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GROWTH, YIELD AND FRUIT QUALITY OF MUSKMELON AS AFFECTED BY TRANSPLANT TRAY CELL SIZE AND PLANT DENSITY

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ABSTRACT

This investigation was carried out during two successive summer seasons of 2014 and 2015, at Vegetable Private Farm at Fakous District, Sharkia Governorate, under sandy soil conditions with drip irrigation system (GR dripper at 30 cm space). It aims to study the effect of transplant tray cell size and plant spacings within-row in open filed on growth, yield and fruit quality of Hanny F_1 hybrid muskmelon. The obtained results showed that both root and stem length, stem diameter and number of leaves/transplant, fresh and dry weight of root, shoots and total weight/transplant at transplanting (25 days after seed sowing) were significantly increased when transplants were produced in trays with larger cell size (40 cm^3) in both seasons. While using smaller cell size (28 cm^3) gave lower values of transplant vegetative growth and fresh and dry weight in both seasons. Planting muskmelon transplants at 60 cm on one side of the dripper line increased plant length, number of leaves/ plant, root length, number of fruits/plant and yield/plant when transplants were produced in trays with bigger cell size (40 cm^3). Planting at 45 cm on two sides of the dripper line increased number of main branches/plant and average fruit weight when transplants produced in trays with bigger cell size (40 cm^3), whereas planting at 45 cm on one side of the dripper line increased number of secondary branches/ plant, dry weight of roots, shoots and total dry weight/plant when transplants were produced in trays with bigger cell size (40 cm^3). Planting muskmelon transplants produced in tray with cell size of 40 cm^3 at 45 and 60 cm on two sides of the dripper line gave the highest values of marketable, total yield/fad., as well as total carbohydrates in fruits, total sugars, TSS and TSS/acid ratio contents in both seasons, whereas planting those obtained from trays with 28 cm^3 cell size at both 45 and 60 cm on two sides of the dripper line gave the highest values of total fibers in fruits. Planting at 45 cm on one side of the dripper line increased firmness in fruits when transplants were produced in tray with smaller cell size.

Key words: Muskmelon, transplant tray cell size, plant spacings, yield and fruit quality.

INTRODUCTION

Muskmelon is considered an important horticultural crop that is often cultivated in semiarid or arid regions under irrigation and at various plant densities and inputs (Mendlinger, 1994). The cultivated area with muskmelon in Egypt, have enormously increased through the last decades reaching about 12,747 fad., in 2013, producing about 102,899 tons in 2013, with average of 8.072 tons/fad., in (Statistics of the Ministry of Agriculture, 2014).

Transplants which produced from the classic seed beds faces in most cases some problems like the bare roots of seedlings, transplanting shock and diseases of soil. Recently, the technique of plug tray-grown seedling has been applied more commonly, whether in the open field planting or under plastic houses, especially in muskmelon ensures the productivity of seedlings of a better establishment and higher earliness and quality, since their roots can grow in a separate medium of ideal growing conditions. Peat-moss and vermiculate have long been used as basic materials in culture

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media of trays for growing vegetable seedlings under plastic house. Nowadays, the plug tray-grown seedling cover the demand of all protected cultivated and a part of open field areas of vegetable crops in Egypt (El-Sawy, 2012a and b). Cell size of tray is a major factor affecting transplants grown of many vegetable plants (Vavrina, 2001).

In addition, the production of muskmelon transplants is important to established filed planting of expensive hybrid cultivars, and to improve grower's ability to meet early market demands (Ivanoff *et al.,* 1960). The production of muskmelon transplants, normally, takes place in containers or pots (plugs). The use of these plugs trays is drawing much attention because of their advantages in handling, shipping and transplanting.

The tendency to decrease the cell volume in trays during vegetable production has been observed for a long time. The use of smaller pots allows to obtain more plants from the same unit area. In effect, the cultivation area is used more effectively, the amount of substrate can be decreased and, in consequence, production costs go down (NeSmith and Duval, 1998). However, diminishing the pot size may lead to root system growth reduction and, in effect, to a weaker development of the over ground transplant mass, which may negatively influence the further plant growth following planting in the field (Booij, 1990).

Some researchers showed that, the transplants produced in tray with larger cell sizes recorded the highest values of plant growth, yield and its components as well as fruit quality (NeSmith, 1993 on squash; Liu and Iatimer 1995 on watermelon; Maynard *et al.* 1996 on muskmelon; Duval and NeSmith 2000; Graham *et al.*, 2000) on watermelon, Refaat, 2003; Yaping and Diankui, 2005 on watermelon).

Plant spacing is a major problem faced by farmers in their production. The use of spacing in crop production is very important and good because it reduces competition between plants and weeds. When adequate spacing is done in plant production, it increases crop growth and yield. Generally, in watermelon, the yield and number of fruits per unit area increased with increasing crop density, whereas the yield and number of fruits per plant decreased (Motsenbocker and Arancibia, 2002).

Competition for water and nutrients in dense plant stands might be responsible for the decrease in plant growth and yield .One of the most important factors in flourishing crop plant is correct spacing because it allows plant to develop to their full potential above and underneath the ground. Adequate space ensures less competition for sunlight, water and fertilizer. Spacing also prevents the spread of pests and diseases from one plant to another (Celac, 2011).

