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Impact of plant spacing and density on yield and quality of newly local developed Cantaloupe F_1 hybrids

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Abstract

Five newly developed local cantaloupe hybrids (Yathreb 7, 8, 22, 73 and 100) (*Cucumis melo* var. *cantaloupensis*), were evaluated at two plant spacing (30 and 50 cm between plants) and two plant densities (1 and 2 plants / hill) using split-split plot design in early summer seasons of 2009 and 2010. This experiment was carried out in the open field using a drip-irrigation system at Private farm in Sadat city. Date were recorded on leaf area index (LAI), flowering, yield components, fruit quality and chemical determinations. Results show that Hybrid Yathreb 8 had the highest LAI, average fruit weight (AFW), flesh thickness and fruit shape index (FSI). Hybrid Yathreb 22 was earlier in flowering and yielding ability than all other tested hybrids. Hybrid Yathreb 7 produced the highest total yield (TY) and marketable yield (MY). Hybrids Yathreb 7 and Yathreb 22 had the lowest seed cavity diameter. Hybrid Yathreb 73 had the highest total soluble solids (TSS). Hybrid Yathreb 100 had the greatest leaf dry matter (LDM) percentage, total and reduced sugars content. Meanwhile, the five local cantaloupe hybrids were not significantly different in the percentage of netting and flesh dry matter content (FDM). Moreover, the plant spacing 50 cm had the highest LAI, early yield (EY), TY, MY, TSS, percentage of LDM, percentage of FDM, total and reduced sugars content. Meanwhile, the two plant spacing 30 and 50 cm were not significantly different in flowering, AFW, seed cavity diameter, flesh thickness, FSI and netting percentage. Also, one plant per hill gave higher values than 2 plants / hill in LAI, the first season of flowering, EY, TY, MY, AFW, seed cavity diameter, flesh thickness, total and reduced sugars content. Meanwhile, the number of plants / hill was not effective in the second season for flowering, FSI, netting percentage, TSS, percentage of LDM and FDM.

The interaction between the three tested factors indicated that hybrids Yathreb 8, Yathreb 22, Yathreb 100 and Yathreb 7 grown at 50 cm apart along with one plant / hill gave the highest LAI, EY, percentage of LDM, TY and MY, respectively. Meanwhile, the all treatments were not significantly different in flowering, AFW, seed cavity diameter, flesh thickness, FSI, netting percentage, TSS, percentage of FDM, total and reduced sugars content.

Key words: *Cucumis melo* var. *cantaloupensis*, Cantaloupe, Hybrids, Plant spacing, Number of plants / hill, leaf area index, Flowering,Yield components, Fruit quality, Chemical determinations.

Introduction

Cantaloupe is one of the most important crops for export in Egypt. Cantaloupe with its refreshing rich flavor and odor and low number of calories, is the most popular form of melons. Cantaloupe is also referred to as a netted melon because it has a ribless rind with a distinctive netted skin (Refai *et al*, 2008). Besides, Badr and Abou Hussein (2008) reported that Cantaloupe (*Cucumis melo* L.) has become one of the popular fruits that are often cultivated with drip irrigation in arid or semiarid regions such as Egypt.

According to García *et al*. (2006) the variability of melon hybrids resulted in the effect on yield, average fruit weight and fruit quality. Also, they reported that the distance between melon plants had an effect on the yield and they found that all cultivars showed the highest yield by planting at40 cm.

The plant density was one of the most effective factors in melon planting and it is responsible of the productivity of melon cultivars (Davis and Meinert, 1965; Maynard and Scott, 1998). Under field conditions, muskmelon yields could be improved by increasing plant density (Maynard and Scott, 1998; Nerson, 2002). Wherever, Mohamed and Mohamed (1987) used cv. Mullah Ahmed which was sown on three plant densities (30, 40 and 50 cm between plants). They found that the highest total yield in both years was obtained by planting at 40 cm apart along. Although higher plant populations may result in increased marketable yield per unit area (Paris *et al*., 1985), the number of fruits per plant and fruit size are often reduced (Kultur *et al*., 2001). Also, Brandenberger and Wiedenfeld (1997) indicated that different plant spacing in honeydew cultivars can result in differences in fruit size, earliness, and returns/acre over different seasons and environments although spacing and cultivar acted independent of one another. Lower plant populations resulted in the production of larger fruit and higher plant populations resulted in the production of smaller fruit. On contrast, in field experiments conducted in north–central Florida, planting densities of 1.0, 2.0, and 3.0 plants / m^2 of Galia-type muskmelons did not affect fruit yield (Paris *et al*., 1988), but Mozo (1999) reported that the reduction of the distance between melon plants resulted in the reduction of melon yield.

