EFFECT OF NITROGEN AND SOME WEED CONTROL METHODS ON YIELD AND QUALITY OF ONION IN A NEWLY RECLAIMED SOIL

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Two field experiments were carried out during the two successive winter seasons of 2014/2015 and 2015/2016, at the Farm of the Faculty of Agriculture, New Valley University, to study the effect of four rates of mineral nitrogen fertilizer, i.e., 0, 178.60, 357.14 and 535.71 kg N ha^{-1} and three weed control methods, i.e., unweeding, hand weeding and chemical herbicides, i.e., bentazon (Basagran® 48% AS) and clethodium (Select super® 12.5% EC) at the recommended rates (1.19 L/238L/ha and 0.595 L/238L/ha, respectively) on yield and bulb quality of onion cv. Giza 6. The obtained results showed that the interaction from mineral nitrogen at the highest rate (535.71 kg N ha^{-1}) and hand weeding method significantly increased the percentages of bulbs ranged from 6-8 cm in diameter, doubles, bulb fresh weight (g), bulb diameter and length (cm), bulb dry matter (%), bulb quality such as vitamin C concentration, percentages of sulfur volatile oil, total soluble solids (TSS), crude protein and total carbohydrates in onion bulb. On the other hand, the percentages of bulbs ranged from 3.5-6 cm in diameter, bolters and pickles were the highest with the interaction between unfertilized and unweeding plants in both growing seasons. In this regard, the interaction between the highest rate of nitrogen ha^{-1} and hand weeding method significantly increased yield ha^{-1}. In addition, the highest values of yield due to the interaction between the highest rate of nitrogen ha^{-1} and hand weeding method were 12.59 and 13.51 ton ha^{-1}, when compared to the interaction between unfertilized and unweeding plants (4.29 and 4.19 ton ha^{-1}) in both growing seasons, respectively.

Keywords: *Allium cepa*, nitrogen, hand weeding, herbicides, yield, volatile oil

Onion (*Allium cepa* L.) belongs to the family of Alliaceae. In Egypt, onion is one of the major and popular vegetable crops; it is considered the third most important vegetable crop after tomato and potato. The volatile flavors of onion increased its consumptions rate worldwide (Abbey and Joyce, 2004). Additionally, several medical constituents presented in the onion tissues are used for the therapy of several diseases (Martinez et al., 2007 and Stajner et al., 2008). During 2014 season, the total harvested area in Egypt amounting to 68487 ha, produced about 2505189 ton with an average of 36.58 ton of dry onions/ha (FAOSTAT, 2015).

Onion is one of the major vegetable cultivated in the New Valley Governorate, and there is a continuous need for applying nitrogen fertilizers to overcome the infertility problems of soil.

The New Valley Governorate is located in the south-west of Egypt's Western Desert; most where newly reclaimed sand soils are characterized by low organic matter and nutrients contents.

Nitrogen is considered the major element in plant tissues with average percentage of 7% of total dry matter of plants and is a constituent of many fundamental cell components and plays an important role for increasing crop production (Marschner, 1995 and Bungard et al., 1999).

Several researchers showed that increasing nitrogen fertilizer's levels led to increase yield and its components and bulb onion quality (Rizk, 1997; Tiwori et al., 2002; Abdel-Mawgoud et al., 2005; Khan et al., 2007; Nasreen et al., 2007; Al-Fraihat, 2009; Rizk et al., 2012; Soleymani and Shahrajabian, 2012; El-Hadidi et al., 2016 and Gebretsadik, 2016). In this regard, El-Hamady (2017) showed that the highest rate of nitrogen fertilizer (216 kg N/ha) gave the highest values of plant height, number of leaves/plant, leaves fresh weight/plant, bulbing ratio, bulb diameter and length, bulb fresh weight, total fresh bulb yield, marketable bulb yield and total soluble solids (TSS) % in bulbs than other rates of nitrogen fertilizer.

One of the major problems in agricultural production is the spread of weeds, which affect the growth and quality of the growing crops. Onion plant is characterized by slow growth, shallow roots and lack of adequate foliage. Therefore, onion crop cannot compete well with weeds. Consequently, farmers tend to combat weeds by using several ways to achieve high production of onion; especially, in a newly reclaimed soil with low fertility characteristics.

Herbicides are common compounds (chemical-organic) used to eliminate weeds growth (Ramalingam et al., 2013). Several types of herbicides are used extensively to combat weeds, and may contaminate the growing plants (Albero et al., 2001).

In this concern, Uygur et al. (2010) found that weed-free check caused 76.3% increase in the onion yields, when compared with weedy checks. So the aim of this study is to optimize the production of onion cv. Giza 6 and its quality through application of nitrogen fertilizer rates, beside combating

weeds through hand weeding and chemical herbicides.

