EFFECT OF WATERMELON PROPAGATION BY CUTTINGS ON VEGETATIVE GROWTH, YIELD AND FRUIT QUALITY

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Abstract

Watermelon (*Citrullus lanatus)* is an important vegetable crop grown in Egypt. Seedless watermelon hybrids are preferred by most consumers because of their sweet taste and lack of hard seeds. The seedless watermelon (triploid hybrid watermelon) seeds are very expensive, do not germinate well and show least homogenous germination and growth. For these reasons, the present study aims to propagate seedless watermelon by cuttings to minimize the amounts of imported watermelon hybrid seeds in general and seedless watermelon in particular and reducing the cost of production and producing homogenous plants. Cutting is a method of asexual plant propagation widely used in horticulture. It is most commonly used for the propagation of trees and shrubs grown commercially. In vegetable crops cuttings are used on sweet potato and cassava as a commercial propagation method and cuttings can be used as a commercial propagation method in tomato, potato, eggplant, cucumber, melon and watermelon. The seedless watermelon cv. Yellow Buttercup "QV 766" F1 (yellow flesh) and SSX 7402 F1 hybrid (red flesh)) and seeded watermelon cv. Aswan F1 hybrid were grown in plastic house for use as a source of cuttings (mother plants). Two types of cuttings were use, the first type was cuttings from terminal growing point of the main stem and lateral branches 10-15cm in length 0.45and 0.6 cm in diameter and the second type was cuttings including one node, bud and leaf. The study was conducted in three different experiments using randomized complete blocks design with three replicates during the seasons of 2010/2011 and 2011/2012 at a private farm in El-Badrashein City. Each hybrid was conducted in a single experiment. Each experiment included two types of cuttings treated with three concentrations (0, 100, 200 ppm) of IBA and planted in seedling trays or pots No.8cm. Twelve cutting treatments beside the control which was produced from true seeds were used in each experiment. The obtained results showed that shoot tip cuttings with any concentrations of IBA and planted in seedling trays or in pots treatments gave a lower survival percentage than cuttings including one node and treated with any concentration of IBA and planted in seedling trays or in pots. This may be due to the significant increment in number of roots in cutting treatments have one node compared with both cutting include shoot tip and control plants. All cutting treatments which included one node gave a higher survival percentage than the seeds germination in both seedless cv. Yellow Buttercup (QV 766) F1 and SSX 7402 F1 hybrid while, the highest seed germination were recorded in Aswan F1 in both seasons. All cutting treatments gave a significant increment in all vegetative characteristics after 45 days from transplanting and early yield compared with control. The number of days from transplanting to flowering showed significant decrease than the control. The plants from cuttings reached harvesting 15 days earlier than the control. No significant differences were recorded between all cutting treatments and the control plants in all vegetative growth, yield

components and fruit characteristics. All cutting treatments gave a significant increase in early yield when compared with control plants.
Kay words: Seedless watermelon, triploid, cuttings, propagation.
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INTRODUCTION

Watermelon (*Citrullus lanatus*) is an important crop cultivated in Egypt. It is considered one of the cash crops beside beings a popular summer fruit. Egypt occupied the fourth ranking in watermelon production after China, Turkey and USSR respectively, (Allred and Lucier, 1990). The watermelon cultivated area was 164, 529 feddans with average yield of 12.3 (ton/ fed.) according to the statistical data of ministry of agriculture 2006.

Triploid hybrids were first reported in Japan in 1947 (Kihara, 1951). In Egypt, tetraploid and triploid watermelon were first produced by Abd El- Hafez (1963) and who used the gene markers in the development the production of seedless watermelon in 1969. In the United States, triploid production became significant only in the 1980s. Triploid watermelons fruit are smaller, have a tougher rind and a much longer shelf life and have considerably more resistance to fruit blotch than diploid watermelon fruits (Garret *et al.,* 1995). Consumers in the USA have accepted the so-called seedless watermelon despite the higher price to gain high return.

Seedless watermelons are sterile hybrids which develop fruits, but with no seeds. Seeds are produced by crossing a normal watermelon diploid (2X=22 chromosomes) as a male with one that has been changed genetically by the treatment with colchicine (tetraploid (4X=44 chromosomes) as a female parent. The seeds from this cross produce plants that, when pollinated with pollen from normal plants, produce seedless watermelons fruits (Kihara, 1951).

Triploid seeds production areas are primarily located in developing countries because of low labor costs. Andrus (1971) proposed low-cost production of triploid seeds by tetraploid plants interspersed in rows of diploid pollinators. Cross-pollination will predominate because diploid pollen is more abundant and competitive. Mixtures of triploids and a few tetraploid seed are sold, tetraploid watermelons are later separated by hand at harvest, based on fruit shape and color. This also requires trained workers.

In 1995 in the United States, commercial growers were paying $140-$180per 1000 seed, several fold the price of diploid hybrid seed. These prices are offset in the market, where triploid fruit can bring significantly higher prices than diploid fruit (Adelberg *et al.,* 1997).

Despite costly inputs, triploid seeds do not germinate well. Having small, triploid embryos encased in a thick tetraploid seed coat. During germination, numerous air spaces can fill with water, inhibiting the respiration of the expanding embryo. The seed coat sticks tightly to the cotyledons and frequently keeps the emerging cotyledons from expanding and photosynthesizing. To optimize emergence, triploid seed should be scarified, planted flat and germinated at temperatures above 27 °C with careful moisture control and then drenched with warm water just after emergence to remove the still pliable seed coat. Four weeks after planting, the seedlings are ready for transplant to the field. Triploid seed can be germinated under field conditions if carefully pregerminated (Adelberg *et al.,* 1997).

Use of triploid hybrids has provided a method for production of seedless fruit. Kihara began working on seedless watermelons in 1939, and had commercial triploid hybrids available 12 years later. The development of triploid cultivars add several problems to the process of watermelon breeding: extra time for the development of tetraploids, additional selection against sterility and fruit abnormalities, choice of parents for reduced seed coat production, the reduction in seed yield per acre obtained by seed companies, reduced seed vigor for the grower, and the necessity for diploid pollenizer taking one-third of the grower's production field (Adelberg *et al.,* 1997).

In Egypt the seedless watermelon (triploid hybrid watermelon) seeds are very expensive. Its price is about 1.75 -2.00 L.E /seed. Moreover the maximum percent of germination is 70% (according to Syngenta Company). So the cultivated area of seedless watermelon is about 100 feddans from 164.529 feddans watermelon production according to statistical data of Ministry of Agriculture (2006). In this connection, the fruit price of seedless fruit is about five times the price of seeded watermelon fruits. So, an efficient method for developing tetraploids is needed.

Mason (2004) recorded that chemical hormones may be applied to stimulate the formation either of roots or foliage/shoot growth. Heating may be used to warm the root zone (bottom heat) and encourage faster growth of roots, periodic misting of the foliage will cool the top of the plant or prevent dehydration of the foliage. Auxins are involved in a variety of things including stem growth, root formation, inhibiting lateral bud development, fruit and leaf abscission, fruit development and activating cambium cells. Of all the hormones, auxins have the greatest effect on root formation in cuttings. Root formation and development in a cutting. Indole butyric acid (IBA) is artificial, the most widely used rooting hormone, used on its own or in combination with NAA. Auxins can be applied to plants as a powder, gel or liquid. Cuttings are frequently treated with hormones which encourage root development.

Treating different plant cuttings by dipping in IBA at 500 to1000 ppm for few seconds promote adventitious roots formation, root number and root length (Robbins *et al.,* 1983). The application of IBA alone increased root fresh weight especially with the lowest concentration of IBA. Mepiquat Chloride (MC) also increased the root fresh weight in the same auxin level the response may be due to the reduction of ethylene production (El-Abd, 1997).

El-Abd (1997) found that all IBA treatments were effective in increasing the number, length and fresh weight of adventitious roots in cucumber cuttings as compared with control cuttings. IBA increased ethylene production comparing with MC treatments which reduce ethylene production but enhanced root elongation.