According to Paris *et al*. (1988) Galia-type muskmelons planted in the field at plant densities of 1.0 and 2.0 plants/m^2 resulted in yields of 1.8 and 2.1 fruit/m^2, respectively. Total fruits weight at both plant densities was ≈ 2.3 kg.m^{-2}. Although more fruit per unit area were produced at the higher density, mean fruits weight per plant was less. Nerson *et al*. (1984) reported 20% greater yields of field produced Galia muskmelon at 3.1 plants/m^2 than at 1.4 plants/m^2; however, mean fruit weights were similar. The European market desires a Galia fruit size around 1.0 kg; therefore, higher densities may result in more desirable yields for certain markets (Ban *et al*., 2006). Galia muskmelon yields greater than 4.5 kg_m^{-2} were produced under field conditions in north–central Florida (Hochmuth *et al*., 1998). A muskmelon yield of 9.4 kg. m^{-2} was reported when plants were grown in walk-in tunnels using perlite soilless culture (Waldo *et al*., 1997).

According to Refai *et al*. (2008) there were no significant differences between the cantaloupe hybrids in the flowering trait. Also,
Rodriguez *et al*. (2007) indicated that Plant density in Galia type muskmelon cv. Gal-152 had no influence on the early or total number of fruits produced per plant. Marketable yields increased linearly from 11.0 to 20.0 kg.m^{-2} in fall and from 21.9 to 48.3 kg.m^{-2} in spring with increasing plant density. Mean fruit size was unaffected by plant density during fall (mean weight, 1.0 kg), but was reduced linearly during spring from 1.8 kg at 1.7 plants/m^2 to 1.5 kg at 4.1 plants/m^2.

Soluble solids content (SSC) of muskmelon plants grown at higher densities has been reported to decrease as plant density increased from 2.0 to 8.0 plants/m^2 (Mendlinger, 1994), whereas others reported no difference in SSC from fruits grown at 3.6 and 7.3 plants/m^2 (Kultur *et al*., 2001). Also, Rodriguez *et al*. (2007) reported that Soluble solids content in Gal-152 was unaffected by plant density in either fall or spring planting and averaged 10.1% in both seasons.

Number of leaves per plant in Gal-152 was unaffected by plant density, but internode length was increased at 4.1 plants/m^2 compared with plants from the other densities (Rodriguez *et al*., 2007).

The objective of this research work was to detect the suitable plant density (plant spacing and the number of plants / hill) for each of five local cantaloupe hybrid in order to obtain high vegetative growth, yield and fruit quality of cantaloupe produced under open field conditions.

Materials and methods

This study was carried out at Private farm in Sadat city, Menofia Governorate during the early summer seasons of 2009 and 2010 in the open field using a drip-irrigation system and polyethylene plastic mulch. Five local melon hybrids (*Cucumis melo* var. *cantaloupensis*), Yathreb 7, 8, 22, 73 and 100, were used in this investigation. These hybrids were developed and introduced by the first two authors of the present study and registrant since October 2008.

The treatments were arranged in split-split plot design with 4 replicates. Each experimental plot (EP) consisted of 1 bed, 1.5 m wide and 10 m long (EP= 15 m^2). Each replicate consisted of 5 local cantaloupe hybrids as main plot, while two plant spacing (30 and 50 cm apart along each of the two kinds of drip-irrigation tubes) as sub-plot factor and number of plants / hill (1 and 2 plants/ hill) as sub-sub-plot factor.

Seeds of these local cantaloupe hybrids were sown on 20 February, 2009 and 2010 in foam trays under greenhouse and transplanted on March 15, 2009 and 2010 in the open field. The seedlings of each of them were transplanted at 30cm apart along the two drip-irrigation tubes of each replicate (30 cm between the drippers) and 50cm apart along the other two drip-irrigation tube of each replicate (50 cm between the drippers) according to treatment. Also, the seedlings of each 5 local cantaloupe hybrids for each plant spacing were planted 1 seedling / hill and 2 seedlings / hill according to treatment apart along each of drip-irrigation tube. Plants were given common agricultural practices.