MATERIALS AND METHODS

1. Description of the Study Site

The study soil is located in the Farm of the Faculty of Agriculture, New Valley University. Two field experiments were conducted from October to April of 2014/2015 and 2015/2016 growing seasons. The soil is very poor in its nutritive as well as its organic matter contents (Abdelhafez et al., 2016).

2. Soil Analysis

Results of the initial soil analysis are listed in table (1).

Table (1). Physicochemical characteristics of the study soil.

*pH	†EC, (dS m^{-1})	‡OM, (g kg^{-1})	Nutrient content, mg kg^{-1}						Particle size distribution %			Textural class
			N		P		K					
			Total	Available	Total	Available	Total	Available	Clay	Silt	Sand	
7.97 ±0.06	0.26 ±0.04	1.10 ±0.2	159.60 ±11.30	29.20 ±2.45	62.30 ±6.74	4.66±0.92	243.00 ±13.23	154.00 ±8.76	6.84 ±0.48	11.24 ±0.47	81.92 ± 0.31	Sand

*pH, determined in 1:1 soil: water mixture
† EC, determined in 1:1 soil: water mixture
‡ OM, Organic matter

3. Experimental Procedure

This experiment included 12 treatments, which were the combination between four rates of mineral nitrogen fertilizer, i.e., 0, 178.60, 357.14 and 535.71 kg N ha^{-1} and three methods of weed control (unweeded, hand weeding and chemical herbicides). These treatments were arranged in a split plot system in a complete randomized block design with four replications. Nitrogen rates were arranged in the main plot, while methods of weed control were arranged in the sub plots. Onion seedlings cv. Giza 6 were planted on 30th and 25th October in 2014 and 2015, respectively, at distance of 10 cm apart in both sides of water line and harvested on the first week in April 2015 and 2016.

4. Fertilization

The fertilization was adopted according to the recommendations of the Ministry of Agriculture, Egypt. 806.50 kg ha^{-1} of ordinary super phosphate (15.5% P_2O_5) equals to 125 kg P ha^{-1}, in addition to 119.05 kg ha^{-1} of potassium sulphate (48% K_2O) equals to 57.14 kg K ha^{-1} were add to soil during preparation. Ammonium nitrate (33.5% N) was used as a source of nitrogen fertilizer and was applied at rates of 0.0, 533.14, 1066.09 and 1599.13 kg ha^{-1} to achieve the rates of 0.0, 178.60, 357.14 (recommended)

and 535.71 kg N ha^{-1}, respectively. The plot area was 30 m^2, including five lines with 10 m length and 0.6 m distance between two lines. Nitrogen fertilizer was divided into equal four application portions; these additions started after 15 day from transplanting and repeated three times at 15 days intervals as soil application.

5. Weed Control Methods

5.1. Unweeded treatment

Weeds were allowed to grow freely without any applications of herbicides or hand weeding.

5.2. Conventional herbicides treatment

In this treatment the recommended herbicides were used to combat broad leaves weeds by using bentazon (Basagran® 48% AS, BASF) at the recommended rate (1.19 L/238L/ha) with a chemical formula [3-isopropyl-1H-2,1,3-benzothiadiazin-4(3H)-one 2,2-dioxide] and narrow leaves weeds by using clethodium (Select super® 12.5% EC, Shoura Chemicals) at the recommended rate (0.595 L/238L/ha) with a chemical formula [2-{(E)-1-[(E)-3-chloroallyloxyimino] propyl}-5-[2-(ethylthio) propyl]-3-hydroxycyclohex-2-enone]. Herbicides applications began after 20 days of transplanting and repeated 2 times 30 days intervals as foliar application for each herbicide.

5.3. Hand weeding treatment

This program intended only hand weeding as a common practice for cultural control of Integrated Pest Management (IPM). The practice was performed twice per month. The treatment was adopted continuously for five months.

6. Measured Parameters

6.1. Yield

At the harvest date, all onion plants of each plot were harvested and cured for 15 days after harvest, weighted and converted to record the following data:

a. Yield (ton ha^{-1})

c. Relative yield (%) = $\frac{\text{Yield of treatment}}{\text{Yield of control}} \times 100$

6.2. Characteristics of bulb

The harvested bulbs were separated to marketable and non-marketable yield. Briefly, bulbs with single, homogenized and without any distortions were classified as marketable yield, while bulbs which doubles, bolters, pickles, un-homogenized and with any distortions were classified as non-marketable yield. Marketable yield was distinguished into;

a. Percentage of bulbs ranged from 3.5-6 cm in diameter

b. Percentage of bulbs ranged from 6-8 cm in diameter

Each of the above mentioned percentages was determined as percentage of the weight of each one of them per plot of the corresponding total weight of marketable yield per plot. Non-marketable yield was differentiated into;

a. Percentage of doubles
b. Percentage of bolters
c. Percentage of pickles (bulbs less than 3.5 cm in diameter)

Percentage of each of doubles, bolters and pickles was determined by counting the weight of each one of them per plot as percentage of the total weight of non-marketable yield per plot.