The aim of the study was to develop new pattern of cuttings technique for watermelon plants propagation to minimize the amounts of imported watermelon seeds in general and seedless watermelon in particular. Also to study the effect of using cuttings for watermelon propagation on plants homogeneity, growth rate, early yield productivity, and the time from planting to harvesting in three watermelon hybrids(two seedless and one seeded).

MATERIALS AND METHODS

Plant cutting, also known as striking or cloning, is a technique for vegetative (asexually) propagating plants in which a piece of the stem or root of the source plant is placed in a suitable medium. The cuttings produce new roots, stems, or both, and thus becomes a new plant independent from the parent. Two types of cuttings were taken from the watermelon mother plants, which were cultivated in the plastic house as a mother plants, *i.e.,* cuttings from terminal growing point of main stem and lateral branches 10-15cm in length and 0.45-0.6 cm in diameter and cuttings included one node, bud and a leaf.

This study was conducted during 2010/2011 and 2011/2012 on three watermelon hybrids, two seedless and one seeded watermelon hybrids. Such hybrid was treated as a separated experiment. Each experiment included 13 treatments, *i.e.,* two types of cuttings, three concentrations (0, 100, 200 ppm) IBA (3- Indole butyric acid) for cuttings treating before planting and culture containers, *viz*, speedling trays or in pots no.8

1. **Plant material**

   a. **Watermelon hybrids**

Two seedless watermelon (*C. lanatus*) hydrids, *viz*. Yellow Buttercup (QV 766) F_1 (yellow flesh) and SSX 7402 F_1 hybrid (red flesh)) and seeded watermelon cv. Aswan F_1 hybrid from Sakata Seed Company, Japan were used in the present study.

   b. **Cuttings preparation**

Seedless and seeded watermelon seeds were sown in a greenhouse in Badrashein city on 7th of October 2010 in the first season and 12th of October 2011 in the second season in the foam speedling trays with 84 cells filled with a mixture of peat-moss, vermiculite and berlite at the ratio of 1:1:1 (v/v). Three hundred grams of ammonium sulphate, 400 g calcium superphosphate, 150g potassium sulphate, 50 ml. nutrient solution and 50 gm of a fungicide were added for each 50 kg of the peatmoss. Seedless and seeded watermelon seedlings transplanted on 12th of November, 2010 and 18th of November 2011 in a plastic house in Badrashein city as mother plants to obtain cuttings in both seasons. Mother plants were treated with the conventional agricultural practices *i.e.,* irrigation, fertilization, pests and diseases management as recommended by the Ministry of Agriculture in Egypt. For producing good watermelon vegetative growth, all female flowers and fruits were removed. Healthy mother plants, free of pests and diseases especially virus diseases, were selected for cuttings collection at 75 days after transplanting. Suitable branches chosen for cuttings from the shoot tip, upper, middle and bottom nodal segments of all primary or secondary branches.

Each type of cutting *i.e.,* shoot tip and one node cuttings were divided into three groups, the first group was treated with 200 ppm of IBA, the second group was treated with 100 ppm. by dipping it in IBA solution followed by immersing the bases of the cuttings in MC (Mepiquat Chloride) solution at the concentration 100 ppm and the third group was not treated with IBA but immersed in distilled water for 10 seconds. The treated and untreated cuttings were planted in speedling trays 84 cells and in pots no. 8 filled with previous culture mixture. Speedling trays and pots after planted were removed immediately into the shaded plastic low tunnel for healing and root formation from the node region that was key factors for the survival of cutting plants. A polyethylene sheet was laid on the floor of the low tunnels and covered with a shallow layer of water. Speedling trays were placed on bricks to support the plants above the water layer. The plastic tunnel was closed to achieve a temperature of 25-32 ºC and (>85% RH) humidity for five to seven days. Watermelon plants which formed from cuttings were moved out of the tunnel and placed into a screenhouse, for seven days.

The control plant was cultured by seeds from all cultivars were sown in speedling trays in the nursery at 2nd of January 2011 in the first season and 24th of December 2011 in the second season.

Watermelon seedlings were transplanted on 11th February, 2011 in the open field in a private farm in El-Badrashein City, Giza in the first season and on the 8th of February 2012 in the second season. 2200 Seedlings were transplanted in the feddan, 70% seedless and 30% seeded (pollinator plants), in rows 5 meter length and 2 meter width. The space between plants was 1m. The single treatment contained 10 plants in two rows for seedless and one row from Aswan plants as pollinator. The conventional agricultural practices *i.e.,* irrigation, fertilization, and weeding and pest control followed standard commercial practices, were done as recommended by the Ministry of Agriculture in Egypt, for watermelon production. Plots were first harvested on the 25th of April in 2011 and 2012. The other harvesting, were done where the fruits were ripen. Three harvest times were conducted in the first and second seasons.

Experimental design and statistical analysis

Three experiments were conducted in randomized complete blocks design with three replications. Data were statistically analyzed using analyses of variance by the technique of analysis of variance ANOVA, with the Stat soft statistical MSTATC software program (Michigan State University, East Lansing, MI, USA). Probabilities of significance among treatments and means were compared with least significant difference L.S.D. ($P \leq 0.05$) were used to compare means within and among treatments according to Gomez and Gomez (1984).

2. Studied characteristics

- **a. Survival rates:** Survival rate was measured after 10-12 days from the cuttings by counting the surviving seedlings and dividing on the total number.
- **b.** Number of root formed from the cuttings after 12 days from planting.

The following data were recorded during growth period until the end of harvesting.

c. Vegetative growth characteristics

Vegetative growth characters were recorded after 45 days from transplanting and at the end of harvesting in samples of four plants randomly chosen from each plot as follows

1. Plant length (cm)
2. Leaves area (cm^2):

It was expressed as the mean leaf area in cm^2 using the dry weight method. The leaves were cleaned from dust and then weighed to nearest 0.001 g. Therefore 20 disks of known area were separated, dried and weighed.

$$\text{leaves area}\ \left(cm^2\right) = \frac{\text{Dry weight of plant leaves}}{\text{Dry weight of 20 disks}} \times 20 \times \text{the area of disk}$$

Where, the area of a disk is about 1.0 cm

3. Number of leaves per plant
4. Number of branches/plant
5. Plant fresh weight (kg)
6. Plant dry weight (g)

d. Flowering

1. Number of days to appearance of the first flower: Determined by calculating the days from transplanting in open field to the appearance of the first flower.

e. Yield and its components: The fruits were harvested 75 days after transplanting as a first harvest and the other harvesting were implemented where the fruits were ripen.

The following traits were evaluated

1. Early yield (ton/ feddan)
2. Total yield (ton/ feddan)
3. Total weight of fruits /plant
4. Marketable yield: It was determined by removing the abnormal fruits, fruit cracked, smitten fruits with any diseases and misshapen fruits which were considered culls as well as the fruit less than 3.0kg from the total yield.

f. Fruit characteristics: Fruit characteristics were determined by measuring the following measurements

1. Average fruit weight (kg)
2. Fruit rind thickness (mm): Using a caliper.
3. Fruit size (cm^3): It was measured by using water displacement technique by displacement the same size from water in normative beaker and estimated the same size from water. This was done in a special container which was filled with water until overflows form the spout. Fresh fruits were immersed and the overflow water volume was measured in a graduated cylinder.

g. Chemical determinations

1. **Panel test:** Panel test was determined by panel testing (flavor) by 3 persons per replication with 3 replication based on the criterion, where 5= Excellent,4= Good, 3= Medium, 2=Fair and 1= Poor
2. **Total soluble solids (T.S.S. %):** It was measured in fruit juice by using a hand refractometer. This was estimated according to the methods described in A.O.A.C. (1975).
3. **Dry matter percentage of fruit flesh:** It was determined by allowing 100 g of fruit flesh to dry in an oven at 70°C till a constant weight.
4. **Total sugars content:** was determined in each fruit sample according to the method of Malik and Singh (1980).
5. **Determination of leaf pigments:** Green color reading: It was determined by using a SPAD 501 leaf chlorophyll meter (for using the greenness measurements) for fully expanded leaves (the fifth leaf from the shoots growing tip without destroying them) (Yadva, 1986).

