ADAPTATION OF SOME ONION CULTIVARS UNDER MIDDLE DELTA CONDITIONS IN RELATION TO NITROGEN FERTILIZATION.

II- Bulbs yield, quality and storagability.

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تأقلم بعض أصناف البصل تحت ظروف منطقة وسط الدلتا وعلاقة ذلك بالتسميد النتروجينى

٢- محصول الأبصال وصفات الجودة والقابلية للتخزين

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ملخص البحث

تم دراسة محصول الأبصال وصفات الجودة والتخزين كمؤشر لأقلمة ثلاثة أصناف من البصل هى : شندويل ١ ، جيزة ٦ محسن وجيزة ٢٠ ، تحت ظروف وسط الدلتا . ولقد تم أيضا بحث علاقة مستويات التسميد الآزوتى (صفر ، ٣٠ ، ٦٠ ، ٩٠ كجم نتروجين / فدان) وعدد مرات اضافته (مرتين أو ثلاثة مرات) بكفاءة المحصول فى الأصناف تحت الدراسة . ولقد أوضحت النتائج المتحصل عليها :-

- حقق الصنف جيزة ٢٠ أعلى محصول كلى وتسويقى ومزدوج من الأبصال كما أثبت تفوقا فى متوسط وزن البصلة وقطرها وكذلك نسبة المادة الجافة والمواد الصلبة الذائبة فيها ولكن كان له أقل قيمة فى مؤشر شكل البصلة .
- أظهر الصنف جيزة ٦ أكبر نسبة فى الفقد من وزن الأبصال عندما تم تقدير هذا فى الفترات المختلفة خلال وجود الأبصال فى المخزن وتلا الصنف جيزة٦ فى هذا الصنف شندويل ١ وجيزة ٢٠ على التوالى .
- زيادة مستوى التسميد الآزوتى كان مصحوبا بزيادة مماثلة فى جميع مكونات المحصول حيث أدى الى زيادة معنوية فى قطر البصلة ومتوسط الوزن الغض بها . كما أن زيادة التسميد الآزوتى أدى الى زيادة فى نسبة الفقد من وزن الأبصال خلال جميع فترات وجودها فى المخزن .

- كانت لاضافة السماد الآزوتى على مرتين متساويتين أكثر تأثيرا فى زيـــــادة المحصول الكلى والتسويقى والمزدوج من الأبصال ، كما أدت الى زيادة متوسط وزن البصلة وقطرها فى موسم واحد فقط . ولم يكن لعدد مرات اضافة السماد الآزوتى تأثير معنوى على قابلية الأبصال للتخزين .

- تم دراسة تأثير التفاعل بين العوامل تحت الدراسة على المحصول وصفـــات الجودة والقابلية للتخزين فى الأبصال .

ABSTRACT

Bulbs yield, quality and storagability as indications to three onion cvs., i.e., Shandaweel No. 1, Giza 6M. and Giza 20, adaptation under Middle Delta conditions were studied. Nitrogen level, i.e., 0, 30, 60 and 90 kg/fed. along with its number of applications, i.e., twice or three times, in relation to yield performance in the tested cultivars were also investigated.

Giza 20 cv. significantly achieved the highest total, marketable and double bulbs yield. It also approved superiority in bulbs weight, and diameter, as well as, dry matter percentage and T.S.S., but had the least shape index value in bulbs.

Giza 6M. generally had the highest losses in bulbs weight as assessed at all tested storage periods, so it was followed in this connection by Shandaweel No. 1 and Giza 20, respectively.

Besides, increasing N-level was accompanied by an increase in all studied yield components. It significantly increased bulb diameter and average fresh weight. Besides, increasing N-level increased weight loss in storaged bulbs as this storagability index was assessed at all tested storage periods.

The twice applications of N was more effective in increasing total, marketable and double bulbs yield. It also increased bulb fresh weight and diameter in one season only. On the other hand, number of N applications seems to be of no significant effect on bulbs storagability. The combined effect of the tested factors on bulbs yield, quality and storagability was also studied.

