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EFFECT OF PLANT SPACING AND APICAL SHOOT PINCHING ON GROWTH AND PRODUCTIVITY OF WATERMELON PLANTS UNDER SANDY SOIL CONDITIONS

Naglaa A.M. Anwar*, A.A. Gad, A. Bardisi and H.G. Zyada

Hort. Dept., Fac. Agric., Zagaizg Univ., Egypt

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ABSTRACT: The present work was carried out in Private Vegetable Farm at El- Heez, Al-Wahaat Al-Baharyia District, Giza Governorate, Egypt, during two successive summer seasons of 2016 and 2017, to study the effect of plant spacing and apical shoot pinching (ASP) stage on growth and productivity of watermelon plants under sandy soil conditions using drip irrigation system. Results showed that, the interaction between plant spacing at 30 cm and ASP at the 6^{th} node gave the tallest plants, whereas the interaction between plant spacing at 60 cm and ASP at the 6^{th} node gave the highest values for each of number of leaves and branches/plant at 45 days after planting. On the other side, planting watermelon at 45 cm and ASP at the 6^{th} node increased average number of fruits/ plant, average fruit weight, yield/plant and total yield/faddan.

Key words: Watermelon, *Citrullus lanatus*, plant spacing, apical shoot pinching, growth and yield.

INTRODUCTION

Watermelon (*Citrullus lanatus*, Thumb.) is one of the important vegetables crops in Egypt. The major nutritional components of the fruit are carbohydrates, vitamin A and lycopene, and anti-carcinogenic compound found in red flesh watermelon. Lycopene may help reduce the risk of certain cancer of prostrate gland, pancreas and stomach.

The total watermelon cultivated area in 2017 in Egypt, was 131, 215 fad., which produced 1, 709,964 tons with average 13.03 ton/fad., **(FAO, 2017)**. About 50-53% of watermelon cultivation area during that period was cultivated in new reclaimed land using drip irrigation system. Watermelon production in Egypt is meanly conducted during the summer season in open fields, but about 10 percent of its cultivation area is grown under plastic low tunnel conditions during winter season.

Culture practices such as irrigation, cultivation, planting spacing, chose of cultivar, control of weeds, insect pests and diseases play important roles in determining yields of watermelon (**Taylor *et al*., 2003**).

Adequate plant spacing strategies and nutrient management has been reported to have a positive impact on watermelon yield **(Goreta *et al*., 2005)**.

Inappropriate plant density has accounted for poor yields of this crop among most small scale watermelon farmers. If plants are widely spaced, not all land area is covered by leaves and much of light available for photosynthesis is wasted, so also water and mineral resources in the soil. But if plants are closely spaced, competition for water and minerals in the soil, as well as light will occur among plants because their leaves will begin to shade one another **(Forbes and Watson, 1992)**. High plant density is recommended for watermelon seed production because more fruits per area is achieved at a denser spacing **(Edelstein and Nerson, 2002).**

In the production of watermelon, plant spacing is a major problem faced by farmers in

* **Corresponding author: Tel. :** +201004655525
E-mail address: ne.anwar@zu.edu.eg

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 increased crop density, whereas the yield and number of fruits per plant decreased. High planting density increased the number of fruits per area **(NeSmith, 1993)**. However, some studies showed that average weight of fruits decreases with increase in plant density **(Motsenbocker and Arancibia, 2002).** Competition for water and nutrients in dense plant stands might be responsible for the decrease in plant growth and yield **(Knavel, 1988)**.

Dantata (2014) found that planting watermelon at 100 cm increased vine length, number of leaves, number of fruits/plant and fruit yield/ha., followed by planting at 75 cm. **Aldan and Abu Sarra (2018)** indicated that 70 cm intra-row spacing with one plant/hill gave the optimum plant density for watermelon, since it resulted in optimum growth and the highest marketable yield and best quality

In watermelon, apical shoots are pinched when the vines are 1m while allowing the side shoots to grow. This practice gives significantly higher fruit yield. At the initial stages of fruit setting, malformed, diseased and damaged fruits are removed and only 2-3 fruits per vine are retained. This results in increased fruit size and yield.

