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RESPONSE OF ONION YIELD, BULBS QUALITY AND STORAGE ABILITY TO WATER REGIME

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ABSTRACT

The present investigation has been carried out at Giza Agricultural Research Station-ARC in the three winter seasons of 2007/2008, 2008/2009 and 2009/2010. The main objective of this work is to investigate the effect of irrigation water regime on onion production. Combined analysis of the three seasons indicated that the highest values of marketable and total yield (t/fad.) were recorded from the wet treatment. Also, average bulbs weight, bulb diameter, number of growing points/bulb were significantly increased with increasing number of irrigations up to five irrigations. Bulb total soluble solids and bulb dry matter content were significantly increased with decreasing number of irrigations and the highest value was recorded with three irrigations. Sprouting bulb %, rot bulbs % and total weight loss % were significantly higher with five irrigations than three irrigations. Seasonal water consumptive use ranged from 1270 to 1981m^3. Irrigation water requirements ranged from 2066 to 2920 m^3/fad. It can be noted that the highest values of water consumptive use were found to be from the wet treatment. Water use efficiency values were 5.80, 6.36 and 5.49 kg onion bulbs/m^3 for water consumed of dry, medium and wet levels of irrigation, respectively. It can be concluded that application of four irrigations could be recommended for good yield and storability; in addition, the medium irrigations regime (four irrigations) produced the highest values of water use efficiency.

INTRODUCTION

Onion is one of the important vegetable crops in Egypt, which is cultivated in a large scale. The total area planted in 2007/2008 was 102,703 fad. (1 faddan = 4200 m^2) and produced 1,259,007 tons with an average yield of 12.6 t /fad. [†] The average of exports reached 340,000 tons[††]. Most of onion cultivated area is furrow irrigated with 5-6 irrigations as recommended. Because of rising in air temperature, due to the global climatic changes, combined with limited water resources in Egypt in recent years; the need has become urgent to find out the impact of water shortage on onion yield and quality. Accordingly, save some of water irrigation for agricultural expansion in other areas and other purposes is an important objective. Therefore, knowledge about the responsiveness of the cultivated onion cultivars to water shortage and maximizing use of water and area units is needed.

Onion plants have shallow roots, while have a poor suction face, also it is not well adapted to drought condition. Shock *et al.* (1998 and 2000) stated that onion yield and its grade are very responsive to careful irrigation scheduling and maintenance of optimum soil moisture.

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Also, Goltz *et al.* (1971) and Miller *et al.* (1971) reported that onion growth is very sensitive to water stress, where its yield is usually decreased. Onion bulb yield was 8.99 and 10.93 t/fad. when irrigation was ceased after the second application in two seasons; and when irrigation was ceased after the third application, the yield decreased to 8.15 and 3.53 t/fad., in two seasons. Weight of exportable bulbs was inversely related to number of irrigations (Ahmed *et al.,* 1987), and water deficit resulted in higher dry matter percentage in bulbs (Sorensen and Grevsen, 2001). Pelter *et al.,* (2004) showed that soil –water stress caused by withholding irrigation (causing soil water stress) at both the 3-and7-leaf stages reduced yield by 26% compared with the control, the percentage of single –center bulbs was reduced by 40, 32 and 18% when soil-water stress was imposed at 3-and7-leaf, 3-leaf, and 5 leaf stages, respectively. Giving onion 2-3 irrigation decreased dry matter, total soluble solids, and total weight loss after four months storage. One, two and three irrigations saved 54.2 and 36.49, and 16.69 m^3/fad., respectively (Kandil *et al.,* 2010a). Applying 80 and 60% of crop water requirements resulted in yield decreases of 14 and 38 % and saved 18 and 33 % of irrigation water compared to full irrigation in two years, respectively (Kumer *et al.,* 2007).

Mohamed and Gamie (2000) found that irrigation at 35-40 % depletion from available water increased total, marketable, exportable yields and average bulb weight, while TSS was decreased. The averages water consumption used by onion was 2291, 1458, and 1144 m^3 /fad. at three regimes. Regime 3 produced the highest yield per cubic meter of water (9.53kg/m^3) and the onion cultivar Giza 20 produced higher bulb yield per one cubic meter (9.69 kg/m^3). Mostafa and Leilah (1993) , Mahmoud (1999) and El-Sharkawy *et al.,* (2006) found that number of complete rings/bulb , bulb weight was increased by application of water irrigation at 30 days intervals, while , TSS and dry matter content increased at irrigation every 40-50 days intervals. Total soluble solids of bulb were significantly increased with irrigation after the depletion of 75-80 % from available soil water. While, it decreased with irrigation at 25-40% from available soil water (Mohamed and Gamie, 2000).