INTRODUCTION

In Egypt, onion is cultivated not only for local consumption but also for export. Most of the area cultivated for export is located in Middle and Upper Egypt where Giza 6M and Shandaweel No. 1, those well known to be of earlier maturity (Ahmed et al., 1977), are the main grown cultivars.

The early production of onion in the Middle Delta region gave the opportunity to increase bulbs yield for export. Production of Giza 6M and Shandaweel No. 1 cvs. in Nile Delta region may considered as one of the means of escaping from white rot disease, which widely contminate the soil in Middle and Upper Egypt, on one hand and gave the opportunity to profit from the earliness characteristics of these cultivars on the other hand. In Delta, Giza 20 cv. is a new cultivar well adapted for local conditions and shows good uniformity in shape and colour of bulb (El-Gammal, 1980), thus it may be considered an exportable cultivar.

Nitrogen usually limits onion yield than any other nutrient. It positively affects bulb fresh weight and total and marketable yields (El-Tabbakh et al., 1979 b and Hassan, 1984). A tendency of decreases number of doubles was noticed with lower N-levels (Basilious, 1975 and Hassan, 1984).

Number of N-fertilizer applications seems also to affect bulb yield Split application of N with 4 weeks interval increased bulb yield than single application (Satter and Hague, 1975). Besides, delaying N-application was reported by Basilious (1975) to reduce average bulb weight as well as total, exportable and doubles yield.

Nitrogen application was also reported to affect bulbs storagability. Higher rates of applied N- had an adverse effect on keeping quality of onion bulbs (Thomas, 1968 and Moustafa, 1979). Besides,

the time of N- application was reported by Sypien et al. (1972) to affect bulbs storagability, whereas it was observed by Basilicus (1975) to be of no effect in this respect.

Studing the adaptation of Shandaweel No. 1, Giza 6M and Giza 20 onion cultivars under Middle Delta conditions in relation to N-level and number of applications is the aim of this work. Yield and yield components in addition to bulb characteristics along with its storagability for the above mentioned cultivars were considered.

MATERIALS AND METHODS

Two field experiments were carried out at the Gemmeiza Agric. Res. Station to study the response of three onion cvs. i.e., Giza 20, Giza 6M and Shandaweel No. 1 to nitrogen fertilizer levels (0, 30, 60 and 90 kg. N/fed.) as applied either twice or at three additions, i.e., 55 and 75 days or 55, 75 and 95 days from transplanting, respectively. A split- split plot design with four replications was adopted where cultivars, nitrogen level along with its number of applications were arranged as main, sub and sub- sub plots, respectively. Seeds were sown in the nursery on October 15th in both seasons, whereas transplanting took place on January 9th and 12th in 1984 and 1985 seasons, respectively. The experimental plot was of 10.5 m^2 in area and includes 6 ridges each of 50 cm. wide and 3.5 m. in long (1/400 feddan). Cultural practices were completed by traditional methods for such crop. The recommended fungicides and pestisides along with their program of application were respected. Bulb yield of the four inner ridges was harvested on May 27th and June 1st in 1984 and 1985, respectively (when 50% of the tops were down). After harvest, plants were left in the field to cure for two weeks, then tops and roots were removed, so the total, marketable and double bulb yield were recorded.

A bulb samples, 10 bulbs each were chosen from the produced yield for every experimental plot and used to study bulb quality, thus the following measurements were recorded:

1- Bulb diameter and length as well as shape index (bulb diameter/ bulb length).
2- Average fresh weight of bulb (gm.).
3- Dry matter percentage and T.S.S. in bulbs.

For storagability studies, a sample of 50 cured uniform bulbs was undertaken from each replication and kept in common storage conditions (temp. 25° ± 5°C) for a period of four months. During storage period, bulbs were monthly inspected, since rotted and sprouted bulbs were descarded and the remaining was weighed. The percentages of total loss in weight, due to descarding rotted and sprouted bulbs, were monthly recorded i.e., 1st, 2nd, 3rd and the 4th month of storage.