Pruning is an act of cutting off plant branches so as to encourage flowering or fruiting. Shoots, flowers and fruits are pruned to maintain a proper balance between the vegetative growth and fruit load. This will maximize production **(Wayne, 1990).** Watermelon vine pruning treatments can serve these purposes: to enhance mechanical harvesting, production of hybrid seed, ease of control of pests and diseases, use of higher plant population without significant yield reduction and the production of uniform fruits **(Jarrick, 1986).**

Oga and Umekwe (2016) indicated that the pruned watermelon plants produced the longest vine, number of leaves, number of flowers and number of fruits.

Pinching at the 6th node increased number of branches/plant of *cucurbita moschata* (**Eve *et al.* 2016**) and number of fruits , yield per vine and yield per hectare of cucumber (**Nayak *et al.* 2018**).

Therefore, the aim of this study was to determine the suitable plant spacing and apical shoot pinching stages to obtain maximum yield with good quality of watermelon grown under sandy soil conditions using drip irrigation system.

MATERIALS AND METHODS

The present study was carried out in Private Vegetable Farm at El-Heez, Al-Wahaat Al-Baharyia District, Giza Governorate, Egypt, during two successive summer seasons of 2016 and 2017, to study the effect of plant spacing and apical shoot pinching (ASP) stage on growth and productivity of watermelon plants under sandy soil conditions using drip irrigation system.

This experiment included 18 treatments which were the combinations between 3 plant spacings and 6 apical shoot pinching (ASP) stages as follows:

A. Plant spacing: 30, 45 and 60 cm.

B. Apical shoot pinching (ASP) stages: Without ASP (control), ASP at the 4th, the 6th, the 8th, the 10th and the 12th node.

These treatments were arranged in a split plot in a complete randomized block design with three replicates. Plant spacings were randomly arranged in the main plots and ASP stages were randomly distributed in the sub plots. The watermelon plants were pinched manually by removing the apical shoots for leaving 4, 6, 8, 10 and 12 nodes, respectively.

Plant spacings, plant densities and plant populations of watermelon plants are presented in Schedule 1.

The experimental unit area was 18 m^2. It contains two ridges with 6m length and 1.5m distance between each two ridges. One ridge was used to measure the morphological traits and the other was used for yield determination.

Schedule 1. Plant spacing, plant densities and plant populations of watermelon plants

Plant spacings	Plant densities (plant/m^2)	Plant populations (plant/fad.)
30 cm	2.22	9324
45 cm	1.48	6216
60 cm	1.11	4662

The distance between each two ridges = 1.5 m.

The seeds of watermelon Giza 1 cultivar were sown on 10th and 18th Feb. in seedling trays in the 1st and 2nd seasons, respectively. Transplants were transplanted on 7th and 15th March on one side of the ridge (1.5 m) in the 1st and 2nd seasons, respectively.

The sources of nitrogen, potassium and phosphorus fertilizers were ammonium sulphate (20.5% N) and ammonium nitrate (33.5% N) at 100 and 150 kg/fad., respectively, potassium sulphate (48% K_2O) at 200 kg/fad., and calcium superphosphate (15.5% P_2O_5) and phosphoric acid at 150 kg and 20 l./fad., respectively. All experimental units received equal amounts of FYM at 20 m^3/fad., ammonium sulphate and calcium superphosphate during soil preparation. All plants were fertilized with ammonium nitrate, phosphoric acid and potassium sulphate as fertigation at equal doses two times weekly from 10 and 60 days after transplanting, the other cultivated practices for watermelon production were used according to the instruction laid down by the Ministry of Agriculture, Egypt.

Data Recorded

Vegetative growth

At flowering stage (45 days after transplanting), main vine length, number of leaves/plant, and number of lateral branches were measured.

Yield and its components

Watermelons were harvested by hand when the fruit matured (75–80 days after transplanting), in general, fruit were considered mature when the tendril nearest to fruit start to dry, and color of fruit on the bottom side changed from creamy white to yellowish. Fruits were weighed, then average fruit weight (kg) and total yield (ton/ fad.) were calculated.

