J.Agric.&Env.Sci.Alex.Univ.,Egypt Vol.6 (1)2007

EFFECT OF NPK FERTILIZATION ON BULB YIELD AND QUALITY OF ONION UNDER RECLAIMED CALCAREOUS SOIL CONDITIONS

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ABSTRACT

Two field experiments were achieved with onion cv. Giza 20 at Nubaria Agricultural Research Station Farm during the two consecutive winter seasons of 2003/2004 and 2004/2005, to assess growth, yield and bulb quality response to nine different combinations of NPK fertilization (T1 = 60:00:00 NPK kg/fed. - T2 = 90:00:00 NPK kg/fed. - T3 = 120:00:00 NPK kg/fed. - T4 = 60:30:00 NPK kg/fed. - T5 = 90:30:00 NPK kg/fed. - T6 = 120:30:00 NPK kg/fed. - T7 = 60:30:24 NPK kg/fed. - T8 = 90:30:24 NPK kg/fed. and T9 = 120:30:24 NPK kg/fed.) under reclaimed calcareous soil conditions. The combinations of NPK significantly affected most important bulb characteristics in this study. The positive effect of NPK addition was observed during the two seasons in the following characters; number of days to maturity, average bulb weight, marketable yield, total yield, and percentage of single and double bulbs. However, it is noticed only in one growing season on number of leaves, total soluble solids (T.S.S) contents of mature bulb and percentage of bolters, with the exception of plant height and percentage of sprouted bulbs (after six months of storage period) traits which did not show any significant effect under any NPK combination.

High N rates treatments as T3 (120:00:00 NPK kg/fed.) and T6 (120:30:00 NPK kg/fed.) increased the number of days to bulb maturity viz. delayed bulbs maturity. While, low N rates treatments as T4 (60:30:00 NPK kg/fed.) and T7

(60:30:24 NPK kg/fed.) decreased the number of days to maturity.

Maximum average bulb weight (152.25, 131.50 g), marketable yield (23.67, 20.96 ton/fed.) and total yield (24.28, 21.03 ton/fed.) in both seasons, respectively were recorded with the use of the highest rates of NPK, T9 (120:30:24 NPK kg/fed.) with percentage of increasing (22.29%, 19.55%) for average bulb weight, (26.13%, 19.16%) for marketable yield and (21.89%, 19.49%) for total yield in both seasons, respectively comparing with the lowest NPK rates, T1 (60:00:00 NPK kg/fed.). However, the highest mean values of the average bulb weight, marketable and total yield were obtained at the fertilizer rate of T9 (120:30:24 NPK kg/fed.), and this treatment was not significantly different from that of T6 (120:30:00 NPK kg/fed.) and T8 (90:30:24 NPK kg/fed.) so, the highest net return can be obtained at either T6 (120:30:00 NPK kg/fed.) or T8 (90:30:24 NPK kg/fed.) depending on the price of nitrogen or potassium fertilizers and soil contents of these elements.

It can be concluded that NPK at (120:30:00 NPK kg/fed.) or (90:30:24 NPK kg/fed.) were found to be the best fertilizer combinations in this study for giving higher yield with an increase about 2-4 ton/fed. more than (60:00:00 NPK kg/fed.) of onion cultivar Giza 20. Moreover, N element is likely to be the limiting factor concerning onion maturity, productivity and bulb quality more than P_2O_5 or K_2O under reclaimed calcareous soil conditions at Nubaria region.

Key words: Onion – NPK combinations – Reclaimed calcareous soil

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important and widely used vegetables worldwide. The crop is grown for consumption in green stage and as fresh mature bulbs or dehydrated slices. In Egypt, almost all traditional dishes contain onion as one of the important ingredient used for culinary purposes. Onion is extensively used as condiment in the preparation of stuffing, cooking, soup, curry, pizza, salad and pickle.

Onion ranks the first major exportation crop. Bulbs are exported either fresh (272.000 ton) or dehydrated (16.000 ton) according to export statistics of 2005/2006*. Egypt is considered as the fourth leading countries in onion exportation after Netherlands, India and USA (FAO, 2002). In Egypt, the annual cultivated area by onion usually varies from 150.000 to 200.000 feddans with an average production of 10-12 ton/fed.

