

# Improving cantaloupe fruit sugar content in the UVI Commercial Aquaponic System



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## INTRODUCTION

Controlled water stress imposed during the reproductive stage of fruit crops are well-known for increasing flowering and fruit quality. However, deficit irrigation is challenging to apply on recirculating aquaponics systems due to the use of deep water hydroponic troughs for vegetable production.

## OBJECTIVES

Our study evaluated the effect of partial root and canopy cut performed before two different harvest schedules on cantaloupe fruit sugar content.

## MATERIALS AND METHODS

**UVI Commercial Aquaponic System.** The system used consisted of three main components: fish rearing, solids removal and hydroponic vegetable production troughs. The hydroponic troughs were 30 × 1.2 × 0.3 m with a volume of 11.3 m<sup>3</sup> and a surface area of 214 m<sup>2</sup>. The water flow rate on the troughs was 125 L/min for a retention time of 3 h. Fish waste products were the source of nutrients for plant growth (Fig. 1).



**Fig. 1** UVI Commercial Aquaponic System.

**Plant material.** Three-week old cantaloupe (*Cucumis melo*) 'Goddess' seedlings grown on peat-based substrate were transplanted into 1.2 × 2.4-m (2.97 m<sup>2</sup>) styrofoam rafts on the aquaponics system on Oct 2, 2015 (day after transplanting, DAT 1). We planted 2 plants/raft spaced every 1.2 × 1.2 m in a density of 1.485 plants/m<sup>2</sup> and used 12 rafts/trough.



**Fig. 2** Styrofoam rafts lifted to show the cantaloupe root system (A) and green fruits 10 days before harvest (B) grown on the UVI Aquaponics System.

**Treatments.** Combination of partial root and canopy cuts (0%, 25%, 50%, and 75%) in two harvest schedules (10 days after partial root and canopy cutting or at fruit maturation). The root and canopy cutting was performed on DAT 37. The first and last harvest were performed on DATs 47 and 64, respectively.

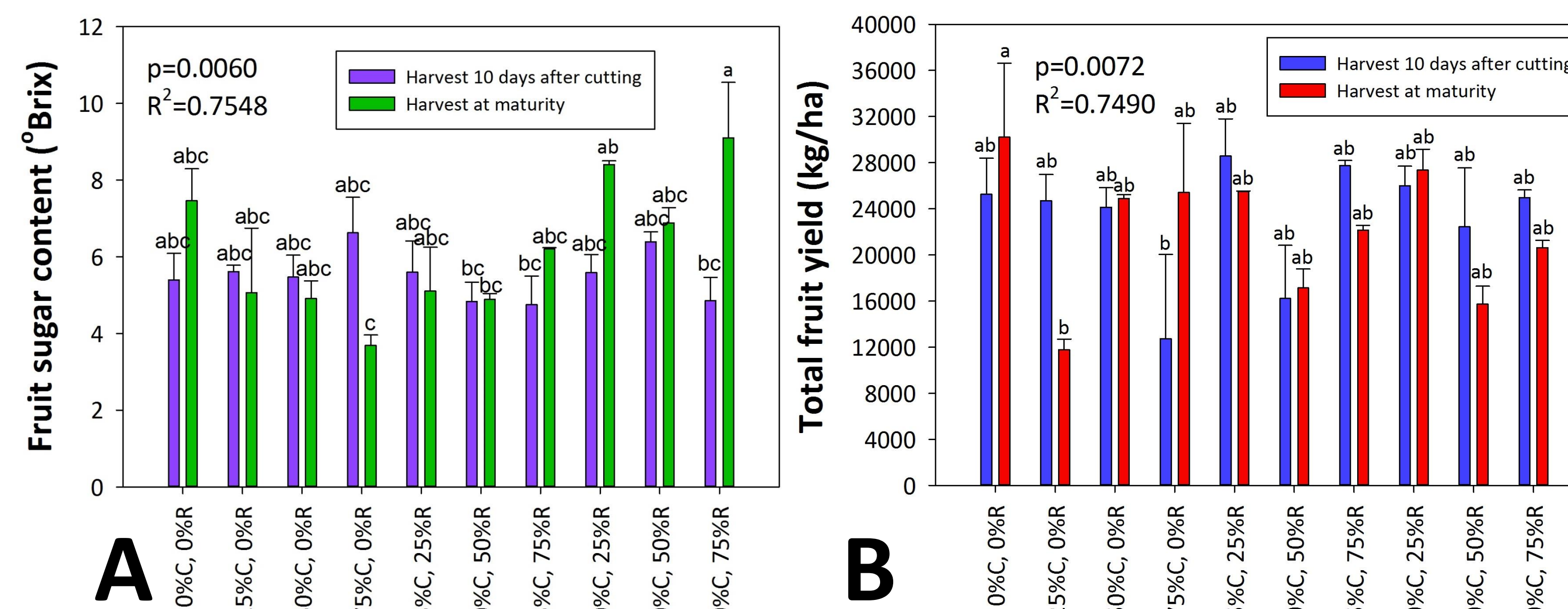
**Measurements.** Fruit sugar content; fruit yield and pulp thickness, length and width, hardness; chlorophyll and anthocyanin; root/shoot dry weight and shoot fresh weight.

