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EFFECT OF GRAFTING ON VOLATILE COMPONENTS OF TWO MELON VARIETIES

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ABSTRACT

An experiment was conducted under unheated plastic house conditions at Kaha experimental station, Kaliobia Governate, in winter season of 2004 to study the effect of grafting of two melon cultivars, namely Kahera 6 and Galia F1, on some rootstocks, namely *Cucurbita ficifolia*, hybrid No.6, Butternut squash and Shammam Eljordon on volatile components of fruits was studied. Fruit volatile components of cv. Kahera 6 consisted of 34.6% alcohols, 32.5% esters, 20.9% hydrocarbons and 10.5% aldehydes, while those of Galia F1Consisted of 24.5% alcohols,5% esters, 36.9% hydrocarbons, 15.9% acids, 9%nitrogenous.

Grafting on the different rootstocks led to greet changes in the percentages of different volatile components in addition to containing new compounds, which were passed from the rootstocks or created in the scion fruits. The contents of grafted fruits depended on the interaction between both of scion and rootstock type. So, the present study indicated that grafting affects aroma of melon fruits.

Keywords : aroma, melon, grafting, rootstocks.

INTRODUCTION

Vegetable grafting has been manily used to control nematodes and soil-borne diseases, such as *Verticillium* (Slobbe, 1965) *Fusarium* (Slobbe, 1965; Rugger, 1968; Matsuo *et al*., 1985; Igrashi *et al*., 1987) and rootknot nematode (Igrashi *et al*., 1987), as well as improving plant growth and yield (Zijlstra *et al*., 1994). However, rootstocks may negatively affect the quality of fruit born on scions. For example, it is well known that grafting onto some varieties of *Cucurbita* spp. rootstocks degrades the fruit taste of watermelon and melon (Harnett, 1974). More than 160 compounds have been identified in the volatile fractions of muskmelon (Maarse and Visscher, 1987). The characteristics of muskmelon aroma are very preferential by many consumers. The flavour of melon varieties is due to a complex but well defined mixture of different classes of chemical compounds (Engel *et al*., 1990). As regard to aroma composition, Nijsser *et al*. (1996) mentioned that the volatile compounds in melon tabulated 219 compounds. One hundred and seventy four of the compounds are alcohols, aldehydes, ketones, esters and sulfur containing compounds. Beaulieu and Crimm (2001) showed that most of compounds in melon were esters and aldehydes. Several factors such as, ethylene, fruit maturity and attachment to the parent plant influence the production of volatiles by muskmelon during the ripening period (Engel *et al*., 1990). A previous study also demonstrated that volatile compounds in melon could affected by storage condition after harvesting (Kemp *et al*., 1973). All esters and aldehydes belived to have flavour impact increased often harvest maturity. However, these compounds were decreased when

fruits were harvested over-ripe. The importance of esters as a main flavour component and their relationship with maturity stage of melon was confirmed by Emilio *et al*.(2005) who found that the different aroma components were depending on the ripening stages, and esters, which were the main flavour component, increased 10-15 fold from ripe and over-ripe stages.Very few informations about the effect of grafting on melon volatile components were found. Therefore, the objective of the present work was to study the effect of grafting on volatile compounds of scion fruits of two melon varieties, i.e. Galia F1 and Kahera 6.

MATERIALS AND METHODS

The present study was carried out under unheated plastichouse condition at Kaha Expermental station, Kaliobia Governorate in the winter season of 2004.

Two muskmelon cultivars; namely Kahera 6 (Produced in Faculty of Agriculture, Cairo University) and Galia F1(A hybrid produced in Holand) as well as 4 rootstocks, namely, *Cucurbita ficifolia*, Hybrid No.6, Butter nut squash and Shammam Eljordon were used in the present study. The characters of scions and rootstocks in the present study are as follows :

Scion characters :-

1- Kahera 6 :

It is an early melon variety with 1.0-1.5 Kg fruit weight the rind of fruit is light green with blue green stripes. The flesh is white green and sweet. The seeds are big and have light yellow colour.

2- Galia F1 :

Early hybrid produces netted fruits with average weight of 1.5-2.0 Kg. The flesh is green white and crush. The seeds are small and have light yellow colour.

Rootstocks characters :-

1- *Cucurbita ficifolia* :

It is an annual or short season plants, and the fruits have unedible black colored seeds; seeds are roasted fruits and globular or cylindrical, 15 to 50 cm long with white strips. Mature fruits have an excellent storage life as long as a year without refrigerating.