Irrigation at 5 and 15 days intervals produced the highest yield, highest gross return and net return and benefit cost ration (Biswas *et al.,* 2003), while maximum yield was obtained with 5 days of irrigations interval with cv. Swat-1 and Phulkara (Khahan *et al.,* 2005). Biswas *et al.,* (2010 a) found that the highest onion yield was obtained from irrigation every 10 days or 15 days intervals, the lowest yield was recorded with no-irrigated treatments, total water use was 248 mm in every 10 days and the incremental benefit cost ratio was the highest (28.36) in irrigation every 15 days interval. Increasing water quantity decreased the exportable bulbs, while increased double and bolters. Ahmed *et al.,* (1987) indicated that loss in bulb weight during storage for 8 months was significantly increased with increasing irrigation frequently. Onion yield and storage loss increased gradually with increasing number of irrigations at 10 days or 15 days, loss due to rotting, sprouting and physiological weight loss was found higher with irrigation treatment after six months of storage, maximum weight loss 56.72% obtained with 10 days. While, minimum 46.80% recorded with non-irrigated onion (Biswas *et al.,* 2010 b). Bhatt *et al.* (2006) reported that when water stress was imposed 30 days after transplanting for a period of 15 days, leaf area and bulb growth were considerably decreased with a reduction of 17–26% in onion yield.

The objective of this work was to determine the optimum water regime for onion grown in clay soil to obtained higher bulb yield with higher quality.

MATERIALS AND METHODS

The present investigation was conducted at Giza Agricultural Research Station, Egypt, during 2007/2008, 2008/2009 and 2009/2010 seasons to study the effect of irrigation regime on yield and yield components, bulb characters, storage ability characters and crop water relation in onion crop.

A separated experiment for each irrigation treatment was used in randomizes complete block design (RCBD) with four replicates. Experimental plots size was 1.8 m wide and 3.5m long. . Each irrigation treatment was isolated from the others by allays 1.5 m in between to avoid the lateral movement of water. Sowing date of the nursery was first of October for each season. Onion seedlings (Giza 20 cv.) were transplanted in 10 cm apart on both sides of the ridges (60 cm width) on the 15^{th} of December, whereas harvesting was done at 50% tops down on mid of June in the three seasons. All normal cultural practices for onion crop were followed. The irrigation water regime treatments were applied as follows:

I_1: Three irrigations, (dry treatment)
I_2: Four irrigations, (medium treatment)
I_3: Five irrigations, (wet treatment)

In addition to transplanting irrigation for each treatment, some of soil physical properties of the experimental plots were determined according to Klute (1986) and Page *et al.* (1982) and are presented in Table 1, and some soil moisture constants are illustrated in Table 2.

Table 1: Soil mechanical analysis at Giza Agricultural Station

Soil fraction	Content (%)
Coarse sand	2.91
Fine sand	13.40
Silt	30.51
Clay	53.18
Texture class	Clay

Table 2. Soil moisture constants of the experimental field at Giza Agricultural Station

Depth	Field capacity %	Wilting point %	Available water %	Bulk density g/cm^3
0 – 50	41.85	18.61	23.24	1.15
15 – 30	33.68	17.5	16.18	1.24
30 - 45	28.36	16.92	11.46	1.20
45 – 60	28.05	16.54	11.51	1.28

The averages of weather factors for Giza Governorate during the onion crop growing seasons are recorded in Table 3.

Table 3. The monthly averages of weather factors for Giza Governorate during 2007/2008 & 2008/2009and 2009/2010 seasons.