The newly reclaimed lands at Nubaria region produce about 12% of the total onion production (Moursy *et al*. 2007). It is expected that this region will be the main production area for onion crop in future because it is still relatively free from the epidemic soil diseases such as white rot disease which limits the ability of Egyptian onion to be exported ,especially, in Upper Egypt and major Delta governorates (Ashry and Yaso, 2006 and Moursy *et al*. 2007). Also, it is still relatively new reclaimed soils (new virgin soils) which respond successfully to plant nutrition and other agricultural treatments.

Marschner (1995) stated that improving nutritional management is required to grow crops successfully on calcareous soils. Crops fertilizer management on calcareous soils differs from those of non-calcareous soils due to the effect of soil pH on soil nutrient availability and chemical reactions that affect the loss or fixation of some nutrients. Many studies have shown that levels of available P, K and micronutrients are fairly low under calcareous soils conditions (FAO, 2005).

Optimum fertilizers application for onion and cultivation of suitable cultivars under reclaimed calcareous soils are necessary for obtaining good yield with high quality of bulbs. The essential nutrients particularly, the primary macro nutrients e.g. nitrogen,

phosphorus and potassium (NPK) are necessary for plant growth, maturity, bulb yield and quality.

Experience and literature have shown that NPK mineral nutrition each alone or in combinations had a pronounced effect (positive or negative) on the growth, maturity, productivity and quality of onion crop (Saimbhi and Randhawa, 1983, Haggag *et al*. 1986, Henriksen,

* Source: Central Administration of Agricultural Statistics

1987, Khalil *et al*. 1988a and 1988b, Farag and Koriem, 1990, Farghali and Abo Zeid 1995, Rizk, 1997, Badr and El-Shebiny, 1999, Al-Moshileh, 2001, Jilani *et al*. 2003, El-Desuki *et al*. 2006a and 2006b, Moursy *et al*. 2007, and Yaso and Moursy, 2007) under different types of soils including reclaimed soils but with clear shortage in reclaimed calcareous soils.

Nitrogen is an integral part of chlorophyll. It is essential for synthesis of proteins, enzymes and promotes vigorous vegetative growth. Phosphorus and potassium play a vital role in several keys physiological processes viz. photosynthesis, respiration, energy storage (ATP, ADP formation), and enhancing the translocation of assimilates and protein synthesis (Marschner, 1995, El-Desuki *et al*. 2006a and 2006b). Hence, for economical feasibility of onion the application of NPK fertilization in a balanced ratio is prerequisite.

Onion is a long season crop and has special root architecture i.e., shallow root system, low root densities and lack root hairs, so, it needs a high concentration of N, P and K in the soil solution to satisfy the potential demand, hence onion needs for high levels of N, P and K in the soil (Brewster, 1994). On the other hand, the interaction and equilibrium among N, P and K ,especially, under calcareous soils are difficult and still need more investigations due to increase of compaction, coarse texture and high content of CaCO3, as well as complexity of nutrient availability in such soils (Khalaf and Taha, 1988, and Farghali and Abo Zeid, 1995).

Keeping in view the previous aspects, therefore, the present research work was initiated to determine the best combination or the balanced fertilization ratio of NPK for onion Giza 20 cv. which gives higher yield with the best bulb quality characters under new reclaimed calcareous soil conditions at Nubaria region.

MATERIALS AND METHODS

Two field experiments were accomplished at Nubaria Agricultural Research Station Farm during the two winter seasons of 2003/2004 and 2004/2005.

Plant material:-

Onion Giza 20 cv. (initiated from Behairy cv.) an exportable cultivar, which is characterized by uniformity in bulb shape and color (El-Gammal *et al*. 1980) was chosen for this investigation. Its superior characters was documented by many researches when compared by other local cultivars such as Giza 6M and Shandaweel 1 (Khalil *et al*. 1988a, 1988b and Koriem and Farag, 1990) or American cultivars (Hanna-alla *et al*. 1991), and well adapted to grow in Nubaria region (Badr and El-Shebiny, 1999).

Soil analysis:-

Before conducting the experiment soil samples were collected from two depths (0-20 and 20-40 cm) of the experimental sites and analyzed according to Page *et al*. (1982) methods. The physico-chemical characteristics of both experimental fields are given in Table 1.

Table 1: Some physico-chemical properties of both experimental sites.

