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EFFECT OF ALTERNATE-FURROW IRRIGATION AND TRANSPLANTING DISTANCE ON WATER UTILIZATION EFFICIENCY FOR ONION CROP

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ABSTRACT

Two field experiments were executed at Gemmiza Agricultural Research Station during 2003/ 2004 and 2004/2005 seasons, to find out the extent to which alternate-furrow irrigation technique and distance between seedlings affected yield of onion crop and water utilization. The obtained results could be summarized as follows:

1- Volumes of applied water under alternate-furrow irrigation (AFI) treatments were reduced in comparison with those under every- furrow irrigation, and these results were true in the two seasons of study.

2- The onion marketable yield was decreased by 5.85%-14.19%with AFI at 30 days Interval, while 14.77%-21.19% increase was obtained under AFI at 15 days interval, comparable with EFI. The lowest value of culls onion yield was obtained with AFI at 15 days interval compared with EFI and AFI at 30 days interval. Total onion yield was reduced by 12.27- 3.87% with AFI at 30 days interval, while it increased by 11.28-13.87% with AFI at 15 days interval, in comparison with EFI.

3- Water utilization efficiency values were improved under AFI either at 15 or 30 days intervals, as compared with the value with EF I.

4- Bulb size and diameter values seemed to be reduced due to AFI either at 15 or 30 days intervals, while bulb total soluble solids and dry matter were significantly increased.

5- Increasing the distance of seedling transplanting resulted in reduction in volume of applied water, reduced onion marketable yield, reduced total onion yield and reduced values of bulb total soluble solids and dry matter %. On the other hand, values of culls onion yield and bulb weight and diameter were increased as transplanting distance increased.

INTRODUCTION

Under common furrow irrigation, to refill the root zone over irrigation is inevitable, particularly in upper part of a field near the water source. Over

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irrigation water used was less by 30-50 % **Bakker et al. (1997)** demonstrated the potential of alternate-furrow irrigation(AFI)to reduce sugarcane water use. irrigation leads to greater water losses and leaches the pesticides and chemicals into the ground water causing lower water application efficiency and pollution problems as well. **Carbtree et al. (1985)** found a slight decrease in soybean yield due to applying alternate- furrow irrigation but the (AFI) reduced yield compared to every furrow irrigation (EFI) when the same irrigation frequency was used in both treatments. However, when (AFI) was applied more frequently in response to the crop's evapotranspiration demands there was no decrease in yield. In addition, (AFI) also improved crop water use efficiency **Benjamin et al.(1997)** found that placement of irrigation water either in every furrow or only in alternate- furrow had no effect on corn plant development, growth or grain yield. In Egypt, **EL-Sherbeny et al. (1997)** found that the irrigation water applied through alternate- furrow techniques were lower by 23.8% to 26.7%, compared with traditional furrow irrigation method. **Ying Hua and ShoaZhong (2000)** stated that alternate- furrow irrigation (AFI) compared with conventional furrow irrigation (CFI), decreased deep percolation of irrigation water, decreased evapotranspiration rate and increased evapotranspiration efficiency for maize crop**, Abdel–Maksoud et al. (2002)** found that significant reductions in applied water due to the alternate-furrow irrigation at 7 and 14 days interval and water saving were about 8% and 30%, respectively, comparable to common furrow irrigation. Moreover, alternate- furrow irrigation at 14 days interval seems to decrease the yield insignificantly, whereas, under alternate- furrow at 7 days interval, the figure was increased by 14.5%, as compared with every- furrow irrigation. The authors also found that water utilization efficiency (WUtE) values were improved under alternate- furrow irrigation, either at 7 or 14 days interval compared to every furrow irrigation. **Mostafa and Leilah (1993)** mentioned that widening irrigation interval from 20 to 30, 40 and 50 days gave total bulbs yield of 16.48 to 16.98, 15.46 and 13.99 ton/fed, respectively.

Mostafa (1979) showed that increasing the distance between seedlings form 5 to 7.5 and 10 cm resulted in yield decrease reaches 13.7 ±0.09 ton/fed. **Wilson and Hutton (1983)** stated that the best yield of large export grade onions were produced with density level of 45-70 plants/m^2 , while above this level, the proportion of large bulbs (5-7 cm diameter) fell although the total yield increased. **Brewster (1994)** concluded that the yield and size of onion bulbs can be controlled with considerable extent by plant density. The author added also that 5-7 cm diameter bulbs must be grown at 50-100 plants/m^2 whereas, planting of 35-50 plants/m^2 produced larger bulbs (diameter >7 cm). Onion bulbs yield was increased as transplanting densities increased while bulb size correspondingly declined. In other words, maximum onion yield was attained with high transplanting density.