The increase of plant density increased the total number and the total weight of the fruit, the number and weight and marketable fruits and the number and weight of unmarketable fruits (Paulo *et al*., 2003).

Plant growth, yield and its components and fruit quality were affected by different plant spacings as reported by Edelstein and Nerson (2002) on watermelon, Cushman *et al*. (2004) on pumpkin, Olufemi and Salami (2006) on melon, Rodriguez *et al.* (2007) on muskmelon , Walters (2009) on watermelon, Khalid and Elwan (2011) on pumpkin, Arora *et al.* (2013) on muskmelon Nweke *et al.* (2013) on cucumber and Kavut *et al.* (2014) and Sylvestre *et al*. (2015) on watermelon.

The objective of this study was to evaluate the effect of transplant trays cell size in combinations with plant spacing (within-row and rows number) on growth, yield and fruit quality of muskmelon plant under sandy soil conditions.

MATERIALS AND METHODS

This investigation was carried out during two successive summer seasons of 2014 and 2015, at Vegetables Private Farm located on the road between EL-Salhyia Al-Jadida and Al-Salhyia Al-Kadima, Fakous District, Sharkia Governorate, Egypt, under sandy soil conditions with drip irrigation system (GR dripper at 30 cm space). This was initiated to study the effect of twelve treatments which are the combination between two transplant tray cell size and six plant densities on growth, yield and fruit quality of Hanny F_1 hybrid of muskmelon as follows:

Transplant Tray Cell Size

1. 40 cm^3 (Seedling trays contains of 84 cells; 7 × 12).
2. 28 cm^3 (Seedling trays contains of 209 cells; 11 × 19).

Plant Density

1. Planting at 30 cm on one side of the dripper line.
2. Planting at 45 cm on one side of the dripper line.
3. Planting at 60 cm on one side of the dripper line.
4. Planting at 30 cm on two sides of the dripper line.
5. Planting at 45 cm on two sides of the dripper line.
6. Planting at 60 cm on two sides of the dripper line.

The combination of treatments were distributed in split plots in a randomized complete blocks design. The two transplant tray cell sizes were randomly arranged in the main plots and plant spacing within-row and rows number were randomly distributed in the sub plots.

The chemical analyses of used soil, irrigation water and organic manure were done in Central Laboratory, Fac. Agric. Zagazig University and were presented in Table 1.

Seeds of muskmelon cv. Hanny (origin, Peru produced by Seminis Vegetable Seeds and Introduced by Suez Canal Trade and Agricultural Development, Cairo Egypt). Seeds were sown (one seed/cell) on Feb. 15th, in speedling trays; *i.e.*, 209 cells (28 cm^3) or 84 cells (40 cm^3) in both seasons. The trays were disinfected by dipping in Clorox 0.8%. The growing medium consisted of peatmoss and vermiculite 1:1 (*V/V*). Calcium carbonate was added to the growing medium (25 g/kg medium) to adjust pH at range (5.8-6.4). After seed germination, the trays were kept under plastic house covered by black Ceram film reduced light intensity by 63%). Seedlings were sprayed 3-4 times by macro and micro-nutrients solution (Power) 20-20-20 trace element produced by the Egyptian Co. for development and chemical industries, Ismailia, Egypt at the rate of 1.5 g/l, other managements and pest control were added as followed in vegetables nursies.

After about 25 days the transplants were planted at field with spacings (30, 45 and 60 cm. within-rows) and in (1 or 2 planting/lateral row). The obtained seedlings were transplanted on March 6 in summer seasons, (2014 and 2015). Plot area was 18 m^2 (2 rows, 6 m length and 1.5 m width. One line for samples was taken and the other line was allotted for yield determination.

Other agricultural practices; fertilization, irrigation and pest control were applied as recommended for muskmelon cultivations.

Data Recorded

Transplants growth traits

After 25 days from seed sowing, five seedlings were taken as a sample from all three replications of both seedling trays cell size treatments for measuring the transplant growth vigor to determine the suitable tray cell size.

Root length (cm), stem length and diameter (cm), leaf number/ seedling, root fresh and dry weights/seedling, shoot fresh and dry weight (g)/ seedling were measured.

Plant growth traits

At flowering stage, sample of three plants were taken randomly from every plot to determine the plant growth parameters as follows: Plant length (cm), number of leaves/ plant, root length, number of main and secondary branches/plant, average leaf area (cm^2), dry weight of root, shoot and total dry weight / plant (g).

Yield and its components

At harvesting stage, mature fruits were picked from every plot to estimate: fruit number/plant, average fruit weight, yield/ plant, marketable and total yields/faddan.