**Experimental design.** CRD with two replications (20 experimental units).

**Statistical analysis.** GLM procedures of SAS; treatments as main effects in the model.

## RESULTS AND DISCUSSION

**Fruit sugar content.** Sugar content increased only on the treatments with no root cut, 75% and 25% of canopy cut and fruits harvested at the maturation (9.1 and 8.4°Brix), with a negative effect on the treatment with 75% of root cut, no canopy cut and fruits harvested at the maturation (3.7°Brix) ( $p=0.0060$ ) (Fig. 3A).



**Fig. 3** Fruit sugar content (A) and total fruit yield (B) of cantaloupe subjected to root and canopy cut grown on the UVI Aquaponics System.

**Fruit yield.** The treatment with no root or canopy cut and fruits harvested at the maturation promoted the highest yield (30,227 kg/ha), indicating a negative effect of the partial root and canopy cutting on fruit total yield ( $p=0.0072$ ) (Fig. 3B).

Fruit length, fruit width, fruit hardness, fruit pulp thickness, leaf chlorophyll and anthocyanin content, root and shoot dry weight and shoot fresh weight. No treatment response was found ( $p>0.05$ ) (Tables 1 to 3).

**Table 1** Fruit length, width, hardness, and pulp thickness.

Treatment	Fruit length (cm)		Fruit width (cm)		Fruit hardness (kgf)		Fruit pulp thickness (mm)	
	10 days	Maturity	10 days	Maturity	10 days	Maturity	10 days	Maturity
0%C, 0%R	14.6 ± 0.57	0.57 ± 16.3	16.3 ± 0.34	0.34 ± 12.25	12.25 ± 0.47	0.47 ± 13.91	40.01 ± 2.16	45.89 ± 5.36
25%C, 0%R	14.61 ± 0.19	15.16 ± 0.59	12.42 ± 0.07	13.19 ± 0.81	3.61 ± 0.03	2.24 ± 0.47	39.7 ± 0.8	41.21 ± 1.79
50%C, 0%R	15.78 ± 1.63	16.23 ± 0.42	13.09 ± 1.33	13.91 ± 0.68	2.8 ± 0.5	2.65 ± 0.25	41.33 ± 4.17	42.25 ± 2.25
75%C, 0%R	15.34 ± 0.66	15.16 ± 0.54	12.93 ± 1.23	12.52 ± 0.48	1.36 ± 0.61	2.85 ± 0.4	44.62 ± 2.89	40 ± 2.5
25%C, 25%R	14.82 ± 0.12	16.44 ± 1.11	12.59 ± 0.11	13.37 ± 0.83	2.84 ± 0.08	6.55 ± 4.29	40.15 ± 2.57	32.74 ± 8.84
50%C, 50%R	15.21 ± 0.51	14.68 ± 1.58	12.81 ± 0.58	12.25 ± 0.75	3.1 ± 0.53	4.32 ± 0.74	44.15 ± 1.48	28.28 ± 4.12
75%C, 75%R	15.4 ± 0.4	15.92 ± 0.86	12.92 ± 0.85	13.43 ± 0.72	3.08 ± 0.27	2.31 ± 0.03	43.44 ± 1.36	42.88 ± 1.13
0%C, 25%R	15.39 ± 0.15	15.87 ± 0.41	12.73 ± 0.2	12.83 ± 0.1	2.19 ± 0.14	10.63 ± 2.95	40.48 ± 2.18	36.79 ± 3.54
0%C, 50%R	15.51 ± 0.53	15.92 ± 0.65	13.27 ± 0.51	13.46 ± 0.47	2.93 ± 0.63	3.72 ± 0.11	43.18 ± 0.07	36.13 ± 3.25
0%C, 75%R	15.53 ± 0.31	15.53 ± 0.59	12.74 ± 0.33	12.78 ± 0.84	3.22 ± 0.46	8.15 ± 5.83	38.76 ± 2.84	39.29 ± 1.21
P-value	0.8845	0.9233	0.1583	0.0970				
R2	0.3526	0.3282	0.6000	0.6332				