Statistical Analysis

Statistical analysis was conducted for all collected data. The analysis of variance was calculated according to **Snedecor and Cochran (1980)**, means separation was done according to LSD at 0.05 level.

RESULTS AND DISCUSSION

Plant Growth

Effect of plant spacing

Results in Table 1 show that planting watermelon plants grown in sandy soil at 30 cm recorded the tallest plants, whereas planting at 60 cm recorded the shortest plants. Planting at 60 cm gave the highest value for each of number of leaves/plant and number of branches/plant, whereas planting at 45 cm gave the lowest values at flowering stage (45 days after transplanting in both seasons.

From the foregoing results, it could be concluded that, narrow spacing gave the tallest plant, whereas wider spacing gave the highest value for each of number of leaves and branches/plant. Competition for water and nutrients in dense plant stands might be responsible for the decrease in plant growth and yield **(Knavel, 1988).**

Effect of apical shoot pinching

The obtained results in Table 2 indicate that apical shoot pinching (ASP) at the 6th node recorded the tallest plants and gave the highest value for each of number of leaves and number of branches/plant, whereas Asp at 12th node recorded the shortest plants at 45 days after planting in both seasons. These results agree with those reported by **Eve *et al.* (2016) and Oga and Umekwe (2016).**

Table 1. Effect of plant spacing on vegetative growth of watermelon plants at 45 days after planting during 2016 and 2017 seasons

Plant spacing	Plant length (cm)	Number of leaves/plant	Number of branches/plant
		2016 season	
30 cm	201.35	201.44	7.55
45 cm	181.73	171.83	6.21
60 cm	163.90	229.34	8.16
LSD at 0.05 level	11.99	8.16	0.43
		2017 season	
30 cm	194.35	226.05	8.33
45 cm	180.93	173.45	6.11
60 cm	168.40	246.13	8.00
LSD at 0.05 level	5.77	6.52	0.29

Table 2. Effect of apical shoot pinching on vegetative growth of watermelon plants at 45 days after planting during 2016 and 2017 seasons

ASP	Plant length (cm)	Number of leaves/plant	Number of branches/plant
		2016 season	
Without ASP	201.10	185.21	6.55
ASP at the 4th node	182.47	204.67	7.66
ASP at the 6th node	228.57	261.43	8.88
ASP at the 8th node	156.23	191.13	7.55
ASP at the 10th node	176.47	213.43	7.66
ASP at the 12th node	149.13	149.36	5.55
LSD at 0.05 level	8.32	7.41	0.45
		2017 season	
Without ASP	201.00	214.70	7.22
ASP at the 4th node	178.00	188.10	8.00
ASP at the 6th node	231.43	333.13	9.88
ASP at the 8th node	156.00	187.80	6.22
ASP at the 10th node	171.37	202.77	7.66
ASP at the 12th node	149.57	164.77	5.88
LSD at 0.05 level	8.18	6.51	0.30

ASP: apical shoot pinching

Effect of the interaction between plant spacing and ASP

Results in Table 3 illustrate that the interaction between plant spacing at 30 cm and ASP at the 6^{th} node recorded the tallest plants with no significant differences with the interaction between plant spacing at 45 cm and ASP at 6^{th} node, whereas the interaction between plant spacing at 60 cm and ASP at the 12^{th} node recorded the shortest plants. The interaction between plant spacing at 60 cm and ASP at the 6^{th} node recorded the highest value of number of leaves/plant with no significant differences with the interaction between plant spacing at 30 cm and ASP at 6^{th} node as for number of branches/plant. The interaction between plant spacing at 60 cm and ASP at 6^{th} node and the interaction between plant spacing at 30 cm and ASP at 6^{th} node gave the highest number of branches/plant in the 1^{st} and 2^{nd} seasons, respectively.

From the foregoing results, it could be concluded that, the interaction between plant spacing at 30 cm and ASP at the 6^{th} node gave the tallest plants, whereas the interaction between plant spacing at 60 cm and ASP at the 6^{th} node gave the highest value for each of number of leaves and branches/plant at 45 days after planting.