The measured traits of all treatments were as follow:-
1. Leaf area index (LAI) : The leaf area of each plant was determined after maturity of fruits by the area meter (LI-COR, model: LI 3050A/4,U.S.A) measured as an average of 3 randomly chosen plants per EP and the LAI was calculated by average leaf area, then dividing by the ground area occupied by the plant.
2. Flowering : Three plants were randomly chosen per EP to determine the number of days from transplanting to appearance of the first andromonocious flower on the plant.
3. Yield: Early yield (EY) was measured as the yield of the first 3 pickings, total yield (TY) was measured as the weight of all fruits harvested at the yellow-netted ripe stage from each EP. Marketable yield (MY) as determined after excluding cracked, rotten and infected fruits with diseases and pests.
4. Fruit quality: average fruit weight (AFW), seed cavity diameter and flesh thickness were determined as the mean of 15 fruits randomly chosen from each EP, fruit shape index (FSI) calculated as the ratio of fruit length to fruit diameter. Each EP was represented by 15 fruits. Fruits with a FSI less than 0.88 were classified as oblate, those with a FSI

ranging from 0.88 to 1.1 were considered round, those with a FSI ranging from 1.1 to 1.5 were classified as cylindrical and those with a FSI above 1.5 were classified as oblong (Rashidi and Seyfi 2007). The netting percentage was measured as a ratio of the netting covered fruit rind to full fruit rind as visual method and determined as the mean of 15 fruits randomly chosen from each EP. Total soluble solids (TSS) was determined in 15 yellow-ripe fruits of each EP using a hand refractometer.

5. Chemical determinations : 100 gram fresh leaves and fruit flesh from each EP were dried at 65 °C for 48 and 72 hours, respectively, in the oven, then the dry matter was weighted by sensitive balance to determine the leaves (LDM) and flesh dry matter (FDM) percentage as a ratio of dry matter weight to total fresh weight. Also, 0.1 gram ground FDM for each EP was used to estimate the total sugars and reduced sugars using spectrophotometer with wave length 490 nm according to Dubois *et al*. (1956).

Obtained data were statistically analyzed and mean comparisons were based on the LSD test according to Gomez and Gomez (1984). Also, the Bartlett's test (using Chi-square test) of the three variance of errors for both years (2009 and 2010) were homogeneous for all traits except flowering and FSI. So, the combined analysis of variance for the two years was computed for all traits except the two previous traits according to Koch and Sen (1968).

Results and discussion

1. Leaf Area Index

Obtained data on LAI in the early summer seasons of 2009 and 2010 were combined in Table 1. Data show that hybrid Yathreb 73 had the least LAI, but it was not significantly different from hybrid Yathreb 22, other hybrids were similar in this concern. Also, the plant spacing 50 cm had the highest LAI and was significantly different from the plant spacing 30 cm. One plant per hill had the highest LAI and was significantly different from two plants per hill. These results disagree with Rodriguez *et al* (2007) who reported that the number of leaves per plant in Gal-152 was unaffected by plant density. This contradiction in results can be explained depending on the dissimilarity of genotypes in vegetative growth vigor.

The interaction between hybrids, plant spacing and the number of plants per hill indicate that Yathreb 8 was grown at 50 cm apart along with one plant / hill gave the highest LAI and was significantly different from all other treatments. Yathreb 7 when grown at 50 cm apart along with one plant / hill ranked the second in the LAI and without significant difference from treatment Yathreb 100 which was grown at 50 cm apart along with one plant / hill.

2. Flowering

Obtained data on Flowering in early summer seasons of 2009 and 2010 are presented in Table 1. In the two seasons, hybrid Yathreb 22 was significantly earlier in flowering than all other hybrids. In the meantime, hybrid Yathreb 73 was significantly the latest in flowering compared with the other tested hybrids. Concerning plant density, there were no significant differences between the two plant spacing. However, in 2009 early summer season, two plants per hill was significantly earlier in flowering than one plant per hill. While in the 2010 early summer season, there were no significant differences in earliness. These results disagree in part with Refai *et al* (2008) who indicated that there were no significant differences between the cantaloupe hybrids in the flowering trait.

In the two seasons, the interaction between hybrids and plant density indicate that there were no significant differences between the treatments in this trait. This result disagrees with Brandenberger and Wiedenfeld (1997) who indicated that different plant spacing and honeydew cultivars resulted in differences in earliness. This contradiction in results could be due to the different germplasm used.

3. Yield and its Components

Obtained data in Table 2 indicate that Hybrid Yathreb 22 produced the highest early yield and was significantly different from all other hybrids. Hybrid Yathreb 7 was the second in early yield and was also significantly different from other hybrids. Hybrid Yathreb 7 followed by hybrid Yathereb 8 produced the highest TY and were significantly different from all other hybrids. Hybrid Yathreb 7 and 8 produced the highest MY and without significant difference between them. The hybrid Yathreb 100 was the second in MY and was significantly different from other tested hybrids. These results are in agreement with García *et al*. (2006) who reported that the variability of melon hybrids resulted in the effect on yield. Also, Hochmuth *et al*. (1998) found that Galia muskmelon yields produced under field conditions in north–central Florida were greater than 4.5 kg_m^{-2}. This concordance in results could be due to all the genotypes in these studies followed the Galia muskmelon. The plant spacing 50 cm had the highest EY, TY and MY and was significantly different from the narrow plant spacing. One plant per hill had the highest EY, TY and MY and was significantly different from two plants per hill. These results disagree with Nerson et al. (1984) who reported that 20% greater yields of field produced Galia muskmelon at 3.1 plants/m2 than at 1.4 plants/m2.

