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IMPROVING THE FRUIT YIELD AND QUALITY OF CUCUMBER BY GRAFTING ONTO DIFFERENT ROOTSTOCKS UNDER SALINE CONDITIONS

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ABSTRACT

Two experiments were carried out under low polyethylene tunnels which furnished with drip irrigation during the two successive winter seasons of 2014-2015 and 2015-2016 at Elbrollous area which represents the circumstance and conditions of coastal zone of north Nile Delta kafr Elsheikh Governorate. The objective of the investigation was to find out the effect of grafting by different cucurbita rootstocks on cucumber hybrid "ESHRAK" (*Cucumis sativus, L.*) on vegetative growth, flowering, yield and fruit characteristics, beside nutrient contents of cucumber plants. Results showed that grafted cucumber plants on Super Shintoza led to significant increase in vegetative growth,i.e**.,** stem length, number of leaves, number of branches and leaf area,fruit fresh weight (g), number of fruits, total yield were greater with grafted cucumber plants on Super Shintoza followed by grafted cucumber plants on cv. Ferro. However grafting had no significant effect on potassium % of fruit on both seasons. The highest total yield was obtained by grafting cucumber plants on Super Shintoza rootstock followed by grafting on cv. Ferro rootstock by 130 % and 73 %, respectively in the first season and 160% and 147 %, in the second season respectively as compared with ungrafted cucumber plants. Accordingly, this study ensured that the use of rootstocks were more beneficial than ungrafted cucumber in both tested seasons.

Keywords: *Cucumis sativus*, salt stress, grafting

INTRODUCTEION

Cucumber (*Cucumis sativus, l.*) is one of the important vegetable crops belongs to family Cucurbitaceous. The cucumber cultivated area in Egypt reached about 69000 feddan in 2015. This area produces about 630 thousand tons, with an average of about 9 tons / feddan according to **(Ministry of Agriculture, 2015).**

Salinity is known as the most important a biotic stress changes the anatomy and morphology of plants.The cucumber is a sensitive vegetable crop to salinity of irrigation water up to 2 mellimos. Due to limited availability of arable land and high market demand for off-season vegetables, cucurbits (including cucumber) are continuously cultivated under unfavorable conditions in some countries such as salinity, drought, low temperature, wet and low-light winter greenhouses. Successive cropping can increase salinity, the incidence of cucurbit pests, and soil borne diseases like fusarium wilt caused by *Fusarium spp*. These conditions cause various physiological and pathological disorders leading to severe crop loss. Chemical pest control is expensive, not always effective, and can contaminate the environment. Grafting can overcome many of these problems **(Singh and Rao 2014).** Chlorophyll, carotenoid contents, stomata length and width of upper and lower surface of leaf were generally reduced under salinity stress **(Yars et al 2017).**

Colla et al (2010b) and Fallik & Ilic (2014) mentioned that grafting vegetables can protect against soil-borne diseases and nematodes, against a biotic stress such as high/low temperatures, salinity, soil alkalinity, drought or excessive

soil-water content. **Farhadi and Rezaie (2015)** reported that use of grafted seedlings increased in greenhouses due to enhancement of fruit quality and increase yield where production faces with unsuitable suboptimal conditions from late fall to early spring such as low temperature, low light intensity, high humidity and salinity. **Rouphael et al (2017)** indicated that the use of grafted vegetable plants can minimize problems associated with successive cropping and a biotic stress, and the enhanced vigour and root growth can provide yield benefits independently from mechanisms to tolerate abiotic stress conditions. Therefore, the application of grafting in crops of the cucurbitaceous and Solanaceae is currently acknowledged worldwide; however, two main challenges remain when grafted plants are used as a tool to improve a biotic stress tolerance.

