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Study of vegetative growth and yield of seven onion varieties (*Allium cepa L.*)

A dissertation submitted to Sudan University of Science and Technology in partial fulfillment of the requirements of the degree of B.sc.Honours in Horticulture

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October, 2017

Dedication

To the candles of my life….. Father and Mother

To my guardians in my life…….. my Brothers (Asim-Mohamed – Hozayfa –Ahmed)

To my great sister (Omama) and her daughter (Huda)

To my best friends (S-M-K-O-N-I-A-T)

With love and great respect

Acknowledgement

First I thank God to offer me a health to complete this work. Thanks extended to the Department of Horticulture. I would like to express my sincere gratitude to my supervisor**Prof. Gaafar H. Mohamed Ali**for his keen interest,constant guidance , help and encouragement throughout the course of this study to bring this work to reality. It has been a privilege and a pleasure to work with him. I will also take my opportunity to express my sincere thanks to Mr: SiefEldinGadkareem, deep thanks toMrs: HanadiAwad El-Kareem for her help and constructive criticism, encouragement andefforts to help me completing my study. Thanks also are extended to my colleagues in this College of Agricultural Studies

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Abstract

This research was carried out at the Horticultural Crops Research Center Farm, Shambat. To study the performance of seven onion varieties namely: Baftaim“S” Red, Baftaim Yellow, Zalingi Red, Abu Feraiwa Deep red, Falatia Red, Texas Early Yellow Grano and El-Hilo White.

The results showed a considerable variation in vegetative growth among the seven varieties, where the varietiesBaftaim“S”and Falatia gave thehighest values in vegetative growth, while the variety Baftaim“S” gave the highest marketable yield, indicating that variety Baftaim“S” the best among the seven varieties.

ملخص الأطروحة

أجريت هذه الدراسة بمزرعة محطة بحوث المحاصيل البستانية بشمبات، لفحص وتقييم خصائص سبعة من أصناف البصل وهي: بافطيم S أحمر ، بافطيم أصفر، زالنجي أحمر ، أبو فريوة أحمر داكن ، فلاتية أحمر ، تكساس والحلو أبيض اللون.

أوضحت النتائج وجود إختلافات في النمو الخضري والانتاجية بين الأصناف السبعة حيث أعطي الصنفان بافطيم "S" وفلاتية أعلي نسب في النمو الخضري بينما أعطي الصنف بافطيم "S" أعلي إنتاجية تسويقية مما يتضح أن الصنف بافطيم "S" الأفضل بين الأصناف السبعة.

CHAPTER ONE

INTRODUCTION

Onion (AlliumcepaL.) has been domesticated in central Asia about 6000 years ago.

Growing areas have been expanding ever since. It is presently grown almost in all parts of the world. The two main economic vegetables in sudan are onion and tomato (Abu – sara 2001). Occupying more than 50% of the vegetable area grown in sudan.

Onion is widely used as vegetable by almost all classes of society. Onion is produced mainly in: Gezira, River Nile, Khartoum, Kassala, Northern state, Sennar state and Darfur states.

Onion are second only to tomatoes in importance as a vegetable in the tropic. Both are used for their flavors, mineral, constituents and trace elements contribution to the diet rather than nutritional valve. Also the shoot system of onion is rich in a number of vitamins. Fourty 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.

Values of the world production of bulb onions are estimated at five billion dollars. More than 90% of onion is consumed within the countries of production. The leading producing areas are: China, India, Mexico and Turkey. While the top importing countries are: Germany, U.K, USA, France, Malaysia and Belgium.

Onion is a leading vegetable crop in the sudan. It is eaten fresh, pickled, dry or cooked. Onion is planted annually as a winter crop. Estimation of total production area in sudan is about 400,000 feddans. However reliable figures concerning total production fluctuates from one year to another depending on the total area and the prices of the previous year. years of low production resulting from unfavorable climatic factors are associated with high prices, which encourage farmers to expand the area under production the following year. Such behavior leads to supply gluts and consequently low prices. With low prices in mind the area under production shrinks in the year after.