RESULTS AND DISCUSSION

1. Survival percentage

This study provides the success of producing plants from two cutting types *i.e.,* shoot tip and cuttings including one node treated with three concentrations of IBA (0, 100, 200 ppm). These cuttings were cultured in speedling trays having 84 cells or pots 8cm. The survival percentage of plants produced from plant cuttings (shoot tip and one node cuttings) from mother plants of all seedless and seeded cultivars and treated with three concentrations of IBA followed by planted in speedling trays and pots compared with germination ratio of all seedless and seeded cultivar are presented in Table (1).

Data in Table 1 showed significant differences between the two types of cuttings in survival percentage. The lowest survival percentage (58.24 and 61.15%) were recorded in Aswan hybrid when using shoot tip cutting treated with zero concentration from IBA in both seasons. The same result was obtained for the hybrid SSX 7402 in the second season. On the other hand, the survival percentage of cuttings which include one node treated with any concentrations of IBA followed by planting in speedling trays or pots showed the highest value which ranged between 94.74 % and 98.46% in all cultivars in both seasons. The highest value of seed germination (99%) was obtained from Aswan watermelon whereas it ranged from 75 to 83% in seedless cultivars Buttercup and SSX7402.

No significant differences were detected between both types of containers in all characteristics in both seasons.

The lowest survival percentage was observed in shoot tip cuttings treated with distilled water without IBA in both containers, which were 61.31 % in both cultivars (SSX7402 and buttercup) in both seasons. As for number of roots data showed insignificant differences among shoot tip cuttings treated with different concentration of IBA in both containers in the first and second season. Data in this Table also showed significant increment in number of roots for cuttings with one node compared with shoot tip cutting. The highest value of the roots number formed from cuttings were recorded when cuttings included one node while the lowest value was observed when using cutting of shoot tip. These results were true regardless of the concentrations of IBA or containers. These results were true in all cultivars in both seasons. The survival percentage of plant cuttings depends on the success root formation which depends on the nutrients, hormones, quality and physiological case in these cuttings of the mother plants and the management conditions in the period after planting (Hartmann *et al.,* 2002). These results were in agreement with that recorded by El-Abd, (1997) and Mason (2004).

Table 1. Effect of cutting types treated with three concentrations of IBA and planted in two containers compared with true seeds germination of three watermelon hybrids on survival percentage and number of roots in 2011 and 2012 seasons.

Characteristics			Survival percentage %						Number of roots					
			Cultivars						Cultivars					
Treatments			Buttercup		SSX 7402		Aswan		Buttercup		SSX 7402		Aswan	
		IBA ppm	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012	2011	2012
Control (seeds)			83.2	79.4	75.4	81.1	99.0	97.1	1	1	1	1	1	1
Shoot tip	Trays	0	61.3	61.9	62.7	61.3	62.1	66.3	5.21	5.39	5.67	5.29	4.35	4.05
		100	64.5	68.1	66.6	65.5	72.3	73.2	6.19	6.15	6.72	6.06	4.75	5.20
		200	68.1	69.8	69.3	67.3	74.2	61.2	7.19	6.34	6.90	6.82	5.35	5.05
	Pots 8cm	0	62.3	62.2	62.7	61.9	58.2	69.2	5.31	5.53	5.68	5.33	5.75	6.05
		100	66.9	67.6	68.1	66.2	79.3	73.1	6.36	6.15	6.50	6.29	5.05	5.75
		200	69.5	69.9	70.2	68.8	77.2	72. 2	7.31	6.68	6.61	6.44	6.15	6.35
One node	Trays	0	95.1	94.8	94.7	95.1	98.3	96.2	9.17	8.97	8.25	8.54	7.75	8.05
		100	96.5	96.4	96.7	96.5	97.3	97.1	9.66	9.42	8.97	9.22	8.05	8.05
		200	97.5	97.7	96.8	97.5	96.2	98.2	9.86	9.60	9.55	9.77	8.75	9.05
	Pots 8cm	0	95.5	95. 7	95.1	93.9	97.2	98.3	8.92	9.06	8.25	8.81	8.05	8.35
		100	97.2	97.6	96.5	95.9	98.3	97.2	9.12	9.59	9.35	9.13	9.35	9. 50
		200	98.4	98.4	98.0	98.5	98.3	97.2	10.08	10.14	9.75	9.94	9.75	10.25
L.S.D. 0.05			14.2	11.2	12.8	13.4	10.9	11.4	3.36	3.00	2.73	2.81	2.74	2.62

2. Vegetative growth characteristics

Data in Tables 2,3and 4 indicated that there was significant increment in plant vegetative growth which was obtained from cuttings compared with watermelon plants produced from seeds (control). These results were true in the three, *i.e.* seedless cultivars Buttercup F1and SSX7402 F1 and seeded hybrid "AswanF1" in both seasons. This appeared in plant length, leaf area and number of branches and leaves in the first 45 days after planting. These results may be due to the increment in the root formation from cuttings when compared with the primary root which formed from seeds. Cuttings formed large number of lateral roots from the root initiation at the nodes in cuttings. On the other hand data in Tables 5, 6 and 7 showed that at the harvesting stage, there were no significant differences between vegetative growth characteristics, *i.e.* plant length, leaves area, number of branches and leaves and plant fresh and dry weight of watermelon plants from different treated cuttings and that obtained from seeds (control). These results were evidence in all cultivars under this study during the two seasons.

Table 2. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on some vegetative growth characteristics of Aswan hybrid after 45 days from planting in 2011 and 2012 seasons.

Characteristics			2011				2012			
Treatments		IBA ppm	Plant length (cm)	Leaf area (cm^2)	Number/plant		Plant length (cm)	Leaf area (cm^2)	Number /plant	
					Branches	Leaves			Branches	Leaves
	Control from seeds		152	132.65	5.5	111.8	137	136.43	6.0	107.6
Shoot tip	Speedling Trays	0	186	165.68	7.3	128.8	168	189.22	7.5	135.5
		100	189	181.13	7.0	136.4	182	188.93	7.5	143.7
		200	183	188.57	7.0	141.1	188	178.9	6.3	141.4
	Pots 8cm	0	191	175.20	7.3	125.2	189	192.28	8.0	145.1
		100	209	187.16	7.0	147.7	210	190.89	7.0	139.6
		200	193	181.47	6.7	151.0	216	194.23	7.0	129.8
One node	Speedling Trays	0	231	216.09	8.0	154.3	223	232.66	8.5	144.3
		100	197	225.68	8.0	147.7	203	239.41	8.0	148.7
		200	235	229.94	7.0	150.5	237	225.65	8.0	159.9
	Pots 8cm	0	222	229.99	8.3	145.9	217	218.48	8.0	152.4
		100	231	235.85	8.0	160.3	235	233.14	8.5	157.2
		200	236	227.40	7.0	157.9	227	233.63	8.0	154.9
L.S.D. 0.05			24.5	31.240	1.7	16.10	30.1	36.210	1.2	23.45

Table 3. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on some vegetative growth characteristics of Buttercup hybrid after 45 days from planting in 2011 and 2012 seasons.

Characteristics			2011				2012			
Treatments		IBA ppm	Plant length (cm)	Leaf area (cm^2)	Number/plant		Plant length (cm)	Leaf area (cm^2)	Number /plant	
					Branches	Leaves			Branches	Leaves
	Control from seeds		143	149.47	5.3	100.9	151	141.58	6.0	112.8
Shoot tip	Speedling Trays	0	182	175.38	6.7	123.6	169	186.58	7.7	135.8
		100	179	183.57	7.0	129.6	189	179.57	7.3	139.4
		200	178	180.75	7.3	139.8	182	181.87	6.7	134.9
	Pots 8cm	0	186	186.25	6.7	131.7	191	185.78	7.3	143.8
		100	189	179.98	7.3	139.5	212	191.88	7.3	141.8
		200	190	191.67	7.0	149.6	209	196.98	7.7	148.7
One node	Speedling Trays	0	218	229.09	7.7	157.8	227	241.54	8.7	143.8
		100	228	238.68	8.3	158.6	214	231.58	8.7	152.5
		200	226	234.94	7.3	148.5	229	229.74	8.3	149.2
	Pots 8cm	0	228	232.99	7.7	151.7	226	238.58	8.7	155.4
		100	219	227.66	8.7	161.8	248	241.74	8.0	148.4
		200	231	238.65	8.3	152.8	238	239.57	9.0	151.8
L.S.D. 0.05			32.4	22.240	1.3	22.00	26.9	39.800	1.5	22.00

Table 4. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on some vegetative growth characteristics of SSX7402 hybrid after 45 days from planting in 2011 and 2012 seasons.

