢٨٣ طن/فدان في موسم ٢٠٠٤/٢٠٠٥ للمعاملتين بو ٥ ، بو ٧ علي الترتيب.

٤- لم تكن هناك فروقا معنوية ما بين المعاملات الثلاثة بو ٣ ، بو ٥ ، بو ٧ للمحصول القابل للتسويق في الموسم ٢٠٠٣/٢٠٠٤.

٥- زيادة معدل إضافة السماد البوتاسي إلي ٤٨ وحدة بو٢أ/فدان (بو ٣ ، بو ٥ ، بو ٧) أدي لزيادة كل من متوسط وزن البصلة ، متوسط طول النبات ، متوسط عدد الأوراق/نبات.

٦- زيادة معدل إضافة السماد البوتاسي إلي ٤٨ وحدة بو٢أ/فدان (بو ٣ ، بو ٥ ، بو ٧) أدي إلي خفض عدد الأيام اللازمة للنمو ، زيادة نسبة المواد الكلية الذائبة ولم يكن له تأثير ملحوظ علي القدرة التخزينية للبصل.

٧- بصفة عامة أوضحت الدراسة أن إضافة معدل مرتفع من السماد البوتاسي (٤٨ وحدة بو٢أ/فدان) تحقق أعلي إنتاجية لمحصول البصل القابل للتسويق بالأراضي الجيرية حديثة الإستصلاح بمنطقة النوبارية.