On the other hand, Mozo (1999) reported that the reduction of the distance between melon plants resulted in the reduction of melon yield. Also, The plant density was the most effective factor in melon planting and it is responsible effect on the productivity of melon cultivars (Davis and Meinert,1965; Maynard and Scott, 1998).García *et al*. (2006) reported that the distance between melon plants affected the yield. Meanwhile, Mohamed and Mohamed (1987) reported that the highest total yield in both years was obtained by planting at 40 cm spacing. But Paris *et al*. (1988) found that the plant densities of 1.0, 2.0, and 3.0 plants / m^2 of Galia-type muskmelons did not affect fruit yield. Nerson (2002) reported that under field conditions, muskmelon yields may be improved by increasing plant density. Similarly, Rodriguez *et al*. (2007) indicated that Marketable yields was increased linearly from 11.0 to 20.0 $kg.m^{-2}$ in fall and from 21.9 to 48.3 $kg.m^{-2}$ in spring with increasing plant density. This contradiction in results can be explained depending on the dissimilarity of genotypes and the environmental conditions.

The interaction between hybrids, plant spacing and number of plants per hill indicate that the treatment Yathreb 22 which was grown at low plant density gave the highest EY and was significantly different from all other treatments. Hybrid Yathreb 7 with the same plant density was the second in EY and was also significantly different from other treatments. While the treatment Yathreb 7 was grown at low density gave the highest TY and MY.

Table 1. Leaf Area Index I in the combined 2009 and 2010 years and flowering of each year independently at early summer seasons for local cantaloupe hybrids grown at different plant densities and the interaction between them.

Treatment			LAI	Flowering (day)	
				2009	2010
		Genotype			
Yathreb 7			1.01	45.88	45.50
Yathreb 8			1.10	51.38	53.00
Yathreb 22			0.92	41.56	41.50
Yathreb 73			0.70	53.88	55.19
Yathreb 100			1.02	45.31	45.94
$LSD_{0.05}$			0.20	1.27	1.34
		Plant spacing			
50			1.09	47.85	48.45
30			0.83	47.35	48.00
$LSD_{0.05}$			0.08	NS	NS
		No. of plants / hill			
1			1.34	48.45	48.60
2			0.57	46.75	47.85
$LSD_{0.05}$			0.07	0.71	NS
		The interaction			
Hybrid	Spacing	No. of plants / hole			
Yathreb 7	50	1	1.60	47.50	46.25
		2	0.80	45.50	47.25
	30	1	1.17	46.50	45.00
		2	0.47	44.00	43.50
Yathreb 8	50	1	1.91	51.75	53.50
		2	0.55	51.25	52.25
	30	1	1.37	51.00	53.50
		2	0.55	51.50	52.75
Yathreb 22	50	1	1.40	41.50	40.50
		2	0.69	40.50	41.25
	30	1	1.12	42.75	42.50
		2	0.47	41.50	41.75
Yathreb 73	50	1	1.10	55.50	56.00
		2	0.54	53.25	55.00
	30	1	1.00	56.00	56.00
		2	0.36	50.75	53.75
Yathreb 100	50	1	1.49	46.50	46.50
		2	0.82	45.25	46.00
	30	1	1.27	45.50	46.25
		2	0.47	44.00	45.00
$LSD_{0.05}$			0.16	NS	NS

Table 2. Early, Total and Marketable yield of local cantaloupe hybrids grown at different plant densities and the interaction between them in early summer seasons of combined analysis 2009 and 2010 years.

Treatment			Early yield (ton / feddan)	Total yield (ton / feddan)	Marketable yield (ton / feddan)
Genotype					
Yathreb 7			2.18	12.36	11.27
Yathreb 8			0.39	11.33	10.81
Yathreb 22			2.56	9.93	8.91
Yathreb 73			0.08	8.59	8.21
Yathreb 100			1.74	10.55	9.87
LSD $_{0.05}$			0.11	0.41	0.60
Plant spacing					
50			1.68	12.21	11.40
30			1.10	8.90	8.23
LSD $_{0.05}$			0.06	0.20	0.28
No. of plants / hill					
1			1.76	12.65	11.85
2			1.02	8.46	7.77
LSD $_{0.05}$			0.07	0.19	0.30
The interaction					
Hybrid	Spacing	No. of plants / hole			
Yathreb 7	50	1	3.24	17.43	15.94
		2	2.24	11.58	10.60
	30	1	2.28	12.53	10.16
		2	0.98	7.91	7.01
Yathreb 8	50	1	0.63	14.95	14.41
		2	0.34	10.93	10.36
	30	1	0.39	11.65	11.15
		2	0.18	7.81	7.31
Yathreb 22	50	1	3.79	14.09	12.85
		2	2.22	9.00	7.96
	30	1	2.67	10.16	9.18
		2	1.52	6.48	5.64
Yathreb 73	50	1	0.18	11.03	10.60
		2	0.06	8.43	7.98
	30	1	0.07	9.19	8.83
		2	0.01	5.74	5.43
Yathreb 100	50	1	2.39	15.15	14.46
		2	1.69	9.49	8.84
	30	1	1.94	10.31	9.58
		2	0.93	7.25	6.60
LSD $_{0.05}$			0.21	0.61	0.95