The objective of this study is: study the differences in vegetative growth and marketing productivity of seven varieties of onions.

CHAPTER TWO

LITERATURE REVIEW

2-1 Onion:

AlliumcepaL.

Family: Alliaceae

Plant description:

Allium cepa L. is a herbaceous biennial monocotyledon plant. It has a 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 form a bulb topped by a false stem or collar. In deep, homogenous soils, the plant develops a root system that expands to a depth of 30 – 50cm. Seed structure includes the embryo and endosperm described by Sachs (1863) and by Haffman (1933). The seeds are convex on one side and flattend on the other and covered by a black seed coat. The embryo is crescent shape or curled in a spiral form consisting of long cotyledon and short root axis.

2-2 Crop Management:

2-2-1 Irrigation:

Onion has a shallow and limited root system which explore mainly the upper 30 cm of the soil.

This crop should be irrigated frequently throughout the growing season. The soil moisture should not be allowed to fall below 50%. Most soils should receive 2.5 cm of water per week from the combination of rainfall and irrigation. Soil moisture is important in the growth of new roots, the

soil moisture must reach the base of the bulb periodically if the newly formed roots from the stem are to grow into the soil. New roots will not grow in to dry soil.

2-2-2 Nutrition:

All additions of lime and fertilizer or manures should be based on recommendations from a soil test.

Onions require a highly fertile soil but well balanced. Manure is not recommended as weeds are serious problem in this crop and due to the irregular availability of nitrogen. Lime-mineral soils must have a pH of 6.5 to 6.8 for satisfactory crops. On peat soils pH of 5.5 is sufficient. The soil must contain adequate Calcium for the crop growth. This means that Calcium must be evenly distributed and incorporated into the field. Crop failure is common on fields with in adequate liming. Also, some cultivars may be more sensitive than other to pH.

Nitrogen: apply most of nitrogen pre planting incorporated (at least 2/3 of the required amount). Side dress the remainder in mid to late June after seeded onions are about 15 cm tall.

Excessive nitrogen especially in July can cause delayed maturity (thick necks) and soft bulbs.

Phosphorus: should be banded if possible at the time of seeding. Otherwise relatively heavy applications of phosphorus must be broadcast and pre plant incorporated.

Potash: potash should be broadcast and pre plant incorporated. Application rates depend on the level in the soil.

Micronutrients Copper: deficiency occurs on acid mineral or peat soil. Copper may be mixed with the fertilizer and applied on peat soils 50 kg of copper sulphateper hectare is recommended. Copper sulphate can be applied by spraying into the soil surface and incorporating in into the soil (this material is extremely corrosive to metal).

Manganese: at high soil pH's a deficiency may show up. Soil application of this element is not suggested due to the large amounts required. Foliar applications of manganese sulphate are recommended, starting when the plants are about 15 cm tall with 1.5 to 2.7 kg manganese per hectare in 300 L of water and repeated in 4 to 5 sprays 10 days apart. Use the low rate on small plants increasing the rate as the season progresses.

Molybdenum: deficiency may occur when onions are grown and acid mineral or peat soils. A seed treatment has proven beneficial. The treatment is accomplished by dissolving 15 grams of Sodium molybdate in 45 ml of water. Spray this solution from an atomizer bottle on 2.3 kg seed spread thinly on a plastic sheet. Do not use excessive water as this can cause the chemical to penetrate the seed embryo and cause injury. Mix the seed thoroughly and let dry. Spraying the plants with Sodium molybdate at rates supplying 0.1 to 0.25 kg molybdenum per 1000 L also will help to avoid deficiency symptoms. On new peat soils apply an initial application of 10 kg of either ammonium molybdate or Sodium molybdate per hectare.

Zinc: if zinc becomes a problem spray the foliage with zinc sulphate at rates supplying 0.6 kg zinc per 1000 L of water.

Boron: on peat soils an initial application of 1.5 kg of actual boron is recommended. On high pH sandy soils with low organic matter and

where boron has not been used on rotational crops, foliar or soil sprays of boron may be considerd.