2- Hybrid No.6 F1 :

A hybrid melon produced in Japan Takii seeds company. It has a vigorous root system, described as resistant to *Fusarium* and nematode diseases. It is widely using as a rootstock in melon grafting.

3- Butter nut squash :

It has a deep-orange flesh which is rich in complex carbohydrates and is a good source of dietary fibers, vitamin C, magnesium, manganese, and potassium.

4- Shammam Eljordon :

Its fruits are like Galia in the shape, but their average weight ranged from 250 to 300g.

The present study included 14 treatments as follows :-

1- Non-grafted plants of Kahera 6 (control for Kahera 6).
2- Non-grafted plants of Galia (control for Galia).
3- Cucurbita ficifolia.
4- Hybrid No.6 F1.
5- Butter nut squash.
6- Shammam Eljordon.
7- Kahera 6 scion grafted on *Cucurbita ficifolia*.
8- Kahera 6 scion grafted on Hybrid No.6 F1.
9- Kahera 6 scion grafted on Butter nut squash.
10- Kahera 6 scion grafted on Shammam Eljordon.
11- Galia F1 scion grafted on *Cucurbita ficifolia*.
12- Galia F1 scion grafted on Hybrid No.6 F1.
13- Galia F1 scion grafted on Butter nut squash.
14- Galia F1 scion grafted on Shammam Eljordon.

Seeds of the rootstocks and scions genotypes were swon on 8th of Septamber 2004 in a foam speedling trays (84 cells) that filled with a mixture of peat moss and vermiculite (1:1 volum). After seven or eight days from sowing (depending on temperature) uniform and strong transplants were chosen and taken to the grafting operation. The technique of "Hole insertion grafting" which described by Oda (1995) was used in this study. Transplants of grafted and non-grafted plants transplanted on 23rd of September 2004 in unheated plastic house. The experimented design was completely randomized design with five replicates. The pot area in each replicate was 5m^2 containing 10 plants on both sides of the ridge, the distant between plants was 50 cm and the ridge was 1.5m wide and 2.5m in length. Cultural practices such as drip irrigation, chemical fertilization, diseases and insects control were carried out as recommended by Ministry of Agriculture.

Identifiation and determination of melon volatile components:-

Volatile components in fruits of some grafted melon genotypes and their F1 generations were extracted and determined as follows:-

Extraction :-

Volatile components from fresh flesh melon samples were extracted according to the method described by Sass Kiss *et al*. (1989) and Curtis (1990). Five hundred grams of fresh fruits flesh and one of fifteen grams of dehydrated samples were mixed with 100 ml of distilled water and macerated in a waring blender for 30 sec. The blended samples were treated in steam distillation continous extraction in water bath at 70-80 ^oC for 6-8 hrs, about 50-70mls were received in flask containing 30 ml of diethyl ether as extracting solvent. Then the mixture was transfered to a separating funel and mixed gently upper layer containing solvent+ volatile components was taken up and transfered to a beaker 250 ml containing few grams of anhydrous sodium sulphate to remove the traces of water adsorbed in the solvent. The extract was then concentrated two mls by slow evaporation at ambient temperature. This extract was kept in amber glass bottles at (-18^oC) for further gas chromatograph (GLC) and Gas Cromatographic Mas. Spectrometer (GC.MS) .

GC-MS analysis :-

Volatile compounds of melon fruits were determined by using GC. Ms QP-5000 schimad Zu equipment Rtx-S-Ms (30m x 0.320mm x 0.5mm film thickness) column was used. The injector temperature used was 150^{o}C and ion source temperature was 250 ^{o}C. The temperature was program ed as follows: initial temperature was 30 ^{o}Cwhich remained for 2 minutes. Then the temperature was raised at the rate of 5.0 ^{o}C per minute and the final temperature was 180 ^{o}C remained for 5 minutes. Concerning the mas ranged,it was ranged from 40.00 to 350 M/Z (mass number). Solvent cut was performed until 2.0 minutes. The start was conducted after 3.0 minutes and the end time was 52.0 minutes. Programe time was 37 minutes and the detecta volts were 1.5 (Kv). The sample volume injected was 1.0 ML comparison of the retention times of the volatile compounds under study with the retention times of the standard compounds in the direct identification of peaks in NIST 12 and NIST 62 libraries search was done.

All lab. Studies were performed at the Central lab. of Horticulture Research Institute, Agric. Research Center, Ministry of Agriculture, Egypt.