Yield and its Components

Effect of plant spacing

Results in Table 4 show that planting watermelon plants grown in sandy soil at 45 or 60 cm increased average number of fruits/plant compared to planting at 30 cm. Planting at 45 cm gave the highest value for each of average fruit weight and yield/plant, followed by planting at 60 cm in both seasons. As for total yield/fad., planting at 45 cm increased total yield, followed by planting at 30 cm compared to planting at 60 cm.

Generally, in watermelon, the yield and number of fruits per unit are increased with increased crop density, whereas the yield and number of fruits/plant decreased. High planting density increased the number of fruits per area (**NeSmith, 1993**). However, some studies showed that average weight of fruits decreases with increase in plant density **(Motsenbocker and Arancibia, 2002)**. Competition for water and nutrients in dense plant stands might be responsible for the decrease in plant growth and yield **(Knavel, 1988)**.

From the foregoing results, it could be concluded that, plant spacing at 45 cm increased average fruit weight and yield/plant followed by plant spacing at 60 cm, whereas plant spacing at 45 cm increased total yield/fad., followed by plant spacing at 30 cm.

Effect of apical shoot pinching

Results in Table 5 show that ASP at the 4 and the 6^{th} node gave the highest value for each of average number of fruits/plant, average fruit weight, yield/plant and total yield /fad, followed by without ASP, whereas ASP at the 8,10 and 12^{th} node gave the lowest values.

From the foregoing results, it could be concluded that, ASP at the 4 or the 6^{th} node increased average number of fruits/plant, average fruit weight, yield/plant and total yield/ fad., compared without ASP and ASP at the 8,10 and 12^{th} node. These results agree with those reported by **Nayak *et al.* (2018)**.

The simulative effect of ASP at the 6^{th} node on yield of watermelon may be due to that ASP node increased vine length, number of leaves and number of branches/plant (Table 2), therefore there was positive correlation between number of fruits and both vine length and number of branches/ plant of watermelon. In this respect, **Warren *et al.* (1998)** indicated that watermelon plants with many branches produce higher yields than those with few branches or those whose branches have been pruned. This was confirmed by a strong and highly significant correlation that was observed between branch number and fruit number. Also, they found that watermelon plants with longer vines produce higher yields than those with shorter vines. This was confirmed by a strong and highly significant position correlation that was observed between main vine length and fruit number

Also, **Warren *et al.* (1998)** indicated that more watermelon foliage translates into high photosynthetic and assimilation rates and ultimately more fruits, and any reduction in foliage reduces fruit yields. They added that watermelon plants with longer vines also produce

Table 3. Effect of the interaction between plant spacing and apical shoot pinching on growth of watermelon plants at 45 days after planting during 2016 and 2017 seasons

		Plant length (cm)		Number of leaves/plant		Number of branches/plant	
Plant spacing	**ASP**	**2016 season**	**2017 season**	**2016 season**	**2017 season**	**2016 season**	**2017 season**
30 cm	**Without ASP**	235.70	241.00	176.33	188.70	5.33	7.33
	ASP at the 4th node	214.70	220.70	193.30	217.30	9.33	10.00
	ASP at the 6th node	248.00	250.30	286.00	387.00	8.66	12.00
	ASP at the 8th node	167.70	153.70	205.70	184.00	7.66	6.33
	ASP at the 10th node	220.00	177.70	207.30	213.30	8.33	8.33
	ASP at the 12th node	122.00	122.70	140.00	166.00	6.00	6.00
45 cm	**Without ASP**	183.30	187.70	183.30	187.70	5.66	6.00
	ASP at the 4th node	141.70	145.30	159.70	145.30	6.00	7.00
	ASP at the 6th node	264.00	252.30	209.30	238.70	7.66	8.00
	ASP at the 8th node	161.00	179.30	157.00	154.70	5.33	5.66
	ASP at the 10th node	140.70	130.70	184.00	161.30	6.66	5.00
	ASP at the 12th node	199.70	190.30	137.70	153.00	6.00	5.00
60 cm	**Without ASP**	184.30	174.30	196.00	267.70	8.66	8.33
	ASP at the 4th node	191.00	168.00	261.00	201.70	7.66	7.00
	ASP at the 6th node	173.70	191.70	289.00	373.70	10.33	9.66
	ASP at the 8th node	140.00	135.00	210.70	224.70	9.66	6.66
	ASP at the 10th node	168.70	205.70	249.00	233.70	8.00	9.66
	ASP at the 12th node	125.70	135.70	170.37	175.30	4.66	6.66
LSD at 0.05 level		**14.41**	**14.17**	**12.83**	**11.28**	**0.78**	**0.52**