Application Method- Generally N, P and K are broadcasted pre planting incorporated. N, P and K maybe partly banded. Nitrogen maybe side dressed early in the season. Foliar sprays may be used for micronutrient applications.

2-2-3 Soil type:

The pH ranging from 6 – 7 is usually recommended for growing onions (Brewster, 1990). Jones and Mann (1963) reported that the good yields of onion could be obtained from soil pH between 5.5 to 6.5. Onion yield was reduced by soil salinity (Bernstein and Ayers, 1953).

2-3 Growing requirement:

Onion can be grown under a wide range of climatic condition, but the crop succeeds in mild climate without excessive rainfall or great extremes of heat and cold, cool condition with adequate moisture supply are most suitable for early growth, followed by a warm drier condition for maturation, harvesting and curing.

2-4 Varieties:

Onion varieties are characterized by bulb skin, color, thickness, bulb pungency taste and bulb shape. Bulb shape can be globe, flattened

globe, sometime with a flat to spindle or cylindrical (Dorker and Fennel, 1974; Magruda et al., 1941; Swiader, 1992). Onion varieties differ in their quality characters (Dowker and Fennel,1974; Brewstes, 1977). The quality characters of onion varieties are described in several ways that

include bulb doubling, the firmness of bulb, dry matter content, bulb pungency, flavor and its potential storage life (Magruder et al., 1941).

2-4-1 Varieties in Sudan:

The varieties that need relatively short day are grown to form the bulbs, defined as short day varieties in areas that are between latitudes 30 20 south and north. These areas are characterized by the length of the photoperiod which is slightly different or relatively constant throughout the year and therefore the length of the photo period is not important factor in the formation of the bulbs. The growth and formation of the bulbs under high temperatures in the tropical regions increases the phenomenon of doubling with the increase of lateral buds.

Accreditation of farmers to produce their own seeds has led to significant genetic variation in most qualitative and quantitative qualities and is therefore important in breeding programs.

The origins of Sudanese varieties are based on three main sources:

1- Onion in northern Sudan:

Resulting from hybridization among local and Egyptian varieties. They are mostly yellow or brown such as Yellow Dongola and Selaim bulbs. Characterized for high in dry matter (>15%), pungent, good storage with low early bolters.

2- Onion in central Sudan:

Resulting from hybridization among local and imported varieties especially from USA, like Saggai. And they are mostly red, high in dry matter, pungent with good storage capacity. This group includes many local varieties named after the areas where they are grown

commercially such as: Shendi, Wad Rumli, Helalia, Kanour, Fadasi…… etc, but the most famous Saggai.

3- Onionin western Sudan:

Resulting from hybridization among local and west African varieties. They are mostly yellow, white and red like: Zalingi, Fur onions and some known as Furawia, Darfuria. They are low in dry matter, mild, of bad storage capacities and mixed color, shape and size.

Most of the Sudanese onions are red to brown, and some varieties are characterized by special color (Saggai is a crimson red color- Abu Feraiwa is dark red). Solid and high in dry matter (15 – 18%) therefore it is suitable for normal storage. But it has a number of quantitative and poor qualities resulting from open pollination and the wrong practice of seed production such as: early bolters, doubles, color, size and susceptibility to diseases.

2-4-2 Approved varieties in Sudan:

1- Saggai Improved:

Approvedin 1987 by ARC,Variety Release Committee. Characterized by: big size, crimson red color, The bulb is multi-center, solid, high dry material, high storage capacity and good. It needs 142 days for full maturity.

2- Kamleen:

Approved in 1987 by ARC, Variety Release Committee.Characterized by: flattened globe, yellow, solid, big size,pungent, high in dry matter,it needs 4 - 5 months for full maturity and highest productivity of Saggai.

3- EL-Hilo:

Approved in 1987 by ARC, Variety Release Committee.Characterized by: dry matter content of about 18%, big bulb, pungent, good storage and it is equivalent in productivity of Saggai and Kamleen and fastest mature.

4- Baftaim S:

Candidate from Yemen,approved in 2006. Characterized by: big size, solid, pungent, high in dry matter(16%), free fromthe phenomenon at early bolters and doubles, it needs 153 days to mature and it is the most productive varieties in Sudan.

