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STORAGE ABILITY OF ONION (*Allium cepa* L.) GIZA 6 *CV.* AS AFFECTED BY WATER REGIME AND HARVEST STAGE UNDER ASSIUT CONDITIONS.

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ABSTRACT

This investigation was carried out at the experimental farm of Assiut University in 2004/2005 and 2005/2006 seasons to study the effect of irrigation regime and stage of maturity on onion Giza 6 *cv*. storage ability .The quantity of applied water ranged between 350 to 7350 m^2/fed..Irrigation interval was 15 or 30 days .Cured bulbs stored at room temperature for180 days.The lowest percent of damage after 90 days was recorded in regime1early harvesting. The highest water quantity resulted in the highest weight loss percent after both 90 and 180 days of storage The lowest percent of total loss after 90 days was recorded in early harvested bulbs under regime 1 which received the lowest water quantity .The height marketable bulbs (%) was obtained after 90 days storage in regimes which received the lowest water supply. Early harvesting resulted in lower total loss and higher marketable percent after both 90 and 180 days of storage .
Keywords: Onion storage – water loss- Marketable bulbs – bulb decay

INTRODUCTION

The storage of onion bulbs (*Allium cepa* L.) is very crucial to ensure its availability throughout the year. Onion yield usually store after maturity to save bulbs for home consumer and or for seed crop production by transplanting the mature bulbs. Storability of onion bulbs depends on many factors which involved in identify storage life for it. Chope *et al.*(2006) reported that onion storability is dependent on the rate of internal sprout growth which is controlled, in part, by endogenous hormones. Hurst *et al.*(2006) reported that changes in quality parameters of stored onions were factors of size and cultivar and may influence sprouting and decay over storage. Msuya *et al.* (2005) showed significant differences among the cultivars in yield, yield components and storability. Omar *et al.* (2005) reported that weight loss and decay percentage were significantly higher in stored bulbs of *cv*. Giza 6M.than *cv* Giza 20.

Results of many investigations demonstrated an evident relation between cultural practices and bulb storage ability . Srinivasan *et al.* (2002) applied 400 kg/ha of calcium in the form of gypsum with only 50 kg/ha of urea to the field and advancing the harvest of onion bulbs by fifteen days significantly reduced the spoilage of bulbs during storage. Katung *et al.* (2005) reported that applying of poultry manure at 10 t/ha or more significantly reduced loss after 5 months of storage by 19.96 - 37.12 (%) . Omar *et.al* (2005) demonstrated significant interaction between cultivar and level of nitrogen supply affect weight loss .Also, the kind of organic fertilizations affected onion storability of Giza 20 and Giza 6M *cvs.*

There are a lot of losses which take place during storage period .Decay; sprouting and weight loss as a result of water loss or and respiration of the bulbs.Ullah *et al.*(2008) reported that loss in weight of bulb is usually known to be occurred due to rotting, dehydration transpiration, respiration, sprouting, etc. Srinivasan *et al.* (2002) reported that *Aspergillus niger* was found to be the predominant pathogen associated with black mould rot of onion during storage. These diseases attacked different parts from base to the neck of the bulbs

Investigators studied many methods to save the onion bulbs in the stores for the possible longer periods.Downes *et al.*(2010) reported that storability of onion bulbs is dependent on the incidence and rate of sprout growth. Using a short 24 h treatment with ethylene and or (1-MCP), 1-methylcyclopropene can suppress sprouting in onion. Bufler (2009) reported that the application of ethylene at concentration 10.2_LL^{-1} and the preharvest application of Ethephon have both been shown to increase the storage and shelf-life of onions

Ullah *et al.* (2008) reported that applying of 45 kg/h sulphur fertilization lowered the percentage of rotten bulbs from 63.75 in control to 37.04 (%) after 180 days. Benkeblia and Varoquaux (2003) reported that onion bulbs kept under N_2O for 5 days had less rots than control bulbs .Chope *et al.* (2006) reported the storage life of short-storing cultivars might be prolonged by slowing the decline in ABA concentration. Johnson (2006) reported that Currently, standard methods of suppressing sprouting in temperate climates include controlled atmosphere (CA), ambient or cold storage with/without controlled relative humidity in addition to the preharvest application of maleic hydrazide .Croci *et al.*(1995) treated onion bulbs 30 days after harvest with a dose of 30.0 Gy of 6oC0 gamma rays in air at 2O^{o}C. gamma rays applied during dormancy was sufficient for sprout inhibition.