Grafting increases the ability of plants to absorb water and nutrients from the soil. **Colla et al (2012)** found that grafted cucumber plants exposed to Na_2SO_4 were capable of maintaining a better nutritional status (higher K, Ca and Mg and lower Na) in the shoot tissues and higher membrane selectivity in comparison with ungrafted ones. **Lei et al (2014 a)** showed that the NaCl treatment decreased content of Ca_2+ and K+ but increased the Na+ content in roots and shoots. **Yang et al (2015)** found that the bottle gourd rootstock-grafted seedlings could maintain much higher % of K^+ and a higher ratio of K^+ / Na^+ in all the organs as compared with self-grafted seedlings. This could do the favor to maintain the ion homeostasis for a plant exposed to the salt stress.

Grafting increases, the period of growth and harvest, which stimulates the growth of plants. **Davis et al (2008) and King et al (2010)** mentioned that use of rootstocks can enhance plant vigor through vigorous attainment of soil nutrients, avoidance of soil pathogens and tolerance of low soil temperatures, salinity, and wet-soil conditions. The type of rootstock affects cucurbit plant growth, yield, and fruit quality. **Wang LiPing et al (2012)**, **Zhao Yuan and Wu FengZhi (2014)** and **Farhadi and Rezaie (2015)** reported that the rootstock-grafted cucumber showed improved plant growth significantly compared to non grafted ones.

Grafting increases crop productivity. Whereas, **Huang Yuan et al (2009 a) and Marsic & Jakse (2010)** showed that grafted cucumber plants had higher fruit number, marketable and total fruit yield than those of self-grafted cucumber plants under saline condition. Cucumber plants decrease their productivity and fruit quality by increasing the salinity of irrigation water or soil in some areas irrigated with saline water such as the area of El-borollous.

Therefore, this research aims to improve the productivity and quality of cucumber fruit under saline conditions by cultivating the grafted cucumber seedlings on different tolerant rootstocks to saline conditions.

MATERIAL AND METHODS

Experiments were carried out under low polyethylene tunnels at borollous site, Kafr ElSheikh-Governorate, North Nile Delta during the two successive seasons of 2014-2015 and 2015-2016 to investigate the effect of grafting on plant growth, yield and its components as well as fruit quality of sensitive cucumber plants to salinity.The effect of grafting on cucumber plants was studied under salinity condition Plant growth, flowering, fruit yield and quality characteristics and nutrient contents of the popular tunnels cucumber cultivar *(cucumis sativus*) (F1 hybrid Eshrak as scion) grafted on different cucurbita rootstocks were tested. The study included five genotypes of cucurbita rootstocksShintoza viz, (*cucurbita maxima*cucurbita moschata*), Ferro (*cucurbita maxima*cucurbita moschata*), pumpkin *(cucurbita moschata*), winter squash *(Cucurbita pepo)* and bottle gourd *(Lagenaria siceraria*) to examine their relative tolerance to salinity by determining some physiological and chemical parameters associated with their sensitivity or tolerance to salinity.

The experimental design was complete randomized block design with three replicates. The experimental plot consisted of six treatments. Each treatment was layed in one ridge of 60 m long and 1 m wide. Seedlings were planted on the two sides of each ridge at 50 cm apart, and each plot contained 120 plants.

Plant materials and grafting technique

Seeds of Shintoza supreme pumpkin and Ferro were obtained from Rijk-zwaan company and the seeds ofcucumber cultivar(F1 hybrid 'Eshrak), pumpkin, winter squash and Bottle gourd were kindly taken from Horticulture Research Institute. Seeds were sown on 15 and 20 on November in first and second seasons respectively in trays (84 cells) filled with mixture of peat: vermiculite (1:1, v: v). The seeds of bottle gourd rootstock were sown 6-10 days later than the seeds of the scion to ensure similar stem diameters at the grafting time

due to the differences in growth vigor. Hole insertion grafting technique was used.

The recorded data

Vegetative growth measurements

Five plants were chosen random from each experimental plot at 70 days after transplanting for recording the following data: - Plant length (cm), number of leaves and branches per plant, average leaf area (cm2),fresh and dry weight of leaves and stem/plant (g)were determined.