Soil characters	**2003/2004**		**2004/2005**	
Soil depth (cm)	**0-20**	**20-40**	**0-20**	**20-40**
Soil pH	8.20	8.23	8.48	8.25
EC, dS/m	1.84	1.96	3.86	4.58
Soil texture class	Sandy loam		Sandy loam	
CaCO3 (%)	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	12.80
Mg (meq/L)	1.85	2.11	5.10	5.44
Na (meq/L)	7.98	8.34	29.80	36.70
K (meq/L)	1.89	1.98	5.19	5.45
Soluble anions:				
CO3	--	--	--	--
HCO3	3.25	3.62	11.10	15.90
Cl	9.16	9.85	30.10	38.70
SO4	5.99	6.13	7.70	5.80

Planting date:-

Healthy transplants of the onion Giza 20 cv. were transplanted on December 29, 2003 and on December 15, 2004 in the first and second growing seasons, respectively.

Experimental design:-

The experiment was laid out in randomized complete blocks design (RCBD) with four replicates. The experimental plot size was 7.0 m², each plot consisted of four ridges, 50 cm wide and 3.5 m long. Seedlings were planted in both sides of the ridge and spaced at 10 cm.

NPK fertilizer treatments:-

Different nine combinations of NPK fertilizer treatments of experimental site are shown in Table 2.

Table 2: Detail of NPK fertilizer treatments in experimental site.

	NPK fertilizer rate (kg/fed.)				
Treatment Number	N	+	P	+	K
T1	60		00		00
T2	90		00		00
T3	120		00		00
T4	60		30		00
T5	90		30		00
T6	120		30		00
T7	60		30		24
T8	90		30		24
T9	120		30		24

NPK fertilizer applications:-

The doses of phosphorus fertilizer as calcium supper phosphate (15.5 % P_2O_5) and potassium fertilizer as potassium sulfate (48.5 % K_2O) were added during soil preparation. However, nitrogen fertilizer as ammonium nitrate (33.5% N) was divided into three equal parts and side dressed at 30, 60 and 90 days after transplanting process. All other recommended cultural practices including irrigation, weed, diseases and pest control concerning onion production under calcareous soils at Nubaria region were respected.

Data recorded:-

During the two growing seasons, the following data were recorded:

(1) Vegetative growth characters:-

During the growth period, 15 randomly selected plants were taken from the three outer ridges of each experimental plot after 120 days from transplanting and used to measure both plant height (cm) and number of tubular leaves per plant.

(2) Number of days to maturity:-

Number of days from transplanting process to maturity stage was recorded. Maturity stage was determined based on both softening of bulb neck and as 50% top-down of bulb leaves.

(3) Bulb yield and its components:-

At harvest, all onion plants in each experimental plot were pulled and the following data were estimated:-

-a- Total yield (ton/fed.)

It was calculated on the basis of all yields for the experimental plot.

-b- Marketable yield (ton/fed.)

It was calculated as the weight of single bulbs yield.

-c- Average weight of bulb (g)

It was calculated by dividing the weight of single bulbs by their number.

-d- Percentage of single and double bulbs

The onion bulb consists of a short underground stem with fleshy scale leaves which develop from the terminal bud. Lateral buds either remain dormant during the vegetative phase of the plant life cycle, or they develop into multi-hearted bulbs which sometimes double i.e., divide into shoots. Such plants finally produce two or more separated bulbs of irregular shape (Khokhar *et al*. 2002). Percentage of single and double bulbs was estimated by dividing number of single and double bulbs by the total number of bulbs per plot x 100

-e- Percentage of bolters

It was determined by dividing number of plants which flowered in the same season during their growth by the total number of bulbs per plot x 100.

(4) Bulb quality:-

Percentage of total soluble solids (T.S.S) contents in mature bulbs, and percentage of sprouted bulbs (as an indicator to storability) were estimated to indicate onion Giza 20 cv. quality.

-a- Percentage of total soluble solids (T.S.S.)

It was determined by using hand refractometer. Measurements were done by the end of storage period (six months after harvesting).

-b- Percentage of sprouted bulbs

For bulbs storability studies, each experimental plot was kept under common storage conditions at Nubaria region for a period of six months. Then, the percentage of sprouted bulbs was recorded.

Statistical analysis:-

The mean data were subjected to the Analysis Variance Technique (Steel and Torrie, 1980) using SAS version 8.1 (SAS, 2000) computer software package. LSD variance was adopted for comparing their means among the NPK treatments.

RESULTS AND DISCUSSION

(1) Vegetative growth characters:-

Data recorded in Table (3) showed that NPK combinations had no significant effect on onion growth characters in terms of plant height and number of tubular leaves per plant, with the exception that, there were slight significant differences for number of leaves per plant, in the first season only.