The aim of this investigation was to study the different losses in onion bulbs stored at the ambient temperature and the relation between applied water quantity during growth of onion plants in the field.

MATERIALS AND METHODS

This investigation was carried in a clay soil of experimental farm of Assiut University, Assiut, Egypt in 2004/2005 and 2004/2006 seasons. The aim of this study was to identify the relation between water regime applied in field and harvest timing on storage ability of yielded onion bulbs. The used design was split-plot with three replications. The main plot was water quantity while the sub plot was the harvesting timing. Seeds of Giza 6 *cv*. were sown on 20th September in a nursery. transplanting take place at November 29th. Seedling were spaced 5-7 cm apart in lines 15 cm in between. The plot size was 4 m^2 and consisted of 200 seedlings.

Applied water regimes :

Six water regimes were applied in this study .The following table shows these regimes:

Water regime	Irrigation interval (Days)	Number of irrigations	Total water quantity m^3 /feddan	Remarks
1	----------	1	350	At transplanting only
2	----------	2	700	At transplanting and manuring
3	15	8	3850	
4	15	8	7350	
5	30	4	1850	
6	30	4	3350	

In all regimes the amount of water was measured by a water meter. Irrigation was withholded two weeks before harvest.

Harvest stage:

Bulbs harvesting was done at two different stages under all water regime :

The first harvesting : Early stage of maturity : Bulbs were pulled when about 95 percent of tops had fallen over the ground but green at April 9.

The second harvesting : Late stage of maturity: Bulbs were pulled when tops fallen over ground down and became dry and yellow at April 29 .

Bulbs were cured to 15 days after harvesting in clean dry floor .After the end of curing bulbs were sorted and graded into the different classes, marketable (exportable) bulbs which hadn't defects, double, scaleless ,bolters and mechanically injured.

Bulbs storage :

Uniform in size and shape bulbs were selected from the marketable bulbs from each plot . Bulbs were cleaned, roots were removed and the tops were cut off one inch above the bulbs. Then the weight of the selected bulbs was recorded and packed in net bags and stored under normal storage conditions at room temperature. Storage duration was 6 months.

Experimental destine:

Split plot was applied in the field .The main plot was the Irrigation regime and the harvest timing in the split-plot. Storage measurements were arranged in three replicates from each treatment.

Statistical analysis.

The data were subjected to combine over years statistical analysis using F test and means were compared using Duncan's multiple range test. Some data were shown as histograms. Correlation coefficient (*r*) between all studied characters was calculated.

Recorded data :

1- Damage loss((%)) after 90 days :After recording the weight ,sprouted and decayed bulbs were removed and then the weight was recorded again. The differences between this weight and the previous calculated as percentage and considered as damage loss (%).

2-Damage loss ((%)) after 180 days :The same calculation after 90 days was done after 180 days

3-Weight loss (%) after 90 days : After 90 days of storage the weight was recorded and the negative change in weight was calculated as percentage and considered as weight loss (%).

4- Weight loss (%)after 180 days : The same calculation after 90 days was done after 180 days.

5-Marketable bulbs (%) after 90 days: The clean and healthy bulbs after 90 days were weighted and the percent was calculated.

6- Marketable bulbs (%) after 180 days: The clean and healthy bulbs after 180 days were weighted and the percent was calculated.

RESULTS AND DISCUSSION

1-Damage loss % after 90 and/or 180 days:

The data of this character are shown in (fig.1).Bulbs from plots which received 3850 m^3 /fed. and early harvested showed the height damage percent after 90 days of storage compared with all other treatments. The lowest percent of damage after 90 days was recorded in regime 1 early harvesting. All plots received high water supply (regimes 3,4 and 6) showed higher damage percent. After 180 days bulbs showed reversed trend early harvested bulbs showed higher percent of damage loss than late harvested onions.Ali and Elshabrawy (1971) observed increasing of neck rot disease in early harvested onion bulbs during storage**.** Manzano *et al.*(1994) reported that onions stored at room temperature (25±3) were completely rot in the week fourteen. Barrios *et al.*(2006) reported that storage of garlic *cv*.Perla at 30^{o}C inhibited sprouting, but increased weight loss. Sargent *et al.*(2001) reported that Decay became more prevalent with delayed harvest, but `Granex 33' was more resistant to decay than Texas Grano which developed up to 40(%) decay after 2 weeks at 20 °C. L.S.D value is 2.36** for 90 days and 1.90** for 180 days storage.