Random samples composed of 30 bulbs were taken from each plot at harvesting date to determine the following data:

a. Bulb fresh weight (g), bulb diameter and length (cm) and bulb dry matter (%)

$$\text{b. Percentage of bulb net weight} = \frac{\text{Bulb fresh weight}}{\text{Whole plant fresh weight}} \times 100$$

6.3. Bulb quality

Bulb quality parameters such as vitamin C concentration and total soluble solids (TSS) % in fresh onion bulbs juice, percentages of sulfur volatile oil and crude protein (calculated by multiplying nitrogen content by the factor 6.25) in bulbs were determined according to the methods described by A.O.A.C. (2000). Total carbohydrates percentage in bulbs was determined according to Hedge and Hofreiter (1962).

7. Statistical Analysis

Data were subjected to the statistical analysis of variance according to the method mentioned by Snedecor and Cochran (1980). The treatment means were compared using Duncan's multiple range test at probability of 5% level according to Duncan (1958).

RESULTS AND DISCUSSION

1. Yield

1.1. Effect of nitrogen fertilizer rates

Fertilization of onion plants under newly reclaimed soil with the highest rate of mineral nitrogen (535.71 kg N ha^{-1}) had significantly increased yield ha^{-1} in both growing seasons (Table 2). The increases in yield were about 67.41 and 70.26% for the highest rate of nitrogen over unfertilized plants in the 1st and 2nd seasons, respectively. This might be attributed to the vital role of nitrogen for enhancing the metabolism and achieving high carbohydrate contents, which increased the bulb weight consequently total yield increased (Khan et al., 2007). These results are

harmony with these recorded by Aliyu et al. (2007), Yaso and Abdel-Razzak (2007), Rizk et al. (2012) and El-Hadidi et al. (2016), who recorded significant increases in the bulb yield of onion with application of N fertilizers.

Table (2). Yield of onion plants as affected by nitrogen fertilizer rates, weed control methods and their interaction between them during 2014/2015 and 2015/2016 seasons.

Treatments	2014/2015 season				2015/2016 season			
	P0	P1	P2	Mean	P0	P1	P2	Mean
	Yield (ton ha^{-1})							
N0	4.29l	6.83h	7.49g	6.20d	4.19l	7.24h	8.03g	6.49d
N1	5.00k	9.07f	9.33e	7.80c	4.94k	9.49f	10.19e	8.21c
N2	5.27j	10.57d	11.47c	9.10b	5.66j	11.02d	12.24c	9.64b
N3	6.38i	12.16b	12.59a	10.38a	6.66i	12.97b	13.51a	11.05a
Mean	5.23c	9.66b	10.22a		5.36c	10.18b	10.99a	
	Relative yield (%)							
N0	100.00	159.20	174.59	100.00	100.00	172.79	191.64	100.00
N1	116.55	211.42	217.48	125.80	117.89	226.49	243.19	126.50
N2	122.84	246.38	267.36	146.77	135.08	263.00	292.12	148.53
N3	148.71	283.44	293.47	167.41	158.94	309.54	322.43	170.26
Mean	100.00	184.70	195.41		100.00	189.92	205.03	

Means with the same letters are not significantly differed at 5% according to Duncan's multiple range test.
N0 = 0 kg N ha^{-1} & N1 = 178.60 kg N ha^{-1} & N2 = 357.14 kg N ha^{-1} & N3 = 535.71 kg N ha^{-1}.
P0 = Unweeded & P1 = Chemical herbicides & P2 = Hand weeding.

1.2. Effect of weed control methods

Hand weeding method recorded maximize yield ha^{-1} than using other weed control methods in both growing seasons (Table 2). The increases in yield were about 95.41 and 105.03% for hand weeding method than unweeding in the 1st and 2nd seasons, respectively. Results are in agreement with Abdelhafez et al. (2016), they indicated that hand weeding method was more effective for controlling weeds when compared to unweeding and chemical herbicides. This may led to a positive effect on yield per hectare.

1.3. Effect of the interaction between nitrogen fertilizer rates and weed control methods

The interaction between mineral nitrogen (535.71 kg N ha^{-1}) and hand weeding method had significantly increased yield ha^{-1} than the other interaction treatments in both growing seasons (Table 2). The increases in yield due to application of the highest rate of nitrogen and hand weeding

method were about 193.47 and 222.43% over control treatment (unfertilized and unweeding plants) in the 1st and 2nd seasons, respectively. The obtained results may suggest that even at high growth of weeds, the high N application protects the growing plants from the nutrient deficiency. Furthermore, Lee et al. (2011) found that fertilizer level of 120 kg N ha^{-1} produced as much onion bulb yield as higher N levels (240 and 360 kg N ha^{-1}).