Table 1. The chemical analyses of soil, irrigation water and organic manure

Sample	Soluble anions				Soluble cations			
	CO_3^-	HCO_3^-	Cl^-	SO_4^-	Ca^{++}	Mg^{++}	Na^+	K^+
Soil	0.0	0.23	0.18	0.47	0.08	0.24	0.39	0.06
Water	3.53	7.16	4.92	23.61	0.96	1.16	31.81	0.34
Manure	0.0	9.33	14.44	15.11	1.68	1.33	109.20	61.81

Fruit chemical composition

Five fruits were taken as a sample from every plot to estimate some measurements:

Total carbohydrate (%), fiber content and total soluble sugars were determined according to the method described by Dubois *et al.* (1956). AOAC (1990) and Forsee (1938), respectively. Total soluble solids (TSS): It was determined in the fruit juice using a hand refractometer. Total soluble solids to titratable acidity ratio (TSS/ TA): The calculations were based on the values of TSS and total titratable acidity percent. Fruit firmness: was determined using Chatillon Penetrometer (N,4, USA) with a needle 3mm in diameter

Statistical Analysis

Recorded data were subjected to the statistical analysis of variance according to Snedecor and Cochran (1980) and means separation were done according to LSD at 5% level.

RESULTS AND DISCUSSION

Vegetative Growth of Transplants

Effect of transplant tray cell size

Sowing of muskmelon seeds in trays with different cell sizes (40 and 28 cm^3) had significant effect on seedling root length and both stem length, diameter and number of leaves/ transplant in both seasons (Table 2). In addition, fresh weight of roots, shoots and total fresh weight as well as dry weight of different transplant parts at 25 days after seed sowing were significantly increased when transplants produced in trays with larger cell size (40 cm^3) in both seasons. While using the smaller cell size (28 cm^3) gave lower values of transplant vegetative growth and fresh and dry weight in both seasons.

From foregoing results, it could be concluded that, produced muskmelon seedling in trays with larger cell size (40 cm^3) increased root length, both length and diameter of stem, number of leaves/transplant, both fresh and dry weight of roots, shoots and total dry weight in both seasons, compared to those produced in trays with smaller cell size (28 cm^3).

These results are in harmony with those reported by D'Amore *et al.* (1992) on melon, Liu and Latimer (1995) on watermelon ,Maynard *et al.* (1996) on muskmelon, Baskan and Arin (1999) on watermelon, Refaat (2003) on cucurbits and El-Sawy (2012a and b) on tomato. All of them found that production of vegetable crops transplants in larger cell size increased seedling growth.

Plant Growth at Flowering Stage

Effect of tray cell sizes

Growth of plant; *i.e.*, plant length, number of leaves / plant, number of both lateral and secondary branches/ plant, dry weight of shoots, total dry weight and average leaf area were significantly affected by tray cell size in both seasons, except root length and root dry weight in both seasons and number of leaves/ plant and number of main branches/ plant in the 2nd season (Tables 3 and 4).

The produced transplants in tray with larger cell size (40 cm^3) recorded longer plant and gave higher values of number of leaves/ plant, number of both lateral and secondary branches/ plant , dry weight of shoots, total dry weight and average leaf area. On the other hand, the transplants that produced in smaller size tray (28 cm^3) recorded shorter plants and gave lower values of number of leaves/ plant, both number of lateral and secondary branches/ plant as well as dry weight of different plant parts in both seasons.

Table 2: Effect of transplant tray cell size on vegetative growth of muskmelon seedlings before transplanting during 2014 and 2015 summer seasons

Character / Tray cell size	Root length (cm)	Stem length (cm)	Stem diameter (mm)	Leaf number / transplant	Fresh weight of root (g)	Fresh weight of shoot (g)	Total fresh weight (g)	Dry weight of root (g)	Dry weight of shoot (g)	Total dry weight (g)
2014 season										
40 cm^3	8.22	8.31	4.25	3.85	1.54	4.83	6.37	0.32	1.47	1.80
28 cm^3	7.79	6.49	3.40	2.90	0.87	2.44	3.32	0.22	0.72	0.94
LSD at 0.05 level	0.28	0.81	0.54	0.30	0.33	0.75	1.07	0.08	0.52	0.60
2015 season										
40 cm^3	7.65	5.60	3.85	3.85	1.08	2.18	3.26	0.42	1.55	1.97
28 cm^3	6.32	5.12	3.25	2.95	0.69	1.37	2.06	0.27	1.15	1.42
LSD at 0.05 level	0.77	0.38	0.25	0.31	0.27	0.22	0.40	0.09	0.26	0.22

Table 3. Effect of transplant tray cell size, plant densities and their interactions on vegetative growth at 40 days from transplanting of muskmelon during 2014 and 2015 summer seasons