It was significantly different from all other treatments. The treatment Yathreb 100 which was grown at low density ranked second in TY and MY. It was not significantly different from the treatment Yathreb 8 which was grown at the same plant density. These results are in agreement with Brandenberger and Wiedenfeld (1997) who indicate that different plant spacing and honeydew cultivars can result in differences in yield earliness. This concordance in results could be due to the competition between plants increases in high plant density, but it decreases in low plant density. So, the early yield increases in low plant density because the competition between plants belongs low and vice versa.

4. Fruit quality

Obtained data on fruit quality traits in early summer seasons of 2009 and 2010 were combined in Tables 3 and 4 except FSI presented each year independently in Table 4.

Plants of Hybrid Yathreb 8 produced the heaviest fruits in AFW and was significantly different from all other hybrids. Whereas hybrid Yathreb 22 ranked second in AFW and was not significantly different from Yathreb 100 and Yathreb 7. Meanwhile Yathreb 73 ranked last in this respect.These results are in agreement with those of Brandenberger and

Wiedenfeld (1997) and García *et al*. (2006) who reported that the variability of melon hybrids resulted in the effect on average fruit weight and fruit quality. This concordance in results due to each genotype has different AFW according to its genome.

With regard to seed cavity diameter, hybrid Yathreb 7 had the lowest seed cavity diameter and was not significantly different from Yathreb 22. Hybrid Yathreb 100 ranked second in seed cavity diameter and was not significantly different from Yathreb 73.

Concerning flesh thickness, hybrid Yathreb 8 gave the highest flesh thickness and was not significant different from Yathreb 100 and Yathreb 22. Hybrid Yathreb 7 ranked second in flesh thickness and was not significantly different from Yathreb 22 and Yathreb 100.

There were no significant differences between the two plant spacing 30 and 50 cm in AFW, seed cavity diameter and flesh thickness. These results coincided with those of Nerson *et al*. (1984) as they found that the mean fruit weights of Galia muskmelon were similar at 3.1 plants/m^2 and at 1.4 plants/m^2 .

Table 3. Average fruit weight, seed cavity diameter and flesh thickness of local cantaloupe hybrids grown at different plant densities and the interaction between them in early summer seasons of combined 2009 and 2010 years.

Treatment			AFW (gram)	Seed cavity diameter (cm)	Flesh thickness (cm)
Genotype					
Yathreb 7			596.67	3.88	3.15
Yathreb 8			824.95	4.29	3.43
Yathreb 22			617.77	3.88	3.28
Yathreb 73			463.34	4.10	2.94
Yathreb 100			609.48	4.10	3.29
LSD $_{0.05}$			63.03	0.19	0.16
Plant spacing					
50			634.59	4.10	3.24
30			610.29	4.03	3.19
LSD $_{0.05}$			NS	NS	NS
No. of plants / hill					
1			662.65	4.16	3.32
2			582.23	3.97	3.11
LSD $_{0.05}$			38.80	0.10	0.10
The interaction					
Hybrid	Spacing	No. of plants / hole			
Yathreb 7	50	1	632.45	3.95	3.24
		2	577.12	3.88	3.15
	30	1	649.78	3.99	3.33
		2	527.32	3.73	2.90
Yathreb 8	50	1	845.76	4.49	3.44
		2	719.00	4.19	3.18
	30	1	896.88	4.38	3.70
		2	838.12	4.40	3.40
Yathreb 22	50	1	696.22	3.93	3.28
		2	596.20	3.90	3.28
	30	1	637.11	3.99	3.44
		2	541.33	3.72	3.13
Yathreb 73	50	1	518.42	4.24	3.00
		2	490.00	4.04	2.40
	30	1	444.87	4.15	3.10
		2	400.00	3.99	2.90
Yathreb 100	50	1	678.89	4.35	3.33
		2	591.46	4.08	3.29
	30	1	626.00	4.15	3.39
		2	541.47	3.83	3.15
LSD $_{0.05}$			NS	NS	NS

However, Rodriguez *et al*. (2007) indicated that mean fruit size in Gal-152 was unaffected by plant density during fall, but was reduced linearly during spring planting. Meanwhile, these results disagree with those of Brandenberger and Wiedenfeld (1997) who indicated that different plant spacing can result in differences in fruits size where lower plant populations resulted in the production of larger fruit and higher plant populations resulted in the production of smaller fruit. Also, Paris *et al*. (1988) indicated that although more muskmelon fruit per unit area were produced at the higher density; mean fruit weight per plant was less.