In this direction, the medium level of applied N in combination with 30 kg P_2O_5 and 24 kg K_2O, T8 (90:30:24 NPK kg/fed.) was more effective for increasing number of tubular leaves than those of other combination treatments. However, the highest N-rate 120 kg with 30 kg P_2O_5 and 24 kg K_2O, namely T9 (120:30:24 NPK kg/fed.) or the lowest N-rate 60 kg with 30 kg P_2O_5 namely, T4 (60:30:00 NPK kg/fed.) gave the lowest values as shown in Table (3).

Table 3: Effect of NPK combinations on plant height (cm), number of leaves per plant and number of days to bulbs maturity.

TN	Treatment NPK (kg/fed.)	Plant height (cm)	Number of leaves/plant	Days to bulbs maturity
			2003/2004	

1	60:00:00	68.80	7.60ab	141.00a
2	90:00:00	69.80	7.58ab	140.75ab
3	120:00:00	69.65	7.75ab	141.00a
4	60:30:00	66.00	7.03b	135.00c
5	90:30:00	72.55	7.70ab	139.75ab
6	120:30:00	73.65	7.65ab	140.50ab
7	60:30:24	68.15	7.73ab	137.00bc
8	90:30:24	71.45	7.90a	138.75abc
9	120:30:24	68.25	6.95b	138.50abc
		NS*		
			2004/2005	

1	60:00:00	62.45	7.45	140.75abc
2	90:00:00	63.05	7.43	141.00abc
3	120:00:00	65.30	7.40	142.25a
4	60:30:00	64.15	7.78	137.50c
5	90:30:00	65.55	7.70	141.50ab
6	120:30:00	62.40	7.50	142.50a
7	60:30:24	63.05	7.60	137.75bc
8	90:30:24	62.65	7.20	140.25abc
9	120:30:24	65.65	7.33	140.50abc
		NS*	NS*	

Means followed by the same letter(s), within each column are not significantly different at 5% LSD test.

* Values are not significant at 0.05 probability level.

The same finding was obtained by Khalil *et al*. (1988a) and Woldetsadik *et al*. (2003), who stated that number of leaves tended to increase with increasing N-rate. The stimulating effect of NPK combination on the above mentioned characteristics were confirmed by Jilani *et al*. (2003), who found that NPK doses (150:100:50 kg/ha) resulted in the tallest plant height and maximum number of leaves per plant, closely followed by (180:100:100 NPK kg/ha) compared with control treatment (00:00:00 NPK) or the lowest NPK doses (60:30:30 NPK kg/ha).

On the other hand, the results of El-Oksh *et al*. (1993) indicated that N application resulted in insignificant effect on onion growth characters including both plant height and number of leaves per plant.

The differences in response to NPK applications between both seasons might be attributed to the diversity of NPK contents in upper surface of experimental soils (0-20 cm) as shown in (Table 1).

(2) Number of days to bulbs maturity:-

It is evident from Table (3) that NPK treatments reversed clear significant differences of number of days to maturity, in both seasons. T1 (60:00:00 NPK kg/fed.) and T3 (120:00:00 NPK kg/fed.), the lowest and the highest N-rate alone increased number of days to maturity in the first season. However, T3 (120:00:00 NPK kg/fed.) and T6 (120:30:00 NPK kg/fed.), the highest N-rate alone or with P_2O_5 only increased number of days to maturity in the second one. While, T4 (60:30:00 NPK kg/fed.) and T7 (60:30:24 NPK kg/fed.), the lowest N-rate with P_2O_5 only or with both P_2O5 and K_2O decreased number of days to maturity viz. accelerating bulbs maturity, in both seasons. The obtained results are in harmony with those obtained by Khalil *et al*. (1988a) and Woldetsadik *et al*. (2003), who pointed out that additional nitrogen to onion plants delayed bulb growth and development. Henriksen (1987) declared that low N-rates can delay bulbs maturity. However, Drost *et al*. (2002) reported that both N source and rate had no effect on bulb maturity under their experimental conditions.

Generally, these results can confirm that shortage of N-rates may be responsible for onion maturity than slight excess of N-rates. Moreover, N element is likely to be the limiting factor concerning onion maturity more than P_2O_5 or K_2O under reclaimed calcareous soil conditions.