Characteristics			2011				2012			
Treatments		IBA ppm	Plant length(cm)	Leaf area (cm^2)	Number/plant		Plant length(cm)	Leaf area (cm^2)	Number /plant	
					Branches	Leaves			Branches	Leaves
	Control from seeds		139	141.85	6.0	121.5	132	162.00	6.0	119.9
Shoot tip	Speedling Trays	0	174	165.89	7.7	138.9	171	197.65	7.7	142.6
		100	182	178.36	7.3	139.9	177	201.57	7.0	140.6
		200	179	187.75	7.7	147.1	183	213.19	7.0	139.8
	Pots 8cm	0	189	173.86	7.3	137.6	190	218.56	8.3	146.4
		100	205	183.92	7.3	143.1	201	124.54	8.0	140.3
		200	211	199.69	7.3	152.0	209	214.45	8.0	143.8
One node	Speedling Trays	0	238	209.95	8.7	158.1	228	234.54	8.3	147.6
		100	209	235.68	8.3	146.0	222	242.47	8.3	151.5
		200	222	229.87	8.0	151.6	231	240.15	8.7	149.7
	Pots 8cm	0	230	242.96	8.0	150.6	227	229.48	8.7	158.8
		100	228	237.87	8.7	160.1	236	236.05	8.3	149.7
		200	237	236.85	8.0	153.3	232	235.15	8.3	156.8
L.S.D. 0.05			33.8	22.580	1.5	14.10	36.0	32.909	1.1	20.50

Table 5. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on some vegetative growth characteristics of Aswan hybrid at harvesting in 2011 and 2012 seasons.

Characteristics			2011					2012				
Treatments		IBA ppm	Plant length(cm)	Plant fresh weight	Leaves area (cm^2)	Number/plant Branches	Number/plant Leaves	Plant length(cm)	Plant fresh weight	Leaves area (cm^2)	Number /plant Branches	Number /plant Leaves
Control from seeds			508.0	2.493	57167	12.7	512.6	489.3	2.403	55257	12.5	513.3
Shoot tip	Speedling Trays	0	499.3	2.467	56740	11.6	489.0	499.6	2.450	53935	11.8	485.0
		100	501.0	2.390	59062	11.6	491.3	491.6	2.380	57440	11.5	500.0
		200	495.0	2.460	56800	11.2	485.0	481.6	2.417	57898	11.8	481.3
	Pots 8cm	0	501.0	2.387	56901	11.7	499.6	525.6	2.373	58153	12.0	484.6
		100	505.6	2.520	53636	11.5	481.0	478.6	2.367	57955	11.5	503.3
		200	496.0	2.440	54692	11.6	484.0	489.0	2.427	58307	11.9	503.0
One node	Speedling Trays	0	510.3	2.443	54403	11.7	485.6	490.0	2.430	57170	11.6	492.0
		100	505.3	2.407	57019	11.6	492.6	495.0	2.407	58051	10.8	491.3
		200	525.0	2.440	57118	11.7	493.0	505.6	2.467	57739	11.3	499.3
	Pots 8cm	0	496.3	2.507	57435	11.5	487.6	490.6	2.480	55393	11.0	494.0
		100	516.0	2.503	56868	11.9	487.0	491.0	2.470	57834	11.4	498.0
		200	493.0	2.510	58511	12.0	494.7	491.6	2.453	57701	10.7	490.3
L.S.D. 0.05			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 6. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on some vegetative growth characteristics of Buttercup hybrid at harvesting in 2011 and 2012 seasons.

Characteristics			2011					2012				
			Plant length (cm)	Plant fresh weight	Leaves area (cm^2)	Number/plant		Plant length (cm)	Plant fresh weight	Leaves area (cm^2)	Number /plant	
Treatments		IBA ppm				Branches	Leaves				Branches	Leaves
Control from seeds			379.07	2.167	46766	11.23	456.00	380.40	2.159	48001	11.57	482.47
Shoot tip	Speedling Trays	0	388.77	2.135	47620	10.77	444.13	391.50	2.167	47530	10.87	469.83
		100	375.23	2.120	49390	10.57	459.50	382.07	2.161	49337	11.00	478.07
		200	387.73	2.149	46552	10.70	436.23	379.63	2.199	50022	11.13	463.90
	Pots 8cm	0	374.03	2.122	47568	11.13	448.20	404.27	2.171	49771	11.47	466.17
		100	378.27	2.173	45663	10.67	447.07	377.97	2.142	49111	11.23	474.67
		200	383.00	2.129	45978	10.63	446.43	388.17	2.206	50017	10.93	471.07
One node	Speedling Trays	0	381.47	2.121	46495	10.97	453.40	388.60	2.187	49777	11.13	475.00
		100	387.57	2.149	46967	10.80	456.90	387.87	2.190	49834	10.77	473.63
		200	385.90	2.157	47475	10.70	464.97	387.53	2.218	50281	10.83	480.03
	Pots 8cm	0	393.17	2.164	47587	10.87	448.27	382.37	2.201	48091	10.73	477.77
		100	380.83	2.198	46341	11.00	459.83	381.17	2.210	49872	11.03	477.73
		200	390.13	2.172	47818	10.90	455.70	385.87	2.213	49019	10.77	477.47
L.S.D. 0.05			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

Table 7. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on some vegetative growth characteristics of SSX 7402 hybrid at harvesting in 2011 and 2012 seasons.

Characteristics			2011					2012				
			Plant length (cm)	Plant fresh weight	Leaves area (cm^2)	Number/plant		Plant length (cm)	Plant fresh weight	Leaves area (cm^2)	Number /plant	
Treatments		IBA ppm				Branches	Leaves				Branches	Leaves
Control from seeds			337.7	2.255	45323	12.0	486.7	344.3	2.328	49939	12.8	544.7
Shoot tip	Speedling Trays	0	344.0	2.213	47621	12.0	484.3	358.3	2.300	50229	12.0	547.7
		100	323.0	2.255	49179	11.5	515.7	345.7	2.357	50683	12.6	535.3
		200	348.7	2.250	45220	12.2	471.0	350.3	2.402	51728	12.6	537.0
	Pots 8cm	0	324.7	2.263	47345	12.6	482.7	360.3	2.383	50923	13.2	537.0
		100	328.0	2.242	46437	11.8	498.7	349.7	2.327	49674	13.1	529.3
		200	333.7	2.227	46070	11.6	494.3	361.7	2.407	51308	12.1	549.0
One node	Speedling Trays	0	340.0	2.205	47493	12.3	508.0	361.7	2.363	51918	12.8	546.7
		100	339.0	2.303	45911	12.1	508.7	355.0	2.393	51163	12.7	552.7
		200	340.3	2.287	46925	11.8	526.0	343.7	2.395	52455	12.4	553.0
	Pots 8cm	0	336.7	2.235	46853	12.2	494.7	347.3	2.343	50000	12.5	549.0
		100	338.3	2.313	44689	12.2	520.7	344.3	2.373	51463	12.8	544.7
		200	339.0	2.250	46283	11.9	504.0	354.0	2.397	49726	12.8	556.0
L.S.D. 0.05			NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

3. Flowering

It is obvious from Table 8 that the watermelon plants obtained from plant cuttings in all cultivars in both seasons showed a significant speedily transformation to flowering (15-20 days) earlier than the watermelon plants produced from seeds (control). This result may be due to the more vigorous vegetative growth than the control during the first 45 days after planting, and also due to significant increment in roots number in all seedlings from all cuttings (Table 1). Early flowering may be due to using the cuttings from adult watermelon plants and the mother plants had exceeded the juvenility stage. Similar results were found by Kurata (1976) and Sakata *et al.* (2007) they found that grafting watermelon onto bottle gourd caused early formation of female flowers. Flowering date affects fruit harvesting time, which show a direct impact on quality. Sex expression and flowering order are controlled by plant hormones.