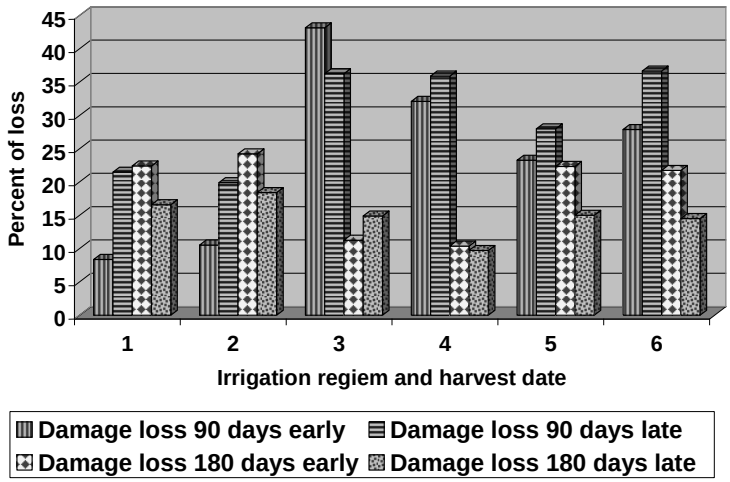

Fig.1: Damage loss % in onion bulbs after 90 and / or 180 days in 2004 and 2005 seasons

2- Weight loss % after 90 and / or 180 days:

Figure 2 show percent of weight loss after 90 and 180 days.L.S.D.value 2.2* for 90 days and 2.51** for 180 days. The highest weight loss percent was recorded in regime 4 received 7350 m2/fed.late harvested. Early harvested bulbs showed lower weight loss than late harvested ones under the different regimes after both 90 and 180 days of storage .Sargent *et al.*(2001) reported that bulbs of two studded cultivars when late harvested showed initial respiration rates decreased >60(%) between harvest after 94 days(early) and late harvest after 132 days.

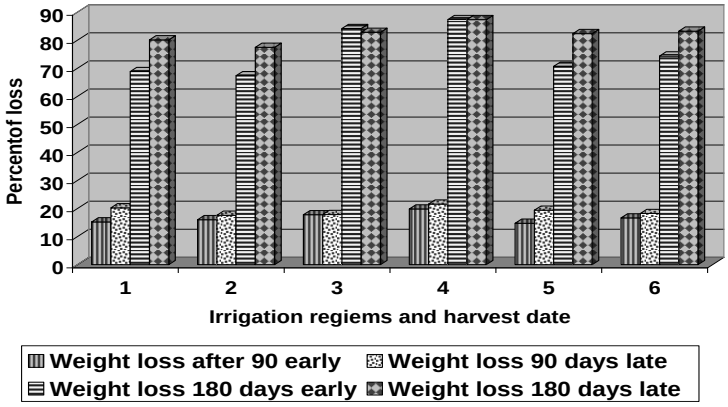

Fig. 2:Weight loss % in onion bulbs after 90 and / or 180 days in 2004 and 2005 seasons

3-Total loss % after 90 and /or 180d days:

The data of this character are shown in fig 3. The lowest percent of total loss after 90 days was recorded in early harvested bulbs under regime 1 which received the lowest water quantity . Late harvested bulbs under all regimes showed higher losses than early harvested but regimes 1 and 2 showed lower values compared with the other treatment.

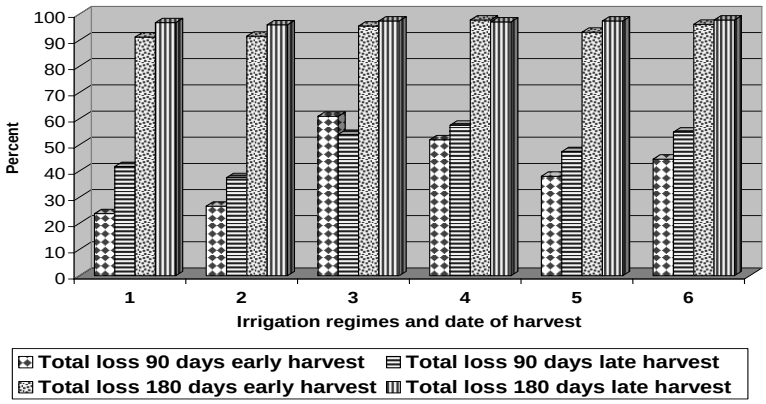

Fig. 3: Total loss % in onion bulbs after 90 and /or 180 days in store in 2004 and 2005 seasons.