Fruit yield and its components as well as its quality

The different fruit yield characteristics were measured at harvesting time (marketable stage) in all picked fruits for calculating number of fruits per-plant, average fruit weight (gm), plant total yield. (Kg /plant) and plant total yield. (ton /fed.): All fruits harvested from each treatment along the harvesting period were weighed to calculate the total yield per feddan. Representative samples of ten fruits were taken from each treatment at harvesting time; the average fruit firmness was measured. The total soluble solids (T.S.S) in fruits were determined using a hand refractmeter according to **A.O.A.C. (1996).**

Chemical constituents

Potassium and sodium % in fruits were determined by using flame photometer according to **Jackson (1967).** Chloride concentration was determined according to **Ramsay et al (1955).**

Leaf Relative Water Content (LRWC)

It was determined according to **Yamasaki and Dillen burg (1999)**, the LRWC was calculated using the following formula: LRWC % = (fresh weight-dry weight) / fresh weight at full turgor – dry weight) ×100

Membrane permeability

It was measured according to **(Shi et al 2006)** the electrical conductivity was calculated as (EC1) / (EC2) and expressed as percentage.

Determination of proline

Proline concentration was determined using the method described by **Sadasivam and Manickam (1992).**

Soil and water analysis

Soil and water samples were taken from the farm before and after planting for mechanical and chemical analyses which represented in **Tables (1, 2, 3 and 4).** Soil samples were analyzed at the Soil and Water Research Institute, ARC, Giza.

Table 1. Water analyses of the experimental farm.

EC DS/m	pH	Cations meg/ l^-				Anions meg/ l^-			
		Ca^{2+}	Mg^{2+}	Na^+	K^+	Cl^-	HCO_3^-	SO_4^{2-}	CO_3^{2-}
3.65	7.8	6.8	8.34	25.1	0.72	21.43	5.3	7.2	6.5

Table 2. Mechanical analysis of the soil in the experimental farm.

Depth	Clay %	Silt %	Sand %	Texture
10 cm	7	5	88	Sandy soil

Table 3. Chemical properties of soil samples before planting.

Depth	EC DS/m	pH	Cations meg/l^-				Anions meg/ l^-			
			Ca2+	Mg2+	Na+	K+	Cl-	HCO_3^-	SO_4^{2-}	CO_3^{2-}
10 cm	1.5	8.2	2.5	1.3	2.2	1.5	2.1	1.86	1.4	4.5

Table 4. Chemical properties of soil samples after planting.

Depth	EC DS/m	pH	Cations meg/ l$^-$				Anions meg/ l$^-$			
			Ca^{2+}	Mg^{2+}	Na^{+}	K^{+}	Cl^{-}	HCO_3^{-}	SO_4^{2-}	CO_3^{2-}
10cm	1.01	7.8	1.38	0.8	2.11	0.3	1.5	1.6	0.67	4.3

Statistical analysis

Growth parameters and chemical analysis were performed with analysis of variance using. Analysis of variance was performed for the transformed data using the method described by **Gomez and Gomez (1983).**

RESULTS AND DISCUSSION

1- The effect of different rootstocks on vegetative growth characteristics

Data presented in **Table (5)** showed the effect of grafting combinations on vegetative growth characters, i.e., stem length, number of branches, number of leaves, leaf area.

Concerning stem length,the highest value was obtained by graft combinations of cv. Eshrak/ Shintoza in both seasons, while the lowest value was recorded in cv. Eshrak (un-grafted plant) in the first season and it was recorded on cv. Eshrak/ Pumpkin in the second season. Results were obtained by **El- Wanis et al (2012), Zhao Yuan and Wu FengZhi (2014) and Farhadi & Rezaie (2015).** They found that the plant height was greater for grafted plants compared to non grafted ones.