Treatment		Plant length (cm)		Number of leaves/ plant		Root length (cm)		Number of main branches/ plant		Number of secondary branches/ plant	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
						Effect of tray cell size					
40 cm^3		119.47	117.53	122.6	109.3	22.80	20.58	4.72	4.36	6.44	5.94
28 cm^3		116.72	113.25	107.3	109.1	21.38	20.50	4.38	4.33	5.66	5.77
LSD at 0.05 level		NS	4.14	2.78	NS	NS	NS	0.18	NS	0.60	0.14
						Effect of plant density					
Planting at 30 cm on one side of the DL*		117.00	113.33	111.4	105.83	22.75	19.50	4.66	4.25	4.83	4.91
Planting at 45 cm on one side of the DL		119.42	125.00	138.7	136.00	23.41	21.83	4.91	5.00	8.16	7.83
Planting at 60 cm on one side of the DL		120.92	118.50	137.8	130.92	22.58	21.83	5.00	4.41	7.25	7.08
Planting at 30 cm on two sides of the DL		108.25	111.42	99.0	104.50	19.58	19.75	4.16	4.16	4.33	4.83
Planting at 45 cm on two sides of the DL		120.42	115.33	101.5	86.75	20.16	18.58	4.41	4.25	5.75	5.50
Planting at 60 cm on two sides of the DL		122.58	108.75	101.4	91.50	24.08	21.76	4.16	4.00	6.00	5.00
LSD at 0.05 level		5.23	6.20	6.78	5.23	1.62	1.96	0.63	0.63	0.83	0.98
						Effect of interaction					
40 cm^3	**Planting at 30 cm on one side of the DL**	113.1	119.3	113.33	99.1	22.66	18.16	4.16	4.33	5.33	4.33
	Planting at 45 cm on one side of the DL	120.5	129.3	158.50	138.0	24.16	20.50	4.16	4.66	9.66	8.83
	Planting at 60 cm on one side of the DL	135.3	111.5	157.83	153.1	24.16	24.00	4.16	4.66	7.66	7.50
	Planting at 30 cm on two sides of the DL	108.5	111.6	103.83	114.3	20.00	20.50	5.16	4.50	4.83	5.33
	Planting at 45 cm on two sides of the DL	115.3	122.1	97.17	62.6	21.66	18.50	5.16	3.66	4.66	4.00
	Planting at 60 cm on two sides of the DL	124.0	111.1	105.33	89.0	24.16	21.86	5.50	4.33	6.50	5.66
28 cm^3	**Planting at 30 cm on one side of the DL**	120.8	107.3	109.50	112.5	22.83	20.83	4.16	4.16	4.33	5.50
	Planting at 45 cm on one side of the DL	118.3	120.6	119.00	134.0	22.66	23.16	4.66	5.33	6.66	6.83
	Planting at 60 cm on one side of the DL	106.5	125.5	117.83	108.6	21.00	19.66	4.50	4.16	6.83	6.66
	Planting at 30 cm on two sides of the DL	108.0	111.1	94.17	94.6	19.16	19.00	4.16	3.83	3.83	4.33
	Planting at 45 cm on two sides of the DL	125.5	108.5	106.00	110.8	18.66	18.66	4.16	4.83	6.83	7.00
	Planting at 60 cm on two sides of the DL	121.1	106.3	97.50	94.0	24.00	21.66	4.66	3.66	5.50	4.33
LSD at 0.05 level		7.40	8.77	9.59	7.40	2.30	2.77	0.89	0.89	1.18	1.38

*DL= Dripper line

Table 4. Effect of transplant tray cell size, plant densities and their interactions on dry weight and leaf area at 40 days from transplanting of muskmelon during 2014 and 2015 summer seasons

Treatment		Dry weight of root (g)		Dry weight of shoots (g)		Total dry weight (g)/ plant		Average leaf area (cm^2)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
					Effect of tray cell size				
40 cm^3		1.45	1.35	49.41	41.00	50.87	42.29	41.14	39.11
28 cm^3		1.38	1.29	42.78	39.64	44.17	41.00	40.07	37.92
LSD at 0.05 level		NS	NS	2.46	1.02	2.64	1.03	0.98	1.09
					Effect of plant density				
Planting at 30 cm on one side of the DL*		1.600	1.23	45.39	38.31	46.99	39.55	40.64	37.58
Planting at 45 cm on one side of the DL		1.633	1.80	48.91	54.05	50.55	55.86	42.22	40.25
Planting at 60 cm on one side of the DL		1.550	1.40	53.74	45.02	55.29	46.43	35.28	33.62
Planting at 30 cm on two sides of the DL		1.066	1.15	39.54	34.51	40.61	35.66	37.40	35.64
Planting at 45 cm on two sides of the DL		1.258	1.20	44.11	37.13	45.37	38.33	45.31	43.20
Planting at 60 cm on two sides of the DL		1.425	1.15	44.89	32.90	46.31	34.05	42.78	40.80
LSD at 0.05 level		0.17	0.19	2.57	2.16	2.60	2.13	3.21	2.57
					Effect of interaction				
40 cm^3	**Planting at 30 cm on one side of the DL***	1.71	1.21	51.65	39.98	53.36	41.23	42.75	40.09
	Planting at 45 cm on one side of the DL	1.75	1.90	57.15	52.76	58.90	54.48	42.07	40.13
	Planting at 60 cm on one side of the DL	1.56	1.48	60.86	39.48	62.43	40.81	35.56	33.89
	Planting at 30 cm on two sides of the DL	1.15	1.18	38.88	32.13	40.03	33.25	38.84	37.01
	Planting at 45 cm on two sides of the DL	1.06	1.10	36.40	49.56	37.46	50.86	44.59	42.50
	Planting at 60 cm on two sides of the DL	1.50	1.26	51.53	32.08	53.03	33.11	43.04	41.05
28 cm^3	**Planting at 30 cm on one side of the DL***	1.48	1.25	39.13	36.65	40.61	37.86	38.53	35.06
	Planting at 45 cm on one side of the DL	1.51	1.71	40.68	55.35	42.20	57.25	42.38	40.38
	Planting at 60 cm on one side of the DL	1.53	1.33	46.61	50.56	48.15	52.05	35.01	34.27
	Planting at 30 cm on two sides of the DL	0.98	1.11	40.20	36.88	41.18	38.07	35.96	43.90
	Planting at 45 cm on two sides of the DL	1.45	1.30	51.83	24.71	53.28	25.81	46.03	40.54
	Planting at 60 cm on two sides of the DL	1.35	1.03	38.25	33.71	39.60	34.98	42.53	33.35
LSD at 0.05 level		0.25	0.27	3.63	3.05	3.68	3.02	4.54	3.63

