



Deficit Irrigation Influences Yield and Lycopene Content of Diploid and Triploid Watermelon

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BOTTOM LINE

● Deficit irrigation reduces watermelon yield by 36% and 50% at 0.75 and 0.50 ET rates, respectively. Triploid (3n) watermelon plants had higher yield and water use efficiency than diploid (2n) or seeded watermelons. Lycopene levels were highly affected by cultivar, and were generally higher in triploids. Highest lycopene content was measured at 0.75 ET.

Introduction

Many vegetable production regions in southwestern US are strictly regulated on water use. In addition, demand for high quality and nutritious vegetables has increased. Watermelon is a natural source of lycopene, a carotenoid known for its antioxidant properties. The average content of lycopene in watermelon fruits sampled from the retail produce was reported to be 48.7 ug/g FW (USDA, Carotenoid Database for US Foods, 1998). Recently, Perkins-Veazie et al. (2001) reported that seedless watermelons have more lycopene (> 50 ug/g FW) than seeded ones. The interaction of watermelon cultivar with environmental factors, such as irrigation, on the fruit lycopene content is unknown. This study explored the effects of deficit irrigation on yield, fruit quality and lycopene content of red-fleshed

diploid and triploid watermelon cultivars.

Experimental Approach

Four-week old watermelon transplants were mechanically established in the field at the Texas A&M Agr. Exp. Station, Uvalde, on 9 April 2001. Irrigation treatments were based on evapotranspiration (ET) rates, 1.0ET, 0.75ET and 0.5 ET. Diploid (2n) cultivars used were Summer Flavor 710, RWM 8036, Allsweet, Sugar Lee, and SWD 7302. Triploid (3n) cultivars used were Summer Sweet 5244, SWT 8706, Sugar Time, and Tri-X-Sunrise. Plants for each experimental plot were grown on three single raised beds on 80-inch centers with one row/bed and 3 feet within row spacing, giving a theoretical plant population of 2,180 pl/ac. Each plot was separated by a blank 80-inch row, giving a 0.75 ratio of planted area per acre (1,635 pl/ac). A subsurface drip system (8 inch depth) and plastic mulch were used. Total irrigation applied was 15.5, 11.7 and 6.8 inches for the 1.0ET, 0.75ET and 0.50ET, respectively. Rainfall amounted to 6.5 inches. Harvests were made on 25 June, 16 July and 1 August 2001. In each harvest fruits were individually counted and weights measured according to the following class sizes: < 11 lb, 11-18 lb, 18-24 lb, and >24 lb (comparable to commercial watermelon grades #6, #5, #4, and #3 fruits per box). Fruit

firmness was measured with a digital force meter in Newtons (N), and soluble solids content (SSC) with a digital refractometer. Fruit lycopene content was extracted by acetone and hexane and measured spectrophotometrically at 503 nm. Lycopene content was measured at mature (25 June) and overripe (2 July) stages.

Results and Discussion

Average total yields across all nine cultivars were highest at 1.0 ET (48,100 lb/ac) compared to 0.75 or 0.5ET. At 1.0ET rate, there was a significant increase in the weight of larger fruit sizes (>18 lb fruits). Triploids had a 34% higher total yield and fewer culls (2%) compared to diploid cultivars (25%). Increasing irrigation rate (1.0ET) increased individual fruit size (length and diameter) as well as rind tissue, which were significantly higher compared to deficit irrigation rates (0.75ET and 0.5ET). Triploids produced relatively more fruits per plant than diploids in the second harvest. Highest yields were obtained for SWT 8706, Tri X Sunrise and Summer Sweet 5244. Triploid watermelons had a higher water use efficiency than 2n watermelons. Highest SSC was measured for Sugar Time (13.4%) and was significantly higher than other cultivars (range 9.7-11.0 %). Triploid cultivars had a more firm flesh compared to 2n cultivars (12.0 vs. 9.9 N). Lycopene

content increased slightly with maturity (55.8 to 60.3 ug/g FW), and was significantly higher at 0.75ET than 1.0ET at ripe and overripe stage. Averaged over all treatments lycopene content at the overripe stage was 61-66 ug/g FW for triploids and 46 to 81 ug/g FW for diploid fruits.

This study showed that triploid watermelon plants may have a different acclimation, fruit yield and fruit quality responses to deficit irrigation than diploids. Under deficit irrigation, the reduction of total marketable yield will be less in triploids. Lycopene content varied widely among red-fleshed 2n and 3n cultivars. Deficit irrigation was not detrimental to lycopene content on a per fruit basis.

Table 1. Effect of irrigation rate and cultivar on diploid (2n) and triploid (3n) watermelon on total marketable yield and lycopene content at ripe and overripe stage. Uvalde, TX, 2001.

Treatment	Yield (lb/ac)	Lycopene (ug/g FW)		
		Ripe	Overripe	
Irrigation rate				
1.0 ET	48,032 ^a	54.3 ^b	58.8 ^b	
0.75 ET	30,674 ^b	57.9 ^a	62.4 ^a	
0.5 ET	23,875 ^c	55.3 ^{ab}	59.6 ^b	
LSD (0.05)	5,509	2.5	2.1	
Cultivar	Ploidy			
Summer Flavor 710	2n	36,614 ^{ab}	77.3 ^a	80.6 ^a
RWM 8036	2n	25,711 ^{cd}	50.1 ^{cd}	62.3 ^b
Allsweet	2n	18,442 ^d	43.5 ^e	45.7 ^c
Sugar Lee	2n	32,133 ^c	48.2 ^{cd}	49.0 ^c
SWD 7302	2n	35,716 ^{ab}	47.2 ^{de}	46.8 ^c
Summer Sweet 5244	3n	40,304 ^{ab}	62.2 ^b	65.9 ^b
SWT 8706	3n	42,193 ^a	58.8 ^b	63.8 ^b
Sugar Time	3n	35,649 ^{ab}	62.5 ^b	66.3 ^b
Tri X Sunrise	3n	40,979 ^{ab}	51.8 ^{cd}	61.6 ^b
LSD (0.05)		9,542	4.6	6.2

Two treatments (irrigation rate or cultivar) are significantly different if the difference between the means are larger than the LSD value (0.05).