Storage for 180 days showed equal percent of total loss and this mean that long duration of room storage there were not differences between high or low water supply and early or late stage of harvest in their effect on total loss. L.S.D.value is 3.14** for 90 days and 2.46** for 180 days.

4-Marketable bulbs% after 90 and/or 180 days:

Figure 4 show the data of marketable bulbs after 90 and 180 days .The highest percent of marketable bulbs was recorded in bulbs stored for 90 days which received the lowest water(regime 1 and 2) early harvested compared with all other regimes. As a general trend plots of regimes 3,4 and 6 which received higher water supply showed lower percent of marketable bulbs than regimes 1 and 2 . The lowest percent observed in plots of regime 6 after 180 days of storage.Waly *et al.*(2005) reported that lower water supply resulted in higher percent of exportable bulbs according to this results it seems that lower water supply has advantage of saving water , higher exportable yield and higher marketable bulbs after 90 and 180 days especially when the bulbs were early harvested. Kumar *et al.*(2007) reported that loss in marketable yield was significantly higher in irrigation treatment which received the lowest water supply. This observation might be due to early rotting of onion bulb as a result of early maturity and resulted into development of either immature or partial matured bulbs, which started rotting during storage at an early date.L.S.D.3.28 ** for 90 days 2.47** for 180 days of storage

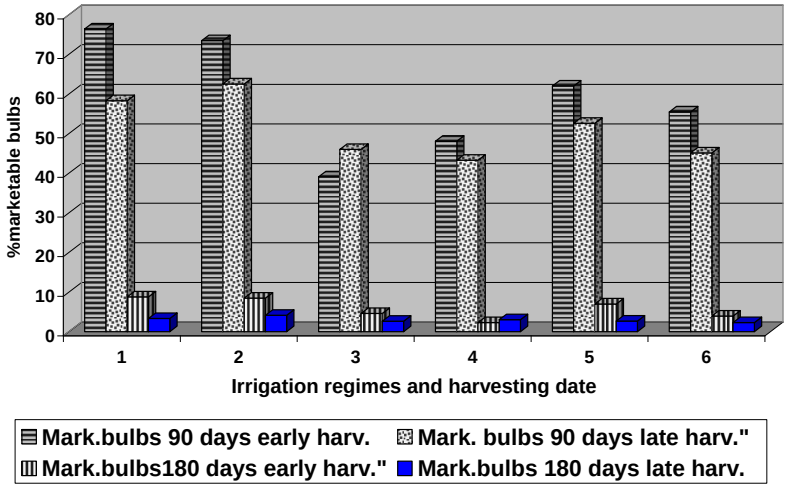

Fig. 4: Marketable bulbs % after 90 and/or 180 days in 2004 and 2005 seasons.

5- Main effect of harvest stage on storability of onion:

Figure 5 show the effect of harvest stage over the water regime .As a general trend early harvesting resulted in lower total loss and higher marketable percent after 90 and180 days. Ali and Elshabrawy (1971) observed increased incident of neck rot disease in early harvested onion bulbs during storage, which resulted in lower marketable bulbs. Maw and Mullinix (2005) reported that harvest maturity had the greatest influence on

the variation of moisture loss during curing, diminishing from 10.1(%)-early, to 7.3(%)-optimal, to 5.9(%)-late. Sargent *et al.*(2001) reported that bulbs of two studded cultivars retained higher fresh weight during storage as harvest was delayed .Wall and Corgan (1994) reported that in all studded short day cultivars, average bulb weight increased and firmness decreased with delayed harvest. Percent diseased bulbs increased for all cultivars as harvest was delayed .The optimum harvest time was at 80(%) maturity. Wall *et al.*(1999) reported that both bulb weight and percent dry weight tended to decline when harvest was delayed >15 days after maturity of (80(%) of the tops had fallen)**.** Mullinixe *et al.* (1996) reported that moisture loss was correlated with harvest maturity: early 25(%); optimum 28(%); late 31(%). moisture loss rates were similar regardless of grade size.