Concerning number of branches, The highest value was obtained by Eshrak/Shintoza and Eshrak/Ferro in the first season and it was with Eshrak/Shintoza, Eshrak/ Ferro, Eshrak/ Bottle Gourd, and Eshrak/Squash without significant differences among them in the second season while the lowest value was with Eshrak (ungrafted) plants in both season and it was with Eshrak/ Squash in the first season. The Results indicated that grafted plants had the highest number of branches/plant. These results are in harmony with the previous work of **Mohamed et al (2014)** in grafted watermelon, The different genetic background of the different rootstocks was associated with their different rooting and tolerance characteristics to biotic and abiotic stress could explain the observed different impacts of rootstock on vegetative growth.

Regarding number of leaves, the effect of graft combinations on number of leaves was significant in both seasons for all combinations except Eshrak/ Shintoza, Eshrak/ Ferro and Eshrak/ Bottle Gourd, in the second season. The highest values were obtained by Eshrak/Shintoza in the first season and it was with Eshrak/Shintoza, Eshrak/ Ferro and Eshrak/ Bottle Gourd without significant differences in the second season while the lowest value was with Eshrak/ Squash in the first season and it was with Eshrak (ungrafted) plants in second season. these results agree with those of **El- Wanis et al (2012),** who showed that leaf number was greater for grafted plants compared to non grafted ones.

Concerning leaf area, the highest value was obtained by Eshrak/Shintoza and Eshrak/ Ferro in the first season and it was with Eshrak/Shintoza and Eshrak/ Squash without significant differences in the second season while the lowest value was with Eshrak ungrafted plants in both seasons without significant differences with Squash in the first season. Such results were confirmed by those of **El- Wanis et al (2012) and Petropoulos et al (2012)** they showed that leaf area index was greater for grafted plants compared to non grafted ones.

Table 5. Effect of grafting on Eshrak cucumber plantstem length, number of branches, number of leaves and leaf area per plant of cucumber during (2014/2015 and 2015/2016) seasons.

Treatments	Stem Length (cm)		Number of Branches		Number of leaves		Leaf area (cm^2)	
1st season	2nd season	1st season	2nd season	2nd season	1st season	1st season	2nd season	2nd season
C	90.9 E	97.0 D	2.67 C	3.00 C	72.6 D	66.0 D	116 D	112.2 D
C /Sh	185.8 A	173.9 A	6.67 A	5.33 AB	132.0 A	109.7 A	176.7 A	180.9 A
C/F	173.4 B	156.6 B	6.00 A	5.67 A	107.3 B	114.7 A	179.7 A	161.0 B
C /P	103.5 D	86.0 E	3.33 BC	4.00 BC	89.33 C	83.00 B	146.0 B	142.7 C
C /B	121.1 C	144.8 C	4.00 B	4.67 AB	105.3 B	110.0 A	138.0 C	153.8 B
C /Sq	99.4 DE	143.3 C	2.67 C	5.33 AB	66.67 E	76.67 C	110.7 D	172.4 A

Means followed by the same letter are statistically not significant according Duncan's multiple rang test (*P*=0.05)
C: Cucumber Sh: Shintoza F: Ferro P: Pumpkin B: Bottle Gourd Sq: Squash

2- Effect of different rootstocks on yield and its components

Data presented in **Table (6)** showed that all the five used rootstocks gradually and increased yield and its components significantly i.e., fruit weight, fruit number, total yield per plant and total yield per feddan compared with control (ungrafted cucumber)

Data in **Table (6)** showed that the differences in fruit weight were significant in both seasons. The highest value was recordedonEshrak/Shintoza in both seasons while the lowest value was in Eshrak/squash in the first season and Eshrak (ungrafted) plants in both seasons. These results are in agreement with that of **Zhou JunGuo et al (2010) and El- Shraiy et al (2011).**