Mostafa et al. (1996) showed that increasing distance between seedling decreased marketable yield, total yield, total soluble solids % and dry matter %, while it decreased bulb weight, bulb diameter increased, so decreased the quality of onion after storage. The authors also stated that the best distance between seedlings was 5 cm by using hand transplanting.

The aim of the present work is to study the effect of alternate-furrow irrigation and different distance between seedlings on applied irrigation water, water utilization efficiency, marketable yield, culls yield, total yield, bulb weight, bulb diameter, total soluble solids % and dry matter %.

MATERIALS AND METHODS

Two field experiments were executed during 2003/2004 and 2004/2005 seasons at Gemmeiza Agricultural Research Station, ARC Gharbia Governorate, to study the effect of three irrigation methods and three distances of transplanting on growth, yield and quality of onion bulb and water utilization as well. The experimental soil is clay silt loamy in texture as shown in Table (1). The previous crop was rice in both seasons. Transplanting dates of onion seedlings (Giza 20 variety) were 20th of November 2003 and 1st.of December 2004 in the first and second seasons, respectively.

Table (1): Particle size distribution, field capacity and wilting points of the experimental soil in 2003 / 2004 and 2004 / 2005 seasons

Some soil characteristics	2003 / 2004 season Depth (cm)		2004 / 2005 season Depth (cm)	
	0 - 20	20-50	0- 20	20-50
Coarse sand %	0.83	1.11	0.49	0.27
Fine sand %	14.14	8.68	16.01	11.55
Silt %	45.84	45.11	43.74	36.91
Clay %	39.19	45.10	39.76	51.37
Texture %	Clay silt loam	Silt clay	Silt clay	Clay
$CaCO_3$ %	5.14	4.20	3.32	4.37
Field Capacity, wt %	45.60	36.00	46.60	37.00
Wilting Point , wt %	24.80	19.60	25.30	20.10

The adopted treatments were arranged in split-plot experimental design, With 4 replicates, as follows:

Main- plot (water placement)

1- Every – furrow irrigation (EFI) (Traditional furrow irrigation at 30 days interval)

II- Alternate – furrow irrigation at 30 days interval (AFI_1).

III- Alternate- furrow irrigation at 15 days interval (AFI_2)

Water placement techniques are illustrated in Fig. (1)

2- Sub-plot (distance of transplanting)

I- Transplanting at 5 cm between seedlings.

II- transplanting at 7.5 cm between seedlings.

III-Transplanting at 10 cm between seedlings.

Area of each sub-plot was 21 m^2 (1/200 fed) i.e. 5 ridges x 0.60m apart x 7m length. All recommended agricultural practices (i.e. fertilization, weed control… etc) for onion production in Gemmeiza area were done.

Irrigation water was conveyed to the plots through a circular orifice and its quantity was calculated using the equation of immersed orifice as follows.(**James,1988**)

$$Q = 0.61\times 0.334\times A\sqrt{h}$$

where

Q = quantity of irrigation water, L/sec,

A = area of the orifice, cm^2, and

h = effective water head over the orifice center, m.

At harvest, average bulb weight (gm), marketable yield culls yield (double+ bolter) , total yield (ton/fed) ,total soluble solids % (T.S.S%) , percentage of dry matter in bulbs were determined. Quality of bulbs was determined by classifying the marketable bulbs yield into three groups according to **Moursi et al. (1973**) as follows: large bulbs >7 cm, medium bulbs, form 5 to 7 cm and small bulbs< 5cm in diameter. Storability was measured as percentage of total loss in marketable yield during storage period of four months.

Data were statistically analyzed according to **Das and Giri (1986).** The treatment means were compared using New Least Significant Difference as described by **Waller and Duncan (1969**).