(3) Bulbs yield and its components:-

-a- Average bulb weight (g)

Average bulb weight was significantly affected by different combinations of NPK (Table 4). Maximum bulb weight (152.25, 131.50 g) was obtained with a high rate of NPK, T9 (120:30:24 NPK kg/fed.) in both seasons, respectively. Minimum bulb weight (124.50, 110.00 g) was recorded in plots that received only low N-rate, T1 (60:00:00 NPK kg/fed.) in both seasons, respectively. It is clear from the results that applying last dose of N fertilizer after three months from transplanting with applying P_2O_5 and K_2O at soil preparation resulted in an increase of 22.29% and 19.55% in the average bulb weight. The obtained results agreed well with those of Saimbhi and

Randhawa (1983), who concluded that, 50% of uptake of the three major nutrients by onion crop occurs during the last month before harvesting. Moreover they pointed out that, high nutrient availability is important during bulb formation.

Table 4: Effect of NPK combinations on bulb weight, marketable yield and total yield.

TN	Treatment NPK (kg/fed.)	bulb weight (g)	Marketable yield (ton/fed.)	Total yield (ton/fed.)
			2003/2004	

1	60:00:00	124.50c	18.74c	19.92c
2	90:00:00	136.25abc	20.64abc	21.65abc
3	120:00:00	141.00abc	21.43abc	22.56abc
4	60:30:00	131.25bc	20.25bc	20.94bc
5	90:30:00	145.25ab	21.97ab	23.22ab
6	120:30:00	151.00ab	23.26ab	23.91ab
7	60:30:24	138.75abc	21.16abc	22.20abc
8	90:30:24	146.50ab	22.43ab	23.42ab
9	120:30:24	152.25a	23.67a	24.27a
			2004/2005	

1	60:00:00	110.00b	17.59b	17.60b
2	90:00:00	117.50ab	18.73ab	18.79ab
3	120:00:00	120.50ab	18.98ab	19.25ab
4	60:30:00	118.00ab	18.63ab	18.88ab
5	90:30:00	119.25ab	19.02ab	19.06ab
6	120:30:00	124.50ab	19.74ab	19.86ab
7	60:30:24	119.50ab	18.96ab	19.12ab
8	90:30:24	130.00a	20.71a	20.83a
9	120:30:24	131.50a	20.96a	21.03a

Means followed by the same letter(s), within each column are not significantly different at 5% LSD test.

The maximum bulb weight might be due to the role of nitrogen on chlorophyll, enzymes and protein synthesis and the role of phosphorus on root growth development, phospho-proteins and phospho-lipids formation as well as the role of potassium on promotion of enzymes activity and enhancing the translocation of assimilates (El-Desuki *et al*. 2006a and 2006b).

It is worthy to mention that the behavior of bulb weight which was affected by NPK combinations was similar to that of marketable

and total bulbs yield. Moreover, the effects of NPK combinations on average bulb weight, marketable and total bulbs yield exhibited the same manner of significant differences in both growing seasons (Table 4).

-b- Marketable and total yield of bulbs (Ton/fed.)

Statistical analysis reflected that different combinations of NPK fertilizer showed significant effect on marketable and total yield, in both seasons. Nevertheless, no significant results were obtained when nitrogen was applied alone (Table 4). Maximum marketable and total bulb yield were obtained at high rate of NPK, T9 (120:30:24 NPK kg/fed.) with percentage of increasing 26.13%, 19.16% for marketable yield and 21.89%, 19.49% for total yield in the first and second seasons, respectively comparing with T1 (60:00:00 NPK kg/fed.). These results might be due to the role of mineral fertilizers on promotion onion plants growth, which in turn, increasing bulbs yield and improving bulb quality as a result of increasing the level of mineral fertilizers application. These results were in agreement with those reported by Haggag *et al*. (1986), Henriksen, (1987), Rizk, (1997), Al-Moshileh (2001), Drost *et al*. (2002), Jilani *et al*. (2003) and El-Desuki *et al*. (2006a), who found an increase in total yield ranged from 10-90% as a result of using high rates of NPK, particularly with high N-rates. Moreover, the addition of N fertilizer to the soil could be increased the capacity of plant to absorb more nutrients, this might be attributed to increase root surface per unit of soil volume and rate of nutrients uptake as assumed by Badr and El-Shebiny, (1999).