Regarding number of fruits, results indicated that the highest value recorded on Eshrak/ Shintoza and Eshrak/ Ferro without significant differences in the first season and it was also with Eshrak/ Shintoza in second season while the lowest value was with Eshrak (ungrafted) plants, Eshrak/ pumpkin and Eshrak/ Bottle Gourd in both seasons. These results are in agreement with that obtained by **Huang Yuan et al (2009) and El- Shraiy et al (2011).**

Concerning total yield per plant and per feddan**.** Data indicated that using grafting increased total yield significantly in both seasons except Eshrak/ Shintoza and Eshrak/ Ferro in the second season. The highest value was obtained by Eshrak/ Shintoza in the first season and it was with Eshrak/ Shintoza and Eshrak/ Ferro without significant differences between them in the second season while the lowest value was with Eshrak (ungrafted) plants in both seasons.

In conclusion, data **in Table (6)** showed that number of fruits per plant was the main characteristic which affected yield for all different rootstocks. Therefore, the improving effect of different rootstocks in this respect is mainly attributed to the number of flowers per plant and fruit set percentage which, in turn, resulted in high yield. Obtained results are in agreement with that of **Farhadi and Rezaie (2015) and Wang Qing et al (2017)**. They mentioned that the higher crop performance of grafted (Ekron/Affyne) cucumber recorded with NaCl than with $CaCl_2$ was attributed to the limited capability of the rootstocks to restrict Cl^- shoot uptake, thus Cl^-, which continues passing to the leaves, becomes the more significant toxic component of the saline solution.

3- Effect of different rootstocks on Chemical composition

A- Leaf relative water content (LRWC %)

Results in **Table (7)** showed that the highest leaf relative water percentage was recorded in grafted cucumber plants on Ferro and squash cv. without significant differences in the first season while in the second season, the highest percentage was found with cucumber grafted plants on Ferro and Shintoza without significant differences as compared to all graft combinations. The lowest percentage of leaf relative water content was obtained with ungrafted plants (control) in both seasons. These results are in agreement with that recorded by **Colla et al (2010 a)**.

Table 6. Effect of grafting on Eshrak cucumber plant fruit fresh weight (g), number of fruits and total yield (Kg/plant) of cucumber during (2014/2015 and 2015/2016) seasons.

Treatments	Fruit fresh weight (g)		Number of fruits		Total yield (Kg/plant)		Total yield (ton/Fed.)	
Scion / stocks	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
C	98.07D	89.1 E	20.93 C	23.53 D	1.23 D	1.06 D	6.40 D	5.50 D
C / Sh	136.2 A	150.1A	34.30 A	41.78 A	2.533 A	2.683 A	13.17 A	13.93 A
C/ F	123.3 B	127.1 BC	31.93 AB	37.50 B	1.963 B	2.533 A	10.20 B	13.17 A
C / P	109.5 C	96.63 D	23.18 C	26.75 D	1.467 D	1.367 C	7.633CD	7.100 C
C / B	102.4CD	126.0 C	23.67 C	25.90 D	1.700 C	1.567 BC	8.833 BC	8.167 BC
C / Sq	97.90 D	133.6 B	29.30 B	32.05 C	1.633 CD	1.700 B	8.500 C	8.833 B

Means followed by the same letter are statistically not significant according Duncan's multiple rang test (*P*=0.05).
C: Cucumber Sh: Shintoza F: Ferro P: Pumpkin B: Bottle Gourd Sq: Squash

Table 7. Effect of grafting on Eshrak cucumber plant leaf relative water content (LRWC %), membrane permeability (%), free proline and chlorophyll reading of cucumber during (2014/2015 and 2015/2016) seasons.