RESULTS AND DISCUSSION

1- Applied irrigation water:

Data in Table (2) show that applying the irrigation water through alternate-furrow method (AFI) with 30 days interval saved about 31.0% and

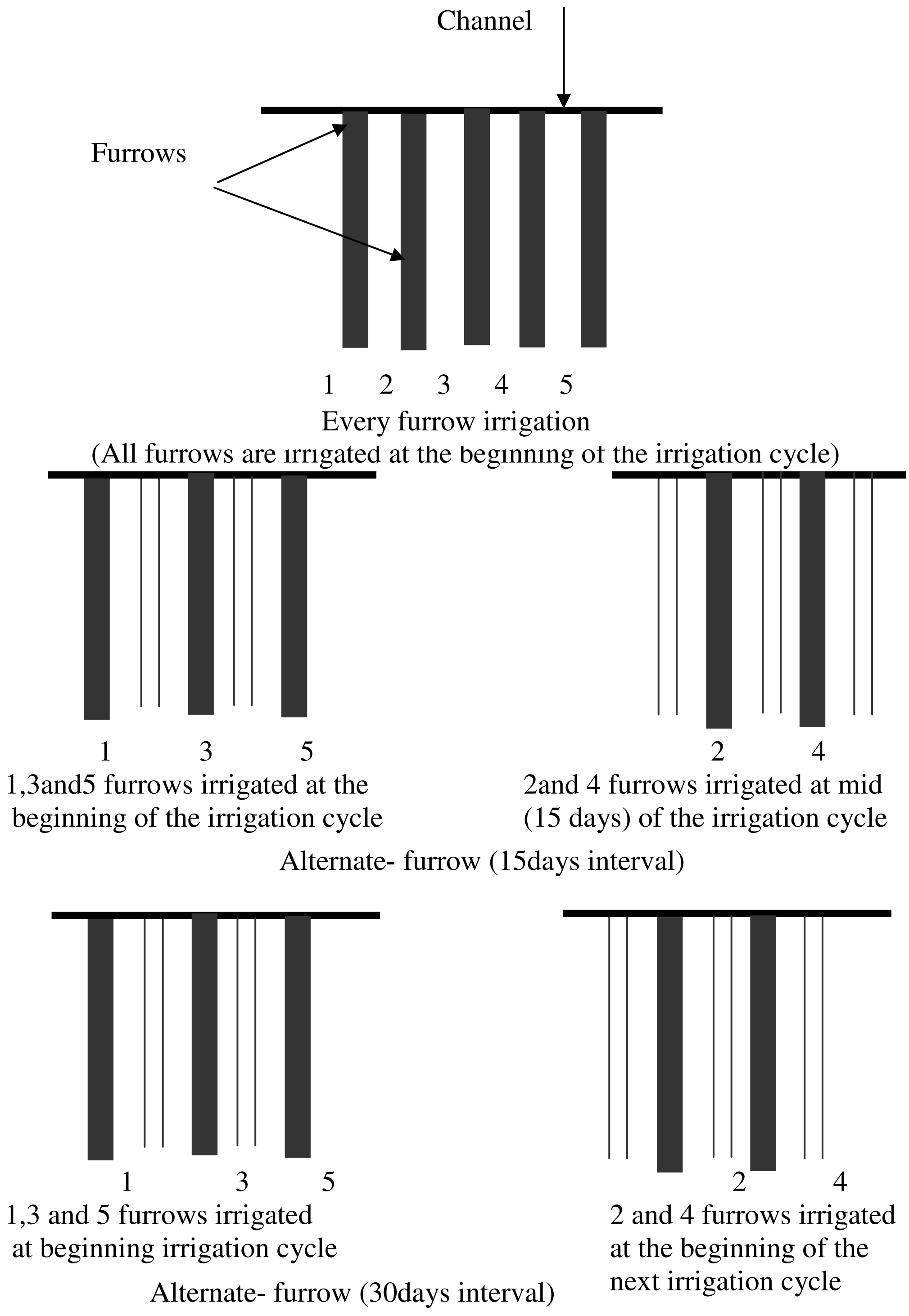

Fig 1: Water placement

29.0% of applied water, compared with every- furrow irrigation (EFI) the 1st. and the 2nd seasons, respectively. In addition, under alternate- furrow irrigation (AFI) at 15-day interval, the same trend was noticed with reduction percentages values reached about 10.0% and 9.0%, as compared with (EFI). The reduction in irrigation water, due to using alternate-furrow technique, were reported by **Carbtree et al. (1985)** and **EL-Sherbeny et al. (1997**) and **Abdel-Maksoud et al. (2002).** .