The obtained data were exposed to the proper analysis of variance (Snedecor and Cochran, 1967) and Duncan's multiple range test at 5% level was used for the comparison among means (Duncan, 1955). The data expressed as percentages were transformed to arcsie values before the analysis of variance.

RESULTS AND DISCUSSION

1- Yield and its components:

1-1- Effect of cultivar:

Data in Table (1) showed a significant variation in bulbs yield and its components due to grown cultivar. Giza 20 cv. achieved the highest total yield (ton/fed.), marketable (ton/fed. and %) and double (kg/fed.) bulbs yield. In this connection, Giza 20 cv. was followed

Table (1): Effect of grown cultivars and nitrogen fertilizer levels along with its number of application on bulbs yield and its components in onion .

Yield and its components / Studied variations	1983/1984 Total yield (Ton/ Fed.)	Marketable yield (Ton/ Fed.)	Marketable yield (%)	Double bulbs yield (Kg/ Fed.)	Double bulbs yield (%)	1984/1985 Total yield (Ton/	Marketable yield (Ton/ Fed.)	Marketable yield (%)	Double bubls yield (Kg/ Fed.)	Double bubls yield (%)
Cultivars										
Giza 20	8.238 a	8.055 a	97.87 a	185.11 a	2.17 a	9.417 a	9.213 a	97.87 a	202.81 a	2.15 b
Giza 6M.	3.257 b	3.132 b	96.35 b	119.39 b	3.65 a	4.158 b	4.021 b	96.74 b	136.63 b	3.26 a
Shandaweel No.1	3.247 b	3.118 b	96.07 b	129.11 b	3.93 a	4.620 b	4.455 b	96.51 b	162.92 b	3.49 a
N-fertilizer level(KgN/Fed.)										
30	4.145 b	4.043 b	97.12 a	103.83 b	2.92 b	5.365 b	5.243 b	97.49 a	120.96 b	2.51 a
60	5.195 a	5.035 a	96.63 b	158.67 a	3.37 a	6.433 a	6.255 a	96.89 b	188.14 a	3.14 a
90	5.402 a	5.226 a	96.55 b	171.11 a	3.46 a	6.387 a	6.193 a	96.74 b	193.25 a	3.26 a
No.of N-fertilizer applications										
2	5.247 a	5.116 a	96.72 a	155.82 a	3.29 a	6.239 a	6.058 a	96.90 a	179.01 a	3.10 a
3	4.553 b	4.420 b	96.82 a	133.26 b	3.21 a	5.891 a	5.736 a	97.18 a	155.89 b	2.83 a

* Means separation columns by Duncan's multiple range test 5 % level .

* Values in the same column followed by the same letter don't differ significantly .

by Giza 6M cv. in respect to total and marketabable bulbs yield. This results is true in 1983/1984 season only. In 1984/1985,Shandaweel No. 1 cv. overbalance Giza 6M in total, marketable (either in ton/fed.) and double (kg/fed. and %) bulbs yield, although the differences did not reach the 5% level of significances. The total bulbs yield of Giza 20 cv. represents 254% and 253% comparing to that of Shandaweel No. 1 and Giza 6M cvs., respectively. This results is true in 1983/1984 season, whereas in 1984/1985 these percentages were 204% and 226%, respectively.

Results may be interpreted as Giza 20 cv. is well adapted cv. for environmental conditions of Nile Delta region, particularly what dealing with photoperiod and temperature, factors that well known to affect growth and bulbing behaviour of onion. Furthermore, Giza 20 cv. was noticed, from field observations, to be resistant for downy mildew disease that widely infected onion plants under Delta conditions and caused a marked reduction in their bulbs yield. Similar variation in bulbs yield of onion plants was also observed by El-Gammal et al. (1980) and El-Kafoury (1986).