Treatments	LRWC (%)		Membrane permeability (%)		Free Proline (µmol/100g FW)		Chlorophyll reading (SPAD)	
Scion/stocks	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
C	73.75 C	76.55 C	28.85 A	31.18 A	87.25 D	105.9 E	35.80 B	37.10 BC
C / Sh	83.48 B	87.59 A	21.39 C	23.63 CD	151.7 A	226.4 A	36.47 AB	41.73 A
C/ F	88.70 A	88.38 A	23.52 BC	22.86 D	138.1 B	132.0 D	40.23 A	39.97 AB
C / P	84.18 B	81.56 B	26.36 AB	26.15 B	132.3 B	155.7 B	35.27 B	37.00 BC
C / B	82.09 B	81.48 B	26.61 AB	25.03 BC	100.6 C	140.7 C	36.57 AB	35.23 C
C / Sq	85.06AB	78.19 BC	25.17 AB	26.37 B	137.9 B	149.7 B	36.17 AB	35.80 BC

Means followed by the same letter are statistically not significant according Duncan's multiple rang test (*P*=0.05)
C: Cucumber Sh: Shintoza F: Ferro P: Pumpkin B: Bottle Gourd Sq: Squash

B- Membrane permeability (%)

Data in **Table (7)** showed that the highest percentage of membrane permeability was recorded with ungrafted cucumber Plants (Control), Eshrak/ Pumpkin, Eshrak/Bottle Gourd and Eshrak/Squash with no significant differences among them in the first season while in the second season, the highest percentage was shown with ungrafted cucumber plants as compared to all graft combinations. The lowest percentage was observed with grafted cucumber on Shintoza in the first season and it was with grafted cucumber on Ferro in the second season. These results are in agreement with that recorded by **Chen and Wang (2008)** stated that the cell membrane permeability in leaves was much less in grafted plant than ungrafted ones.

C- Proline content

Differences among the different graft combinations in proline contents are shown in **Table (7).** Grafted cucumber on Shintozagave the highest value of proline content as compared to all graft combinations. Cucumber (ungrafted) plants had the lowest value of proline content in both seasons.In accordance with our results, proline content increased in watermelon **(Yang et al 2012)** and grafted pepper **(Penella et al 2015)** under salt stress.

D- Chlorophyll reading (SPAD)

Data in **Table (7)** showed that the highest value of chlorophyll was found with grafted cucumber on Ferro, Shintoza, Bottle Gourd and Squash without

significant differences among them in the first season while in the second season; it was with cucumber grafted on Shintoza and Ferro without significant differences between them as compared with to all graft combinations. The lowest value was obtained from grafted cucumber on pumpkin and ungrafted cucumber in the first season and it was when cucumber grafted on bottle gourd in the second season. These results are in agreement with those of **Colla et al (2013) and Wang Qing et al (2017)**.

E- Sodium % in shoots

Regards the sodium % in shoots, Data in Table (8) showed that the lowest % was found with grafted plants than ungrafted plants in both seasons. The highest value was recorded in cv. Eshrak ungrafted cucumber in both seasons while the lowest value in shoots was recorded in Eshrak/ Pumpkin in the first season and with Eshrak/Shintoza, Eshrak/ Ferro and Eshrak/ Bottle Gourd in the second season. These results are in agreement with that stated by **Wang Qing et al (2017) and Yarsi et al (2017).**

F- Sodium % in roots

Regards the sodium **%** in roots, the highest value was found in grafted plants than ungrafted in both seasons. The highest **%** of Na in root was obtained from Eshrak/ Pumpkin, Eshrak/ Squash, Eshrak/Shintoza in the first season while in the second season, it was Eshrak/ Ferro. The lowest value of Na **%** in root was recorded in Eshrak/ bottle gourd and ungrafted Eshrak in the first season and it was with ungrafted plants (control) in the second season. Our data confirmed that grafted cucumber plants outperformed those ungrafted ones for their growth and yield characteristics under NaCl induced stress. This may be attributed to the accumulation of Na in the roots more than in the leaves in grafted plants. These results are in agreement with those of **Chen and Wang (2008)** on cucumber seedlings and **Lei Bo et al (2014 b)** on pumpkin.