One plant per hill gave the highest values of AFW, seed cavity diameter and flesh thickness. It was significantly different from two plants per hill in the previous three traits. These results are in agreement with Kultur *et al*. (2001) who indicated that the higher plant populations may reduce the fruit size. This concordance in results due to the AFW increases in low plant density because the competition between plants belongs low and vice versa.

Table 4. Fruit shape index of each year independently, netting percentage and TSS in the combined 2009 and 2010 years at early summer seasons of local cantaloupe hybrids grown at different plant densities and the interaction between them.

Treatment			FSI		Netting (%)	TSS (%)
			2009	2010		
Genotype						
Yathreb 7			0.99	1.00	98.44	10.97
Yathreb 8			1.09	1.06	97.82	11.65
Yathreb 22			1.02	1.01	98.44	11.57
Yathreb 73			0.99	0.85	98.44	12.06
Yathreb 100			0.95	0.96	98.44	11.75
LSD $_{0.05}$			0.04	0.09	NS	0.63
Plant spacing						
50			1.00	0.98	98.38	11.94
30			1.01	0.98	98.25	11.26
LSD $_{0.05}$			NS	NS	NS	0.39
No. of plants / hill						
1			1.02	0.96	99.25	11.73
2			1.00	0.99	97.38	11.47
LSD $_{0.05}$			NS	NS	NS	NS
The interaction						
Hybrid	Spacing	No. of plants / hole				
Yathreb 7	50	1	0.98	0.98	100.00	11.05
		2	0.99	0.98	100.00	11.01
	30	1	1.01	1.03	97.50	11.10
		2	1.00	1.03	96.25	10.73
Yathreb 8	50	1	1.11	1.05	100.00	11.83
		2	1.09	1.02	93.75	12.45
	30	1	1.10	1.05	97.50	11.19
		2	1.07	1.11	100.00	11.13
Yathreb 22	50	1	1.02	0.98	100.00	12.35
		2	1.00	0.99	93.75	11.15
	30	1	1.02	1.06	100.00	11.73
		2	1.05	1.02	100.00	11.04
Yathreb 73	50	1	1.02	0.90	100.00	12.11
		2	0.94	0.95	96.25	12.34
	30	1	1.00	0.66	97.50	11.84
		2	1.00	0.90	100.00	11.96
Yathreb 100	50	1	0.95	0.97	100.00	12.75
		2	0.95	0.95	100.00	12.33
	30	1	0.95	0.97	100.00	11.34
		2	0.96	0.97	93.75	10.59
LSD $_{0.05}$			NS	NS	NS	NS

The interaction between hybrids, plant spacing and the number of plants per hill indicated that there were no significant differences between the treatments in AFW, seed cavity diameter and flesh thickness.

Concerning fruit shape index, hybrid Yathreb 8 had the highest FSI value in the two seasons. It was significantly different from all other hybrids in the first season, but it was not significantly different from hybrids Yathreb 22 and Yathreb 7 in the second season. In the first season, the hybrid Yathreb 100 had the least FSI value and was not significantly different from Yathreb 73. Meanwhile, the hybrid 73 had the least FSI value and was significantly different from all other hybrids.

There were no significant differences between plant densities for FSI in both seasons.

In the two seasons, the interaction between hybrids, plant spacing and the number of plants per hill indicated that there were no significant differences between the treatments in FSI.

Also, there were no significant differences between each hybrids, the two plant spacing, the two numbers of plants per hill and the interaction between them in netting percentage. These results are in agreement with Refai *et al*. (2008) who reported that cantaloupe is also referred to as a netted melon because it has a ribless rind with a distinctive netted skin.

Concerning TSS, data in Table 4 indicate that the significant differences between hybrids were very low and hybrid Yathreb 73 gave the highest TSS, but hybrid Yathreb 7 produced the least TSS.