These differences in number of days to flowering led to large differences in the time of the harvesting stage between the watermelon plants produced from cuttings compared with the control plants. The harvesting stage started and ended from cuttings 15 days earlier than the control. The early production was due to early flowering in all cutting treatments.

4. Yield and its components

Results in Tables 9, 10 and 11 showed that there were significant differences between the plants produced from all cuttings and the control in early yield in all watermelon cultivars in both seasons. Early yield from all cutting treatments showed a significant earliness as compared with the control plants. The highest early yield in Aswan hybrid was recorded in the first season for one node cutting which was treated with 0 ppm IBA followed by planting in speedling trays (5.41ton/feddan), while in the second season one node cuttings treated with 100 IBA and planted in speedling trays gave (5.37 ton/feddan). The differences among all cutting treatments didn’t arrive to the significant level. Similarly, all cutting treatments showed a higher early yield from 240.67 to 258.85% in the first season and 244.44 to 271.21% in the second season compared with control plants in Aswan cultivar and from 208.46 to 228.57% in the first season and from 217.64 to 229.94%) in the second season in "Buttercup" while this increase in early yield was in the seedless hybrid "SSX7402" from 173.3 to 208.25% in the first season and 179.24 to197.64% in the second season. No significant differences were recorded among all cutting treatments in all cultivars during the two studied seasons. This method of propagation gave positive significant effects on early yield, this may be due to using the mother plants after the flowering stage. Also, it may be due to the strong vegetative growth in the plants which produced from all cutting treatments in both seasons. These results are consistent with those reported by El-Eslamboly, (2010). Data in the same tables showed no significant differences in total, marketable yield among all treatments in all cultivars in both seasons.

Data in the same Tables (9, 10 and 11) illustrated that, no significant differences between all cutting treatments and control concerning, fruit fresh weight, fruit size and rind thickness in both seasons. These characteristics were not affected by this method of propagation in Aswan hybrid.

The red seedless watermelon SSX 7402 F_1 and yellow seedless watermelon Buttercup F_1 hybrid showed the same trend of results as the seeded watermelon Aswan F_1in fruit fresh weight and size and rind thickness. No significant differences were also noticed between all cutting treatments and control plants in fruit weight, size and rind thickness.

Data in Table 12 clearly indicated that there were no significant differences in total chlorophyll content as SPAD values between all treatments during the two seasons as shown in different experiments under this study. SPAD values have been shown to have a strong correlation with leaf chlorophyll content and can be used for rapid diagnosis of leaf N supply status (Yadava, 1986).Generally no plants showed symptoms of N deficiency in the present work. SPAD readings may assist in evaluating the status of N in crops and could potentially define N fertilizer needs in horticultural crops.

Currently, there are no clear sampling guidelines for using chlorophyll N levels as an indicator of leaf N status in a range of crops. The SPAD meter may help growers to optimize N fertilizer applications to improve tree health and long-term cumulative fruit yield. It is presumed that the increased yield and vegetative growth are due to increases in vigor, chlorophyll content, photosynthesis and peroxidase activity in the plants.

Changes in concentration of leaf pigments (chlorophyll and carotenoids) and its relation are good indicators of perturbations in plants caused by environmental factors. Chlorophyll content was measured as an indicator of the photosynthetic rate (Leidi *et al.*, 1991). The plant analysis diagnostic (SPAD) chlorophyll meter provides a quick and non destructive method for estimating the level of N in leaves (Leidi *et al.,* 1991).

Table 8. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on plant dry weight and number of days to flowering of three watermelon hybrids in 2011 and 2012 seasons.

Characteristics			2011						2012					
			Plant dry weight(g)			No. days to flowering			Plant dry weight(g)			No. days to flowering		
Treatments		IBA ppm	Buttercup	SSX 7402	Aswan	Buttercup	SSX 7402	Aswan	Buttercup	SSX 7402	Aswan	Buttercup	SSX 7402	Aswan
Control from seeds			230.77	308.68	264.06	31.0	36.3	31.3	229.19	301.46	245.32	34.7	31.3	34.7
Shoot tip	Speedling Trays	0	226.92	301.09	242.14	16.0	17.3	17.0	229.94	302.98	244.56	14.3	13.3	15.3
		100	224.59	294.32	263.97	15.3	17.0	17.0	227.86	290.81	297.60	13.7	13.7	16.0
		200	227.14	294.09	241.18	15.0	15.7	16.7	231.17	289.3	268.80	15.3	14.3	16.3
	Pots 8cm	0	225.17	294.34	250.12	15.3	16.7	17.0	227.66	281.23	281.42	15.0	14.7	16.7
		100	229.37	295.53	232.57	14.7	16.0	16.3	225.52	285.47	265.14	14.3	13.7	16.0
		200	224.59	287.25	253.01	15.0	15.3	17.3	231.97	291.24	270.77	16.0	15.0	16.0
One node	Speedling Trays	0	223.72	281.03	250.75	15.7	15.7	18.0	230.50	292.28	267.58	17.7	15.7	15.7
		100	226.49	287.96	234.12	16.0	16.7	17.7	230.42	289.49	264.98	16.3	14.7	15.7
		200	228.35	297.35	268.36	15.3	16.7	16.7	234.74	304.12	272.80	15.7	15.0	16.3
	Pots 8cm	0	228.46	295.14	253.69	14.7	15.0	16.7	231.67	290.83	287.79	15.3	14.3	15.7
		100	232.21	300.49	256.75	14.7	15.3	16.7	233.04	297.14	266.33	15.3	14.3	16.3
		200	229.01	294.71	276.39	15.7	16.0	17.7	232.75	291.96	274.19	14.7	14.7	16.0
L.S.D. 0.05			NS	NS	NS	3.57	4.1	3.87	NS	NS	NS	4.81	3.25	3.68

Table 9. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on yield and fruit characteristics of Aswan hybrid in 2011 and 2012 seasons.

Characteristics			2011						2012					
						Fruit						Fruit		
Treatments		IBA ppm	Early yield (ton/fed.)	Total yield (ton/fed.)	Marketable yield (ton/fed.)	Fresh weight (kg)	Size (cm^3)	Rind[a] thickness (mm)	Early yield (ton/fed.)	Total yield (ton/fed.)	Marketable yield (ton/fed.)	Fresh weight (kg)	Size (cm^3)	Rind[a] thickness (mm)
	Control from seeds		2.09	26.08	24.95	7.82	8530	12.1	1.98	24.76	22.70	6.87	7642	12.4
Shoot tip	Speedling Trays	0	5.07	26.40	24.42	7.73	8532	12.2	5.11	24.91	22.99	7.18	7838	12.3
		100	5.05	26.42	24.89	7.70	8423	11.9	5.02	24.71	22.90	7.02	7857	12.1
		200	5.19	26.06	24.23	7.75	8490	12.1	5.30	24.90	23.02	7.49	8158	12.1
	Pots 8cm	0	5.12	25.63	23.94	7.83	8547	12.4	5.08	24.69	23.57	7.27	7968	12.2
		100	5.25	25.92	24.25	7.87	8702	11.9	5.18	24.43	22.60	7.18	7907	12.3
		200	5.17	26.66	25.26	7.43	7558	12.2	5.11	24.20	22.32	7.12	7897	12.5
One node	Speedling trays	0	5.41	26.23	24.74	7.45	8197	12.3	5.08	24.27	22.60	6.95	7763	12.5
		100	5.25	26.54	24.18	7.97	8780	12.4	5.12	24.47	22.58	7.21	8043	12.1
		200	5.07	26.63	24.88	7.65	8392	12.1	5.37	24.70	23.13	7.45	8265	12.3
	Pots 8cm	0	5.12	26.25	24.54	7.78	8488	12.1	5.11	24.70	22.97	7.17	8475	12.3
		100	5.24	26.51	25.07	7.93	8725	12.2	4.84	24.97	23.63	7.41	8110	12.6
		200	5.03	26.71	25.04	7.83	8508	12.2	5.12	24.70	23.24	6.98	7930	12.8
L.S.D. 0.05			1.20	NS	NS	NS	NS	NS	1.42	NS	NS	NS	NS	NS

[a] Rind thickness = rind were measured in four places of the fruit (stem end and thereafter every 90 degrees and an average was taken, average three watermelon fruits).