*DL= Dripper line

These results are in harmony with those reported by Weston (1988) on pepper, NeSmith (1993) on squash, Liu and Latimer (1995) on watermelon, Maynard *et al.* (1996) on muskmelon, Yaping and Diankui (2005) on watermelon, Cebula (2009) on cauliflower, Giménez *et al*. (2009) on strawberry, El-Sawy (2012a and b) and Oagile *et al.* (2016) on tomato. They found that using the largest cell size of trays gave the highest values of vegetative growth and dry weight of different parts as well as average leaf area.

Effect of plant densities

Planting muskmelon transplants at spacings of 30, 45 and 60 on one side (2.22, 1.48 and 1.11 plants/m^2) and two sides (4.44, 2.96 and 2.22 plants/m^2) of the dripper line had significant effect on plant length, root length, number of leaves/ plant, number of both lateral and secondary branches/ plant, dry weight of root, shoots and total dry weight/ plant in both seasons (Tables 3 and 4).

Planting at 45 or 60 cm on one side of the dripper line (1.48 and 1.11 plant/m^2) increased significantly plant length, number of leaves/ plant, root length, number of both lateral and secondary branches/ plant and dry weight of root, shoots and total dry weight/ plant in both seasons.

The stimulative effect of moderate plant density on morphological characters, other than plant length, may be due to more exposing to solar radiation, meanwhile, prevent stem etiolating and consequently gave more branching and higher number of leaves/plant due to large amounts of nutrients available to each plant.

From the above mentioned results, it could be concluded that the plants grown under wider spaces received more nutrients, light and moisture around each plant surrounding compared to plants grown under closer spaces which is probably the cause of better performance of total dry weight of individual muskmelon in wider spaces. The stimulative effect of low plant density on dry weight of plant may be due to that wide spacing make a marked increase in vegetative growth (Table 4) which in turn reflected on increasing plant dry weight.

These results are in harmony with those reported by Rodriguez *et al*. (2007) on muskmelon, Ban *et al*. (2011), Oga and Umekwe (2015) on watermelon, Nweke *et al*. (2013) on cucumber and Sylvestre *et al.* (2015) on watermelon.

Effect of interaction between tray cell size and plant densities

The interaction between tray cell sizes and plant densities had significant effect on plant length, number of leaves/ plant, root length , number of both lateral and secondary branches/ plant in both seasons (Table 3). The obtained results show that planting muskmelon transplants at 60 cm on one side of the dripper line increased plant length (in the first season) , number of leaves/ plant, and root length (in both seasons) , when transplants were produced in tray with bigger cell size (40 cm^3). Planting at 45 cm on two sides of the dripper line increased number of main branches/plant (in the first season) when transplants produced in tray with bigger cell size (40 cm^3). Presented data in Table 4 show that, muskmelon transplants planted at 45 cm on one side of the dripper line increased number of secondary branches/plant, dry weight of root, shoots and total dry weight/plant when transplants were produced in tray with bigger cell size (40 cm^3).

Yield and Its Components

Effect of tray cell sizes

Data in Table 5 indicate that transplants of muskmelon produced in tray with cell sizes 40 and 28 cm^3 had significant effect on number of fruits/ plant, average fruit weight, yield/ plant, marketable yield/fad., and total yield/fad., in both seasons.

The produced transplants in tray with larger cell size (40 cm^3) gave higher values of number of fruits/plant, average fruit weight, yield/plant, marketable yield/fad., and total yield/fad., in both seasons. The relative increases in marketable and total yield/fad., due to producing the transplants in tray with larger cell size (40 cm^3) were about 30.09 and 45.05% for marketable yield and 28.82 and 40.54 % for total yield more than the transplants produced in tray with smaller cell size (28 cm^3) in the 1^{st} and 2^{nd} seasons, respectively.

Table 5. Effect of transplant tray cell size, plant densities and their interactions on yield and its components of muskmelon during 2014 and 2015 summer seasons