2. Characteristics of bulb

2.1. Percentages of marketable and non-marketable yield components

2.1.1. Effect of nitrogen fertilizer rates

In general, marketable yield was more than non-marketable yield of onion plants. In addition, the highest values of marketable yield and the lowest values of non-marketable yield were recorded with application of mineral nitrogen fertilizer at the highest rate (535.71 kg N ha^{-1}) by using hand weeding method in both growing seasons (Abdelhafez et al., 2016).

For marketable yield, fertilization of onion plants under newly reclaimed soil with the highest rate of mineral nitrogen (535.71 kg N ha^{-1}) had significantly decreased percentage of bulbs ranged from 3.5-6 cm in diameter than other nitrogen rates or unfertilized plants (control). The lowest values of bulbs ranged from 3.5-6 cm in diameter were recorded with the highest rate of nitrogen in both growing seasons. On the other hand, percentage of bulbs ranged from 6-8 cm in diameter and increased significantly at the highest rate of mineral nitrogen (535.71 kg N ha^{-1}) than other nitrogen rates or unfertilized plants (control). The highest values of bulbs ranged from 6-8 cm in diameter were recorded with the highest rate of nitrogen in both growing seasons (Table 3).

For non-marketable yield, fertilization of onion plants under newly reclaimed soil with the highest rate of mineral nitrogen (535.71 kg N ha^{-1}) had significantly decreased percentages of bolters and pickles than other nitrogen rates or unfertilized plants (control). The lowest values of bolters and pickles were recorded with the highest rate of nitrogen in both growing seasons (Table 3). This could be associated with the effect of nitrogen in extending the vegetative growth period of plants while delaying flowering. These results are in harmony with these recorded by Yamasaki and Tanaka (2005), who reported that low nitrogen promoted bolting in onion (*Allium fistulosum* L.) and induced flowers to emerge before bulbs that were adequately developed to suppress flower initiation (Roberts et al., 1997). Abdissa et al. (2011) reported that nitrogen fertilization significantly reduced bolting in onion by 11 and 22% in response to applications of nitrogen at rates of 69 and 92 kg N ha^{-1}, respectively. Also, Gebretsadik (2016) found that increasing nitrogen from nil to 150 kg N ha^{-1} decreased bolting percentage by 62%. On the other hand, percentage of doubles increased

significantly at the highest rate of mineral nitrogen (535.71 kg N ha^{-1}) than other nitrogen rates or unfertilized plants (control) and the highest values of doubles were recorded with the highest rate of nitrogen in both growing seasons. Similar results reported that the percent of double bulbs increased significantly with increasing the rate of NPK fertilizers (Yaso and Abdel-Razzak, 2007), especially N enhanced the percentage of marketable doubles up to 200 kg N ha^{-1} in both seasons of study (Al-Fraihat, 2009).

2.1.2. Effect of weed control methods

For marketable yield, using hand weeding method decreasing percentage of bulbs ranged from 3.5-6 cm in diameter than using other weed control methods. The lowest values of bulbs ranged from 3.5-6 cm in diameter were recorded with hand weeding method in both growing seasons. On the other hand, percentage of bulbs ranged from 6-8 cm in diameter increased significantly by using hand weeding method than using other weed control methods. The highest values of bulbs ranged from 6-8 cm in diameter were recorded with hand weeding method in both growing seasons (Table 3).

For non-marketable yield, using hand weeding method decreased percentages of bolters and pickles than using other weed control methods. The lowest values of bolters and pickles were recorded with hand weeding method in both growing seasons. On the other hand, percentage of doubles increased significantly by using hand weeding method than using other weed control methods. The highest values of doubles were recorded with hand weeding method in both growing seasons (Table 3).

These results are in agreement with a previous work conducted by Abdelhafez et al. (2016), who indicated that hand weeding method was more effective for increasing marketable yield and decreasing non-marketable yield of onion plants. In this concern, Uygur et al. (2010) found that weed-free check caused 76.3% increase in the onion yield when compared with weedy checks.

2.1.3. Effect of the interaction between nitrogen fertilizer rates and weed control methods

For marketable yield, the interaction between mineral nitrogen (535.71 kg N ha^{-1}) and hand weeding method had significantly decreased percentage of bulbs ranged from 3.5-6 cm in diameter than the other interaction treatments and the lowest values of bulbs ranged from 3.5-6 cm in diameter were recorded with application of the highest rate of nitrogen and hand weeding method in both growing seasons. On the other hand, the interaction between mineral nitrogen (535.71 kg N ha^{-1}) and hand weeding method had significantly increased percentage of bulbs ranged from 6-8 cm in diameter than the other interaction treatments. The highest values of bulbs ranged from 6-8 cm in diameter were recorded with application of the highest rate of nitrogen and hand weeding method in both growing seasons (Table 3).