1-2- Effect of nitrogen fertilizer level:

It is clear from data in Table (1) that increasing nitrogen level was accompanied with an increase in total, marketable (either in ton/fed.) and double (kg/fed. and %) bulbs yield, although the differences between 60 and 90 kg N/fed. were not significant. As compared to 30 kg N/fed., plants received 60 and 90 kg N/fed. achieved an increase in total bulbs yield reached 25.33% and 30.33%, respectively. This result is true in 1983/1984 season, whereas in 1984/1985 these percentages were 19.5% and 18.12%, respectively. Besides, the highest double bulbs yield (kg/fed. and %) being obtained when 90 kg N/fed. was applied.

Increasing the rate of nitrogen was noticed also by Hassan (1984) and Satyanarayan and Arora (1984) to improve bulb yield of onion plants. Results could be explained as nitrogen application enhanced metabolic activities within plant, improved vegetative growth and thereby may encourage much more metabolities to store in bulbs as storage organs.

1-3- Effect of the number of nitrogen fertilizer applications:

Data in Table (1) show obviously that, the twice applications of N-fertilizer significantly increased total, marketable (either in ton/fed.) and double (kg/fed) bulbs yield in the first season only. These results are in agreement with those of Sattar (1975) and Bhuyan and Hague (1979). Results may be interpreted as the twice N-applications gave the opportunity for earlier bulbing on one side and increased the quantity of storaged metabolities, by means of determining further vegetative growth, on the other side.

1-4- The interactive effect:

Regardless nitrogen level of applications, Giza 20 cv. approved superiority in total (ton./fed.), marketable (ton/fed. and %) and double (kg/fed.) bulbs yield (Table 2). These results are true in both seasons of study. In this connection, Giza 20 was followed by Shandaweel No. 1 in regard to total (ton./fed.), marketable (ton/fed.) and double (kg/fed. and %) bulbs yield, since Giza 6M cv. came the latest. Besides, the highest N- dose was more effective on Giza 20 cv., where the highest total (ton/fed.), marketable (ton/fed.) and double (kg/fed. and %) bulbs yield were obtained in both seasons.

It is worth noting that the interaction of cultivar and number of N-application or between the later and N-dose, in addition to the three factors, i.e., cultivar, N-level and number of N-applications, interactions, showed no significant effect on yield or its components, so its related data were descarded.

Table (2): The interactive effect of cultivars and nitrogen fertilizer levels on yield and its components in onion .

Yield and its components Studied interactions	1983/1984 Total yield (Ton/ Fed.)	Marketable yield (Ton/ Fed.)	Marketable yield (%)	Double bulbs yield (Kg/ Fed.)	Double bulbs yield (%)	1984/1985 Total yield (Ton/ Fed.)	Marketable yield (Ton/ Fed.)	Marketable yield (%)	Double bulbs yield (Kg/ Fed.)	Double bulbs yield (%)
Cultivars X N-dose (KgN/Fed.)										
Giza 20 X 30	7.333 b	7.209 b	98.45 a	130.67 cd	1.67 a	8.596 b	8.445 a	98.24 a	149.33 cd	1.74 a
X 60	8.353 a	8.160 a	97.72 a	192.50 b	2.28 a	9.336 b	9.145 a	97.85 a	203.92 b	2.21 a
X 90	9.028 a	8.796 a	97.44 a	232.17 a	2.56 a	10.306a	10.050a	97.51 a	255.17 a	2.49 a
Giza 6M X 30	2.599 d	2.510 d	96.57 a	88.67 e	3.43 a	3.824de	3.720 a	97.26 a	102.46 d	2.74 a
X 60	3.269cd	3.144cd	96.30 a	121.33de	3.70 a	4.559cde	4.380 a	96.17 a	179.42 bc	3.84 a
X 90	3.904 c	3.741 c	96.19 a	148.17cd	3.81 a	4.091de	3.963 a	96.80 a	128.00 d	3.20 a
Shandaw-eel No.1 X 30	2.503 d	2.411 d	96.34 a	92.16 e	3.66 a	3.676 e	3.565 a	96.97 a	111.08 d	2.03 a
X 60	3.964 a	3.80 c	59.87 a	162.17bc	4.13 a	5.421 c	5.239 a	96.64 a	181.08 bc	3.36 a
X 90	3.274cd	3.141cd	96.00 a	133.00cd	4.00 a	4.763cd	4.566 a	59.92 a	196.58 bc	4.08 a

* Means separation in columns by Duncan's multiple range test 5 % level .

x Values in the same column followed by the same letter dont differ significantly .