Treatment		Fruit No./plant		Fruit weight (g)		Yield / plant (kg)		Marketable yield (ton/fad.)		Total yield (ton/fad.)	
		1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
						Effect of tray cell size					
40 cm^3		1.97	1.98	1.113	1.163	2.157	2.433	17.245	18.277	18.774	19.783
28 cm^3		1.37	1.41	1.204	1.141	1.636	1.596	13.256	12.600	14.573	14.076
LSD at 0.05 level		0.11	0.12	0.037	NS	0.064	0.312	0.832	2.242	0.670	2.332
						Effect of plant density					
Planting at 30 cm on one side of the DL*		1.76	1.77	1.108	1.045	1.888	1.841	16.022	15.444	17.188	16.586
Planting at 45 cm on one side of the DL		1.87	1.88	1.358	1.452	2.413	2.515	13.500	15.209	15.380	17.045
Planting at 60 cm on one side of the DL		2.20	2.25	1.205	1.277	2.548	3.232	10.472	12.052	11.598	13.389
Planting at 30 cm on two sides of the DL		1.04	1.01	0.973	0.847	0.985	0.848	16.742	14.261	17.947	15.440
Planting at 45 cm on two sides of the DL		1.37	1.40	1.181	1.171	1.554	1.609	18.272	19.000	19.804	20.511
Planting at 60 cm on two sides of the DL		1.82	1.86	1.126	1.120	1.990	2.042	16.494	16.665	18.125	18.605
LSD at 0.05 level		0.10	0.17	0.051	0.051	0.137	0.245	1.201	1.562	1.135	1.581
						Effect of interaction					
40 cm^3	**Planting at 30 cm on one side of the DL***	2.10	2.05	1.088	1.085	2.206	2.186	18.922	18.760	20.081	19.901
	Planting at 45 cm on one side of the DL	2.14	2.23	1.210	1.489	2.536	3.227	14.933	19.353	16.161	20.559
	Planting at 60 cm on one side of the DL	2.67	2.65	1.237	1.360	3.074	4.123	12.559	15.212	13.991	16.633
	Planting at 30 cm on two sides of the DL	1.22	1.20	0.881	0.872	1.058	1.032	18.044	17.594	19.274	18.786
	Planting at 45 cm on two sides of the DL	1.60	1.58	1.089	1.074	1.682	1.677	19.344	19.310	21.433	21.370
	Planting at 60 cm on two sides of the DL	2.13	2.18	1.173	1.100	2.384	2.357	19.666	19.431	21.702	21.449
28 cm^3	**Planting at 30 cm on one side of the DL***	1.42	1.50	1.128	1.006	1.570	1.496	13.121	12.128	14.295	13.271
	Planting at 45 cm on one side of the DL	1.59	1.53	1.506	1.416	2.291	1.804	12.067	11.065	14.599	13.530
	Planting at 60 cm on one side of the DL	1.73	1.86	1.172	1.194	2.022	2.342	8.385	8.891	9.205	10.145
	Planting at 30 cm on two sides of the DL	0.86	0.82	1.065	0.822	0.913	0.664	15.440	10.928	16.621	12.094
	Planting at 45 cm on two sides of the DL	1.14	1.22	1.274	1.269	1.426	1.542	17.199	18.690	18.174	19.653
	Planting at 60 cm on two sides of the DL	1.50	1.54	1.078	1.140	1.596	1.728	13.321	13.898	14.547	15.761
LSD at 0.05 level		**0.14**	**0.25**	**0.072**	**0.073**	**0.193**	**0.347**	**1.669**	**2.210**	**1.605**	**2.237**

*DL= Dripper line

The favorable effects resulting from increasing transplants tray cell size on increasing total yield might be due to general reduction in stress greater availability of water and fertilizer, unrestricted root growth and greater shoot development and root: shoot weight ratio (Vavrina, 2001). Also, more rapid field growth of the plants from larger tray cells aids in their ability to combat and resist insects, diseases and other mechanical of physical stresses and higher yield (Grazia *et al*., 2002).

Obtained results agreed with those reported by Graham *et al.* (2000) on watermelon, Refaat (2003) on cucurbits, Cebula (2009) on cauliflower, Giménez *et al*. (2009) on strawberry and El-Sawy (2012a and b) on tomato. They showed that using the largest cell size tray for transplants production gave the highest values of fruit weight, number of fruits/plant, yield/plant and total yield.

Effect of plant densities

Obtained results in Table 5 show that planting at 30, 45 and 60 cm on one and two sides of the dripper lines had significant effect on number of fruits/plant, average fruit weight, yield/plant, marketable yield/fad., and total yield / fad., in both seasons. Planting of muskmelon transplants at 60 cm on one side of the dripper line increased significantly number of fruits/ plant and yield/plant, while planting at 45 cm on one side of the dripper line increased average fruit weight in both seasons. Marketable yield/fad., and total yield/fad., were significantly increased with planting at 45 cm on two sides of the dripper line in both seasons. The relative increases in marketable and total yields/fad., due to transplanting muskmelon at 45 cm on two sides of the dripper line were about 14.04 and 23.02% for marketable yield and 15.21 and 23.66% for total yield than the transplanting at 30 cm on one side of the dripper line in the 1st and 2nd seasons, respectively.

Dense spacing designs may increase competition for water and fertilizers, which results in inadequate vegetative growth and low yields (Knavel, 1988). At low plant density, greater nutrients uptake and improved light environment and water at lower plant population, hence the competition was low which would increase branching, flowers and pods yield/ plant.

These results agreed with those obtained by (Rodriguez *et al.*, 2007; Arora *et al.*, 2013) on muskmelon, (Olufemi and Salami, 2006; Oga and Umekwe, 2015) on melon, Edelstein and Nerson, 2002; Walters, 2009; Ban *et al*., 2011; Kavut *et al.*, 2014; Sylvestre *et al*., 2015 on watermelon, (Cushman *et al.*, 2004; Khalid and Elwan, 2011) on pumpkin and Nweke *et al.* (2013) on cucumber.