ASP: apical shoot pinching

Table 4. Effect of plant spacing on yield and its components of watermelon plants during 2016 and 2017 seasons

Plant spacing	Average number of fruits/plant	Average fruit weight (kg)	Yield/plant (kg)	Yield/fad. (ton)
		2016 season		
30 cm	1.457	3.946	5.879	39.193
45 cm	1.972	4.675	9.504	42.237
60 cm	2.034	4.143	8.680	30.478
LSD at 0.05 level	**0.13**	**0.136**	**0.805**	**4.317**
		2017 season		
30 cm	1.567	3.953	6.259	41.725
45 cm	2.069	5.062	10.825	48.105
60 cm	2.006	4.451	9.192	32.312
LSD at 0.05 level	**0.24**	**0.180**	**1.235**	**6.794**

Table 5. Effect of apical shoot pinching on yield and its components of watermelon plants during 2016 and 2017 seasons

ASP	Average number of fruits/plant	Average fruit weight (kg)	Yield/plant (kg)	Yield/fad. (ton)
		2016 season		
Without ASP	1.666	4.336	7.219	36.048
ASP at the 4th node	2.152	5.406	11.693	53.453
ASP at the 6th node	2.235	5.264	11.990	54.574
ASP at the 8th node	1.610	3.533	5.698	26.865
ASP at the 10th node	1.790	3.620	6.517	30.494
ASP at the 12th node	1.473	3.368	5.013	22.383
LSD at 0.05 level	**0.19**	**0.298**	**1.147**	**5.188**
		2017 season		
Without ASP	1.805	4.616	8.342	42.535
ASP at the 4th node	2.165	5.616	12.416	55.991
ASP at the 6th node	2.207	5.450	12.463	55.165
ASP at the 8th node	1.748	3.883	6.823	32.400
ASP at the 10th node	1.750	3.878	6.841	32.166
ASP at the 12th node	1.610	3.488	5.667	26.026
LSD at 0.05 level	**0.20**	**0.249**	**1.216**	**5.386**

ASP: apical shoot pinching

higher yields than those with shorter vines. Since watermelon flowers develop in the nodes of the plants, additional branching on some watermelon accessions creates more locations for the flowers to develop (**Dittmar *et al.,* 2006**).

There was a strong and highly significant positive correlation between the number of branches on the main vine and fruit number of watermelon. There was a strong and highly significant positive correlation between fruit number and branch number. There was a strong and highly significant positive correlation between the number of female flowers and fruit number (**Gichimu *et al*., 2009**).

Effect of the interaction between plant spacing and ASP

The obtained results in Table 6 indicate that the interaction between plant spacing at 45 or at 60 cm and ASP at the 4 th or at the 6th node in the 1st season and the interaction between plant spacing at 45 or at 60 cm and ASP at 4th node or without ASP in the 2nd season increased average number of fruits/ plant. The interaction between plant spacing at 45 cm and ASP at the 6th node increased average fruit weight, yield/plant and total yield/fad., with no significant differences with the interaction between plant spacing at 45 cm and ASP at the 4th node with respect to yield/plant and total yield/fad., in the 2nd season.

From the foregoing results, it could be concluded that, planting watermelon plants in sandy soil at 45 cm and ASP at the 6th node increased average number of fruits/plant, average fruit weight, yield/plant and total yield/ faddan.