2- Mature bulbs quality:

Fresh weight, dry matter and total soluble solids contents in bulbs were noted to indicate bulbs quality. Bulb diameter and shape index were also considered.

2-1- Effect of cultivar:

Data in Table (3) revealed significant variations in mature bulb quality due to grown cultivar. Giza 20 cv. showed superior fresh weight, dry matter (%) and total soluble solids in bulbs. It also had the highest bulb diameter and the lowest shape index (D/L) value. Besides, Shandaweel No. 1 cv. insignificantly overbalance Giza 6M in regard to dry matter percentage and total soluble solids. These results were insistently observed in both seasons of study.

In harmony with such obtained by El-Gammal et al. (1980) results indicated that Giza 20 cv. was characterized by large size bulbs with thick flate in shape. Furthermore, the superiority of Shandaweel No. 1 in such bulb characteristics, as compared to Giza 6M, was also reported by Ahmed et al. (1977).

2-2- Effect of nitrogen fertilizer level:

Increasing nitrogen level increased both average fresh weight and diameter of bulbs. An increase in bulbs growth was noticed also by El-Tabbakh et al. (1979 a) and Moustafa (1979) to be due to N-applications. Besides, increasing nitrogen level of application insignificantly increased dry matter percentage and total soluble solids in mature bulbs.

2-3- Effect of number of nitrogen fertilizer applications:

Data in Table (3) revealed that splitting N-dose for two additions augmented bulbs fresh weight and diameter, although significances were noticed in 1983/1984 season only. The number of N-

Table (3) Effect of grown cultivars and nitrogen-fertilizer levels along with its number of applications on the mature bulbs characteristics in onion .

Bulb charct-eristics Studied Variations	1983/1984 Bulb fresh weight (gm)	Dry matter in bulb (%)	Bulb diameter (cm)	Shape index (D/L)	T.S.S. (%)	1984/1985 Bulb fresh weight (gm)	Dry matter in bulb (%)	Bulb diameter (cm)	Shape index (D/L)	T.S.S. (%)
Cultivars										
Giza 20	77.44 a	12.30 a	6.13 a	1.20 b	14.07 a	83.27 a	14.12 a	6.31 a	1.18 b	15.24 a
Giza 6M.	49.17 b	10.80 b	4.79 b	1.29 a	12.44 b	54.73 b	13.08 a	5.05 b	1.31 a	14.03 b
Shandaweel No.1	48.10 b	11.30 b	4.64 b	1.26 a	12.73 b	58.17 b	13.70 a	5.31 b	1.29 a	14.86 ab
N-fertilizer (KgN/Fed.)										
30	53.52 b	10.99 a	4.77 b	1.24 a	12.92 a	58.12 b	13.24 a	5.02 b	1.25 a	14.39 a
60	58.53 a	11.75 a	5.27 a	1.24 a	13.26 a	68.28 a	13.91 a	5.78 a	1.27 a	15.03 a
90	62.66 a	11.98 a	5.53 a	1.27 a	13.05 a	69.77 a	13.76 a	5.87 a	1.26 a	14.71 a
No.of N-fertilizer applications										
2	60.47 a	11.77 a	5.37 a	1.25 a	13.14 a	66.52 a	13.57 a	5.65 a	1.26 a	14.63 a
3	56.00 b	11.39 a	5.00 b	1.25 a	13.02 a	64.26 a	13.70 a	5.46 a	1.26 a	14.79 a

* Means separation in columns by Duncan's multiple range test 5 % level.