The plant spacing 50cm had the highest TSS and was significantly different from the plant spacing 30 cm. These results are in agreement with Mendlinger (1994) who reported that soluble solids content (SSC) of muskmelon grown at higher densities has been reported to decrease as plant density increased from 2.0 to 8.0 plants/m^2. This coincided between these results may be due to the high competition between plants reduces the TSS in high plant densities and vice versa. Meanwhile, these results disagree with Kultur *et al*. (2001) who reported that no difference in SSC between fruits grown at 3.6 and 7.3 plants/m^2. Also, Rodriguez *et al*. (2007) reported that Soluble solids content in Gal-152 was unaffected by plant density in either fall or spring and averaged 10.1% in both seasons. These contradictions of results could be due to the distinction of environmental conditions especially prevailing temperatures, whereas it has large effects on AFW, TSS and all fruit quality.

There were no significant differences between one or two plant per hill in TSS. Also, the interaction between hybrids and plant densities indicated that there were no significant differences between the treatments in TSS.

5. Chemical determinations

Obtained data on chemical determinations in early summer seasons of 2009 and 2010 are combined in Table 5.

The significant differences between hybrids were low in LDM and hybrid Yathreb 100 produced the highest LDM percentage, but hybrid Yathreb 8 gave the least LDM percentage. On the other hand, plant spacing at 50cm had the highest LDM percentage and was significantly different from plant spacing of 30 cm. Meanwhile, there were no significant differences between one or two plant per hill and two plant per hill in LDM percentage.

The interaction between hybrids, plant spacing and the number of plants per hill indicated that the treatment Yathreb 100 grown at 50 cm apart along with one plant / hill produced the highest LDM percentage and was significantly different from all other treatments. Meanwhile, the least LDM percentage was detected in treatment Yathreb 8 grown at the highest plant density,i.e.2 plants per hill and 30 cm between plants.

There were no significant differences between all tested hybrids grown at different plant densities in the percentage of FDM.

Regarding total and reducing sugars content data in Table 5 show that hybrid Yathreb 100 produced the highest values of total and reduced sugars content and was significantly different from all other hybrids. Wide spacing had the highest values of total and reduced sugars content and was significantly different from narrow spacing. Besides, low plant density had higher values of total and reduced sugars content and was significantly different from that of higher plant density. Meanwhile, the interaction between hybrids and plant densities indicated that there were no significant differences between these treatments in total and reduced sugars content.

In conclusion, the interaction between hybrids, plant spacing and number of plants per hill indicated that hybrids Yathreb 8, Yathreb 22, Yathreb 100 and Yathreb 7 grown at wide spacing and low plant density gave the highest LAI, EY, percentage of LDM, TY and MY, respectively. Meanwhile, there were no significant differences between the above mentioned treatments in earliness, AFW, seed cavity diameter, flesh thickness, FSI, netting percentage, TSS, percentage of FDM, total and reduced sugars content .

Table 5. Percentage of LDM, FDM, total and reduced sugars content of local cantaloupe hybrids grown at different plant densities and the interaction between them in early summer seasons of combined 2009 and 2010 years.

Treatment			LDM (%)	FDM (%)	Total sugars content (%)	Reduced sugars content (%)
Genotype						
Yathreb 7			25.36	10.38	19.50	12.15
Yathreb 8			23.11	10.75	21.32	14.46
Yathreb 22			24.48	10.58	27.28	17.33
Yathreb 73			27.56	11.49	28.24	17.73
Yathreb 100			28.33	10.74	31.84	20.03
LSD $_{0.05}$			4.85	NS	2.43	1.62
Plant spacing						
50			26.87	10.93	32.10	21.29
30			24.67	10.64	19.17	11.39
LSD $_{0.05}$			1.58	NS	1.15	0.77
No. of plants / hill						
1			25.87	11.10	32.69	21.67
2			25.68	10.48	18.57	11.01
LSD $_{0.05}$			NS	NS	1.11	0.71
The interaction						
Hybrid	Spacing	No. of plants / hole				
Yathreb 7	50	1	24.49	10.33	33.00	21.85
		2	25.83	9.84	16.58	10.06
	30	1	26.71	10.54	19.01	11.04
		2	26.58	10.81	9.39	5.67
Yathreb 8	50	1	22.75	11.39	34.88	23.88
		2	27.06	10.76	19.11	13.46
	30	1	21.64	10.95	20.57	13.82
		2	21.00 i	9.92	10.72	6.69
Yathreb 22	50	1	26.44	11.55	41.07	28.93
		2	22.21	10.00	25.12	15.02
	30	1	23.61	10.26	26.91	16.29
		2	25.67	10.53	16.00	9.08
Yathreb 73	50	1	29.39	11.88	46.85	32.13
		2	29.51	11.42	25.31	15.35
	30	1	26.71	11.42	25.84	15.61
		2	24.64	11.24	14.95	7.84
Yathreb 100	50	1	32.98	11.72	48.41	34.84
		2	28.02	10.47	30.62	17.38
	30	1	26.10	10.98	30.39	18.36
		2	26.22	9.80	16.44	9.52
LSD $_{0.05}$			3.03	NS	NS	NS