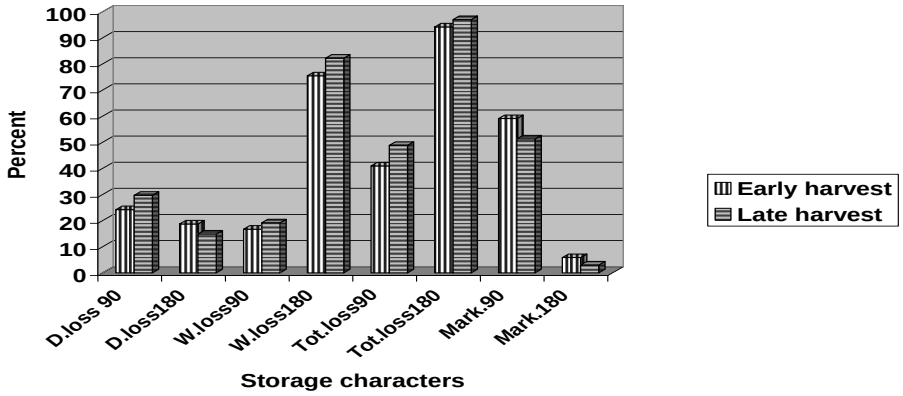

Fig 5: Effect of harvest time on different losses in stored onion bulbs in 2004 and 2005 seasons.

6- Main effect of irrigation on onion storability:

The main effect of irrigation is presented in figures 6 and 7. The high water supply resulted in higher losses and lower marketable bulbs after 90 days of storage.

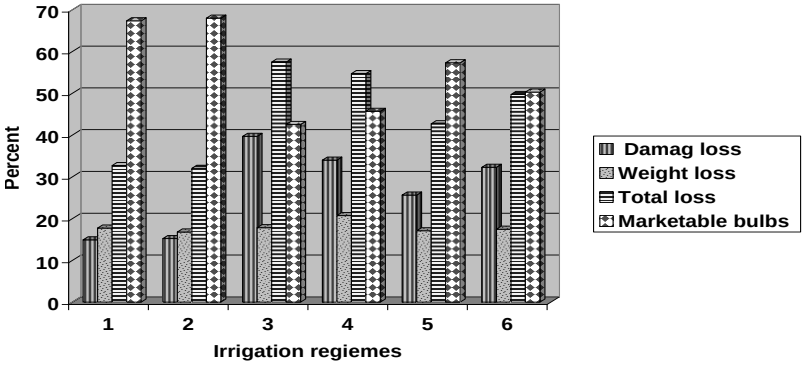

Fig 6:Main effect of irrigation on different losses in onion bulbs after 90 days in 2004 and 2005 seasons

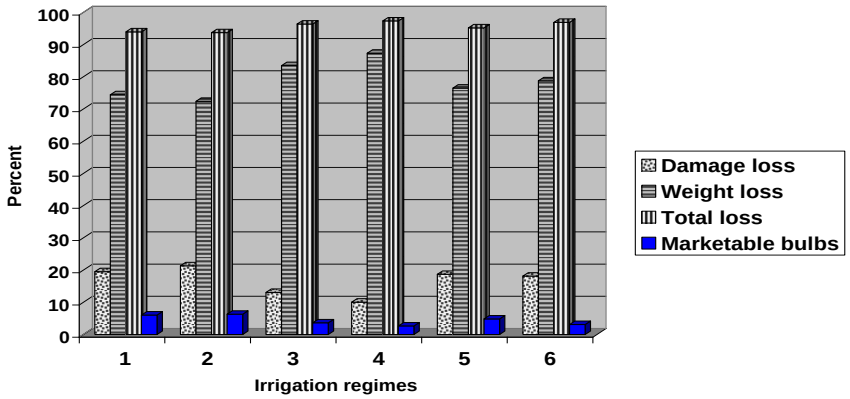

Fig 7:Main effect of irrigation on different losses in onion bulbs after 180 days in 2004 and 2005 seasons

Correlation Coefficient (*r*) between for Storability :

1-Correlation Coefficient (*r*) between water regime and storage characters

Table 1 shows Correlation Coefficient (*r*) between water regime and different losses and marketable bulbs after 90 and 180 days. Correlation demonstrated that there were high significant effect of water supply on onion storability .There were high significant positive correlation between water supply and percent damage loss at 90 days , weight loss at 90 and 180 days and total loss at 90 and 180 days of storage. Higher water regime correlated negatively with the percent of marketable bulbs after 90 and 180 days . These results indicated that the possible lower water supply which gave the highest yield is important to improve bulb storability. Khan *et al.*(2005)reported that number of days for sprouting after harvest in two onion cultivars was 32.33 and 36.33 days under irrigation interval 5 days as compared other treatments 10,15and 20 days.