Effect of interaction between tray cell size and plant densities

Data presented in Table 5 illustrate that the interaction between tray cell sizes and plant densities reflected significant effect on number of fruits/plant, average fruit weight, yield/plant, marketable yield/fad., and total yield /fad., in both seasons.

Planting muskmelon at 60 cm on one side of the dripper line increased number of fruits/ plant and yield/plant when transplants were produced in bigger tray cell sizes (40 cm^3) in both seasons. Fruit weight was at the highest value with the interaction between planting muskmelon at 45 cm on one side of the dripper line and bigger tray cell sizes (40 cm^3) in both seasons. Respecting marketable and total yields/fad., results in Table 5 show that, planting on 45 cm and 60 cm on two sides of the dripper line combined with larger tray cell sizes (40 cm^3) gave the highest values of marketable and total yields/fad., in both seasons. The relative increases in marketable and total yields/fad., due to the interaction between planting at 45 cm on two sides of the dripper line with the larger size (40 cm^3) were about 60.30 and 74.51% for marketable yield and 46.81 and 57.94% for total yield/fad., than the interaction between planting at 45 cm on one side of the dripper line when combined with the smaller size (28 cm^3) in the 1st and 2nd seasons, respectively.

Fruit Quality

Effect of tray cell size

Data in Table 6 show that using tray with larger cell size (40 cm^3) gave higher values of total carbohydrates, total sugars and fruit firmness in muskmelon compared to those produced in tray with smaller size (28 cm^3) in both seasons, whereas production of transplant in tray with smaller cell size (28 cm^3) gave higher values of

Table 6. Effect of transplant tray cell size, plant densities and their interactions on fruit chemical characteristics of muskmelon at harvest during 2014 and 2015 summer seasons

Treatment	Total carbohydrates (%)		Total fiber (%)		Total sugars (%)		TSS		TSS/acid ratio		Firmness (g/cm^2)	
	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
Effect of tray cell size												
40 cm^3	36.15	36.27	9.36	9.40	4.76	4.83	5.04	5.02	42.38	42.69	394.44	391.67
28 cm^3	32.52	32.51	9.72	9.74	4.05	4.17	5.11	5.00	54.91	44.94	372.22	358.33
LSD at 0.05 level	0.13	0.07	0.06	0.05	0.03	0.09	NS	NS	9.56	NS	17.12	20.70
Effect of plant density												
Planting at 30 cm on one side of the DL*	32.90	32.91	8.84	8.91	3.99	4.140	4.86	4.91	56.81	48.06	466.67	375.00
Planting at 45 cm on one side of the DL	33.59	33.75	9.15	9.20	4.20	4.313	5.50	5.50	41.91	45.34	391.67	391.67
Planting at 60 cm on one side of the DL	34.47	34.50	9.60	9.54	4.37	4.501	5.25	4.91	54.47	44.72	316.67	316.67
Planting at 30 cm on two sides of the DL	34.14	34.19	9.59	9.63	4.25	4.253	4.63	4.66	26.28	25.05	400.00	358.33
Planting at 45 cm on two sides of the DL	35.12	35.13	9.83	9.89	4.68	4.745	5.13	5.33	41.19	45.81	316.67	425.00
Planting at 60 cm on two sides of the DL	35.80	35.87	10.23	10.26	4.95	5.053	5.08	4.75	71.19	53.91	408.33	383.33
LSD at 0.05 level	0.15	0.09	0.05	0.04	0.05	0.04	0.45	0.47	15.63	16.84	28.38	35.62
Effect of interaction												
40 cm^3 Planting at 30 cm on one side of the DL*	34.05	34.28	8.57	8.60	4.20	4.27	4.73	4.83	52.81	48.44	566.67	433.33
Planting at 45 cm on one side of the DL	35.09	35.22	8.99	9.10	4.40	4.41	6.00	5.50	37.50	47.69	316.67	383.33
Planting at 60 cm on one side of the DL	35.71	35.70	9.37	9.30	4.66	4.72	4.50	4.83	36.03	46.03	316.67	333.33
Planting at 30 cm on two sides of the DL	36.11	36.28	9.46	9.54	4.53	4.56	4.26	4.83	9.16	14.06	450.00	400.00
Planting at 45 cm on two sides of the DL	37.51	37.56	9.60	9.66	5.18	5.27	5.26	5.50	32.91	47.38	350.00	433.33
Planting at 60 cm on two sides of the DL	38.44	38.61	10.16	10.20	5.63	5.72	5.50	4.66	85.94	52.59	366.67	366.67
28 cm^3 Planting at 30 cm on one side of the DL*	31.75	31.55	9.11	9.21	3.77	4.00	5.00	5.00	60.81	47.69	366.67	316.67
Planting at 45 cm on one side of the DL	32.09	32.28	9.32	9.31	4.00	4.21	5.00	5.50	46.34	43.00	466.67	400.00
Planting at 60 cm on one side of the DL	33.24	33.31	9.83	9.79	4.08	4.27	6.00	5.00	72.91	43.44	316.67	300.00
Planting at 30 cm on two sides of the DL	32.17	32.11	9.72	9.72	3.97	3.94	5.00	4.50	43.44	36.03	350.00	316.67
Planting at 45 cm on two sides of the DL	32.73	32.70	10.06	10.12	4.18	4.21	5.00	5.16	49.47	44.25	283.33	416.67
Planting at 60 cm on two sides of the DL	33.17	33.14	10.30	10.32	4.28	4.38	4.66	4.83	56.44	55.19	450.00	400.00
LSD at 0.05 level	0.21	0.12	0.08	0.06	0.08	0.06	0.64	0.66	22.13	23.84	40.14	50.38