2-5 Statement of problem:

The production of onion in the Sudan is constrained by many problems. These problems include premature bolting, bulb doubling and splitting off-type and non-uniform bulb shapes and size. Doubling and splitting are largely genetically controlled as well as affected by management practices like sowing dates, irrigation, spacing, fertilization…… etc.

Doubled and splitted bulbs are not accepted for export. Using big sized transplants, increasing nitrogen doses and the un-controlled irrigation (this subjecting plants to water stress and then applying enough water) are all factors which could increase the incidence of doubling and splitting. All these problems contribute to the reduction of marketable yield and the downgrading of the onion bulb quality particularly for export.

2-6 Bolting:

The cultural practices likely to induce bolting can be referred from knowledge of the physiology of inflorescence initiation. The critical weight of onion seedlings or sets below a certain weight varies with

varieties but it is about 0.6g shoot dry weight of seedlings and about 4.0g fresh weight for sets of spring sown cultivars a certain weight cannot initiate inflorescence (Brewster,1990).

The factors that influence bolting are of important to the bulb grower because yield and quality are lowered by bolting. Photo period have little effect on the initiation of flower, bolting is induced almost entirely by cool temperature (Jones and Mann, 1963). The influence of sowing date on bolting has been discussed; varieties vary considerably in their susceptibility to bolting. Those with tendency to bolt should be planted late. So that small plant will be over-wintered (Davis and Jones 1944).

2-7 Doubles:

Irregular growth caused by periodic water stress followed by rainfall or irrigation late in bulb development, can impair bulb quality by causing splitting in the outer skin and swollen sheath. However most experiments showed differences in the leaves quality of bulbs between non-irrigated and irrigated treatments.Although in one study irrigation in a wet season increased the number of doubled bulbs and other defects at harvest (Drinkwnt et al., 1955). The percentage of doubles in onions differ from varieties to other, so it is considered as genetic factor, but it was affected by other factors such as spacing, use of large size seedling, high quantity of nitrogen fertilizer, irregular irrigation intervals, irregular degrees of temperature (Ahmed, 1984).

2-8 Diseases:

1- Damping off.
2- Pink root rot disease of onion.
3- Purple blotch.
4- Powdery mildew.

5- Onion yellow dwarf virus disease (OYDV).

6- Black mold.

7- Bacterial soft rot.

2-9 Insects:

1- Onion thripsThripstabaci

2- Army wormSpodopteraexigum

3- Onion fly.

4- NematodaMeloidogyne spp.

CHAPTER THREE

MATERIALS AND METHODS

The present study was carried out at the farm of the Horticultural Crops Research Center-Shambat on the eastern bank of the Nile (let 15 40 N, long 32 32 E, elev. 376 m).

Seven varieties of onion (*Allium cepa L.*) namely Baftam“S”, Baftaim Yellow, Zalingi, Texas Early Grano, Abu Feraiwa, El-Hilo and Falatia, were compared.

The seeds were sown during the first week of November in the nursery in plots and transplanted to the field after 53 days. A randomized complete block design with three replications was used. Seedlings were planted on both sides of the ridge 70 cm width at 10 cm spacing between plants.

3-1 Irrigation

Irrigation was applied at 6 days interval and stopped 21 days before harvesting.

3-2 Weeding

Manual weeding was practiced carried out 7 weeks after transplanting. Two doses of urea fertilizer each 50 kg were applied, one at four weeks from transplanting and the other one four weeks from the first one.

Karati was used to control thrips. For data collection, random samples of 3 plants from each plot.were used at two stages of growth for the following parameters:

1- Number of leaves/plant: leaves number per plant was determined by counting the visible leaves.

2- Plant height (cm): plant height was measured from the tip of the longest leaf to the neck of the bulb at soil level.
3- Yield: The weight of the bulbs.

3-3Marketable yield (t/ha):

The marketable yield means bulbs free from premature bolting, splitting, sprouting, sunscald, small and diseased bulbs.

