Chapter one

Introduction

Onion (*Allium cepa* L.) belongs to family Alliaceae. It had been domesticated in central Asia (Gad Elrab, 2004).

Fresh onion bulbs contains about 89.1% water, 87 grams carbohydrates, 1.5 protein, 38 calories, 0.1 grams fat, 0.6 grams fiber, 0.2% to 0.5% calcium, 0.05% phosphorus, traces of Fe, Al, Cu, Zn, Mn and vitamins A, B. $B_{2,}$ it can be considered medicinal and aromatic vegetables. It is used by diabetic patients to regulate insulin. Also onion extract has antibacterial properties (Jones and Man, 1963).It is very essential for the preparation of sudanese meals and it is used either fresh or cooked with a mixture of other vegetables and meat (El hilo and Nourai, 1988).

Forty million tons of bulbs are produced annually in the world of which 23 million tons are produced in Asia, 2.7 million tons in Africa and 2.5 million tons in South America with the remainder produced in Europe, North America and Russia (Mohamedali, 2009).

The onion is the most important and popular vegetable in Sudan (Abu-Sara, 2001). It is produced mainly all over the country Gezira, River Nile, Khartoum, Kassala, Northern, Sennar , West and North Darfur and

Blue Nile state. (Mhamedali, 2009) . The area planted by onion about 8600 hectares, it almost 33% of the total area under vegetable production and with an average yield of 6-7t / ha (Alamen, 2008).

Onion production is greatly influenced by the environmental factors, variety and agronomic practices. It is more susceptible to nutrient deficiencies than most crop plants because of their shallow and un-branched root system; hence they require and often respond well to addition of fertilizer (Brewster, 1994).

Quantity and source of nitrogen play an important role to reach the optimum yield potential. It is essential to increase the bulb size and yield but excessively high doses of nitrogen delayed bulb maturity (Shaikh et al, 1987).

Objective of the study:-

This study was conducted to assess the effect of different sources of nitrogen on onion yield and quality.

Chapter Two

Literature Review

The onion herbaceous biennial monocotyledon plant .It has short axis and a stem that consists of a base from which the elongated, cylindrically hollow leaves and the roots grow .under the optimum conditions, the leaf bases swell to from bulbs topped by fals stem or collar in deep, homogenous soils. It gives vegetative growth and bulb in first season growth than complete plant growth in second season.

1-Effect of Nitrogen fertilizer:

Although nitrogen nutrient is an essential to increase bulb size and yield ,onion growers believed that excessive nitrogen prevented proper ripening and resulted in bulbs with poor storage quality (Sheikh et al,1987) supplying vegetable crops with an optimum nitrogen level was proved to be very essential for plant growth and production of high yield as well as improving the quality of onion bulbs (Abu-Rayyan and Al-Hadidi, 2005; Balemi et al, 2007,Biesiada and Kotlota, 2009and Shaheen et al, 2010).

1-1-Effect of nitrogen on vegetative growth:-

Many researches (Kumar *et al.*, 2001, Lemma and shimelis (2003),Khan *et al.*,2007,Dina *et al.*,2010,and Abdissa *et al.*,2011) studied optimum dose of nitrogen to have optimum plant growth and yield. Their

recommendations, however, varied widely. Nasreen *et al.* (2007) found that addition of 120KgN/ha increased significantly the number of leaves/plant and plant height compared to control.

1-2- Effect of nitrogen on Yield and quality:-

The increase of vegetative growth due to nitrogen application 120 up to 150Kg urea/ha or 120KgN/ha was reflected on onion yield (bulb size and weight) as stated by Moradi (2015)and Nasreen *et al.*(2007).

2-Effect of NPK:-

2-1-vegetative growth:-

The positive significant effect of balanced NPK fertilizer on growth of many vegetables compared to a sing dose of nitrogen, phosphorus or potassium were reported by many researchers. Abdel Naby *et al.*(2012) found that a balanced combination of NPK fertilizer gave the highest value of plant height.Moreover, many investigators (Bagali *et al.*,2010,Kandel,*et al.*,2013 and Shedeed *et al.*,2014) reported that the NPK combination of 162-214KgN/ha,32-71KgP/ha and 57-148KgK/ha, respectively, increased onion vegetative growth (plant height and number of leaves/plant) compared to their application as single doses.

2-2-Yield and quality:-

Yoldas *et al.,* (2011) showed that the recommended dose (120:100:150 NPK) influenced significantly bulb width, number of storage leaf and bulb yield but bulb weight and height. Also many researchers, Bagali *et al.*(2012), Kandil *et al.*(2013) and Kadiri *et al.*(2015) reported high onion yield (bulb weight) and quality (increased marketable yield, total soluble solids and dry matter) due to high combination of NPK(81-214KgN/ha,16-71KgP/ha and 57-148Kg K/ha) compared to single doses of them.

3-Ammonium sulphate:-

3-1-Effect of ammonium sulphate on growth, yield and quality:-

Sculpture application at a rate of 400kg S/fed. Markedly enhanced all measured parameter of vegetative growth and the highest values of the average weight of harvested bulb and bulb yield Rizk *et al*, (2012).