* Values in the same column followed by the same letter don't differ significantly .

fertilizer applications insignificantly affected dry matter percentage, T.S.S. and shape index in mature bulbs as assessed in both seasons of study. In spite of that, a trend of increasing dry matter percentage and T.S.S. was observed to follow the twice and triple applications of N-fertilizer in the first and second seasons. Increasing the number of N-fertilizer applications gave the opportunity to add a part of N at latened growth stage, thereby may affect unfavourably such bulb characteristics. This conclusion was previously confirmed by Basilious (1975).

2-4- The interactive effect:

Again, and irrespective the tested nitrogen levels, Giza 20 cv. showed superior fresh weight in bulbs, although significances were noticed in 1984/1985 only. It seems also to be of least shape index value indicating, in this connection, less flateness in shape (Table 4). The mature bulbs of Giza 20 cv. contain insignificantly superior dry matter and total soluble solids contents %. The other tested interactions of cultivar, N-level and number of N-applications insignificantly affected bulb quality indices, so their related data were omitted.

3- Storagability:

The percentage of weight loss due to descarding rotted and sprouted bulbs during storage period was considered in this study as an indicator for storagability.

3-1- Effect of cultivar:

Data in Table (4) show that Giza 6M cv. had, in general the highest losses in bulb weight as assessed at the different intervals of storage period. It was generally followed, with no significant variation, by Shandaweel No. 1 cv. Giza 20 cv. significantly came the latest. These results are true in both seasons of study.

Table (4): Effect of cultivars and nitrogen fertilizer levels along with its number of applications on the weight loss (%) in bulbs during storage period in onion .

Studied variations	1983/1984 Storage period in months				1984/1985 Storage period in months			
	1	2	3	4	1	2	3	4
Cultivars								
Giza 20	5.33 c	3.95 b	4.41 b	4.41 b	5.00 c	4.44 b	5.54 b	7.02 c
Giza 6M	9.86 a	7.18 a	8.41 a	8.84 a	9.31 a	5.74 a	10.10 a	11.03 b
Shandaw-No.1	8.12 b	6.19 a	7.45 a	7.98 a	7.13 b	6.18 a	9.38 a	13.77 a
N-fertilizer level(KgN/Fed.)								
30	6.75 b	5.01 b	5.73 c	6.59 b	6.26 b	4.56 b	6.72 b	8.29 b
60	7.86ab	5.90 a	6.79 b	7.08ab	7.24ab	5.74 a	8.76 a	10.98 a
90	8.70 a	6.41 a	7.75 a	7.67 a	7.95 a	6.07 a	9.55 a	12.55 a
No.N-fertilizer applic.								
2	8.13 a	5.95 a	6.68 a	7.03 a	7.71 a	5.56 a	8.24 a	10.54 a
3	7.41 b	5.59 a	6.83 a	7.20 a	6.59 b	5.36 a	8.45 a	10.66 a

* Means separation in columns by Duncan's multiple range test 5 % level .

* Values in the same column followed by the same letter dont differ significantly .

The rate of loss in bulb weight adversily related to their dry matter and T.S.S. contents. Thus, the highest dry matter and T.S.S. percentages the least loss percentage in weight of bulbs. The obtained results confirmed those of Ahmed et al. (1977 a) who reported that the percentage of T.S.S. might be an indication to onion storagability and dry matter contents as well. They also mentioned that Shandaweel No. 1 cv. overed Giza 6M in respect to dry matter content and T.S.S. in bulbs.

3-2- Effect of nitrogen fertilizer level:

Data in Table (4) show that, increasing N-level increased weight loss in storaged bulbs as assessed at all tested intervals. Results may be explained partially on the basis that increasing nitrogen level increased moisture contents in the produced bulbs, thereby may increased weight loss by means of water evaporation. Besides, high moisture contents in bulbs encouraged respiration process and consequently led to a reduction in storaged dry matter.

Obtained results are in confirmity with those of Moustafa (1979) and Midan and Sandhu (1983). They noticed that high nitrogen rates have an adverse effect on bulbs storagability.