Table (2): Applied water (m^3 /fed), water utilization efficiency (kg/ m^3)as affected by different irrigation methods and seedling distances and the interaction in 2003/2004 and 2004/2005 seasons

Treatmeants	**2003/2004 season**			**2004/2005 season**		
	Yield ton/ fed	**Applied water m^3/fed**	**WUtE kg/ m^3**	**Yield ton/fed**	**Applied water m^3/fed**	**WUtE kg/ m^3**
EFI	15.436	1835.61	8.409	15.838	1852.01	8.55
AFI at 30days	14.38	1274.47	11.642	13.895	1309.47	10.61
AFI at 15 days	17.577	1661 .85	10.577	17.625	1699.63	10.40
LSD 0.05	0.75	72.27	---	1.38	17.17	---
d1 5.0 cm	18.387	1623.63	11.325	17.077	1657.85	10.30
d2 7.5 cm	15.330	1292.66	9.64	15.706	1629.99	9.64
d3 10 cm	14.134	1556.66	9.07	14.576	1593.30	9.15
LSD 0.05	0.42	26.27	---	1.19	26.11	---
Interaction EFI d1	17.662	1870.93	9.44	16.364	1886.33	8.68
d2	15.950	1835.2	8.69	15.791	1866.9	8.46
d 3	12.696	1800.7	7.05	15.359	1802.85	8.52
AEI at30 days d1	16.548	1297.76	12.75	16.212	1347.76	12.03
d2	13.021	1270.16	10.25	13.882	1324.16	10.48
d3	12.948	1255.2	10.31	11.591	1316.5	8.80
AEI at15days d1	18.953	1702.19	11.13	18.655	1739.45	10.72
d2	17.098	1672.61	10.22	17.445	1698.9	10.27
d3	16.681	1610.74	10.36	16.775	1660.54	10.10
LSD 0.05	---	---	---	---	---	---

As for distance between seedlings and its effect on irrigation water applied, increasing distance between onion seedlings from 5 to 7.5 and 10cm resulted in reduction in the irrigation water applied, since the values were 1592.6 and 1556.66 m^3/fed. under seedling distance of 7.5 and 10 cm, compared with 1623.63 m^3 /fed under seedling distance of 5 cm in the 1st season. The same trend was observed in the 2nd.season with corresponding values of applied irrigation water reached 1629.99, 1539.30 and 1657.85 m^3/fed. respectively

2- Water utilization efficiency (WUtE):

The calculated water utilization efficiency values (kg/m^3) as affected by the treatment variables are presented in Table (2). Results indicated that (WUtE) values were, in the first season, improved under (AFI) at 30 and 15 days intervals by 38.45 and 25.98 % more than under (EFI), respectively, In the 2nd season similar trend was observed with corresponding values reached 24.10 and 21.64%, respectively. These results are in accordance with **Bakker et al. (1997), EL-Sherbeny et al. (1997**) and **Abdel-Maksoud et al. (2002)** who concluded that (AFI) improved crop water utilization efficiency for the crop under study.

3- Marketable onion yield (ton/ fed) :

Data in Table (3) show that marketable onion yield was significantly affected by the adopted irrigation methods in the two seasons of study. Marketable onion yield was reduced under (AFI) at 30 days interval by 5.85% and 14.19%, as compared with (EFI) in the 1st and the 2nd seasons, respectively .**Musick and Dusek (1974)** with sugar beet, sorghum and potato and **Carbtree et al. (1985)** with soybean, observed a slight yield reduction due to applying alternate- furrow irrigation- Nevertheless in the present study ,(AFI) at 15 days interval, proved to be superior to increase the marketable onion yield by 14.77 %, 21.9% more than (EFI) in the 1st and the 2nd seasons, receptively. This may be attribute to the better availability of soil moisture during the irrigation cycle under (AFI) at 15 days intervals, which doubtless reflected on the marketable onion yield. This result is in accordance with **Abdel- Maksoud et al. (2002)** who stated that the average maize grain yield was increased with AFI at half interval.

Regarding seedling distances and its effect on marketable onion yield, it is clear that by increasing the distance was accompanied with significant reduced values of onion marketable yield. The average decrease in the 1st season due to increase distances between seedlings to 7.5 and 10 cm were 18.08% and 25.31% compared with distance between seedlings (5cm). In the 2nd season, similar trend was observed with corresponding value reached 10.02% and 18.28%, respectively. Data showed that the final output of onion may depend on number of plants per unit area. **Mostafa (1979), Hegazy (1990), Brester (1994)** and **Mostafa et al. (1996)** came to the same conclusion.