Chapter Three

Materials and methods

Location of experiment:-

The experiment was conducted in winter season (2017) at the Experimental Farm of Shambat Research station, Khartoum North (Lat15^{o}- 40^{o} E and long .23^{o}-32^{o} N), and 281m above sea level

Agriculture Research Corporation, Sudan.

The Materials:-

The planting material used was onion seed of variety “Baftaim S” red .They were sown in a nursery on a well prepared seed bed and seedlings transplanted to the field after 45 days from sowing (3-4 leaves or 12-15 cm length of seedlings).

Treatments:-

Nitrogen was applied in equal three different sources amounts (80 kg / fed) Urea (46%), NPK (15:15:15) and Ammonium Sulphate (21%N, 24% S) as following:

1-Control (without Nitrogen)

2- Urea at rate 39.0 Kg/fed.

3- NPK at rate 119.5 Kg /fed.

4- Ammonium sulphate at rate 85.3 Kg/fed.

Cultural practices:-

The soil was ploughed, leveled, and divided into plot (Experimental units). Each plot consists 3 ridges of 60 cm spacing and 3.0 m length. Its gross area was (10.44m^2) and its net planted area was (4.7m^2).

Onion seedlings were transplanted on 21th January, 2017 in three rows on each ridge at 7.5cm within row spacing. They were irrigated at 7-10 days intervals (16 irrigations), the missed plants were replanted after 3days from planting.

Weeds were controlled by herbicide after 19 days from planting in addition to four hand weddings. Pest (Thrips) and diseases were controlled when needed.

Urea, NPK and Ammonium sulphate were applied in two doses the first one after 20days from transplanting and second dose after one month from the first one.

The crop was harvested after about 4.5 months (139 days) from planting.

Data collected:-

1- Vegetative growth parameters:

After 43and 94 days from planting five plants were randomly selected from each experimental unit to evaluate the following parameters:

1-plant height (cm):

The height of the five plants was measured from the base of bulb to the tip of the last leaf and the average plant height was recorded.

2- Number of leaves:

The number of leaves of the same plants was counted and the average leaf number per plant was recorded.

3- Leaf length (cm):

The leaf length of the same plants was measured from the leaf base to the tip and the average leaf length was recorded.

2-Yield and yield components:

1-bulb weight (g):

Five bulbs were selected randomly from each experimental unit and weighted. The average weight per bulb was calculated.

2-Total yield (t /ha):

The total yield/ plot was recorded and the yield/ha was calculated as follows:

$$\textbf{Yield t/ha} = \frac{\textbf{Yield kg/plot} * \textbf{10000}}{\textbf{planted plot area}(m^2)} / \textbf{1000}$$

3-Marketable yield (sound bulbs) (%):

The total yield of sound bulbs/plot was recorded and the yield/ha was calculated as for total yield.

3- Bulb quality:

1-Bulb diameter (cm):

Five sound bulbs were randomly selected from each experimental unit to and their diameter was measure using the vernier. Then the average bulb diameter was calculated.

2-Bulb length (cm):

The bulb length of the same five bulbs was recorded and the average bulb length was calculated.

3-Bulb neck diameter (cm):

The neck diameterof the same five bulbs was measured using a verneir and the average bulb neck diameter (cm) was calculated.

4-Number of rings:

The number of ring of the same five bulbs was calculated and the average number per bulb was recorded.

5-Total soluble solids (T.S.S):

The T.S.S of the same five bulbs was recorded using a digital refractometer and the average per bulb was recorded.

6-Bulb dry matter (%):

The fresh weight of the same five bulbs was recorded before T.S.S. estimation. They were oven dried at 80^{o}C for 48haours. Their dry weight was recorded and the percentage of bulb dry mater was calculated using the following formula:

$$\textbf{\% bulb dry matter} = \frac{\textbf{Bulb dry weight}}{\textbf{Bulb fresh weight}} \times \mathbf{100}$$

Design and data analysis:

The experimental units were laid in completely randomized block design with three replications. Analysis of data was done using GenStat (Computer Program) Version18 and the means were separated using Duncan Multiple Range Test (DMRT) at $P \leq 0.05$ (Gomez and Gomez 1984).

CHAPTER FOUR

RESULTS

1-Effect of nitrogen sources on onion growth:

1.1 Plant height(cm):

As shown in (Table 1) the fertilizers had no significant effect was noticed on plant height due to nitrogen source. Generally the lowest effect was shown by ammonium sulphate.

1.2 Number of leaves:

As noticed in Table 1 there was significant effect on number of leaves due to nitrogen source. The NPk recorded the highest significant on number of leaves (12.7) compared to other nitrogen source. No significant different was noticed among the nitrogen source (Urea, Ammonium sulphate and control).

1.3Leaf length (cm):

The result in (Table 1) reflected no significant effect was noticed among nitrogen source on leaf length.