Table 10. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on yield and fruit characteristics of Buttercup hybrid in 2011 and 2012 seasons.

Characteristics			2011						2012					
						Fruit						Fruit		
Cutting types		IBA ppm	Early yield (ton/fed.)	Total yield (ton/fed.)	Marketable yield (ton/fed.)	Fresh weight (kg)	Size (cm^3)	Rind[a] thickness (mm)	Early yield (ton/fed.)	Total yield (ton/fed.)	Marketable yield (ton/fed.)	Fresh weight (kg)	Size (cm^3)	Rind[a] thickness (mm)
Control from seeds			1.89	19.86	19.06	7.41	7913	10.8	1.87	19.25	17.86	6.84	7658	11.2
Shoot tip	Speedling Trays	0	4.05	20.20	18.76	7.28	7842	11.0	4.25	18.91	17.66	6.82	7651	11.1
		100	4.26	20.42	19.36	7.07	7756	10.7	4.03	19.13	17.95	6.94	7741	11.0
		200	4.32	20.06	19.28	7.47	8028	10.5	4.28	19.46	18.42	7.07	7967	11.3
	Pots 8cm	0	4.17	19.46	18.63	7.33	7870	11.4	4.30	19.61	18.65	6.94	7765	11.2
		100	4.18	19.98	18.65	7.30	8158	11.0	4.14	19.48	18.28	7.09	7899	11.2
		200	4.13	20.42	19.29	7.10	7968	10.8	4.21	19.25	17.92	6.86	7646	11.0
One node	Speedling Trays	0	4.07	19.89	19.09	7.20	7975	11.1	4.08	18.88	17.73	6.81	7745	11.3
		100	4.27	20.08	18.62	7.30	8050	10.9	4.07	19.42	17.87	7.05	8022	11.0
		200	3.94	20.44	18.97	7.31	7984	11.0	4.24	19.15	18.02	7.11	8261	11.2
	Pots 8cm	0	4.07	20.00	18.80	7.43	7988	11.0	4.19	19.16	17.91	7.59	8301	11.1
		100	4.21	20.18	19.20	7.46	8244	11.0	4.10	19.61	18.53	7.07	7918	11.2
		200	4.07	20.24	18.99	7.80	8410	11.3	4.23	19.35	18.39	7.01	7963	11.5
L.S.D. 0.05			1.08	NS	NS	NS	NS	NS	1.27	NS	NS	NS	NS	NS

[a] Rind thickness = rind were measured in four places of the fruit (stem end and thereafter every 90 degrees and an average was taken, average three watermelon fruits).

Table 11. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on yield and fruit characteristics of SSX 7402 hybrid in 2011 and 2012 seasons.

Characteristics			2011						2012					
						Fruit						Fruit		
Treatments		IBA ppm	Early yield (ton/fed.)	Total yield (ton/fed.)	Marketable yield (ton/fed.)	Fresh weight (kg)	Size (cm^3)	Rind[a] thickness (mm)	Early yield (ton/fed.)	Total yield (ton/fed.)	Marketable yield (ton/fed.)	Fresh weight (kg)	Size (cm^3)	Rind[a] thickness (mm)
	Control from seeds		2.06	17.44	16.82	6.42	7059	11.6	2.12	16.82	16.45	6.29	6950	12.1
Shoot tip	Speedling trays	0	3.80	17.86	16.69	6.26	7121	11.9	4.19	16.54	15.72	5.93	6298	12.0
		100	3.93	18.34	17.55	5.89	6820	11.6	3.81	17.21	16.45	6.32	7137	11.9
		200	4.29	17.90	18.02	6.17	6912	11.1	4.08	17.75	17.34	6.10	6892	12.6
	Pots 8cm	0	4.01	17.00	16.88	6.26	7166	12.4	4.05	18.27	17.30	6.07	6858	12.3
		100	3.92	17.86	16.62	6.17	6986	12.3	3.89	18.26	17.46	6.45	7213	12.3
		200	3.88	18.09	17.02	6.21	7055	11.5	4.12	17.98	16.95	6.08	6888	11.6
One node	Speedling trays	0	3.87	17.36	17.10	6.39	7089	12.0	3.85	17.11	16.26	6.14	7018	12.3
		100	4.10	17.47	16.62	6.06	6890	11.6	3.80	18.10	16.58	6.35	7347	12.1
		200	3.57	18.16	16.68	6.40	7133	12.1	4.21	17.25	16.36	6.21	6990	12.3
	Pots 8cm	0	3.79	17.57	16.66	6.50	7263	12.1	4.08	17.29	16.28	6.46	7307	12.0
		100	3.99	17.72	17.02	6.41	7150	12.0	4.15	18.02	16.98	6.18	7050	11.9
		200	3.89	17.66	16.59	6.20	7731	12.4	4.16	16.70	17.06	6.49	7330	12.3
L.S.D. 0.05			0.98	NS	NS	NS	NS	NS	1.13	NS	NS	NS	NS	NS

[a] Rind thickness = rind were measured in four places of the fruit (stem end and thereafter every 90 degrees and an average was taken, average three watermelon fruits).

Table 12. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on total chlorophyll of three watermelon hybrids in 2011 and 2012 seasons.

Characteristics			2011			2012		
			Total chlorophyll (SPAD value)					
Treatments		IBA ppm	Buttercup	SSX 7402	Aswan	Buttercup	SSX 7402	Aswan
	Control from seeds		58.56	56.90	65.21	60.53	58.20	67.01
Shoot tip	Speedling Trays	0	63.25	57.25	67.22	59.25	57.18	66.07
		100	58.38	57.31	66.61	57.30	56.41	66.34
		200	58.89	57.27	65.52	59.87	58.37	68.04
	Pots 8cm	0	57.64	56.20	66.36	57.64	56.44	66.06
		100	58.53	56.99	66.55	59.84	58.41	68.17
		200	58.61	57.11	67.20	59.01	57.57	67.16
One node	Speedling Trays	0	57.72	57.00	64.65	58.77	57.41	67.04
		100	59.71	56.75	67.39	58.86	57.70	67.59
		200	59.36	57.84	67.93	58.54	56.34	64.93
	Pots 8cm	0	58.77	57.81	66.60	60.70	58.09	66.61
		100	62.20	56.94	65.21	66.86	57.13	67.33
		200	58.78	56.81	65.72	59.65	57.06	65.40
L.S.D. 0.05			NS	NS	NS	NS	NS	NS

5. Fruit characteristics

Data in Tables 13, 14 and 15 illustrated that, this method of propagation had no significant effect on fruit characteristics (concerning TSS., fruit dry matter percentage, total sugar content and panel test) in all watermelon cultivars under this study in both seasons and did not show any harmful effects on fruit quality. The vegetative propagation may give plants genetically identical with the mother plants. In this regard Hartmann *et al.,* (2002) reported that cutting is the most common artificial vegetative propagation method, where pieces of the "parent" plant are removed and placed in a suitable environment. So they can grow into a whole new plant, the "clone", which is genetically identical to the parent. Cutting exploits the ability of plants to grow adventitious roots (*i.e.* root material that can generate from a location other than the existing or primary root system, as in from a leaf or cut stem) under certain conditions. Vegetative propagation is usually considered a cloning method.