3-4Harvest:

Started in 20-28 May.

CHAPTER FOUR

RESULT

4-1 Vegetative growth:

4-1-1 Leaves number:

The variety Baftaim“S” gave the highest number of leaves, followed by the varieties Falatia and Abu Feraiwa, while Texas Early Grano gave the lowest number of leaves.

Randomized Complete Block AOV Table for leaves number

Source	DF	SS	MS	F	P
BLOCK	2	8.222	4.11111		
TREM	6	44.317	7.38624	2.23	0.0543
Error	54	179.111	3.31687		
Total	62	231.651			

Grand Mean 10.460 CV 17.41%

Table 4.1. Leaves number

Treatment	Mean
Baftaim“S”	11.77^{A}
Baftaim Yellow	10.22^{AB}
Texas Early Grano	9.333^{B}
El-Hilo	10.556^{AB}
Falatia	11.000^{AB}
Zalingi	9.333^{B}
Abu Feraiwa	$11.00A^{B}$
LSD	1.7213
SE±	0.8585
CV%	17.41%

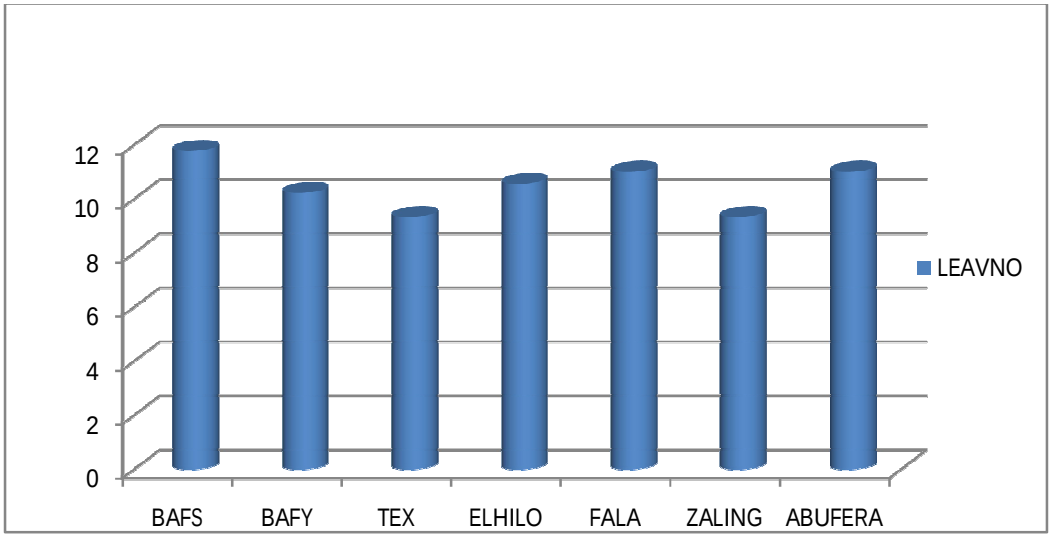

Figure 1. Leaves number

4-1-2 Leaves length:

The variety Baftaim“S” gave the longest leaves followed by Falatia and then Texas Early Grano while El-Hilo gave the shortest leaves.

Randomized Complete Block AOV Table for leaves length

Source	DF	SS	MS	F	P
BLOCK	2	4.57	2.286		
TREM	6	1668.44	278.074	10.87	0.0000
Error	54	1380.98	25.574		
Total	62	3054.00			

Grand Mean 51.333 CV 9.85%

Table 4.2. Leaves length

Treatment	Mean
Baftaim“S”	58.00^{A}
Baftaim Yellow	50.22^{CD}
Texas Early Grano	54.00^{ABC}
El-Hilo	41.44^{E}
Falatia	56.11^{AB}
Zalingi	51.667^{BCD}
Abu Feraiwa	47.88^{D}
LSD	4.7795
SE±	2.3839
CV%	9.85%