Table 1: Effect of different sources of nitrogen on onion (variety Baftaim(S)) growth after three months:

Source of 17.9kg N/fed	Growth parameter		
	Plant height(cm)	Number of leaves	Leaf length (cm)
Control	8a	11.7b	49.3a
Urea	7.9a	11.9b	48.5a
NPK	8.9a	12.7a	51.6a
Ammonium sulphate	7.5a	11.7b	50.4a
C.V.	13.9	3.2	5.7
LSD	2.2	0.3	5.7
Significant level	NS	*	NS

2--Effect of nitrogen sources on onion growth:

2.1 Plant height(cm):

The results showed (Table2) there were significant differences among treatment.NPK fertilizer reflect the longest plant(11.1cm) followed Ammonium sulphate, control and urea(10.0, 9.7and 8.5cm) respectively.

2.2 Number of leaves:

As noticed in (Table 2) there were no significant different between treatments.

2.3 -Leaf length (cm):

The results indicated (Table 2) there were no significant different between treatment.

Table 2: Effect of different sources of nitrogen on onion (variety Baftaim (S)) growth after four months:

Source of 35.8kgN/fed	Growth parameter		
	Plant height(cm)	Number of leaves	Leaf length (cm)
Control	9.7ab	11.5a	22.11a
Urea	8.5b	11.1a	23.8a
NPK	11.1a	12.3a	16.5a
Ammonium sulphate	10.0ab	11.9a	21.9a
C.V.	9	8.1	25.5
LSD	1.770	1.9	10.7
Significant level	*	NS	NS

3. Yield and yield components:

3.1 Bulb weight (g):

As noticed in (Table 3) the highest significant bulb weight was obtained by NPK. No significant different were noticed among other nitrogen source and control.

3.2 Total yield (T/ha):

The results (table 3) showed there were no significant effects between treatments.

3.3 Marketable yield (%):

The marketable yield sound bulb has no significant effects due to fertilizers.

Table 3: Effect of different sources of nitrogen on onion (variety Baftaim (S)) bulb weight, total yield and marketable yield:

Source of 35.8kgN/fed	Parameter		
	Bulb weight(g)	Total yield(t/ha)	Marketable yield (%)
Control	35.2a	12.5a	88%a
Urea	32.1b	13.1a	77.1%a
NPK	45.5a	12.7a	88.2%a
Ammonium sulphate	30.5b	12.9a	86%a
C.V.	14.4	20.4	21.1
LSD	10.32	5.2	4.6
Significant level	*	NS	NS

4. Bulb quality:

4.1 Bulb diameter (cm):

As in (table 4) there were significant different among treatments on bulb diameter. NPk and control gave the highest bulb diameter (4.4cmand 4.3cm) respectively, while Urea and Ammonium sulphate reported the lowest bulb diameter.

4.2 Bulb length (cm):

There were no significant different between treatments (table 4).

4.3 Neck diameter (cm):

The results (Table 4) indicated there were no significant effects on neck diameter.

4.4 Number of rings:

The results showed (Table 4) there were no significant effects on number of rings.

4.5 Total soluble solid (T.S.S):

As shown (Table 4) no significant differences in total soluble solid among treatments.

5.5 Bulb dry weight (g):

The result in (Table 4) reflected no significant effect was noticed among nitrogen source on Bulb dry weight.

Table 4: Effect of different sources of nitrogen on onion (variety Baftaim (S)) quality (Bulb diameter, Bulb length, Neck diameter, Number of rings, T.S.S and dry weight):

Sourceof 35.8KgN/fed	Parameter					
	Bulb diameter (cm)	Bulb length (cm)	Neck diameter (cm)	Number of rings	T.S.S	Bulb dry weigh (g)
Control	4.3a	5.4a	1a	8.9	10.5a	13a
Urea	4.0b	3.5a	1.1a	9.3	11.2a	12.9a
NPK	4.4a	3.8a	1.1a	9.5	11.1a	13.6a
Ammonium sulphate	3.9b	3.7a	1.2a	9	11.8a	13.8a
C.V.	3.3	39.2	13.8	7.4	8.7	4.6
LSD	0.28	3.222	0.3052	1.353	1.941	1.201
Significant level	**	NS	NS	NS	NS	NS

Chapter Five

Discussion

1-Effect of nitrogen sources on vegetative growth:-

The results reflected there were significant effect on plant height and number of leaves due to using different sources of nitrogen. NPK reported the highest plant height and number of leaves after three and four months. Similar results were obtained by Abdel Naby et al. (2012) who found that balanced combination of NPK fertilizer gave the highest value of plant height. While there were no significant effect on other vegetative growth.

2-Effect of nitrogen sources on yield:-

The results showed there were significant effect on bulb yield and quality. The highest bulb diameter and bulb weight were obtained by using NPK fertilizer. Similar results were reported by Kandil *et al*.(2013) and Kadiri *et al*,.*(*2015)who reported that high onion bulb weight were obtained due to high combination of NPK (81-214kg N/ha, 16-71kg p/ha and 57-148 kg k/ha) compared to single dose of them. The other quality characteristics (bulb length, total soluble solids, number of rings and dry matter) were not affected by different sources of nitrogen.

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