Table(3): Average of marketable yield (ton/fed), culls yield(ton/fed) and total yield (ton/fed) as affected by irrigation method and transplanting distances and their interaction in 2003/2004 and 2004/2005 seasons

Treatments		2003/2004 season			004/2005 season		
		Yield (ton/fed)			Yield (ton/fed)		
		Marketable	Culls	Total	Marketable	Culls	Total
Water placement	EFI	14.766	0.670	15.436	13.913	1.925	15.838
	AFI 30	13.902	0936	14.838	11.939	1.956	13.895
	AFI 15	16.947	0.630	17.577	15.754	1.871	17.625
	LSD 0.05	1.796	--	0.75	1.162	--	1.38
Transp. distance	d1	17.776	0.611	18.387	15.313	1.764	17.077
	d2	14.562	0.768	15.330	13.779	1.927	15.706
	d3	13.277	0.857	14.134	12.514	2.061	14.576
	LSD 0.05	0.78	--	0.42	0.901	--	1.19
Interaction EFI	d1	17.152	0.510	17.662	17.611	1.753	16.364
	d2	15.290	0.660	15.950	13.924	1.867	15.791
	d3	11.856	0.840	12.696	13.204	2.155	15.359
AFI at 30days	d1	17.823	0.725	18.548	14.457	1.755	16.212
	d2	11.988	0.960	12.948	11.855	2.027	13.882
	d3	11.896	1.125	13.021	9.504	2.087	11.591
AFI at 15 days	d1	18.353	0.600	18.953	16.870	1.785	18.655
	d2	16.408	0.690	17.098	15.559	1.886	17.445
	d3	16.081	0.600	16.681	14.833	1.942	16.775
	LSD 0.05	1.36	--	0.73	--	--	2.06

As for the interaction of the adopted treatments, a significant effect on marketable onion yield was exerted in the 1st season only. While in the 2nd season the effect did not reach the significance level, however, the highest marketable onion yield in the two seasons were obtained due to transplanting at 5-cm distance under (AFI) at 15 days interval.

4- Culls yield (ton/fed):

Data in Table (3) show that culls yield was insignificantly affected by both methods of irrigation and distance between seedlings. The lowest value of onion culls was under the (AFI) at 15 days interval, since the reduction values reached 5.97% and 32.69% in the1st season compared with (EFI) and (AFI) at 30 days interval. The same trend in the 2nd season was observed . This may by attributed to the better availability of soil moisture during the irrigation cycle under (AFI) at 15 days interval.

Increasing distance between seedlings insignificantly increased culls yield since the increase percentages were 25.70 % and 40.26% under 7.5 and 10cm distances compared with 5cm one in the 1st season .The same trend in the 2nd season was recorded with corresponding values reached 9.24% and 16.84%, respectively. These results may be due to less competition between plants in case of increasing distance between seedlings. These results are in harmony with those obtained by **Mostafa et al (1979), Hegazy (1990) ,Brewster (1994)** and **Mostafa et al.(1996)**

Interaction of irrigation methods and distance between seedlings on culls onion yield was insignificant, however higher values for culls yield were obtained as seedling distance decreased under (EFI) and (AFI) with 30 days interval, in the two seasons.

5- Total yield (ton/fed):

Data in Table (3) reveal that average total yield was significantly affected due to methods of irrigation and distance between seedlings and their interaction in the two seasons. Under (AFI) at 30 days interval ,the total yield was decreased by 13.87% and 12.27%, compared with (EFI) in the1st and the 2nd seasons respectively Nevertheless, under (AFI) at 15 days interval, the total yield increased by 13.87% and 11.28% in the two season respectively, compared with (EFI). These results are in harmony with those obtained by **Adel- Maksoud et al (2002).**

Data in Table (3) show that by increasing distance between seedlings total onion yield values, since under distance of 7.5 and 10 cm, the reduction were 16.63%, and 23.13 %in the1st season and 8.03 %and 14.6% in the2nd season respectively, as compared with 5 cm one. These results are in harmony with those of **Mostafa (1979), Hegazy (1990), Brewser (1994)** and **Mostafa et al (1996).**

Methods of irrigation were interacted significantly with distance between seedlings to affect total onion yield and higher values were recorded with 5cm between seedlings under (AFI) at 15 days interval.