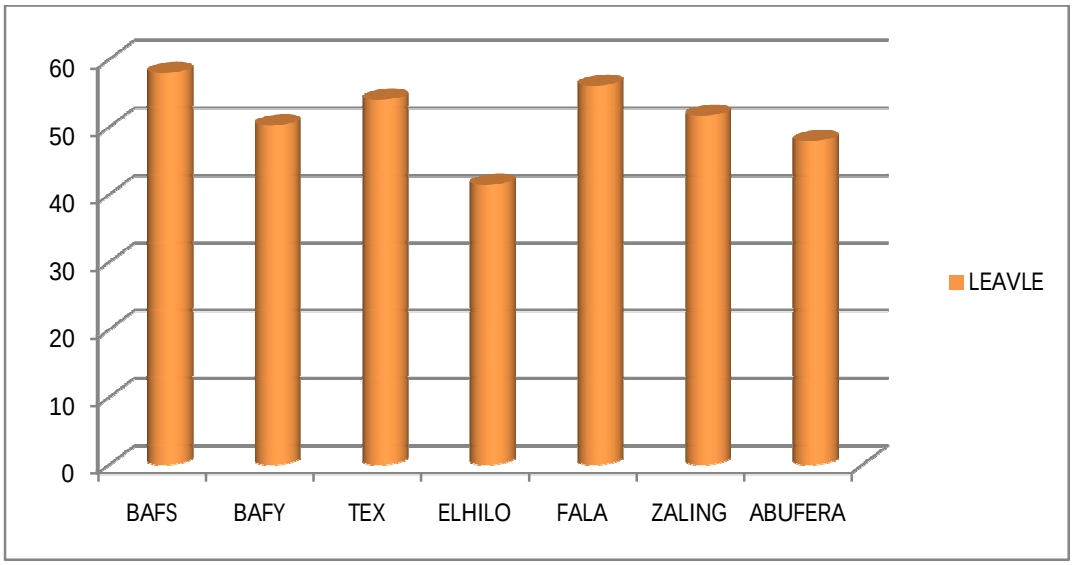

Figure 2.Leaves length

4-2 Marketable yield:

The variety Baftaim“S” gave the highest productivity followed by Texas Early Grano and then Baftaim Yellow, while El-Hilo gave the lowest productivity.

Randomized Complete Block AOV Table for marketable yield

Source	**DF**	**SS**	**MS**	**F**	**P**
TREM	6	1253.79	208.965	7.39	0.0010
Error	14	395.98	28.284		
Total	20	1649.76			

Grand Mean 46.463 CV 11.45%

Table 4.3. Marketable yield

Treatment	Mean
Baftaim“S”	57.56^{A}
Baftaim Yellow	48.48^{ABC}
Texas Early Grano	54.21^{AB}
El-Hilo	31.83^{D}
Falatia	44.26^{C}
Zalingi	45.75^{BC}
Abu Feraiwa	43.11^{C}
LSD	9.3134
SE±	4.3423
CV%	11.45%