Month	season	Temperature C°			Relative humidity %	Wind speed (msec^{-1})	Class A pan evaporation mmday^{-1})(
		Max.	Min.	Mean			
December	2007/2008	21.9	10.8	16.35	64	2.4	1.8
	2008/2009	22.9	11.4	17.15	83	1.8	2.1
	2009/2010	23.3	12.0	17.65	82	3.9	2.1
January	2007/2008	18 .0	7.2	12.60	62	3.6	2.2
	2008/2009	21.8	9.5	15.65	59	1.6	2.1
	2009/2010	21.5	19.5	20.50	57	3.5	2.3
February	2007/2008	20.6	8.1	14.35	55	4.3	3.3
	2008/2009	23.1	9.8	16.45	54	2.2	3.1
	2009/2010	27.7	13.0	20.35	58	3.5	3.6
March	2007/2008	27.6	13.2	20.40	47	4.7	3.5
	2008/2009	24.1	11.0	17.55	56	2.4	4.2
	2009/2010	27.1	13.8	20.45	61	4.9	5.8
April	2007/2008	30.3	15.7	23.00	44	5.2	5.7
	2008/2009	29.4	15.2	22.30	55	2.8	5.9
	2009/2010	30.8	15.6	23.20	53	4.3	6
May	2007/2008	32.6	15.3	23.95	48	4.5	4.4
	2008/2009	31.8	18.4	25.10	51	2.8	7.6
	2009/2010	33.8	19.2	26.50	51	4.2	7.7
June	2007/2008	36.3	22.5	29.40	54	4.0	8.3
	2008/2009	37.4	22.1	29.75	50	4.8	8.0
	2009/2010	37.0	23.0	30.00	52	3.9	8.1

At harvesting time, the following data were collected under each plot:
1. Crop yield

1.1. Yield and yield components:

a- Marketable yield (t/fad.)
b- Culls yield (t/fad.)
c- Total yield (t/ fad.).

1.2. Bulb characters

Bulb characters were recorded from 10 random samples bulbs to determine the following data:
a- Bulb diameters(cm).
b- Number of complete rings/bulb.
c- Number of growing points/bulb.
d- Bulb total soluble solids (TSS) was recorded for 10 random samples bulbs using hand Referactometer.
e- Bulb dry matter content was recorded in 10 bulbs (random sample for each treatment) sliced and oven dried at 70 c° to a constant weight and then recorded.

1.3. Storage ability characters:

Measurements storage ability characters were recorded after six months storage period on 100 bulbs.

a**-** Spourting bulbs (%).

b- Rot bulbs (%).

c- Total weight loss (%)**.**

2). Crop - water relationships:

2.1. Seasonal consumptive use (ET_c).

Crop water consumptive use (ET_c), was determined via soil samples taken from each sub-plot, in 15cm increment system to 60cm depth of soil profile, just before and after 48 hours of each irrigation, as well as at harvesting time. The ET_c between each two successive irrigations was calculated according to the following equation as follows:

Cu (ET_c) = $\{(Q_2 - Q_1) / 100\} \times Bd \times D$ (Israelsen and Hansen, 1962)…….where

Cu = Crop water consumptive use (cm).

Q_2= Soil moisture percentage by weight 48 hours after irrigation.

Q_1= Soil moisture percentage by weight just before irrigation.

Bd = Soil bulk density (gcm^{-3}).

D = Soil layer depth (cm).

2.2. Irrigation water requirements:

Irrigation water requirements were measured using Cut throat flume by measuring the height of irrigation water in front and behind the cut throat flume and calculate the amount of irrigation water added

2.3. Water use efficiency (WUE).

The water use efficiency as kg onion bulb yield/ m^3 water consumed was calculated for different treatments as the method described by Vites (1965)as follows:

WUE, kgm^{-3}= onion bulb yield (kg fad.-1) ÷ Seasonal ET_C (m^3 $fad.^{-1}$)

All of the collected data were subjected to the statistical analysis according to Snedecor and Cochran (1982) and the means were compared using L.S.D. test at 5% significance level. Bartelets test before combined analysis was done according to Gomez and Gomez (1984). Combined analysis of variance over the three seasons was done according to Steel and Torrie (1981).