Table 13. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on fruit characteristics of Aswan hybrid in 2011 and 2012 seasons.

Characteristics			2011				2012			
Treatments		IBA ppm	Fruit dry matter%	T.S.S	Total Sugar (g/100g)	Panel test (Flavor) [a]	Fruit dry matter%	T.S.S	Total Sugar (g/100g)	Panel test (Flavor) [a]
	Control from seeds		7.873	11.93	10.713	3.8	7.923	12.17	10.640	3.8
Shoot tip	Speedling trays	0	7.521	11.63	10.825	3.8	7.762	12.00	10.085	3.7
		100	7.773	11.87	10.322	4.0	7.905	12.03	10.509	4.0
		200	7.782	11.70	10.502	3.6	7.902	11.67	10.420	3.8
	Pots 8cm	0	7.714	11.57	10.483	3.8	7.993	11.50	10.285	3.8
		100	7.725	11.90	10.612	3.8	7.928	11.60	10.821	3.7
		200	7.943	11.83	10.282	3.4	8.050	11.60	10.948	3.8
One node	Speedling trays	0	7.724	11.93	10.428	3.8	7.955	11.43	10.878	3.8
		100	8.197	11.73	10.796	3.8	7.901	11.83	10.751	3.8
		200	8.033	11.70	10.881	3.8	7.997	11.67	10.551	4.0
	Pots 8cm	0	7.891	12.13	10.770	3.7	7.947	11.70	10.917	3.8
		100	7.825	11.93	10.169	3.8	8.010	11.33	10.782	3.7
		200	8.011	11.67	10.845	3.8	8.001	11.90	10.851	3.7
L.S.D. 0.05			NS	NS	NS	NS	NS	NS	NS	NS

[a] Determined by panel testing (flavor)by 3 persons per replication with 3 replication based on the criteria, where 5= Excellent,4= Good, 3= Medium, 2=Fair and 1= Poor

Table 14. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on fruit characteristics of Buttercup hybrid in 2011 and 2012 seasons.

Characteristics			2011				2012			
Treatments		IBA ppm	Fruit dry matter%	T.S.S	Total sugar (g/100g)	Panel test (Flavor) [a]	Fruit dry matter%	T.S.S	Total sugar (g/100g)	Panel test (Flavor) [a]
	Control from seeds		7.489	13.10	9.246	3.7	7.517	11.90	8.285	3.5
Shoot tip	Speedling trays	0	7.172	12.70	8.410	3.3	7.370	12.57	9.074	3.7
		100	7.375	11.90	8.095	3.5	7.530	12.77	8.139	3.5
		200	7.252	12.67	9.183	3.3	7.392	12.47	8.211	3.5
	Pots 8cm	0	7.417	12.60	8.225	3.3	7.330	12.63	8.913	3.7
		100	7.375	12.53	9.184	3.5	7.382	13.07	8.313	3.5
		200	7.321	12.77	8.143	3.3	7.555	12.73	8.501	3.2
One node	Speedling trays	0	7.345	12.47	9.189	3.7	7.545	12.70	8.387	3.7
		100	7.624	13.60	8.353	3.3	7.324	12.70	8.310	3.7
		200	7.539	12.80	8.373	3.7	7.496	12.67	9.253	3.3
	Pots 8cm	0	7.440	12.97	8.328	3.7	7.478	12.90	8.412	3.7
		100	7.482	12.63	9.062	3.3	7.350	12.97	8.881	3.7
		200	7.388	12.70	8.363	3.7	7.386	12.80	8.363	3.3
L.S.D. 0.05			NS	NS	NS	NS	NS	NS	NS	NS

[a] Determined by panel testing (flavor)by 3 persons per replication with 3 replication based on the criteria, where 5= Excellent,4= Good, 3= Medium, 2=Fair and 1= Poor

Table 15. Effect of using cuttings treated with three concentrations of IBA in two containers compared with true seeds on fruit characteristics of SSX 7402 hybrid in 2011 and 2012 seasons.

Characteristics			2011				2012			
Treatments		IBA ppm	Fruit dry matter%	T.S.S	Total sugar (g/100g)	Panel test (Flavor) [a]	Fruit dry matter%	T.S.S	Total sugar (g/100g)	Panel test (Flavor) [a]
	Control from seeds		8.540	12.80	7.516	3.7	8.550	12.63	7.359	4.0
Shoot tip	Speedling Trays	0	8.197	12.20	7.610	3.7	8.390	12.33	7.605	3.7
		100	8.390	12.30	7.328	3.7	8.597	12.50	7.419	3.7
		200	8.110	12.50	7.575	3.7	8.297	12.03	7.431	4.0
	Pots 8cm	0	8.540	12.53	7.496	3.7	8.070	12.47	7.541	3.7
		100	8.437	12.33	7.398	4.0	8.250	13.00	7.324	3.7
		200	8.100	12.50	7.683	3.3	8.507	12.43	7.563	3.7
One node	Speedling Trays	0	8.373	12.30	7.503	4.0	8.580	12.27	7.518	3.7
		100	8.510	12.20	7.461	3.7	8.150	12.47	7.509	3.7
		200	8.490	12.63	7.535	3.7	8.430	12.33	7.469	3.7
	Pots 8cm	0	8.413	12.80	7.518	4.0	8.443	12.37	7.480	3.7
		100	8.573	12.60	7.586	3.7	8.097	12.77	7.499	4.0
		200	8.180	12.23	7.478	3.7	8.187	12.67	7.484	3.7
L.S.D. 0.05			NS	NS	NS	NS	NS	NS	NS	NS

[a] Determined by panel testing (flavor)by 3 persons per replication with 3 replication based on the criteria, where 5= Excellent,4= Good, 3= Medium, 2=Fair and 1= Poor

CONCLUSION

1. Cutting is a new method for watermelon propagation.
2. The container type had no effect of survival percentage, root number.
3. One node cuttings is best type of cuttings for watermelon propagation.
4. The stem cuttings with one node produced a vigorous plant.
5. The plants from cuttings reached harvest 15 days earlier than the plants from seeds.
6. No significant differences according to total and marketable yield, chlorophyll and fruit characteristics were observed between cutting and seeded watermelon plants.

REFERENCES

1. Abd El- Hafez, A. A. 1963. Influence of Ploidy of Some Morphological Charactrs in Watermelon. M.Sc. Thesis, Faculty of Agriculture, Cairo University, Egypt, 394 p.
2. Abd El- Hafez, A. A. 1969. Effect of Gene Markers for The Development of Triploid Watermelon *Citrullus vulgaris,* Schrad. Ph.D. Thesis, Faculty of Agriculture, Cairo University, Egypt, 330 p.
3. Adelberg, J. W., Zhang, X. P. and Rhodes, B. B. 1997. Micropropagation of Citrullus lanatus (Thunb.) Mastsum. and Nakai (Watermelon). pp 60–76. In: Bajaj, Y. P. S. (Ed.) Biotechnology in Agriculture and Forestry, High-Tech Micropropagation V, Vol. 39, Springer-Verlag, Berlin, Heidelerg, ISBN: 3-540-61606-3, 401 p.
4. Allred Amy, J. and Lucier, G. 1990. The U.S. Watermelon Industry AGES9015. ERS Staff Rep. No. AGES9015, United States Department of Agriculture (USDA). Economic Research Service, Commodity Economic Division. VI, Illinois, 73 p, (Cited by Adelberg *et al*., 1997).
5. Andrus, C.F., Seshadri, V. S. and Grimbal, P.C. 1971. Production of seedless watermelons. Technical Bulletin, No. 1425. Agricultural Research Service(ARS), United States Department of Agriculture(USDA), Charleston, South Carolina, 12 p.
6. Association of Official Analytical Chemists. 1975. Official Methods of Analysis of the Association of Official Agriculture Chemists. 12th Ed. Published By the A.O.A.C., Washington, D.C., U.S.A, 870p.
7. Davis, A. R., Perkins-Veazie, P., Sakata, Y., López-Galarza, S., Maroto, J. V., Lee, S. G., Huh, Y. C. , Sun, Z., Miguel A., Cohen, S. R. K. R. and Lee J. M. 2008. Cucurbit Grafting. Critical Reviews in Plant Sciences, 27(1): 50 – 74.