It is clear from data listed in Table (4) that the treatments T6 (120:30:00 NPK kg/fed.) and T8 (90:30:24 NPK kg/fed.) did not differ significantly than the high rate of NPK, viz. T9 (120:30:24 NPK kg/fed.) on average bulb weight, marketable and total bulb yield in both seasons. Therefore, It could be concluded that the most economical and balanced fertilizer NPK rate were T6 (120:30:00 NPK kg/fed.) and T8 (90:30:24 NPK kg/fed.) for giving high mean values for each of bulb weight, marketable and total bulb yield. They could be considered as efficient treatments from the economical point of view for both total bulb yield and fertilizer price (N or K fertilizer), where, they gave an increase about 2-4 ton/fed. more than T1 (60:00:00 NPK kg/fed.) as well as they were sufficient treatments to

meet the requirements of onion plants Giza 20 cv. under this investigation conditions at Nubaria region.

Unexpectedly, the application of phosphorous (P_2O_5) and potassium (K_2O) fertilizers showed insignificant effects on both the marketable and total yield (ton/fed.) in the two seasons (Table 4). This result may be due to the sufficient amount of both P and K in the soil as mentioned in (Table 1) and the great amount of fertilizers which was added to the previous crops (maize and cotton) in the first and second year, respectively. This result is similar to the finding of Al-Moshileh (2001). On the contrary, the results of Farghali and Abo Zeid (1995), El-Desuki *et al*. (2006b), and Yaso and Moursy (2007) reflected clear promoting effect of phosphorus and potassium each alone on total yield of onion.

-c- Percentage of single and double bulbs (%)

Statistical analysis of the data illustrated in Table (5) depicted that the percentage of single bulbs was fluctuated within the two experiments, where in the first season the percent of single bulbs was significantly increased with the highest rate of NPK, T9 (120:30:24 NPK kg/fed.). However, the lowest percent was obtained when N fertilizer was applied alone, viz. T1 (60:00:00 NPK kg/fed.) and T3 (120:00:00 NPK kg/fed.), or when N fertilizer was applied with P_2O_5 alone, T5 (90:30:00 NPK kg/fed.) but in the second season, the highest mean values were obtained with T1 (60:00:00 NPK kg/fed.), T5 (90:30:00 NPK kg/fed), T2 (90:00:00 NPK kg/fed.) and T9 (120:30:24 NPK kg/fed.), respectively. While, T3 (120:00:00 NPK kg/fed.) gave the lowest mean value of single bulbs. This result agrees with the findings of Farag and Koriem (1990), who demonstrated that the percent of single bulbs significantly decreased with higher nitrogen rate up to 90 kg N/fed.

On the contrary, percent of double bulbs was significantly decreased by different combinations of NPK especially in the first season. However, in the second one, lower rates of NPK fertilizers ,especially, T1 (60:00:00 NPK kg/fed.) and T2 (90:00:00 NPK kg/fed.) were responsible for the lowest values of double bulbs.

Hence, the results of this study indicated that N-fertilizer alone was responsible for determine the percentages of both single and double bulbs. Results could be sustained the explanation of Khalil *et al*. (1988a) that nitrogen application enhanced metabolic activities

within plant, which improved vegetative growth and thereby may encourage much more metabolites to be stored in bulbs as storage organs. Moreover, over-fertilization, uneven watering and temperature fluctuations are all believed to influence double bulbs formation, which lowered their marketable appeal (Boyhan *et al*., 2001).

Table 5: Effect of NPK combinations on percentage of single bulbs, double bulbs and bolters.

TN	Treatment NPK (Kg/fed.)	Single bulbs (%)	Double bulbs (%)	Bolters (%)
			2003/2004	

1	60:00:00	94.00c	6.00a	0.00
2	90:00:00	95.25abc	4.25abc	0.50
3	120:00:00	95.00bc	4.75abc	0.25
4	60:30:00	96.75ab	2.50bc	0.75
5	90:30:00	94.50bc	5.00ab	0.50
6	120:30:00	96.25abc	3.50abc	0.25
7	60:30:24	95.25abc	4.25abc	0.50
8	90:30:24	95.50abc	3.75abc	0.75
9	120:30:24	97.50a	2.25c	0.25
				NS*
			2004/2005	

1	60:00:00	99.90a	0.10b	0.00b
2	90:00:00	99.68a	0.10b	0.22ab
3	120:00:00	98.60c	1.05a	0.35ab
4	60:30:00	98.68bc	0.64ab	0.68a
5	90:30:00	99.78a	0.22ab	0.00b
6	120:30:00	99.50ab	0.50ab	0.00b
7	60:30:24	99.23abc	0.65ab	0.12ab
8	90:30:24	99.48ab	0.52ab	0.00b
9	120:30:24	99.63a	0.27ab	0.10ab

Means followed by the same letter(s), within each column are not significantly different at 5% LSD test.