G- Chloride % in shoots

Data in **Table (8)** showed that the lowest **%** was found in grafted plants than ungrafted plants in both seasons. The highest **%** was detected in Eshrak (ungrafted) cucumber in both seasons whereas the lowest **%** Cl in shoots was found in Eshrak/Ferro and Eshrak/ bottle gourd in the first season and it was with Eshrak/ Pumpkin in the second season. The results of **Huang Yuan et al (2009 b) and Gul et al (2017)** confirm these results.

H- Chloride % in roots

The highest value was found in grafted Eshrak/ bottle gourd in the first season while in the second season, it was with Eshrak/Shintoza.While the lowest concentration of Cl in roots was found in ungrafted Eshrak in both seasons **(Table 8).** Such results were recorded by **Romero *et al* (1997)**, **Saccardo et al (2006) and Huang Yuan et al (2009 b)**.

Table 8. Effect of grafting on Eshrak cucumber plant sodium % and chloride % in shoots and roots of cucumber during (2014/2015 and 2015/2016) seasons.

Treatments	Sodium in the shoot%		Sodium in the root %		Chloride in the shoot %		Chloride the root %	
Scion/stocks	1st Season	2nd season	1st Season	2nd season	1st Season	2nd season	1st Season	2nd season
C	5.20A	5.69A	6.97C	6.13D	51.63A	61.84A	27.22D	36.46 E
C / Sh	4.17BC	3.03C	10.50AB	11.26C	37.42B	38.31C	38.33C	64.97 A
C/ F	3.77BC	2.43C	7.87BC	19.83A	24.90C	40.00BC	39.40C	54.69 C
C / P	3.33C	4.07B	11.07A	13.96BC	37.22B	34.85D	52.58B	59.25 B
C / B	3.77BC	2.80C	6.63 C	16.77B	24.11C	40.69BC	55.63A	52.44 C
C / Sq	4.57AB	3.40BC	10.97A	11.57C	34.49 B	42.09B	51.62B	45.98D

Means followed by the same letter are statistically not significant according Duncan's multiple rang test (*P*=0.05).
C: Cucumber Sh: Shintoza F: Ferro P: Pumpkin B: Bottle Gourd Sq: Squash

4- Effect of grafting on physical and chemical fruit characteristics

Concerning firmness in cucumber fruits. Data presented in **Table (9)** showed that there were significant differences among different rootstocks regard fruit firmness. The highest value was recorded in Eshrak/Shintoza, Eshrak/Ferro and Eshrak/ pumpkin without significant differences in the first season and it was with Eshrak/Shintoza in second seasons. While the lowest value of fruits firmness was recorded in Eshrak ungrafted cucumber without significant differences with Eshrak/squash in both seasons. **Colla et al (2006 a)** confirm these results.

Concerning potassium % in fruit, results showed no significant differences among graft combinations and Eshrak (ungrafted) plants in both seasons **(Table 9).**

Concerning total soluble solids in cucumber fruits. Using bottle gourd and pumpkin as rootstocks led to clear increments in the total soluble solids in fruit scion compared with Squash and Ferro rootstocks .The highest TSS % was recorded in all used treatments except Eshrak/Squash in both seasons and Eshrak/Ferro in the second season which had the lowest concentration. Our results agree with those reported by **Colla et al (2006 b), Colla et al (2007), Huang Yuan et al (2009 a) and Colla et al (2013).**

Concerning sodium % in cucumber fruits. Grafting was found to play an important role in increasing fruit quality concerning Na % in fruit (Table 9).The lowest % was found in grafted plants than ungrafted plants in both seasons. The highest value was recorded in Eshrak (ungrafted) cucumber in both seasons. While the lowest Na value in fruits was recorded in Eshrak/Shintoza and Eshrak/ bottle gourd in the first season and it was from Eshrak/Shintoza in the second season.Similar results were obtained by **Huang Yuan et al (2009 a)**.