Pruning is an act of cutting off plant branches so as to encourage flowering or fruiting. Shoots, flowers and fruits are pruned to maintain a proper balance between the vegetative growth and fruit load. This will maximize production **(Wayne, 1990).** Watermelon vine pruning treatments can serve these purposes: to enhance mechanical harvesting, production of hybrid seed, ease of control of pests and diseases, use of higher plant population without significant yield reduction and the production of uniform fruits **(Jarrick, 1986).**

Table 6. Effect of the interaction between plant spacing and apical shoot pinching on yield and its components of watermelon during 2016 and 2017 seasons

Treatment		Average number of fruits/plant		Average fruit weight (kg)		Yield/plant (kg)		Yield/fad. (ton)	
Spacing	ASP	2016 season	2017 season	2016 season	2017 season	2016 season	2017 season	2016 season	2017 season
30 cm	Without ASP	1.333	1.746	4.038	4.415	5.354	7.374	35.691	49.156
	ASP at the 4th node	1.706	1.540	5.188	4.475	8.875	7.806	59.161	52.032
	ASP at the 6th node	1.706	1.580	4.540	4.191	7.746	6.471	51.637	43.132
	ASP at the 8th nods	1.373	1.500	3.471	3.741	4.782	5.903	31.877	39.346
	ASP at the 10th node	1.496	1.373	3.491	3.695	5.208	5.601	34.714	37.335
	ASP at the 12th node	1.126	1.750	2.951	3.200	3.312	4.403	22.078	29.347
45 cm	Without ASP	1.666	2.500	4.773	4.926	7.955	8.607	35.350	38.248
	ASP at the 4th node	2.250	2.500	5.548	6.408	12.479	16.031	55.457	71.243
	ASP at the 6th node	2.500	1.916	6.468	6.941	16.214	17.381	72.056	77.242
	ASP at the 8th node	1.750	2.000	3.976	4.383	6.921	8.375	30.756	37.218
	ASP at the 10th node	2.000	1.750	4.030	4.250	8.066	8.483	35.846	37.700
	ASP at the 12th node	1.666	2.000	3.253	3.466	5.391	6.071	23.957	26.979
60 cm	Without ASP	2.000	2.250	4.198	4.508	8.349	9.046	37.102	40.200
	ASP at the 4th node	2.500	2.583	5.483	5.966	13.723	13.410	45.740	44.697
	ASP at the 6th node	2.500	1.750	4.785	5.216	12.010	13.537	40.031	45.120
	ASP at the 8th node	1.706	1.750	3.151	3.525	5.390	6.192	17.963	20.637
	ASP at the 10th node	1.873	1.706	3.340	3.691	6.277	6.440	20.921	21.463
	ASP at the 12th node	1.626	1.746	3.901	3.800	6.335	6.527	21.113	21.753
LSD at 0.05 level		0.33	0.36	0.516	0.432	1.988	2.107	8.986	9.329

ASP: apical shoot pinching

REFERENCES

Adlan, M.A.A. and A.F. Abu Sarra (2018). Effects of plant density on yield and quality of watermelon (*Citrullus lanatus* Thunb) under Gezira conditions, Sudan. Hort. Int. J., 2 (4): 158- 162.

Dantata (2014). Assessing watermelon cultivars under different planting distances in Bauchi North, Nigeria. Asian J. Appl. Sci., 2 (3): 381-386.

Dittmar, P.J., J.R. Schultheis and D.W. Monks (2006). Characterization of diploid watermelon pollenizers and utilization for optimal triploid watermelon production and effects of Halosulfuron POST and POST-DIR on Watermelon. MSc. Thesis. North Carolina State Univ.

Edelstein, M. and H. Nerson (2002). Genotype and plant density effect on watermelon growth for seed consumption. Hort. Sci., 2725 – 2740.

Eve, B., M. Tuarira and M. Moses (2016). The influence of pinching on the growth, flowering pattern and yield of butternuts (*Cucurbita moschata*). Int. J. Hort. and Ornamental Plants, 2 (1): 19-25.

FAO (2017). Food and Agriculture Organization of the United Nations.

Forbes, F.C. and R.D. Watson (1992). Plant in agriculture. 1st Ed., press syndicate of the Univ. Camb., Camb., New York, ISBN: 97805214.

Gichimu B.M., B.O. Owuor, G.N. Mwai and M.M. Dida (2009). Morphological characterization of some wild and cultivated watermelon (*Citrullus* sp.) accession in Kenya. ARPN J. Agric. Biol. Sci., 4: 1990-6145.