RESULTS AND DISCUSSION

1. Crop yield :

1.1. Yield and yield component :

Marketable yield, culls, total yield (t/fad.) and average bulb weight values are presented in Table (4). The results indicated that irrigation regime has a significant effect on these characters. The highest values were recorded from the wet treatment, which was irrigated five times. However, the lowest values were obtained from the dry treatment, which was irrigated three times. This was true for the three seasons and the combined analysis. In this connection, El-Akram (2012) found similar results in onion plants. The author indicated that the treatment which irrigated after the depletion of 40% from available soil moisture produced the highest values, while the dry treatment which was irrigated after the depletion of 80% from available soil moisture, recorded the lowest values. Biswas, *et al.,* (2010 b) found that onion bulb yield was increased linearly with increasing number of irrigations, when they irrigated each 10, 15 days intervals. Also Kandil *et al.,* (2010a) found that giving onion 2-3 irrigations increased total yield, marketable yield and culls yield and average bulb weight.

1.2. Bulb characters:

Data in Table (5) illustrated the values of bulb characters (bulb diameter (cm), number of complete rings/bulb, number of growing points/bulb, total soluble solids (TSS) and bulb dry matter content (%). The results indicated that irrigations number significantly affected all bulb character values.

Bulb diameter results indicated that the highest values were obtained from the wet level of irrigation. However, the lowest values were produced from the dry irrigation treatment. These results were obtained in the three seasons and also in the combined analysis. The above mentioned findings were in coincided with El-Kalla and El-Kassaby (1985), Olalla *et al*., (2004), Kumar *et al*., (2007) and El-Akram (2012).

Number of complete rings/bulb values presented in Table (5) indicated that, in general, the dry irrigation treatment resulted in the highest values. However, the lowest values were found to be from the wet irrigation treatment. In this respect, Mostafa and Leilah (1993) found that complete rings/bulb were increased by applying irrigation in a 30 day-intervals. Also, these data are confirmed by Kandil *et al.,* (2010 b), who indicated that numbers of rings/bulb were increased with increasing of irrigation up to three applications.

Table 4. Effect of irrigation number on marketable yield(t/fad.), culls yield(t/fad.), total yield(t/fad.) and average bulb weight(g) of Giza 20 onion cultivar over three seasons and their combined analysis.

Season	Treatment	Marketable yield (t/fad.)	Culls yield (t/fad.)	Total yield (t/fad.)	Average bulb weight(g)
2007/2008	Three irrigations	9.668	0.904	10.570	96
	Four irrigations	11.780	0.716	12.500	106
	Five irrigations	12.927	1.818	14.745	162
L.S.D. at 0.05		2.200	0.309	2.127	15
2008/2009	Three irrigations	6.183	0.277	6.460	42
	Four irrigations	10.090	0.350	10.440	59
	Five irrigations	10.910	0.139	11.050	66
L.S.D. at 0.05		1.504	NS	1.686	14
2009/2010	Three irrigations	5.103	0.096	5.199	41
	Four irrigations	7.105	0.096	7.201	54
	Five irrigations	8.627	0.157	8.785	70
L.S.D. at 0.05		0.738	0.055	0.744	5
Combined	Three irrigations	6.985	0.425	7.410	60
	Four irrigations	9.659	0.387	10.047	73
	Five irrigations	10.821	0.705	11.526	100
L.S.D. at 0.05		0.791	0.112	0.805	6.29

NS indicate not significant at P: 0.05.

Table 5. Effect of irrigation number on bulb diameter(cm), number of complete rings/bulb, number of growing points/bulb, bulb TSS and bulb dry matter content of (%) Giza 20 onion cultivar over three seasons and their combined analysis.

Season	Treatment	Bulb diameter (cm)	Number of complete ring	Number of growing points/bulb	Bulb TSS %	Bulb dry matter content (g)
2007/2008	**Three irrigations**	5.27	4.550	2.550	13.52	16.05
	Four irrigations	5.73	4.225	3.025	12.80	14.43
	Five irrigations	6.45	3.600	4.050	12.40	14.40
L.S.D. at 0.05		**0.39**	**0.350**	**1.104**	**0.656**	**1.294**
2008/2009	**Three irrigations**	4.47	5.400	1.050	13.55	15.750
	Four irrigations	5.50	5.600	1.350	14.60	17.250
	Five irrigations	5.77	5.475	1.575	14.37	16.150
L.S.D.at 0.05		**0.41**	NS	**0.146**	**0.586**	NS
2009/2010	**Three irrigations**	4.650	5.225	1.450	14.05	17.22
	Four irrigations	5.375	4.950	1.650	13.35	16.10
	Five irrigations	6.225	4.650	1.900	12.65	14.77
L.S.D. at 0.05		**0.427**	**0.268**	**0.189**	**0.477**	**0.899**
Combined	**Three irrigations**	4.80	5.058	1.683	13.71	16.34
	Four irrigations	5.53	4.925	2.008	13.58	15.93
	Five irrigations	6.15	4.575	2.508	13.14	15.11
L.S.D. at 0.05		0.213	0.232	0.324	0.287	0.654

NS indicate not significant at P: 0.05.