Table 1 : Correlation Coefficient (*r*) between water regime and storability of onion bulbs *cv*. Giza 6 during 2004 and 2005 seasons

	Damage loss (%)		Weight loss (%)		Total loss (%)		(%) Marketable	
	90 Days	180 Days	90 Days	180 Days	90 Days	180 Days	90 Days	180 Days
water regime	0.59**	-0.61**	0.33**	0.59**	0.63**	0.34**	-0.62**	-0.33**
Damage loss 90(%)	---------	-0.78**	0.18	0.75**	0.97**	0.40**	-0.97**	-0.40**
Damage loss 180(%)		---------	-0.37**	-0.91**	-0.81**	-0.40**	0.81**	0.41**
Weight loss 90(%)			--------	0.39**	0.42**	0.29*	-0.42**	-0.29*
Weight loss 180(%)				--------	0.79**	0.75**	-0.79**	-0.75**
Total loss 90(%)					---------	0.44**	-0.999**	-0.44**
Total loss 180(%)						--------	-0.44**	-1.0**
(%)Marketable 90							-------	0.44**

2 - Correlation Coefficient (*r*) between dry matter content and storage characters:

Table 2 shows Correlation Coefficient (*r*) between dry matter percent in leaves and bulbs in April month and different losses and marketable bulbs after 90 and 180 days of bulbs storage. The higher water quantities negatively correlated with lower dry matter percent in both leaves and bulbs . Dry matter in bulbs negatively correlated with dry matter in bulbs ; weight loss and total loss. Correlation between dry matter in bulbs and marketable bulbs at 90 days was high significant positive effect while was significant with marketable bulbs after 180 days storage. Rafika *et al.* (2006) studied storability of 13 onion cultivar and reported that Storage life was correlated with dry matter content.

Table 2 : Correlation Coefficient (*r*) between dry matter at April 8 and storability of onion bulbs *cv*. Giza 6 during 2004 and 2005 seasons

	Dry matt. Leaves (%)	Dry matt. Bulbs (%)	Damage loss 90(%)	Damage loss 180	Weight loss 90 (%)	Weight loss 180 (%)	Total loss 90 (%)	Total loss 180 (%)	Marketable 90(%)	Marketable 180 (%)
water regime	-0.54**	-0.68**	0.59**	-0.61**	0.33**	0.59**	0.63**	0.34**	-0.62**	-0.33**
Dry matt. Leaves (%)	---------	0.46**	-0.06	0.10	-0.39**	-0.15	-0.15	-0.17	0.15	0.17
Dry matt. Bulbs (%)		--------	-0.28*	0.35**	-0.24*	-0.37**	-0.32**	-0.24*	0.31**	0.25*

3 Correlation Coefficient (*r*) between neck and bulb diameter and storability :

Correlation Coefficient (*r*) presented in table 3 showed high significant negative relation between marketable bulbs and diameter of bulb and neck. All losses increased with increasing bulb and neck diameter. Toledo *et al.* (1984) reported that bulb size had no statistically significant effect on weight loss, decay, root sprouting or dry matter content. Small bulbs were significantly firmer than large bulbs initially and throughout storage . Debaene *et al.*(1999) reported that high total soluble solids in onions are desirable for dehydration and in certain cases are associated with good storability Rafika *et al.* (2005) reported that storage life was correlated with dry matter content. Chope *et al.*(2006) studded the storability of different onion cultivars and reported that bulb ABA concentration declined significantly during storage and there was a negative relationship between storage time and ABA concentration for all studied cultivars. Hurst *et al.* (2006) reported that Medium yellow onions held best at 1°C; jumbo sizes showed lowest losses at 4 and 21°C.Dhumal *et al.*(2007) reported that pungency and TSS are important attributes of onion bulb quality for processing and storage. The contents of reducing and total sugars determine the storage life of bulbs. TSS contributes to the flavor, texture and storability.

Table3: Correlation Coefficient (*r*)between neck and bulb diameter at April 8 and storability of onion bulbs *cv*. Giza 6 during 2004 and 2005 seasons.