3-3- Effect of the number of nitrogen fertilizer applications:

Except for the first month of storage period, the number of N-applications insignificantly affected the weight loss in bulbs at all studied storage periods (Table 4). This result is in agreement with those of Basilious (1975) who found that the time of nitrogen application had no effect on weight loss in storaged bulbs. The twice application of N-fertilizer produce bulbs with higher moisture contents, thereby may increase the weight loss in bulbs particularly during the first period of storage.

3-4- The interactive effect:

As the interactions between the tested factors exerted, with a slight descrepancies, no significant effect on the percentage of weight loss in the bulbs during storage, its related data were excluded. The absence of significances indicates somehow independent acts for each studied factors.

REFERENCES

Ahmed, A.A.; A.I. Abou-Zayed and M.M. El-Gammal (1977 a). A new onion strain for export purposes. 1- Effect of inbreeding on bulbs weight of onion (Allium cepa L.) and performance of some internal bulb characters in different onion strains. Agric. Res. Rev. Cairo, Egypt, 55(8): 11-20.

Basilious, S.I. (1975). Effect of some cultural treatments on maturity, yield and quality of onion (Allium cepa, L.) M.Sc. Thesis, Assuit Univ., Egypt, p. 105.

Duncan, D.B. (1955). Multible range test and multible F. test Biometrics, 11: 1-42.

El-Gammal, M.M.; M.F. El-Ayobi; I.A. Salem; F.A. Ahmed; I.A. El-Moufty and A.K. El-Kafoury (1980). Selection of bulk 20. A promizing strain of Behairy onion for exportation and local consumption. Agric. Res. Rev. Cairo, Egypt, 58(8): 41-54.

El-Kafoury, A.K. (1986). Effect of some agricultural practices on yield components and storagability of some onion cultivars Ph.D. Thesis, Fac. Agric. Moshtohor, Zagazig Univ. Cairo, Egypt. p. 106.

El-Tabbakh, A.E.; A.G. Behairy and T.G. Behairy (1979 a). Soil moisture regime effect on yield of onion (Allium cepa, L.) under different levels of nitrogen fertilizer. Res. Bull. No. 991, 17 pp, Fac. Agric. Ain Shams Univ. Egypt.

Hassan, M.S. (1984). Effect of frequency of irrigation and fertilizer nitrogen on yield and quality of onion (Allium cepa,L.) in arid tropics. Acta Hort., (143) 1341-346 Agric. Res. Corporation, Wad Medani Sudan C.F. Hort. Abst. 54(1). 6983, (1971).

Madan, S.P. and J.S. Sandhu (1983). Studies on the storage behaviour of white onion (Allium cepa, L.) variety as influenced by levels of N.P. and K. Haryana Agric. Univ. J. Res. 13(3): 433-438. Punjab Agric. Univ. Ludhiama, India (C.F. Hort. Abst. 54(5): 3329, 1984).

Moustafa, A.K. (1979). Studies on the inter-relations between some cultural practices and the yield of Behairy onion. M.Sc.Thesis, Mansoura Univ. p. 172.

Sattar, M.A. and M.A. Haque (1975). Effect of different levels of nitrogen and potash on the yield onion. Bangaladesh Hort. 3(2): 33-36. Bangaladesh Agric. Univ. Mymensingh, Bangaladesh. (C.F. Hort. Abst. 47(2): 1391, 1977).

Satyanarayana, V. and P.N. Arora (1984). Effect of fertilizers on potato and their residual effect on succeing onion. Ind. J. Agron. 29(3): 309-311. Div. of Agron. Ind. Agric. Inst. New Delhy 110012, India (C.F. Hort. Abst. 56(4): 2363, 1986).

Snedecor, G.W. and W.G. Cochran (1967). Statistical methods 6th Ed. Iowa, Stat, Univ. Press.

Sypien, M.; J. Smoter; A. Kepkowa and O. Noworelski (1973). The influence of nitrogen fertilization on onion quality and storage. Acta. Hort. No. 29: 341-347.

Thomas, P.E.L. (1968). A study of water and nitrogen requirements of onion varieties. Hortus. Rhodesia, 10 pp. 20-25 (C.F. Hort. Abst. 40: 1212, 1970).