The number of growing points per bulb presented in Table (5) indicated that number of irrigations had a significant effect on this character in the three seasons and the combined analysis. It can be noticed that the highest values were recorded from the wet irrigation treatment, whereas the lowest values were recorded from the treatment where plants was irrigated three times. In this connection, Kandil *et al*., (2010b) studied the effect of four irrigations regimes on number of growing points per bulb and found that increasing number of irrigations up to three applications produced the highest values. They added that less number of growing points per bulb was observed when only one irrigation was given.

Bulb total solids were significantly affected by water regime during the three seasons under study and also in the combined analysis (Table 5). The results showed that the highest values were obtained from the dry and medium irrigation regime, which was watered three and four irrigations, while lower values were found to be from the wet irrigation treatment, which receiving five irrigations. Similar results were recorded by Kandil *et al*., (2010b), who found that the highest values of TSS were recorded with giving one irrigation. Meanwhile, the lowest values were obtained by applying three irrigations. Also, Mohamed and Gamie (2000) found that total soluble solids significantly decreased with increasing available soil moisture (wet) compared with medium and /or dry treatments.

Bulb dry mater content (%) results are presented in Table (5). The values were significant in the first and third season and combined analysis.

However, it was insignificant in the second season. In general, it can be noted that the treatments receiving three or four irrigations resulted in higher values compared with five irrigations. From the above mentioned results, it can be noticed that lower dry matter content was obtained from the dry and medium treatments, while maximum values was recorded from the wet level of irrigation. These results are in agreement with those obtained by El-Murabaa *et al.,* (1979) they reported that the highest dry matter contents was recorded with no irrigation after transplanting and the percentage of dry matter content was decreased with delay the time of irrigation withholding. Also, and Kandil *et al.,* (2010b) found that dry matter content was decreased significantly with increasing number of irrigations from one to four applications. These data are confirmed by Sorensen and Geversen (2001), who indicated that water deficit resulted in higher dry matter percentage in bulbs. These findings indicate that moisture content in bulbs at harvest time was higher under wet conditions and tend to decreased by increasing soil moisture stress.

1.3. Storage ability characters

Data in Table (6) illustrates the results of storage ability characters (sprouting bulbs%, rot bulbs%, and total weight loss %) after six months of storage. The results of the three seasons and the combined analysis indicated that irrigation regime have a significant effect on all these characters. Sprouting bulb percentage was higher for onions from the wet treatment, which was irrigated five times, while the lowest values were obtained from the dry treatment, which irrigated three times. The medium level of irrigation values were found to be in between.

The percentage of rot bulbs and total loss of weight gave similar trend to those obtained from sprouting bulbs %. These results coincided with the results given by Biswas *et al.,* (2010b), who found that irrigation regime has a significant effect on the storage ability characters of onion bulbs. They indicated that the highest values of rot bulb, sprouting bulbs % were recorded from irrigations at 10 and 15 days intervals, while the lowest figures were gained with irrigation at 30 days intervals or no irrigation (no further irrigation after transplanting) treatment.

Analysis of variance showed a significant effect of water regime on the total weigh loss % in the first and third seasons and the combined analysis, while it was insignificant in the second season. The maximum weight loss% was recorded with five irrigations and the lowest value was recorded with three irrigations, these results are in agreement with those of Biswas *et al.,* (2010 b) and Kandil *et al.,* (2009a). These results showed that the moisture in bulbs was higher with frequent irrigations (five applications) and decreased with (three applications). It can be concluded that wet conditions seemed to increase the amount of moisture in bulbs, which may be less by storage. This pattern may explain the higher weight loss of moisture in bulbs after storage from wet treatment than dry one.

Table 6. Effect of irrigation number on percentage of sprouting bulbs, rot bulbs, total weigh loss after six months storage period of Giza 20 onion cultivar over three seasons and their combined analysis.