Table (3). Percentages of marketable and non-marketable yield components of onion plants as affected by nitrogen fertilizer rates, weed control methods and their interaction between them during 2014/2015 and 2015/2016 seasons.

Treatments	2014/2015 season				2015/2016 season			
	P0	P1	P2	Mean	P0	P1	P2	Mean
Marketable yield								
Bulbs ranged from 3.5-6 cm in diameter (%)								
N0	84.91a	46.36e	36.22f	55.83a	70.68a	33.26e	30.58f	44.84a
N1	71.76b	31.43g	28.71h	43.97b	65.51b	24.94g	22.38h	37.61b
N2	64.11c	22.38i	19.91j	35.47c	51.46c	18.63i	14.89j	28.33c
N3	47.51d	16.15k	12.24l	25.30d	38.92d	11.66k	7.82l	19.47d
Mean	67.07a	29.08b	24.27c		56.64a	22.12b	18.92c	
Bulbs ranged from 6-8 cm in diameter (%)								
N0	15.09l	53.64h	63.78g	44.17d	29.32l	66.74h	69.42g	55.16d
N1	28.24k	68.57f	71.29e	56.03c	34.49k	75.06f	77.62e	62.39c
N2	35.89j	77.62d	80.09c	64.53b	48.54j	81.37d	85.11c	71.67b
N3	52.49i	83.85b	87.76a	74.70a	61.08i	88.34b	92.18a	80.53a
Mean	32.93c	70.92b	75.73a		43.36c	77.88b	81.08a	
Non-marketable yield								
Doubles (%)								
N0	2.87l	21.13h	25.97g	16.66d	5.22l	25.26h	30.24g	20.24d
N1	8.24k	34.14f	37.94e	26.77c	10.43k	35.41f	39.37e	28.40c
N2	12.73j	43.42d	48.64c	34.93b	15.34j	46.34d	50.47c	37.38b
N3	14.15i	56.48b	64.26a	44.96a	20.46i	59.39b	70.17a	50.01a
Mean	9.50c	38.79b	44.20a		12.86c	41.60b	47.56a	
Bolters (%)								
N0	38.88a	28.89e	26.18f	31.32a	38.15a	28.42e	25.47f	30.68a
N1	35.34b	21.17g	19.95h	25.49b	35.36b	22.24g	19.45h	25.68b
N2	33.63c	17.00i	15.12j	21.92c	32.32c	17.50i	15.26j	21.69c
N3	32.81d	12.71k	10.86l	18.79d	30.43d	12.17k	9.35l	17.32d
Mean	35.16a	19.94b	18.03c		34.06a	20.08b	17.38c	
Pickles (%)								
N0	58.25a	49.98e	47.85f	52.03a	56.63a	46.32e	44.29f	49.08a
N1	56.42b	44.69g	42.11h	47.74b	54.21b	42.35g	41.18h	45.91b
N2	53.64c	39.58i	36.24j	43.15c	52.34c	36.16i	34.27j	40.92c
N3	53.04d	30.81k	24.88l	36.24d	49.11d	28.44k	20.48l	32.68d
Mean	55.34a	41.26b	37.77c		53.07a	38.32b	35.05c	

Means with the same letters are not significantly differed at 5% according to Duncan's multiple range test.

N0 = 0 kg N ha^{-1} & N1 = 178.60 kg N ha^{-1} & N2 = 357.14 kg N ha^{-1} & N3 = 535.71 kg N ha^{-1}.

P0 = Unweeded & P1 = Chemical herbicides & P2 = Hand weeding

For non-marketable yield, the interaction between mineral nitrogen (535.71 kg N ha^{-1}) and hand weeding method had significantly decreased percentages of bolters and pickles than the other interaction treatments. The lowest values of bolters and pickles were recorded with application of the highest rate of nitrogen and hand weeding method in both growing seasons. On the other hand, the interaction between mineral nitrogen (535.71 kg N ha^{-1}) and hand weeding method had significantly increased percentage doubles than the other interaction treatments. The highest values of doubles were recorded with application of the highest rate of nitrogen and hand weeding method in both growing seasons (Table 3).

These results are in agreement with a previous study conducted by Abdelhafez et al. (2016), who indicated that enhancement of yield, increasing marketable yield and decreasing non-marketable yield of onion could be attributed to the increased levels of nitrogen and the use of hand weeding method.

