EFFECT OF REFRAINING IRRIGATION PRIOR HARVESTING OF ONION YIELD IN THE CENTRAL REGION OF SAUDI ARABIA

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ABSTRACT

This field study was conducted to evaluate the effect of refraining irrigation water for different periods prior harvesting time on the quality and quantity of onion (cv. Texas Yellow Grano) production. This study was conducted at the Agricultural research station of the College of Agriculture and Veterinary Medicine King Saud University, in Al-Qassim region, Saudi Arabia during the years of 1999 and 2000. The irrigation refraining treatments were 2 days, 1 week, 2 weeks and 3 weeks prior harvesting time. Inspite of significant differences observed in both leaf area and dry weight, the results revealed that there was no significant differences in onion production yield and dry weight. It was concluded that the short period of refraining irrigation does not affect the yield of onion under the environmental conditions of the central region of Saudi Arabia. This could be also ascribed to the good curing treatments applied after harvesting every experimental treatment. Therefore, it is here advisable to refrain irrigation 3 weeks prior harvesting date for high water use efficiency purpose.

Key words: Onion, *Allium cepa*, production, irrigation, vegetative growth, Harvesting period, Bulb yeild.

INTRODUCTION

Onion (*Allium cepa* L.) ranks the fourth among most important vegetable crops grown in the Kingdom of Saudi Arabia. Its production in 2000 was about 95000 Tons. (Ministry of Agriculture and water, KSA, 2001).

Onion is a crop not necessarily marketed directly after harvest but stored from some weeks up to a year, as traditionally for exportation or by the local consumers. During storage certain changes took place in bulbs which affect the net weight and quality. The moisture content had a distinct reflection on these changes, which in turn was influenced by preharvest irrigation. Therefore, Warid et al., (1961) on onion and Higazy, et al., (1974) on garlic, found that both onion and garlic bulbs produced from irrigated fields lost more weight during storage than those obtained from non-irrigated ones.

Several investigators have been reported that highest marketable yield of onion bulbs were obtained when the plots received higher levels of irrigation

water (Neeraja, et al., 1999, and Olalla, et al., 1994). Chung (1989) reported that applying irrigation throughout the season increasd the total bulb yield from 52 to 84 T/ha while withholding the last two irrigations prior to maturity reduced the 51-70mm bulb yield from 57 to 44 T/ha. Irrigation had no effect on the incidence of bulb defects such as skin cracking, doubles and thickneck, but increased the level of wastage during storage. Moreover, there was a trend for irrigation to decrease the bulb dry matter content but to increase the hardness of the bulbs.

Shock et al, (1999), in dry climates, reported that onions usually have the roots undercut at maturity before harvest. In a 2-year study, dehydrator onions were uprooted at maturity to simulate ndercutting, and harvest was delayed for several time intervals. Treatment effects on fresh and dry yield, the number of bulbs per plot, bulb fresh and dry weights, and percent dry weight of bulbs were measured. Plots were considered mature when 80% of the tops had fallen. Delaying harvest 15 days after maturity without uprooting did not reduce yield significantly. Yield and both bulb weight and percent dry weight tended to decline when harvest was delayed > 15 days after maturity, especially if plants were uprooted. This suggests that undercutting of onions should not be performed until just prior to harvest and that harvest should not be delayed > 15 days past maturity.

The aim of this research is to evaluate the effect of refraining irrigation water for different periods prior harvesting time on the growth and yield of onion bulbs.

MATERIALS AND METHODS

This study was carried out at Experimental Farm, College of Agriculture and Veterinary Medicine, King Saud University, Al-Qassim Branch, Kingdom of Saudi Arabia. The geographical location of the experimental farm is 26 22° N, 44° E, with an elevation of 725m above sea level. The experimental soil was sandy in 1999 and sandy-clay-loam during 2000 cropping season. The physical and chemical properties of the soils are given in table 1.

Onion (*Allium cepa* L.) cultivar Texas Yellow Grano was planted as a test crop, using a seedling rate of 330,000 plants ha^{-1}. The experiment was planted in field having a plot area of 6.30 m^2 (1.8m x 3.5m). The spacing between raws was 75cm and within raws 10cm. The length of every row was 3.5m. Aditional NPK fertilizer was applied to every experiment at the rate of 350 kg N ha^{-1}, 200 kg P_2O_5 ha^{-1} (calcium superphosphate, 16 % P_2O_5) and 60 kg K_2O ha^{-1} (potassium sulfate).

Table 1. Initial Characteristics of the different soil textures used.

Characteristics	Cropping season	
	1999	2000
Particle size distribution(%)		
Coarse sand	50.20	48.70
Fine sand	39.50	22.30
Silt	1.60	7.60
Clay	8.60	21.40
Soluble cations($meq l^{-1}$)		
Ca^{++}	12.10	9.80
Mg^{++}	4.60	6.20
Na^{+}	17.40	14.40
Soluble anions($meq l^{-1}$)		
Cl^{-}	12.80	10.10
$HCO\ 3^{-}$	6.00	7.70
$SO^{=}4$	15.30	12.40
EC (dSm^{-1} at 25° C)	3.56	4.10
PH (paste)	8.10	7.80
Organic carbon	Trace	Trace
Nitrogen	Trace	Trace

The treatments were arranged in a randomized complete block design with three replicates. The treatments were as follows;

1- Stop irrigation 2 days before harvesting date.
2- Stop irrigation 1 week before harvesting date.
3- Stop irrigation 2 week before harvesting date.
4- Stop irrigation 3 week before harvesting date.