**Table 2** Leaf chlorophyll and anthocyanin content.

Treatment	Leaf chlorophyll (CCI unit)				Leaf anthocyanin (ACI Unit)			
	DAT 36		DAT 49		DAT 36		DAT 49	
	10 days	Maturity	10 days	Maturity	10 days	Maturity	10 days	Maturity
0%C, 0%R	13.91 ± 0.41	0.41 ± 2.94	2.94 ± 0.24	0.24 ± 6.6	6.6 ± 1.89	1.89 ± 30.42	30.42 ± 3.61	3.61 ± 32.3
25%C, 0%R	24.18 ± 3.69	26.68 ± 3.96	28.59 ± 2.53	16.63 ± 4.63	6.87 ± 0.12	7.29 ± 0.06	8.06 ± 0.64	5.67 ± 1.55
50%C, 0%R	28.75 ± 1.8	30.7 ± 0.28	24.23 ± 4.1	23.77 ± 5.07	7.25 ± 0.52	7.54 ± 0.16	6.84 ± 0.28	6.93 ± 0.58
75%C, 0%R	34.66 ± 0.97	28.13 ± 1.49	18.4 ± 2.17	17.71 ± 5.03	7.53 ± 0.46	7.73 ± 0.35	7.28 ± 0.34	8.18 ± 2.8
25%C, 25%R	29.54 ± 0.01	27.06 ± 4.01	26.85 ± 2.72	25.63 ± 1.67	7.78 ± 0.13	7.1 ± 0.15	7.78 ± 0.61	8.23 ± 2.14
50%C, 50%R	37.63 ± 10.38	25.33 ± 3.25	17.18 ± 0.57	16.13 ± 2.27	7.58 ± 0.15	7.41 ± 0.19	6.83 ± 0.65	7.48 ± 0.24
75%C, 75%R	30.99 ± 3.36	26.33 ± 1.75	17.98 ± 14.07	18.77 ± 0.58	8.45 ± 0.53	7.25 ± 0.97	5.47 ± 2.93	6.28 ± 0.5
0%C, 25%R	30.33 ± 6.68	27.7 ± 1.1	13.41 ± 1.68	26.33 ± 1.04	7.57 ± 0.2	7.2 ± 0.35	6.58 ± 0.19	7.33 ± 0.43
0%C, 50%R	30.52 ± 1.28	30.86 ± 0.93	21.31 ± 3.92	19.33 ± 5.22	8.2 ± 0.4	7.33 ± 0.09	8.07 ± 0.37	5.82 ± 0.08
0%C, 75%R	26.69 ± 1.89	30.28 ± 2.74	8.43 ± 3.81	18.42 ± 4.32	7.62 ± 0.18	6.98 ± 0.66	6.29 ± 1.89	6.57 ± 0.55
P-value	0.6557	0.3262	0.4603	0.9501				
R2	0.4409	0.5383	0.4981	0.3058				

**Table 3** Root and shoot dry weight and shoot fresh weight.

Treatment	Shoot Fresh Weight (g/plant)		Shoot Dry Weight (g/plant)		Root Dry Weight (g/plant)	
	10 days	Maturity	10 days	Maturity	10 days	Maturity
0%C, 0%R	32.3 ± 2.88	2.88 ± 7.31	7.31 ± 0.36	0.36 ± 7.28	7.28 ± 0.43	0.43 ± 21.02
25%C, 0%R	3458.5 ± 5.5	1211 ± 49	342 ± 4	126 ± 12	63.5 ± 11.5	15 ± 5
50%C, 0%R	2894.5 ± 593.5	1911 ± 48	272.5 ± 43.5	195.5 ± 11.5	46 ± 14	21 ± 9
75%C, 0%R	2281 ± 658	2062 ± 40	216 ± 64	233.5 ± 7.5	29 ± 13	9.5 ± 0.5
25%C, 25%R	3018.5 ± 660.5	1812.5 ± 281.5	289.5 ± 59.5	220 ± 25	42.5 ± 16.5	39 ± 17
50%C, 50%R	2372.5 ± 7.5	1618 ± 115	229.5 ± 8.5	162 ± 9	41.5 ± 17.5	21 ± 1
75%C, 75%R	3116.5 ± 709.5	2921 ± 275	304.5 ± 70.5	298 ± 22	56 ± 22	57 ± 5
0%C, 25%R	1920 ± 230	1878.5 ± 341.5	200 ± 0	244 ± 64	41 ± 26	94.5 ± 30.5
0%C, 50%R	1691 ± 593	1219.5 ± 143.5	177.5 ± 67.5	139 ± 12	51 ± 25	22 ± 3
0%C, 75%R	1024 ± 200	1514.5 ± 1174.5	135.5 ± 4.5	146.5 ± 66.5	38 ± 7	75 ± 2
P-value	0.0258	0.7008	0.0249	0.6403	0.0862	0.6403
R2						

## CONCLUSIONS

Even though our results indicated an increase in fruit sugar content, more research is necessary to develop an alternative practice for increasing cantaloupe sweetness in aquaponics without compromising total yield.

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