2.2. Characteristics of fresh bulb

2.2.1. Effect of nitrogen fertilizer rates

Data in table (4) show that there were significant differences between nitrogen fertilizer rates for bulb fresh weight, bulb net weight, bulb diameter and length and bulb dry matter in both growing seasons. Fertilizing onion plants under newly reclaimed soil with the highest rate of mineral nitrogen (535.71 kg N ha^{-1}) significantly increased bulb fresh weight, bulb net weight, bulb diameter and length and bulb dry matter than other nitrogen rates or unfertilized plants (control) in both growing seasons. The highest values of bulb fresh weight, bulb net weight, bulb diameter and length and bulb dry matter were recorded with the highest rate of nitrogen fertilizer in both growing seasons. This might be attributed to the important role of nitrogen for enhancing chlorophyll contents, enzymes and protein synthesis (El-Desuki et al., 2006a and b). These results are in harmony with those recorded by Aliyu et al. (2007), Sam Ruban (2007), Soleymani and Shahrajabian (2012) and El-Hadidi et al. (2016).

2.2.2. Effect of weed control methods

Hand weeding method recorded maximized bulb fresh weight, bulb net weight, bulb diameter and length and bulb dry matter than using other weed control methods. The highest values of bulb fresh weight, bulb net weight, bulb diameter and length and bulb dry matter were recorded with hand weeding method in both growing seasons (Table 4). These results may be due to that hand weeding method had a positive effect on yield of onion plants as compared to unweeding and chemical herbicides (Abdelhafez et al., 2016).

Table (4). Characteristics of fresh bulb of onion plants as affected by nitrogen fertilizer rates, weed control methods and their interaction between them during 2014/2015 and 2015/2016 seasons.

Treatments	2014/2015 season				2015/2016 season			
	P0	P1	P2	Mean	P0	P1	P2	Mean
Bulb fresh weight (g)								
N0	45.71l	94.62h	113.98g	84.77d	47.13l	96.16h	114.43g	85.91d
N1	71.73k	116.93f	123.62e	104.09c	74.40k	117.45f	125.29e	105.71c
N2	80.57j	139.36d	142.42c	120.78b	80.70j	141.11d	143.32c	121.71b
N3	86.93i	151.57b	164.08a	134.19a	87.62i	153.62b	164.53a	135.25a
Mean	71.23c	125.62b	136.02a		72.46c	127.08b	136.89a	
Bulb net weight (%)								
N0	71.41c	89.53ab	89.58ab	83.51c	65.34h	77.64e	79.57d	74.18d
N1	88.66b	89.80ab	89.99ab	89.48b	74.78g	79.77d	80.03d	78.19c
N2	88.90b	90.19ab	90.37ab	89.82ab	75.74fg	81.45c	82.44bc	79.88b
N3	89.20b	91.04a	91.21a	90.48a	76.45ef	83.30b	84.82a	81.52a
Mean	84.54b	90.14a	90.29a		73.07c	80.54b	81.72a	
Bulb diameter (cm)								
N0	4.66g	5.65de	5.73de	5.34d	4.75g	5.73de	5.90de	5.46d
N1	5.15f	5.95cd	6.12c	5.74c	5.32f	6.03cd	6.28c	5.87c
N2	5.39ef	6.29c	6.64b	6.10b	5.53ef	6.35c	6.79b	6.22b
N3	5.59de	6.79b	7.16a	6.51a	5.66def	6.95b	7.32a	6.64a
Mean	5.19c	6.17b	6.41a		5.31c	6.26b	6.57a	
Bulb length (cm)								
N0	3.15l	3.92h	4.08g	3.71d	3.44l	4.19h	4.35g	3.99d
N1	3.30k	4.22f	4.44e	3.98c	3.64k	4.51f	4.80e	4.31c
N2	3.50j	4.64d	5.16c	4.43b	3.87j	5.15d	5.44c	4.82b
N3	3.75i	5.38b	6.00a	5.04a	4.01i	5.59b	6.02a	5.20a
Mean	3.42c	4.54b	4.92a		3.74c	4.86b	5.15a	
Bulb dry matter (%)								
N0	11.99l	13.49h	13.80g	13.09d	12.02l	13.95h	14.30g	13.42d
N1	12.30k	14.05f	14.36e	13.57c	12.59k	14.83f	15.05e	14.15c
N2	12.78j	14.70d	15.11c	14.20b	13.05j	15.13d	15.30c	14.49b
N3	13.04i	15.39b	15.85a	14.76a	13.50i	15.52b	15.94a	14.98a
Mean	12.53c	14.41b	14.78a		12.79c	14.85b	15.15a	

Means with the same letters are not significantly differed at 5% according to Duncan's multiple range test.

N0 = 0 kg N ha^{-1} & N1 = 178.60 kg N ha^{-1} & N2 = 357.14 kg N ha^{-1} & N3 = 535.71 kg N ha^{-1}.

P0 = Unweeded & P1 = Chemical herbicides & P2 = Hand weeding.