* Values are not significant at 0.05 probability level.

-d- Percentage of bolters (%)

NPK combination had no clear effect on this character under this investigation conditions. There was only slight significant response in

the second year only (Table 5). This result may be affirmed by Hanna-alla *et al*. (1991), who reported that this trait is genetically character which is not easily affected by fertilizer rates. In general, cool temperatures during the latter part of the growing season (March and April), when plants are relatively large, can result in a high percentage of seedstems (bolters), ultimately affecting their consumable appeal as indicated by Boyhan *et al*. (2001) and Khokhar *et al*. (2002).

(4) Onion Bulb Quality

Data in Table (6) showed ,in general, that T.S.S content, and percentage of sprouted bulbs (as an indicator for onion storability) characters did not reverse clear differences due to NPK combinations under this study conditions with the exception of T.S.S. in the second season. Regarding to T.S.S. content, this result in accordance with the results of Khalil *et al*. (1988b), who deduced that, increasing application of N-levels insignificantly increased T.S.S content in mature bulbs. However, it was in disagreement with those of Moursy *et al*. (2007), who showed that increasing of N-level to 80 kg N/fed. resulted in about 8.5% increment in the measured T.S.S value as compared with 40 kg N/fed. On the other hand, the results of Haggag *et al* (1986) and Hanna-alla *et al*. (1991) detected that application of 120-150 kg N/fed. decreased percentage of T.S.S content.

For storability, Drost *et al*. (2002) perceived that there were only small differences between different N-treatments on storability of onion. While, excessive N application contributes to increased storage losses (Brewster, 1994). The results of this investigation could be revealed to the capability of onion cv. Giza 20 to control bulb sprouting phenomena after six months under common storage conditions at Nubaria region.

In conclusion, combination of nitrogen and phosphorus alone at rate of 120:30:00 NPK kg/fed. or combination of nitrogen, phosphorus and potassium at rate of 90:30:24 NPK kg/fed. were found to be the best combined rates in this study for giving the highest marketable and total yield of onion crop under reclaimed calcareous soil at Nubaria region.

Table 6: Effect of NPK combinations on total soluble content T.S.S. (%), and sprouted bulbs (%) of onion Giza 20 cv.

TN	Treatment NPK (kg/fed.)	2003/2004		2004/2005	
		T.S.S. content (%)	Sprouted bulbs (%)	T.S.S. content (%)	Sprouted bulbs (%)
1	60:00:00	10.73	0.005	10.48abc	0.003
2	90:00:00	10.60	0.010	10.08abc	0.003
3	120:00:00	10.80	0.010	10.15abc	0.003
4	60:30:00	10.73	0.005	10.78a	0.000
5	90:30:00	10.78	0.010	9.58c	0.000
6	120:30:00	10.35	0.003	10.78a	0.005
7	60:30:24	10.18	0.010	9.65bc	0.000
8	90:30:24	10.65	0.013	10.63ab	0.000
9	120:30:24	11.38	0.003	10.40abc	0.000
		NS*	NS*		NS*

Means followed by the same letter(s), within each column are not significantly different at 5% LSD test.

* Values are not significant at 0.05 probability level.

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الملخص العربي

تأثير السماد المعدني (النيتروجين + الفوسفور + البوتاسيوم) علي محصول و جودة البصل تحت ظروف الأراضي الجيرية المستصلحة

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أجريت دراسة حقلية في الأراضي الجيرية حديثة الاستصلاح بمحطة البحوث الزراعية بالنوبارية خلال الموسمين الشتويين 2004/2003 و 2005/2004 بهدف تقييم مدي استجابة نباتات البصل صنف جيزة 20 من حيث النمو و الإنتاجية و الجودة لتسعة توليفات مختلفة من السماد المعدني النيتروجين (ن) + الفوسفور (فو$_2$أ$_5$) + البوتاسيوم (بو$_2$أ) وهي كالتالي:-

المعاملة رقم (1) = 00:00:60 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (2) =00:00:90 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (3) =00:00:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (4) =00:30:60 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (5) =00:30:90 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (6) =00:30:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (7) =24:30:60 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (8) =24:30:90 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

المعاملة رقم (9) =24:30:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان

و يمكن تلخيص أهم النتائج في النقاط التالية:-

-1- أدي استخدام التوليفات المختلفة من السماد المعدني (ن : فو$_2$أ$_5$: بو$_2$أ) إلي ظهور تأثير معنوي واضح علي معظم الصفات المميزة الخاصة بالبصل في تلك الدراسة.