	Neck diamet. (cm)	Bulb diamet. (cm)	Damag loss 90 (%)	Damag loss 180(%)	Weight loss 90 (%)	Weight loss 180(%)	Total loss 90 (%)	Total loss 180(%)	Mark. 90 (%)	Mark. 180 (%)
water regime	0.79**	0.70**	0.59**	-0.61**	0.33**	0.59**	0.63**	0.34**	-0.62**	-0.33**
Neck diameter (cm)	---------	0.80**	0.58**	-060**	0.33**	0.58**	0.62**	0.33**	-0.62**	-0.33**
Bulb diameter (cm)	0.80**	--------	0.77**	-0.50**	0.13	0.51**	0.65**	0.33**	-0.66**	-0.33**
Bulbing ratio	-0.93**	-0.58**	-0.40**	0.55**	-0.38**	-0.54**	-0.46**	-0.30**	0.46**	0.30**

4- Correlation Coefficient (*r*) between bulb characters:

Correlation Coefficient (*r*) presented in table 4 showed high significant negative between water regime and dry matter in both leaves and bulbs . The wider bulbs and necks showed high significant negative relation.

Chope *et al.*(2006) repotted that onions with high dry matter content tend to be much firmer and store for longer periods before shoot growth and disease incidence deplete the number. Chope and Terry (2009) concluded variation in mineral content between cultivars was greater than the variation caused by storage time.

of marketable bulbs

Table 4: Correlation between dry matter content and diameter of neck and bulb over 2004 and 2005 seasons

	Dry m. leav	Dry m. bulb	Neck diam.	Bulb diam.	Bulb. ratio
water regime	-0.54**	-0.68**	0.79**	0.70**	-0.67**
dry matt. Leaves (%)	--------	0.46**	-0.46**	-0.40**	0.43**
dry matt. Bulbs (%)		----------	-0.53**	-0.28*	0.55**
Neck diameter (cm)			--------	0.80**	-0.93**
Bulb diameter (cm)				-------	-0.58**

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تـأثير الـري و ميعـاد الحصـاد علـي قـدرة البصل(صـنف جيـزة ٦) التخزينيـة تحـت ظروف أسيوط

أيمن قطب متولي
قسم البساتين - كلية الزراعة – جامعة أسيوط – أسيوط – مصر

أجريت هذه التجربة بمزرعة التجارب - كلية الزراعة - جامعة أسيوط - أسيوط – خلال موسمي ٢٠٠٤/٢٠٠٥ و ٢٠٠٥/٢٠٠٦ علي نباتات البصل(صنف جيزة ٦)لاختبار تأثير الري بالحقل و كذلك ميعاد الحصاد علي القدرة التخزينية للأبصال. طبقت ستة معاملات ري تتراوح كمية الماء الكلية بين ٣٥٠ م٣ و ٧٣٥٠ م٣ للفدان . كانت فترة الري في المعاملات كل ١٥ أو ٣٠ يوم . تم الحصاد إما أول أبريل عند انثناء الأعناق بنسبة ٩٠-٩٥ (%) و مازالت غضة أو آخر أبريل عند وصول الأعناق الي الجفاف واللون الأصفر.

اجري العلاج التجفيفي للأبصال وبعدها خزنت في درجة حرارة الغرفة لمدة ستة أشهر. تم تسجيل النسبة المئوية للتزريع و العفن وكذلك الفقد في الوزن و الأبصال القابلة للتسويق بعد مرور ثلاثة أشهر و كذلك بعد ستة أشهر. أظهرت النتائج أن النباتات التي حصلت علي أقل كمية ماء وهي ٣٥٠ م٣ للفدان أثناء الشتل فقط و حصدت مبكرا حدث بها اقل نسبة عفن في المخزن بعد ثلاثة أشهر. أدي الري بمعدلات عالية في المعاملات ٣و٤ و٦ إلي زيادة نسبة الفقد الكلي بعد ثلاثة أو ستة أشهر. أظهرت معاملات الإمداد المائي الأقل الي زيادة نسبة الأبصال القابلة للتسويق سواء بعد ثلاثة أو ستة أشهر. أظهرت الأبصال التي حصدت مبكرا نسبة فقد أقل ونسبة أعلي من الأبصال القابلة للتسويق.

قام بتحكيم البحث

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