Table (4): Averages of Bulb weight (gm) and bulb diameter (cm) at (2003/2004) and (2004/2005) seasons.

Treatments	2003/2004 season		2004/2005 season	
	Bulb weight(gm)	Bulb diam.(cm)	Bulb weight(gm)	Bulb diam.(cm)
EFI	114.66	6.63	102.0	6.30
AFI at 30 days	110.33	6.46	92.67	6.15
AFI at 15 days	95.50	6.20	78.67	5.88
LSD 0.05	13.00	0.32	12.69	0.29
d_1 (5cm)	97.83	5.97	85.00	5.84
d_2 (7.5cm)	104.33	6.27	89.34	6.09
d_3 (10cm)	118.33	6.99	96.00	6.40
LSD 0.05	9.39	0.39	2.28	0.26
Interaction				
EFI d_1	101	6.13	96	5.83
d_2	10 8	6.28	100	6.40
d_3	135	7.48	110	6.68
AFIat30days d_1	91.5	5.80	70.25	5.85
d_2	95	6.20	76.25	5.88
d_3	100	6.40	89.50	5.90
AFIat15days d_1	101	5.98	88.75	5.83
d_2	110	6.33	91.75	6.00
d_3	120	7.08	97.50	6.63
LSD 0.05	--	--	--	--

6- Bulb weight and bulb diameter:

Data in Table (4) show that the bulb weight (gm) and diameter (cm) were significantly affected by different methods of irrigation, in the two seasons of study. Values of bulb weight were decreased by 3.78 %and 16.71% in the1st season and by 9.15% and 22.87% in the 2nd season under (AFI) at 30 days and 15 days interval, respectively, comparable with (EFI). The bulb diameter character exhibited the same trend with corresponding reduction values reached 2.56 %and 4.49% and 2.38 %and 6.67%, respectively. These results may be attributed to less soil moisture contents under (AFI) at 15 and 30 days interval.

As for the effect of distance between seedlings on the bulb weight and diameter, data show that the increase in bulb weight were 6.64% and 20.95 %in the 1st season and 5.11 %and 12.94% in the 2nd one under seedling distances of 7.5 and 10 cm, compared to 5 cm distance. The same trend was observed with bulb diameter with corresponding increase values reached 5.02%, 17.89% and 4.28 %and 9.59%, respectively. The results may be due to less competition between plants in case of increasing the distance between seedlings and the same conclusion previously stated by **Mostafa (1979), Hegazy (1990) Breaster (1994)** and **Mostafa et al (1996).**

The interaction between methods of irrigation and distance between seedlings on bulb weight and diameter were insignificantly in the two seasons of study, however, higher values were recorded due to increasing seedlings distance to 10 cm under traditional furrow irrigation treatment (EFI).

7- Bulb total soluble solids % and dry matter(%) :

Total soluble solids (T.S.S. %) and dry matter (D.M%) of bulb after storage as affected by the adopted irrigation methods were significantly affected in the1st season only as shown in Table (5). Alternate-furrow irrigation either at 15 or 30 days intervals resulted in increased of bulb (T.S.S %) and (D.M %), comparable to (EFI). The increases in (T.S.S%) were 4.96% and 10.22% in the1st season and 5.12% and 5.91% in the2nd season, compared to the (EFI). Values of (D.M%) followed the same trend with increase values reached 10.72% and 22.49% in the1st season and 3.81 %and 6.42% in the 2nd season, respectively. The higher (T.S.S %) and (D.M%) values under (AFI) at 15 days interval may be due to the better availability of soil moisture during the irrigation cycle.

The effect of distance between seedlings on both (T.S.S %) was significantly in the 1st season and insignificant with (D.M%). Data in Table (5) show that by increasing the distance between seedlings resulted in decreased in value of both (T.S.S %) and (D.M %). Higher values were 14.92% and 15.10% for (T.S.S%), and 14.31% and 14.36 %) in the two seasons values for (D.M%) under 5 cm. These results are in harmony with those obtained by **Hegazy (1990),Brewster (1994**) and **Mostafa (1996).**

Interaction between methods of irrigation and distance between seedlings on both (T.S.S%) and (D.M%) were significantly in 1st season. Increasing distance between seedlings seems to decrease (T.S.S%) and (D.M%) under all methods of irrigation. The highest values of (T.S.S %) and (D.M %) were under (AFI) at 15 days interval, compared with (EFI) and (AFI) at 30 days interval. This led to high storability of onion bulbs produced under such irrigation method.