Goreta, S., S. Perica, G. Dumičić, L. Bućan and K. Žanić (2005). Growth and yield of watermelon on polyethylene mulch with different spacings and nitrogen rates. Hort. Sci., 40 (2): 366-369.

Jarrick, J. (1986). Training and pruning. Hort. Sci., 400.

Knavel, D.E. (1988). Growth, development, and yield potential of short-internode muskmelon. J. Amer. Soc. Hort. Sci., 113: 595–599.

Motsenbocker, C.E. and R.A. Arancibia (2002). In-row spacing influences on triploid watermelon yield and crop value. Hort. Technol., 12: 437 – 440.

Nayak, S.R., V.K. Parmar, A.N. Patel, J. Suchismita, J.B. Lathiya and Y.N. Tandel (2018). Efficacy of pinching and plant growth regulators in enhancing yield characters of cucumber (*Cucumis sativus* L.) Inter. J. Chem. Studies, 6 (1): 1804-1807.

NeSmith, D.S. (1993): Plant spacing influences watermelon yield and yield components. Hort. Sci., 28: 885 – 887.

Oga, I.O. and P.N. Umekwe (2016). Effects of pruning and plant spacing on the growth and yield of watermelon (*Citrullus lanatus* L.) in Unwana-Afikpo. Int. J. Sci. Res., 5 (4): 110-115.

Snedecor, G.W. and W.G. Cochran (1980). Statistical Methods, 7th Ed. Iowa State Univ. Press. Ames. Iowa, USA.

Taylor, M.J., Lu. Wenhua, A. James, B. Duthie, R. Warren and V.E. Jonathan (2003). Effects of high and low management intensity on profitability for three watermelon genotypes. Paper presented at the evaluation of production alternatives 1 session of the Southern Agricultural Economics Association. Annual hetting, Mobil, Alabama, February 1-5, 2003.

Warren, R., J. Duthie, J. Edelson, J. Shrefler and M. Taylor (1998). Relationship between watermelon foliage and fruit. In: Proceedings of the 17th Ann. Hort. Industries Show, 229-234. January 9-10.

Wayne, V. (1990). Greenhouse cucumber production. University of Alaska Fairbanks Cooperative Extension Service. HGA-00434.

تاثير مسافة الزراعة وتطويش القمة النامية على نمو وإنتاجية نباتات البطيخ تحت ظروف الأرض الرملية

نجلاء الشحات محمد أنور- عبد المنعم عامر جاد- عبد الله برديسى – هانى جمال زياده

قسم البساتين - كليه الزراعة - جامعه الزقازيق- مصر

أجرى هذا العمل في مزرعة خضر خاصة بالحيز- منطقه الواحات البحرية- محافظه الجيزة، مصر، خلال موسمى صيف ٢٠١٦، ٢٠١٧ بهدف دراسة تأثير مسافة الزراعة وتطويش القمة النامية على نمو وإنتاجية نباتات البطيخ تحت ظروف الأرض الرملية باستخدام نظام الري بالتنقيط، هذا وتشير النتائج إلى أن معامله التفاعل بين مسافة الزراعة ٣٠ سم والتطويش عند العقدة السادسة قد سجلت أطول النباتات بينما التفاعل بين مسافة الزراعة ٦٠ سم والتطويش عند العقدة السادسة قد سجلت أعلى القيم لكل من عدد الأوراق والأفرع على النبات وذلك بعد ٤٥ يوم من الزراعة، على الجانب الآخر فقد سجلت معامله التفاعل بين مسافة الزراعة ٤٥ سم والتطويش عند العقدة السادسة إلى زيادة عدد الثمار على النبات، متوسط وزن الثمرة ومحصول النبات وكذلك محصول الفدان.

المحكمـــون:

١- د. السيد السيد محمد أبو الخير رئيس بحوث بمعهد بحوث البساتين- مركز البحوث الزراعية.

٢- أ.د. داليا أحمد سامي نـــوار أستاذ الخضر – كلية الزراعة – جامعة الزقازيق.