The seed sowing dates during 1999 and 2000 experiments were 12/11/99 and 15/12/2000, respectively, while the transplanting dates during 1999 and 2000 experiment were 08/01/99 and 15/02/2000, respectively. The harvesting dates were 05/05/2000, and 01/06/2001 for the two experiments respectively.

Surface irrigation was used. The amount of irrigation water applied was to 12 ml per plot per every irrigation time. The chemical composition of irrigation water is given in table 2.

Plant growth measurements include leaf area, leaf fresh weight, leaf dry weight, fresh and dry weight of bulb. The crop yield was taken on whole plot basis. Leaf area and leaf fresh and dry weight was measured on some randomly selected plants. Leaf area was measured using the leaf area meter instrument (CI–202, CID, INC.). To determine the dry weight of leaf and bulb; the plant material was dried in an oven at 65-70° C to a constant weight.

Table 2: Initial characteristics of the irrigation water used.

Water characteristics	Cropping season	
	1999	2000
EC (mmoh.cm^{-1})	1.80	1.10
Soluble cations(meq l^{-1})		
Ca^{++}	8.00	4.66
Mg^{++}	3.20	2.01
Na^{+}	6.50	5.00
K^{+}	0.24	0.17
Soluble anions(meq l^{-1})		
Cl^{-}	5.50	5.15
CO3	None	None
HCO3	3.10	2.75
SO4	5.00	3.94
PPM	1204	736
SAR	3.08	2.70
Water pH	6.90	6.77

The data obtained were statistically analyzed. Mean separations were calculated using the least significant differences (LSD) (p= 0.05) (Steel and Torrie, 1982).

RESULTS AND DISCUSSION

Leaf Area

Mean leaf area show significant increases with water refraining application at the different application times during the two crop seasons (Table 3). As the water refaining increased the leaf area decreased, that's may be due the drought of plant leaves as the soil moisture reduced. These results are coincided with those of Abu-Gerab (1987) and Abd-Alla (1992).

Table 3. Effect of refraining water for different periods prior harvesting time on onion leaf area, dry weight, bulb yield, and bulb dry weight during 1999 and 2000 seasons. (Data is shown as a mean of two growing seasons.)

Irrigation refraining treatments	Leaf area (cm^2)	Leaf dry weight (gm)	Bulb yield (T/ha)	Bulb dry weight (gm/plant)
2 days	355.33	2.98	28.94	5.49
1 week	345.30	2.90	27.93	5.95
2 weeks	333.67	2.85	28.18	5.23
3 weeks	329.33	2.88	28.49	5.09
LSD (0.05)	8.24	0.09	N.S.*	N.S.

***Not significant at 0.05 level of significance.**

Leaf Dry Weight

As a reflectant of leaf area, the difference in leaf dry weight also show a significant increment in the two seasons. As leaf area increased, leaf dry weight increased.

The difference in leaf dry weight was not highly significant among various treatments receiving different amount of water application. The data indicate that the application of water did not cause a highly significant effect of leaf dry weight, which is unusual as compared to the leaf area per plant. El-Habbasha and Shaheen (1976) reported that greatest dry mater was obtained using irrigation at 55% available soil moisture. Whereas, Abd-Alla (1992) found that dry weight of onion plants was, in general, encouraged under the highest soil moisture level.

Bulb yield

Unexpectingly, the comined analysis revealed that bulb yield did not show significant differences between treatments. This could be ascribed to the shortness of the application treatment. However, the two days treatment gave the highest yield, there was no significant differences were observed between the four treatments (Table 3). Therefore, the values of water use efficiency can be increased by refraining irrigation three weeks before harvesting date. El-Mansi et al., (1999) reported that water use efficiency could be increased either by increasing crop productivity or by decreasing values of water consumption. On the other hand, Osman et al., (1996) found that the highest level of water supply increased the total fresh yield of garlic.

Bulb Dry Weight

Mean bulb dry weight did not show significant increases with water refraining application at the different application times during the two seasons, except a slight significant reduction in the fourth treatment when the period of referaining water increased reflecting the leaf area data.

Onion leaf area mean ranged between 355.33 and 329.33cm^2 fro 2 days and 3 weeks respectively. This significant difference could be easily ascribed to the drought of foliage leaves as the irrigation refraining increased. The leaf dry weight almost reflecting the leaf area trends. It is obveious that bulb yield will change according to the leaf area changes (Al-Moshileh, 1992). But since the treatment period was not long enough to affect the bulb yield. No significant changes were observed among various treatments in both seasons. This result is in agreement with Shock et al. (1999) findings.

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الملخص العربي

تأثير فترات إيقاف الري قبل الحصاد على محصول البصل تحت الظروف البيئية للمنطقة الوسطى من المملكة العربية السعودية

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أجريت هذه الدراسة الحقلية بهدف تقيم تأثير فترات إيقاف الري قبل الحصاد على إنتاجية البصل (صنف Texas Yellow Grano) و ذلك بمزرعة كلية الزراعة و الطب البيطري – جامعة الملك سعود – فرع القصيم خلال موسمي١٩٩٩ ،٢٠٠٠م. وكانت معاملات فترات إيقاف الري: يومين، أسبوع، أسبوعين و ثلاثة أسابيع قبل الحصاد.

بينت نتائج هذه الدراسة أنه لا يوجد فروق معنوية بين فترات إيقاف الري قبل الحصاد على إنتاجية البصل تحت الظروف البيئية للمنطقة الوسطى من المملكة العربية السعودية، وربما يعزى ذلك إلى جودة معاملات التجفيف التي أجريت للمحصول بعد الحصاد. ولذلك يمكن إيقاف الري قبل الحصاد بثلاثة أسابيع لهدف زيادة كفاءة استخدام المياه في ري محصول البصل.