*DL= Dripper line

TSS/acid ratio in the 1st season only. There were no significant effect between smaller and larger cell size with respect to total fiber content in fruits.

Effect of plant densities

The obtained results in Table 6 illustrate that, planting at the widest spacing (60 cm) on two sides of the dripper line gave the highest values of total carbohydrates, total fibers, total sugars, TSS and TSS/acid ratio, in muskmelon fruits in both seasons. Planting at 30 on one side of the dripper line increased fruit firmness.

These results are in accordance with those found by Behella (1985) on muskmelons and Mamnoie and Dolatkhahi (2013) on tomato.

Effect of interaction between tray cell size and plant densities

The interaction between tray cell size and plant densities reflected significant effect on total carbohydrates, total fibers, total sugars contents and TSS in muskmelon fruits in both seasons (Table 6).

Planting muskmelon at the widest spacing (60 cm) on two sides of the dripper line gave the highest values of total carbohydrates, total sugars, TSS and TSS/ acid ratio in fruits when transplants produced in tray with larger cell size (40 cm^3), whereas planting at 60 cm on two side of the dripper line gave the highest values of total fiber in fruits when transplants produced in tray with smaller cell size (28 cm^3). Whereas planting at 45 cm on one side of the dripper line increased fruit firmness when transplants produced in tray with smaller cell size (28 cm^3).

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تأثير حجم صلية الشتل والكثافة النباتية على النمو، المحصول وجودة ثمار القاوون الشبكي

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أُجريت هذه الدراسة خلال الموسمين الصيفيين ٢٠١٤، ٢٠١٥ بمزرعة خضر خاصة، مركز فاقوس- محافظة الشرقية تحت ظروف الأرض الرملية وباستخدام نظام الري بالتنقيط (GR) على مسافة ٣٠ سم وذلك لدراسة تأثير ١٢ معاملة عبارة عن التفاعل بين اثنين من الحجوم لصلية الشتل وستة مسافات زراعة على النمو، المحصول وجودة ثمار القاوون الشبكي هجين F_1 هني، وقد أوضحت النتائج أن طول كل من الجذر والساق، قطر الساق وعدد الأوراق/ الشتلة، الوزن الطازج والجاف للجذور والعرش والوزن الكلي/ للشتلة (بعد ٢٥ يوم من الزراعة) قد ازداد معنويا بالشتلات التي أنتجت من الصواني ذات حجم الصلية الكبير (٤٠ سم^3) في كلا الموسمين، بينما أدى استخدام الصواني ذات حجم الصلية الصغير (٢٨ سم^3) إلى الحصول على أقل القيم للنمو الخضري، والوزن الطازج والجاف للشتلة في كلا الموسمين، ازداد كل من طول النبات، عدد الأوراق /نبات، طول الجذر، عدد الثمار/نبات ومحصول النبات بزراعة الشتلات الناتجة من الصواني ذات حجم الصلية الكبير (٤٠ سم^3) على مسافة ٦٠ سم على جانب واحد من خط التنقيط، كما ازداد كل من عدد السيقان الرئيسية /نبات، متوسط وزن الثمرة وذلك بزراعة الشتلات الناتجة من الصواني ذات حجم الصلية الكبير (٤٠ سم^3) على مسافة ٤٥ سم على جانبى خط التنقيط، بينما ازداد كل من عدد السيقان الثانوية/نبات، الوزن الجاف لكل من الجذر، العرش، الوزن الجاف الكلى/نبات، وذلك بزراعة الشتلات الناتجة من الصواني ذات حجم الصلية الكبير (٤٠ سم^3) على مسافة ٤٥ سم على جانب واحد من خط التنقيط، أدى زراعة الشتلات الناتجة من الصوانى ذات حجم الصلية الكبير (٤٠ سم^3) على مسافة ٤٥ ، ٦٠ سم على جانبي خط التنقيط إلى زيادة كل من المحصول القابل للتسويق ، المحصول الكلى /فدان، محتوى الثمار من الكربوهيرات الكلية، والسكريات الكلية و نسبة المواد الصلبة الذائبة الكلية/الحموضة في كلا الموسمين، بينما أدى زراعة الشتلات الناتجة من الصوانى ذات حجم الصلية الصغير (٢٨ سم^3) على مسافة ٦٠ سم على جانبي خط التنقيط إلى زيادة محتوى الثمار من الألياف الكلية، وازدادت صلابة الثمار بزراعة الشتلات الناتجة من الصواني ذات حجم الصلية الصغير على مسافة ٤٥ سم على جانب واحد من خط التنقيط.

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