-2- التأثير الإيجابي الناتج من إضافة السماد المعدني (ن : فو$_2$أ$_5$: بو$_2$أ) كان واضحا خلال موسمي النمو علي الصفات التالية: عدد الأيام اللازمة لنضج الأبصال – متوسط وزن البصلة (جم) – المحصول القابل للتسويق (طن/فدان) – محصول الأبصال الكلي (طن/فدان) – النسبة المئوية للأبصال المفردة و النسبة المئوية للأبصال المزدوجة.

-3- التأثير الإيجابي كان معنويا في موسم نمو واحد فقط علي صفات عدد الأوراق – محتوي الأبصال من المواد الذائبة الكلية – النسبة المئوية للإزهار الحولي. في حين كان التأثير غير معنوي علي صفتي ارتفاع النبات (سم) و النسبة المئوية للأبصال المزرعة بعد فترة 6 شهور من التخزين.

-4- أدت المعاملات ذات معدل السماد الآزوتي المرتفع مثل المعاملة رقم 3 (00:00:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان) و المعاملة رقم 6 (00:30:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان) إلي زيادة عدد الأيام اللازمة للنضج أي أدت إلي تأخير نضج الأبصال.

-5- أدت المعاملات ذات معدل السماد الآزوتي المنخفض مثل المعاملة رقم 4 (00:30:60 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان) و المعاملة رقم 7 (24:30:60 ن: فو$_2$أ$_5$: ب$_2$أ كجم/فدان) إلي تقليل عدد الأيام اللازمة للنضج.

-6- تحققت أعلي قيمة لكل من متوسط وزن البصلة (152.25 و 131.50 جم) و المحصول القابل للتسويق (23.67 و 20.96 طن/فدان) و المحصول الكلي (24.28 و 21.03 طن/فدان) في كلا الموسمين علي الترتيب نتيجة إضافة أعلي معدل من السماد المعدني وهي المعاملة رقم 9 (24:30:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان)، مع نسبة زيادة تصل إلي (22.29% و 19.55%) في متوسط وزن البصلة و (26.13% و 19.16%) في المحصول القابل للتسويق و (21.89% و 19.49%) في المحصول الكلي في كلا الموسمين علي الترتيب عند مقارنتها بالمعدل المنخفض من السماد المعدني أي المعاملة رقم 1 (00:00:60 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان).

-7- بينت النتائج أن المعدل المرتفع من السماد المعدني متمثلا في المعاملة رقم 9 (24:30:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان) لم يختلف معنويا عن المعاملتين رقم 6 ذات المعدل المرتفع من النيتروجين و الفوسفور فقط (00:30:120 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان) و رقم 8 ذات المعدل المتوسط من النيتروجين (24:30:90 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان) لذلك فان العائد الاقتصادي الأعلى يمكن الحصول عليه من أي من تلك المعاملتين رقم 6 (00:30:120 ن:فو$_2$أ$_5$:بو$_2$أ كجم/فدان) و رقم 8 (24:30:90 ن: فو $_2$أ$_5$: بو $_2$أ كجم/فدان) اعتمادا علي سعر السماد النيتروجيني و البوتاسي و محتوي التربة من تلك العناصر.

-8- أوضحت النتائج أن إضافة المعاملة رقم 6 ذات المعدل المرتفع من النيتروجين و الفوسفور فقط (00:30:120 ن: فو $_2$أ$_5$: بو 2أ كجم/فدان) و المعاملة رقم 8 ذات المعدل المتوسط من النيتروجين مع كل من الفوسفور و البوتاسيوم (24:30:90 ن: فو $_2$أ$_5$: بو $_2$أ كجم/فدان) تعتبر أفضل توليفة من السماد المعدني (ن + فو $_2$أ$_5$ + بو$_2$أ) لإعطاء أعلي إنتاجية (حوالي 2-4 طن زيادة) من محصول البصل صنف جيزة 20 مقارنة بالمعاملة رقم 1 (00:00:60 ن: فو$_2$أ$_5$: بو$_2$أ كجم/فدان) تحت ظروف تلك الدراسة.

-9- يعتبر عنصر النيتروجين هو العامل المحدد لنضج البصل و الانتاجية المرتفعة و جودة الأبصال مقارنة بكل من عنصري الفوسفور والبوتاسيوم تحت ظروف الأراضي الجيرية حديثة الاستصلاح بمنطقة النوبارية.