Season	Treatment	Sprouting bulbs (%)	Rot bulbs (%)	Total weight loss (%)
2007/2008	Three irrigations	5.000	2.750	22.306
	Four irrigations	8.500	6.000	15.802
	Five irrigations	11.000	8.000	16.563
L.S.D. at 0.05		**2.234**	**2.627**	**NS**
2008/2009	Three irrigations	2.31	3.46	40.67
	Four irrigations	6.92	5.00	35.62
	Five irrigations	10.19	7.69	38.92
L.S.D. at 0.05		**1.704**	**3.465**	**NS**
2009/2010	Three irrigations	4.750	4.250	22.29
	Four irrigations	7.750	5.000	17.77
	Five irrigations	14.25	1.500	44.70
L.S.D. at 0.05		**7.45**	**2.72**	**6.84**
Combined	Three irrigations	4.019	3.487	28.42
	Four irrigations	7.724	5.333	23.07
	Five irrigations	11.81	5.731	33.39
L.S.D. at 0.05		**2.280**	**1.468**	**4.147**

NS indicate not significant at P: 0.05.

2. Crop water relations:

2.1. Water consumptive use:

Seasonal values of water consumptive use by onion as a function of water deficit for the three seasons are presented in Table (7). Water consumptive use was 1280, 1536 and 1980 m^3/fad. in the first season for dry, medium and wet treatments, respectively. The corresponding values for the second season were 1272, 1517 and 1950 m^3/fad. in the same order. In the third season the values were 1270, 1494 and 1981 m^3/fad.

In the light of the previous results, it can be noted that irrigation numbers exhibited a great response on water consumptive use values. It was low for the dry treatment, followed by the medium treatment and high for the wet level of soil moisture. These results indicated that an increase in soil moisture stress prior irrigation resulted in a decrease in water consumptive use values. In other words, it can be noted that the higher water consumptive use, the higher marketable and total yield. Sammis *et al.,* (2000) indicated that water deficiency decreased evapotranspiration and consequently yield. Mohamed and Gamie (2000) were concluded that the average water consumptive by onion were 2291, 1458 and 1141 m^3/fad. obtained from 35 – 40, 55 – 60 and 75 -80% available water, respectively in three seasons.

The mentioned results are confirmed by the findings of El-Akram (2012), who reported that water consumptive use values were 43.10, 40.21 and 38.05 cm. for treatments irrigated after the depletion of 40, 60 and 80% of available soil moisture, respectively., and the results of Mohamed and Gamie (2000) who found that the average water consumptive by onion were 2291, 1458 and 1141 m^3/fed obtained from 35 – 40, 55 – 60 and 75 -80% available soil moisture, respectively.

2.2. Irrigation water requirements

Irrigation water quantities for the three seasons are presented in Table (7). The applied quantities were 2083, 2640 and 2920 m^3/fad. for the dry, medium and wet treatments, respectively in the first season. The corresponding values for the second season were 2070, 2428 and 2893 m^3/fad. in the same order. For the third season, it was 2066, 2400 and 2809 m^3/fad. The above mentioned results indicated that the highest marketable and total yield (ton/fad.) were obtained from the wet treatment that irrigated five times, compared to three or four irrigations. The wet treatment received 2920, 2893 and 2809 m^3/fad. in the three growing seasons, respectively. In this respect El-Hris and Abdel-Razek (1997) revealed that the increase in yield and yield components was obtained with the increase in total water supply. Metwally (2011) reported that water quantities by onion were 350, 700 and 1850 m^3/fad. for treatments irrigated once, twice and four times, respectively.

Table 7. Effect of irrigation treatment on water consumptive use, irrigation water requirement and water use efficiency for onion crop Giza 20 in the three growing seasons and their combined analysis.