2.2.3. Effect of the interaction between nitrogen fertilizer rates and weed control methods

The interaction between mineral nitrogen (535.71 kg N ha^{-1}) and hand weeding method had significantly increased bulb fresh weight, bulb net weight, bulb diameter and length and bulb dry matter than the other interaction treatments in both growing seasons. The highest values of bulb fresh weight, bulb net weight, bulb diameter and length and bulb dry matter were recorded with application of the highest rate of nitrogen and hand weeding method in both growing seasons (Table 4). These results may be due to that enhancement of vegetation growth and yield of onion plants could be attributed to increasing the rate of mineral nitrogen fertilizer and using of hand weeding method (Abdelhafez et al., 2016).

3. Bulb Quality

3.1. Effect of nitrogen fertilizer rates

Data in table (5) show that fertilizing onion plants under newly reclaimed soil with the highest rate of mineral nitrogen (535.71 kg N ha^{-1}) significantly increased vitamin C concentration, percentages of sulfur volatile oil, total soluble solids (TSS), crude protein and total carbohydrates of onion bulb than other nitrogen fertilizer rates or unfertilized plants (control) in both growing seasons. The highest values of vitamin C concentration, percentages of sulfur volatile oil, TSS, crude protein and total carbohydrates of onion bulb were recorded with the highest rate of nitrogen fertilizer in both growing seasons.

These results are in agreement with the previous studies recorded by El-Hadidi et al. (2016), which showed that protein percentage and sulfur volatile oil percentage in onion bulbs after 90 days from transplanting (at harvest stage) was significantly increased as a result of increasing nitrogen fertilizer levels from 0 to 566.9 and 850.0 kg N ha^{-1}.

3.2. Effect of weed control methods

Hand weeding method maximized vitamin C concentration, percentages of sulfur volatile oil, TSS, crude protein and total carbohydrates of onion bulb than using other weed control methods. The highest values of vitamin C concentration, percentages of sulfur volatile oil, TSS, crude protein and total carbohydrates of onion bulb were recorded with hand weeding method in both growing seasons (Table 5). These results may be due to that the adoption of hand weeding method for controlling weeds growth significantly enhanced the growing plant for nutrients uptake when compared to unweeding and chemical herbicides (Abdelhafez et al., 2016).

Table (5). Quality of onion bulb as affected by nitrogen fertilizer rates, weed control methods and their interaction between them during 2014/ 2015 and 2015/2016 seasons.

	2014/2015 season				2015/2016 season			
Treatments	**P0**	**P1**	**P2**	**Mean**	**P0**	**P1**	**P2**	**Mean**
Vitamin C (mg/100 g fresh weight)								
N0	15.72l	18.18h	18.55g	17.48d	16.14l	18.29h	18.57g	17.67d
N1	15.97k	18.57f	18.73e	17.76c	16.21k	18.94f	18.98e	18.04c
N2	16.17j	19.17d	20.03c	18.45b	16.62j	19.24d	20.06c	18.64b
N3	17.14i	20.07b	20.45a	19.22a	17.89i	20.08b	20.48a	19.48a
Mean	16.25c	18.99b	19.44a		16.72c	19.14b	19.52a	
Sulfur volatile oil (%)								
N0	1.11l	1.62h	1.68g	1.47d	1.12l	1.63h	1.71g	1.49d
N1	1.13k	2.17f	2.19e	1.83c	1.15k	2.19f	2.20e	1.84c
N2	1.14j	2.22d	2.65c	2.00b	1.17j	2.26d	2.68c	2.04b
N3	1.58i	2.73b	2.76a	2.36a	1.60i	2.74b	2.79a	2.37a
Mean	1.24c	2.18b	2.32a		1.26c	2.20b	2.34a	
Total soluble solids (TSS) %								
N0	12.08l	13.13h	13.39g	12.87d	12.52i	13.65f	13.74f	13.30d
N1	12.17k	14.21f	14.40e	13.59c	12.62hi	14.56e	14.77d	13.98c
N2	12.29j	15.21d	15.40c	14.30b	12.71h	15.63c	15.75c	14.70b
N3	12.40i	16.21b	16.38a	15.00a	12.88g	16.58b	16.75a	15.40a
Mean	12.23c	14.69b	14.89a		12.68c	15.10b	15.25a	
Crude protein (%)								
N0	7.19k	7.34j	7.48i	7.33d	7.56l	7.66k	7.84j	7.69d
N1	11.12h	11.23h	12.03g	11.46c	11.50i	11.83h	12.47g	11.93c
N2	13.37f	13.73e	14.18d	13.76b	13.62f	13.87e	14.26d	13.92b
N3	14.66c	14.90b	15.23a	14.93a	14.67c	15.03b	15.70a	15.13a
Mean	11.58c	11.80b	12.23a		11.84c	12.10b	12.57a	
Total carbohydrates (%)								
N0	14.36l	15.40h	15.58g	15.11d	14.42l	15.56h	15.80g	15.26d
N1	14.46k	16.42f	16.64e	15.84c	14.55k	16.44f	16.71e	15.90c
N2	14.60 j	17.42d	17.58c	16.53b	14.68 j	17.45d	17.70c	16.61b
N3	14.71i	18.52b	18.75a	17.32a	14.83i	18.55b	18.85a	17.41a
Mean	14.53c	16.94b	17.14a		14.62c	17.00b	17.26a	

Means with the same letters are not significantly differed at 5% according to Duncan's multiple range test.