Table 9. Effect of grafting on Eshrak cucumber plantSodium (fruit, mg/g), Potassium (%), TSS (%) and Firmness (Kg/cm^2) of Fruit cucumber during (2014/2015 and 2015/2016) seasons.

Treatments	Firmness(Kg/cm^2)		Potassium (%)		TSS (%)		Sodium (%)	
Scion / stocks	1st season	2nd season	1st season	2nd season	1st season	2nd season	1st season	2nd season
C	61.4 C	61.3 D	1.32 A	1.17 A	4.50 A	5.53 A	0.06 A	0.06 A
C / Sh	63.7 A	64.6 A	1.28 A	1.39 A	4.40 A	4.70 AB	0.03 C	0.02 D
C/ F	63.4 AB	62.4 C	1.32 A	1.33 A	4.60 A	4.10 BC	0.05 AC	0.04 CD
C / P	63.2 B	63.3 BC	1.21 A	1.20 A	4.40 A	5.63 A	0.04 BC	0.06 AB
C / B	62.7 B	63.4 B	1.20 A	1.24 A	4.77 A	5.27 A	0.04 C	0.05 BC
C / Sq	60.7 C	60.8 D	1.39 A	1.37 A	3.23 B	3.53 C	0.05 AB	0.03 CD

Means followed by the same letter are statistically not significant according Duncan's multiple rang test (*P*=0.05).
C: Cucumber Sh: Shintoza F: Ferro P: Pumpkin B: Bottle Gourd Sq: Squash

CONCLUSION

The results indicated that certain rootstock genotypes were able to tolerate high salt. Plants of Eshrak/Shintoza had better total yield per feddan (similar to Eshrak/Ferro) and fruit quality compared with other graft combinations. All graft combinations accumulated more Na in their roots than ungrafted plants which may explain the relative tolerance of these plants to salinity stress**.**

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تحسين المحصول الثمري والجوده فى الخيار بالتطعيم على أصول مختلفة تحت الظروف الملحية

[71]

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الموجـــــز

أجريت تجربتان حقليتان تحت ظروف الأنفاق البلاستيكية بنظام الري بالتنقيط فى الموسم الشتوي لعامي 2014- 2015 و2015 - 2016 في منطقة البرلس الواقعة تحت ظروف المنطقة الساحلية لشمال الدلتا لدراسة تأثير التطعيم بأصول قرعية مختلفة والمتحملة نوعاً ما للملوحة علي صفات النموالخضري والمحصول الكلي وصفات الثمرة لنباتات الخيار هجين (أشراق) لزيادة مقدرة نباتات الخيارعلى الإنتاجية مع الحفاظ على الجودة تحت الظروف الملحية. وقد أوضحت النتائج أن نباتات الخيار المطعومة على سوبرشينتوزا أدت الى زيادة معنوية وأعلى قيم لطول الساق، عدد الفروع، عددالأوراق، مساحة الورقة أما بالنسبة للوزن الطازج للثمار، عدد الثمار، المحصول الكلي كانت أفضل مع نباتات الخيار المطعومة على سوبرشينتوزا ثم نباتات الخيار المطعومةعلى أصل الفيرو، ولكن التطعيم لا يؤثر بشكل كبير علي النسبة المئوية للبوتاسيوم في الثمار في كلا الموسمين وتم الحصول على أعلى محصول كلي للثمار مع نباتات الخيار المطعومة على سوبرشينتوزا ثم نباتات الخيار المطعومة على الفيرو بزيادة بنسبة 130٪ و 73٪ على التوالى في الموسم الأول و160٪ و147٪ على التوالي في الموسم الثاني بالمقارنة مع نباتات الخيار غير المطعوم (الكنترول). وتجمل الدراسة أن استخدام الأصول القرعية إضافة كمية كان له فائدة عن الخيار غير المطعوم في الموسمين.

الكلمات الدالة: خيار، الإجهاد الملحي، التطعيم

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