Season	Treatment	Water consumptive use (m^3/fad.)	Irrigation water requirement m^3/fad.)(	Water use efficiency (kg/m3 water)
2007/2008	Three irrigations	1280	2083	7.55
	Four irrigations	1536	2640	7.67
	Five irrigations	1980	2920	6.53
2008/2009	Three irrigations	1272	2070	4.86
	Four irrigations	1517	2428	6.65
	Five irrigations	1950	2893	5.59
2009/2010	Three irrigations	1270	2066	4.02
	Four irrigations	1494	2400	4.76
	Five irrigations	1981	2809	4.35

2.3. Water use efficiency:

Another factor that must be considered is the relationship between crop yield and water, which the water use efficiency. The use of water requirements as a tool for estimating soil moisture needs is not the economic method for evaluation irrigation systems. The problem is the relationship between water and yield in order to obtain the maximum production per each unit of water. Table (7) showed the effect of water regime on water use efficiency (WUE) expressed as marketable yield (kg) per one cubic meter of water consumed for the three seasons. It can be noticed that the soil moisture stress induced a great effect on water use efficiency values. The average mean values of water use efficiency through the three seasons were 5.48, 6.33 and 5.49 (kg/m^3) for the dry, medium and wet irrigation treatments. It is clear that the medium level was obtained from the dry treatment. These results showed that (WUE) was increased by the application of four irrigations. In this connection, Olalla *et al.,* (2004) indicated that in drip irrigation system, with reciving lower water the higher water use efficiency was obtained. Also, Sarker (2008) reported that the lower irrigation quantities gave the higher water use efficiency values.

The previous results could explained by considering the relative decrease in bulb yield and water consumptive use to the increase in soil moisture stress. As soil moisture stress increased, a reduction in onion bulb yield was observed. Viets (1965) summarizing water use efficiency, data concluded that no generalization can be made about water use efficiency as related to available water supply. He added that the seasonal evapotranspiration and the yield are integration of many factors such as plant cover and soil moisture stress.

Finally, it can be concluded that application of four irrigations could be recommended for good yield and storability; in addition, the medium irrigations level (four irrigations) produced the highest values of water use efficiency and five irrigations for highest yield.

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استجابة محصول البصل وجودته والقدرة التخزينية للأبصال لنظام الرى

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أجريت هذه الدراسة فى محطة البحوث الزراعية بالجيزة خلال المواسم الزراعية 08/2007 و2008 /09 و 010/2009 بهدف دراسة تاثير ثلاث معاملات للرى (ثلاث ريات ، اربعة ريات ، خمسة ريات) بالاضافة الى رية الزراعة وكان الصنف المستخدم جيزة 020

وتم استخدام تصميم القطاعات كاملة العشوائية فى أربع مكررات ويمكن تلخيص أهم النتائج فى الآتى:

تاثرت جميع الصفات المدروسة معنويا بمعاملات الرى حيث ادى اعطاء خمس ريات بخلاف رية الزراعة للحصول على اعلى محصول كلى واعلى محصول نقضة وكذلك اعلى محصول صالح للتسويق واعلى متوسط وزن بصلة واعلى فطر للبصلة واعلى عدد مراكز النمو بينما انخفضت هذه الصفات معنويا عندما تم اعطاء ثلاث ريات فقط او اربعة ريات بخلاف رية الزراعة. فى حين ان اعلى محتوى من المواد الصلبة الذائبة الكلية والمادة الجافة تم الحصول عليه عند اعطاء ثلاث ريات فقط او اربعة ريات بخلاف رية الزراعة.

اثرت معاملات الرى على القدرة التخزينية للأبصال وذلك بعد ستة اشهر من التخزين حيث ادى اعطاء خمسة ريات الى الحصول على اعلى نسبة للأبصال المزرعة وكذلك زيادة نسبة الأبصال التى بها اعفان بالأضافة الى نسبة الفقد الكلى بينما كانت اقل عند اعطاء ثلاث ريات او اربعة ريات .

تراوحت قيم الأستهلاك المائى الموسمى من 1270م3 الى 1981 م3/فدان والأحتياجات المائية من 2066م3 الى 2920 م3/فدان.

ادى اعطاء خمس ريات بخلاف رية الزراعة للحصول على اعلى معدل استهلاك مائى وتراوحت قيم كفاءة الأستخدام المائى 5.8 و6.36 و 5.49 كجم من الأبصال/م3 من الماء لمستويات الرى الجافة والمتوسطة والرطبة على التوالى.

وعلية يمكن استنتاج ان الصنف جيزة 20 استجاب للرى معنويا وزاد محصوله مع اعطاء خمس ريات, بينما تاثر معنويا بانخفاض القدرة التخزينية. ويمكن التوصية باعطائه أربع ريات فى حالة الزراعة للتخزين الجيد وتوفيرا لمياه الرى وخمس ريات عند الاستهلاك المباشر .

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