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اثر مسافة وكثافة الزراعة على محصول وجودة بعض هجن الكنتالوب المحلية الستنبطة حديثاً

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زُرعت خمسة هجن محلية مستنبطة حديثاً كنتالوب (*Cucumis melo* var. *cantaloupensis*) هم يثرب 7 ،و 8 ،و 22 ،و 73 ،و 100 وهى على مسافتين زراعة 30 ،و 50 سم بين الشتلات مع استخدام كثافتين من النباتات (شتلة واحدة لكل جورة ،و شتلتين لكل جورة) فى تصميم قطع منشقة مرتين حيث وضعت الهجن فى القطع الرئيسية ،و المسافة بين الشتلات فى القطع المنشقة مرة واحدة ،و كثافة النباتات لكل جورة فى القطع تحت المنشقة مرتين وذلك اثناء العروتين الصيفيتين المبكرتين لموسمي 2009 و 2010 . حيث اجريت هذه التجربة فى الحقل المكشوف مستخدماً نظام الرى بالتنقيط في مزرعة خاصة في مدينة السادات محافظة المنوفية وذلك لدراسة تأثير العوامل سالفة الذكر على معامل مساحة الورقة ،عدد الايام حتى خروج اول زهرة ،و المحصول ،و جودة الثمار ،و بعض المكونات الكيماوية.

اظهرت النتائج أنه أعطى الهجين يثرب 8 أعلى معامل مساحة ورقية ،و متوسط وزن الثمرة ،و سمك لحم ،و معامل شكل الثمرة. كما كان الهجين يثرب 22 مبكراً فى التزهير والمحصول عن كل الهجن المختبرة الأخرى. وأنتج الهجين يثرب 7 أعلى محصول كلى وقابل للتسويق. ايضاً أعطى الهجينان يثرب 7 ،و يثرب 22 أقل قطر فجوة بذور. إما الهجين يثرب 73 فقد حصل على أعلى نسبة مواد صلبة ذائبة كلية. وكان الهجين يثرب 100 الأعلى فى محتوى الأوراق من المادة الجافة ،و محتوى الثمار من السكريات الكلية والمختزلة. بينما الخمسة هجن لم تكن بينها فروق معنوية فى النسبة المئوية لشبكية قشرة الثمار وايضاً محتوى اللحم من المادة الجافة.

وُجد ان التباعد بين النباتات بمسافة 50 سم أعطى أعلى معامل مساحة ورقية ،و محصول مبكر ،و محصول كلى وقابل للتسويق ،و نسبة مواد صلبة ذائبة كلية ،و محتوى أوراق ولحم من المادة الجافة ،و محتوى ثمار من السكريات الكلية والمختزلة. بينما التباعد بين النباتات بمسافة 30 سم لم يختلف معنوياً عن التباعد بين النباتات بمسافة 50 سم فى التبكير فى التزهير ،و متوسط وزن الثمرة ،و قطر فجوة البذور ،و سمك اللحم ،و معامل شكل الثمرة ،و نسبة شبكية الثمار.

وُجد ان زراعة شتلة واحدة لكل جورة أعطى قيم أعلى من زراعة شتلتين لكل جورة فى معامل مساحة الورقة ،و التبكير فى التزهير للموسم الأول ،و المحصول المبكر والكلى والقابل للتسويق ،و متوسط وزن الثمرة ،و قطر فجوة البذور ،و سمك اللحم ،و محتوى الثمار من السكريات الكلية والمختزلة. بينما لم يوجد لهما أى تأثير على التبكير فى التزهير للموسم الثانى ،و معامل شكل الثمرة ،و نسبة شبكية الثمار ،و نسبة المواد الصلبة الذائبة الكلية ،و محتوى أوراق ولحم من المادة الجافة.

ومن نتائج التفاعل الثلاثة تحمل الدراسة ان هجن يثرب 8 ،و يثرب 22 ،و يثرب 100 ،و يثرب 7 المزروعة على 50 سم بين الشتلات مع استخدام شتلة واحدة لكل جورة أعطت أعلى معامل مساحة ورقية ،و محصول مبكر ،و محتوى الأوراق من المادة الجافة ،و المحصول الكلى والقابل للتسويق، على التوالى. بينما لم يوجد أى إختلافات معنوية بين كل المعاملات فى التبكير فى التزهير ،و متوسط وزن الثمرة ،و قطر فجوة البذور ،و سمك اللحم ،و معامل شكل الثمرة ،و نسبة شبكية الثمار ،و نسبة المواد الصلبة الذائبة الكلية ،و محتوى اللحم من المادة الجافة ،و محتوى الثمار من السكريات الكلية والمختزلة.