Table (5): Averages of total soluble solids (T.S.S%) and dry mater (D.M.%) as affected by different treatments in 2003/2004 and 2004/2005 seasons

Treatments	2003/2004 season		2004/2005 season	
	T.S.S%	D.M%	T.S.S%	D.M%
EFI	13.70	12.97	14.05	13.40
AFI ai 30 days	14.38	14.36	14.77	13.91
AFI at 15 days	15.10	14.46	14.88	14.26
LSD 0.05	0.41	0.57	---	---
d1 5.0 cm	14.92	14.31	15.10	14.36
d2 7.5 cm	13.95	14.13	14.43	13.76
d3 10 cm	13.92	13.35	14.17	13.45
LSD 0.05	0.58	---	---	---
Interaction				
EFI d_1	14.20	13.67	14.40	13.66
d_2	13.75	12.95	14.05	13.30
d_3	13.15	12.28	13.70	13.23
AFI at 30 days d1	14.95	14.53	15.80	14.89
d_2	14.85	14.45	14 .30	13.28
d_3	13.30	14.09	14.20	13.27
AFI at15days d_1	15.60	15.57	15.10	14.54
d_2	14.85	15.17	14.95	14.40
d_3	14.85	14.66	14.60	13.85
LSD 0.05	1.00	1.487	---	---

CONCLUSION

In order to maximize onion yield and its quality and to use the irrigation water efficiently, under Gemmeiza area conditions, it is recommended to transplanting the onion seedlings at 5 cm apart and replacing the irrigation water through alternate-furrow irrigation at 15 days interval**.**

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الملخص العربى

تأ ثير الرى التبادلي فى الخطوط والمسافة بين الشتلات على كفاءة استخدام محصول البصل للمياه

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أجريت تجربتان حقليتان فى محطة البحوث الزراعية بالجميزة – محافظة الغربية خلال موسمى ٢٠٠٣ \٢٠٠٤ ٢٠٠٤\ ٢٠٠٥ وذ لك لدراسة تأثير أضافة مياه الري بأسلوب الري التبادلي للخطوط علي كفاءة أستخدام المياه لمحصول البصل تحت مسافات زراعه مختلفة مقارنة بطريقة الري بالخطوط العادية.

و أظهرت النتائج الآتي :

١- تحت ظروف الري التبادلي كل ١٥ أو ٣٠ يوم انخفضت كميات المياه المضافة معنويا مقارنة بالري الخطوط العادى ٠

٢- زيادة المحصول القابل للتسويق بنسبة ١٤%تحت الري التبادلي كل ١٥يوم و كذلك زيادة المحصول الكلي بحوالي ١٢,٥٨ % مقارنة بالري العادي٠

٣- استخدام الري التبادلي كل ١٥ يوم يقل محصول الأبصال النقضة بحوالي ٥ % مقارنة بالري في كل الخطوط ٠

٤- زيادة كفاءة استخدام المياه تحت الري التبادلي كل ١٥و٣٠ يوم مقارنة بالري في كل الخطوط ٠

٥- استخدام الري التبادلي كل ١٥ و٣٠ يوم قلل كلا من وزن و قطر البصلة ، وزاد كلا من المواد الذائبة الكلية % ، و كذلك المادة الجافة% وبالتالي تزداد جودة البصل بعد التخزين مقارنة بالري بالخطوط العادية ٠

٦- زيادة المسافة بين الشتلات أدت الي زيادة كلا من الأبصال النقضة ، وزن ، قطر البصلة و لكن أدي الي نقص المحصول القابل للتسويق، والناتج الكلي. من المحصول ،ونسبة المواد الصلبة %،وكذلك قلت نسبة المواد الجافة % و بالتالي تقل جودة المحصول بزيادة المسافة بين الشتلات ٠

٧- أوضحت النتائج أستخدم الري التبادلي كل ١٥ يوم ، و مسافة الشتل ٥ سم أعطت افضل النتائج تحت ظروف منطقة الجميزة .

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