N0 = 0 kg N ha^{-1} & N1 = 178.60 kg N ha^{-1} & N2 = 357.14 kg N ha^{-1} & N3 = 535.71 kg N ha^{-1}.

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3.3. Effect of the interaction between nitrogen fertilizer rates and weed control methods

The interaction between mineral nitrogen (535.71 kg N ha^{-1}) and hand weeding method had significantly increased vitamin C concentration, percentages of sulfur volatile oil, TSS, crude protein and total carbohydrates of onion bulb than the other interaction treatments in both growing seasons. The highest values of vitamin C concentration, percentages of sulfur volatile oil, TSS, crude protein and total carbohydrates of onion bulb were recorded with application of the highest rate of nitrogen fertilizer and hand weeding method in both growing seasons (Table 5).

CONCLUSION

It could be concluded that, under the New Valley Governorate conditions, fertilizing onion plants cv. Giza 6 with 535.71 kg N ha^{-1} and using hand weeding method were the best treatments for increasing yield and bulb quality.

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تأثير التسميد النيتروجيني وبعض طرق مكافحة الحشائش على محصول وجودة البصل في الأرض المستصلحة حديثًا

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أجريت تجربتان حقليتان متتاليتان خلال موسمي الزراعة الشتوي ٢٠١٤/٢٠١٥م، ٢٠١٥/٢٠١٦م في مزرعة كلية الزراعة، جامعة الوادي الجديد، لدراسة تأثير ٤ معدلات من السماد النيتروجيني المعدني وهي: صفر، ١٧٨.٦٠، ٣٥٧.١٤، ٥٣٥.٧١ كجم نيتروجين/هكتار بالإضافة إلى ثلاث طرق لمكافحة الحشائش وهي: عدم مكافحة الحشائش، المكافحة اليدوية للحشائش، المكافحة الكيمياوية للحشائش بإستخدام مبيدات الحشائش مثل بنتازون (بازاجران ٤٨٪ AS) وكليثوديم (سللكت سوبر ١٢.٥٪ EC) بالمعدلات الموصي بها (١.١٩ لتر/٢٣٨ لتر/هكتار و ٠.٥٩٥ لتر/٢٣٨ لتر/هكتار، على التوالي) على محصول وجودة أبصال البصل (صنف جيزة ٦).

أوضحت النتائج المتحصل عليها أن التفاعل بين السماد النيتروجيني المعدني عند أعلى معدل (٥٣٥.٧١ كجم نيتروجين/هكتار) والمكافحة اليدوية للحشائش قد أدى إلى زيادة معنوية في نسبة الأبصال التي يتراوح قطرها ٦-٨ سم ونسبة الأبصال المزدوجة والوزن الطازج للبصلة وقطر البصلة وإرتفاعها ومحتواها من المادة الجافة بالإضافة إلى جودة البصلة مثل محتواها من فيتامين ج، نسبة كلًا من الزيت الكبريتي المتطاير، المواد الصلبة الذائبة الكلية، البروتين الخام والكربوهيدرات الكلية في الأبصال.

على الجانب الآخر، وجد أن نسبة كلًا من الأبصال التي يتراوح قطرها ٣.٥-٦ سم والأبصال ذات الحنبوط والأبصال الأقل قطرًا من ٣.٥ سم كانت أعلى في نباتات البصل التي لم تسمد ولم تكافح من الحشائش في كلا موسمي الزراعة. في هذا الصدد، أدى التفاعل بين أعلى معدل من السماد النيتروجيني/هكتار والمكافحة اليدوية للحشائش إلى زيادة معنوية في المحصول/هكتار. بالإضافة إلى ذلك، كانت أعلى القيم في المحصول والتي ترجع إلى التفاعل بين أعلى معدل من السماد النيتروجيني/هكتار والمكافحة اليدوية للحشائش هي ١٢.٥٩ و ١٣.٥١ طن/هكتار مقارنة بالتفاعل بين عدم التسميد بالنيتروجين المعدني وعدم مكافحة الحشائش (٤.٢٩ و٤.١٩ طن/هكتار) في كلا موسمي الزراعة، على التوالي.