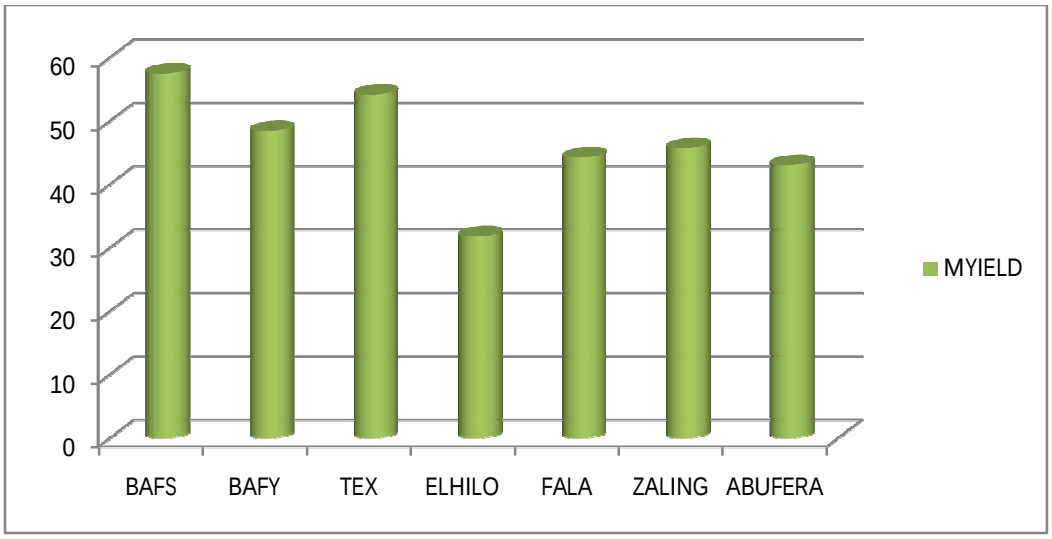

Figure 3. Marketable yield

CHAPTER FIVE

DISCUSSION

The seven varieties under study varied considerably in their growth components including the number of leaves/plant, plant height (cm) and productivity. This may be due to the fact that those varieties differ in their genetic make up which interact differently with the prevailing environmental conditions as temperature, humidity and soil type. This result agreed with the findings of Mohamed Ahmed El-tayeb (2006) who found that successful onion production depends mainly upon selection of varieties. Variety Baftaim“S” gave the highest values of the number of leaves, while the variety Zalingi and Texas Early Grano gave the lowest number of leaves. The variety Baftaim S gave the highest values of leaves length while the variety El-Hilo gave the lowest leaves length. Although harvest was delayed and some inappropriate environmental conditions before harvesting prevailed that affected productivity in some varieties, however the variety Baftaim“S” gave the highest productivity while El-Hilo gave the lowest productivity. It is clear that variety Baftaim“S” the best among the seven varieties in terms of vegetative growth and productivity.

References:

Ahmed,A.H. (1984). Onion and Garlic house for publication and distribution- Cairo (In Arabic).

Bedford, L. V. (1999) Dry matter and pungency test on British grown onions. J. Nati. Inst. Agric. Bot. 16:581-591.

Bernstein, L, and Ayers, A. D., salt tolerance of five varieties of onion, Proc. Am. Soc. Hortic.Sci., 62, 367, 1953.

Brewster, J. L. (1990). Cultural system and agronomy practices in temperate climates, P. P. 1-30. In: H. D. Rabinowitch and J. L. Brewster. (eds). Onion and allied crops.Vol. Agronomy, biotic interactions, pathology, and crop protection CRS press, Inc., Boca Raton, Florida.

Davis,G.N. and Jones, H.A (1944). Experiment with the transplanting onion crops in California. Bull. Calf.Agric Exp. Sta 682:, 3-20.

Dorker, B. D. and j. f. m. Fennel, 1974.Heritability of onion bulb shape in some North European onion varieties. Annals of Applied Biology 77;61-65.

Dorker, B. D. and j. f. m. Fennel, 1974.Some responses to agronomic treatments of bulb onions, Allium cepa.Jouranal of Horticultural scince 49:1-14.

Drinkwnt W.O. and Jones,B. (1995). Effect of irrigation and soil moisture on maturity, yield and storage of two onion hybrids.Proc.Am.Soc.Hort.Sci.60.267.

Evaluation of three Sudanese local onion cultivars for export.

FAO, (1999) production year book (2001). Vol. 53 Food and Agricultural organization in the sudan. In Acta Horti-143.

Haffman (1933).Crop production in tropical Africa Reference book by Romai. H. Raemaekers

Jones, H.A. and Mann,L.K (1963). Effect of large and small transplant, on yield of mature bulbs. Onion and their alliesleonrd H.H., London. P. 120-121.

Magruder, R. Jones, H A; Randall, T. E.; snyler, G. B.; Brown, H. D. Houthoun, L. R. and wilson, A. L. (1941). Description of type of principal American varieties of onion.

Sachs (1863) Crop production in tropical Africa Reference book by Romai. H. Raemaekers.

- البصل في السودان الانتاج – التخزين – التربية بروفسير جعفر حسن محمد علي أبريل 2009.
- إنتاج البصل والثوم أ. د أحمد عبد المنعم حسن.