8. El-Abd, M.T.G. 1997. Vegetative propagation of cucumber hybrid 'Cattia'. Egypt journal of horticulture, 24:(1) 59-66
9. El-Eslamboly, A.A.S. 2010. Studies on propagation of watermelon plants. Ph. D Thesis, Department of Vegetable Crops, Faculty of Agriculture, Cairo University Egypt, 151 p.
10. Garret, J. J., Rhodes, B. B. and Zhang, X. 1995. Triploid watermelons resist fruit blotch organism. Cucurbits Genetics Cooperation Reports, 18: 56–57.
11. Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedures for Agricultural Research. International Rice Research Institute, 2nd Ed. Joho Wiley and Sons. Inc. New- York, 680 p.
12. Hartmann, H.T., Kester, D. E., Davies, F. T. and Geneve, R. L. 2002. Hartmann and Kester's ,Plant Propagation, Principles and Practices. 7th Edition. New Jersey: Regent-Prentice Hall, 07458. 873 p.
13. Kihara, H. 1951. Triploid watermelon. Proceeding of the American Society for Horticultural Science, 58:217-230.
14. Kurata, H. 1976. Studies on the sex expression of flowers induced by day-length and temperature in pumpkin and watermelon. Memoirs Faculty of Agriculture, Kagawa University, 29: 1–49. (Cited by Davis *et al.,* 2008).
15. Robbins J.A., Kays S.J. and Dirr MA. 1983. Enhanced rooting of wounded mung bean cuttings by wounding and ethephon. Journal of the American Society for Horticultural Science, 108: 325-329.
16. Leidi E.O., Silberbush, M. and Lips, S. H. 1991. Wheat growth as affected by nitrogen type, pH and salinity. II. Photosynthesis and transpiration. Journal of Plant Nutrition, 14: 247–256.
17. Malik, C. P. and Singh, M. B. 1980. Plant Enzymology and Histoenzymology. A Text Manual. Kalyani Publishers, New Delhi, 262 p.
18. Mason, J.(2004). Nursery management. 2th Edition. ISBN 0 643 09213 7 (NetLibrary eBook). Landlinks Press, Collingwood VIC 3066 Australia, 320 p.
19. Sakata, Y., Takayoshi, O. and Mitsuhiro, S. 2007. The history and present state of the grafting of cucurbitaceous vegetables in Japan. Acta Horticulturae, 731: 159–170.
20. Yadava, I.L. 1986. A rapid and nondestructive method to determine chlorophyll in intact leaves. HortScience, 21: 1449.

تأثير إكثار البطيخ بالعقل علي النمو الخضري والمحصول وجودة الثمار

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البطيخ من محاصيل الخضر الهامة في مصر. يفضل عديد من المستهلكين البطيخ عديم البذور حيث انه أكثر حلاوة في الطعم كما انه لا يحتوي علي بذور صلبة. كما أن تكاليف زراعة البطيخ عديم البذور مرتفعة في مصر نظرا لارتفاع أسعار البذور واستيرادها من الخارج وانخفاض نسبة الإنبات و عدم تجانس الإنبات الذي يترتب عليه عدم تجانس النمو في الحقل. هدفت الدراسة إلي إكثار البطيخ عديم البذور بواسطة العقل الخضرية لتقليل كمية البذور المستوردة المطلوبة للزراعة من هجن البطيخ بصورة عامة و هجن البطيخ عديم البذور بصفة خاصة وكذا تقليل تكاليف إنتاج الشتلات و الوصول إلي شتلات متجانسة في النمو.

العقل الخضرية طريقة لإكثار النباتات لا جنسيا تستخدم علي نطاق واسع في البساتين وبالأخص في إكثار الأشجار و الشجيرات بصورة تجارية بينما في محاصيل الخضر لا تستخدم الا في كل من البطاطا والكسافا كطريقة اكثار تجارية. ومع ذلك فالعقل الخضرية يمكن ان تستخدم كطريقة اكثار تجارية في الطماطم والبطاطس والباذنجان و الخيار والشمام والبطيخ. و تستخدم العقل النباتية في هذه الدراسة كطريقة للاكثار في نباتات البطيخ.

اعتمدت هذه الطريقة علي زراعة هجيني البطيخ عديم البذورالاصفر اللحم (بتركب QV 766) و هجين SSX 7402 الاحمر اللحم و البطيخ البذري الهجين أسوان والتي زرعت في الصوب البلاستيكية كنباتات أمهات وتم تجهيز نوعين من العقل. النوع الأول عقل طرفية من القمم النامية بطول من١٠ –١٥سم و قطر ٠.٤٥ – ٠.٦ سم و النوع الثاني من العقل يحتوي علي ورقة واحدة وبرعم إبطي واحد وعقدة واحدة من الهجن الثلاث.

تمت الدراسة في ثلاثة تجارب منفصلة كل هجين من هجن البطيخ السالف ذكرها كل في تجربة مستقلة و صممت كل من الثلاثة تجارب بطريقة القطاعات الكاملة العشوائية في ثلاث مكررات في موسمين٢٠١٠/٢٠١١ و ٢٠١١/٢٠١٢ في مزرعة بمدينة البدرشين.شملت كل تجربة كل من نوعي العقل التي عوملت بالثلاث تركيزات من حامض الاندول IBA (٠و١٠٠و٢٠٠ جزء في المليون) ثم زرعت في نوعين من الحاويات وهي صواني فوم ذات ٨٤ خلية و الاصص رقم٨. وبذلك شملت كل تجربة من الثلاث تجارب ١٢ معاملة عقل نباتية بجانب معاملة الكنترول و الذي تم زراعتة بالبذور.

وقد اوضحت الدراسة ان كل العقل النباتية المشتملة علي قمة نامية (العقل الطرفية) و التي عوملت باي من التركيزات الثلاث من IBA في كل من نوعي الحاويات كانت اقل في نسبة البقاء بالمقارنة بالعقل النباتية المشتملة علي عقدة واحدة مع جميع التركيزات في كل من الحاويتين كما

اوضحت زيادة كبيرة في عدد الجذور المتكونة علي العقل المحتوية علي عقدة واحدة بالمقارنة بعـــدد الجذور المتكونة علي العقل الطرفية و الكنترول.

جميع معاملات العقل ذات العقدة الواحدة اعطت معدلات بقاء اعلي عن نسب الانبات فـــي كل من هجيني البطيخ عديم البذور الاصفر بتركبQV 766 و الاحمـــر SSX 7402 بينمـــا الهجـــين البذري اسوان كانت نسبة انباتة مساوية لنسبة البقاء في العقل المحتوية علي عقدة واحدة و المعاملـــة بأي من التركيزات الثلاث في كل من صواني الزراعة او الاصص.

كان هناك زيادة معنوية في كل من القياسات الخضرية التي قيست بعد ٤٥ يوم الاولي من الزراعة وكذا المحصول المبكر عن نباتات الكنترول في حين كان هناك انخفاض معنوي في عـــدد الايام من الزراعة للتزهير بالمقارنة بالكنترول و الذي تم الانتهاء من حصادة بعـــد ١٥ يـــوم مـــن حصاد جميع المعاملات الاخري وبهذا فأن استخدام العقل النباتية في اكثار البطيخ ادي الـــي تقليـــل الفترة اللازمة من الزراعة للحصاد.

لم تسجل فروق معنوية في القياسات الخضرية و قياسات المحصول بين جميع معـــاملات العقل والكنترول في مرحلة الحصاد بينما جميع معاملات العقل اعطت زيادة معنوية في المحصـــول المبكر بالمقارنة بالكنترول و الذي نتج عن التزهير المبكر لجميع النباتات الناتجة مـــن العقـــل عـــن بناتات الكنترول.

الكلمات الدالة : البطيخ عديم البذور– الثلاثي– العقل– الاكثار