RESULTS AND DISCUSSION

As shown in Table 1, there are remarkable differences between the main components of the two scion fruits. While the main compounds of Kahera 6 fruits were alcohol, (34.6%), esters (32.5%) then followed by hydrocarbons (20.9%) and aldehydes (10.5%), the main compounds in Galia fruits were hydrocarbons (36.9%), followed by alcohol (24.5%), then acids (15.6%) and finally nitrogenus compounds (9%) and aldehydes (7.2%). It can be also noticed that Galia F1 fruits have acids (15.6%), relatively high concentration nitrogenus compounds (9%) and low concentration of ester (5.0%), whereas Kahera 6 fruits do not contain acids, and very low concentration of nitrogenus compounds (1.5%) and very high concentration of ester (32.5%). Generally, there are disagreement between the present results and the previous investigation, which may be attributed to the different varieties of melon or the techniques used to obtain aroma samples. In this regard, Wyllie and Leach (1992) assumed that sulfur containing compounds play an important role in the overall aroma profile of melon fruits. Nijssen *et al.* (1996) found 219 volatile compounds in muskmelons, one hundred and seventy-four of the compounds are alcohols, aldehydes, ketones, esters and sulfur containing compounds. Engel *et al.* (1990) mentioned that the techniques employed to obtain the aroma samples are responsible for the striking differences between the results reported by different research groups. Moreover, several factors, such as ethylens, fruit maturity and attachment to the parent plant, influence the production of volatiles by melons during the ripening period.

As show in Table 1, Grafting increased Kahera 6 fruit contents of hydrocarbons (on Butter nut squash), alchols (on *Cucurbita ficifolia* or hybrid No. 6) and esters (on *Cucurbita ficifolia*) as well as Galia F1 fruit contents of hydrocarbons (on *Cucurbita ficifolia* or hybrid No.6) and esters (on Butter nut squash or Shammam Eljordon as compared with non-grafting.

T1

Meanwhile, scion compounds, such as ketons., acids and nitrogenous compounds, are detected in the fruits obtained from grafted plants, such compounds were not existed in their original plants (non-grafted). The increase in hydrocarbon compounds found in the grafted plants may be resulted from translocation of such compounds from roots, such as *Cucurbites ficifolia*, Butter nut squash and hybrid No.6 to the scion. Some previous studies proved that some substances pass from the rootstocks to scions. In this respect, Hieke (1942) reported that tomato grafts on belladonna rootstocks contained atropine. The presence of alkaloids in grafted plant parts was found to depend on the same alkaloids being present in the rootstock, Cromwell (1943) showed that alkaloids in *Atropa belladonna* and *Datura stramonium* pass from the roots of belladonna to tomato scions grafted thereon but no alkaloids, or only very small amounts, appear in tomato stock with belladonna grafts. Grafting tomato on *Datura stramonium* L. caused the Datura alkaloids atropine to pass from the stock to the scion, but no effects were inherited by in the seed progeny (Kerkis-Yu-Ya *et al*. 1998).

On the other hand, presence of some compounds in fruits of grafted plants, which were not existed in either of scions or rootstocks might be attributed to that grafting stimulated production of some compounds in the union region which translocated to the fruits of scions.

As shown in Table (1) the components of aroma of the scion fruits are changed due to grafting. However, the effect of rootstocks on aroma components varied according to used scion. In this respect it was clear that grafting on *Cucurbita ficifolia* increased levels of alcohols and esters; decreased levels of hydrocarbons and aldehydes, existed ethers and eliminated the nitrogenous compounds in Kahera 6 fruits. Meanwhile, the effect of *Cucurbita ficifolia* rootstock on the aroma components of Galia F1 fruits took a reverse effect to that found in Kahera 6 fruits concerning hydrocarbons, alcohols, aldehydes, and was similar to the effect on Kahera 6 regarding esters, nitrogenous compounds and ethers. The increase in some components of aroma fruits of grafted Galia F1 was 1.5 hold in hydrocarbons, 4 hold in aldehydes and 3 fold in esters, while the decrease in alcohols was 18 fold and in acids 8 hold as compared with non-grafted Galia F1. Tremendous changes in the aroma components of Kahera 6 and Galia F1 fruits were also recorded due to grafting on the some rootstock, i.e. hybrid No.6, Butternut squash and Shammam Eljordon Forexample, the composition of aroma of non-grafted Galia F1 fruits was 36.9% hydrocarbons, 24.5% alcohols, 15.9% acids, 9% nitrogenous compounds, 7.2% aldehydes, 5% esters and 1.82% ketones. This means that the main component was hydrocarbons and followed by alcohols and then acids and such components represented 77% of the aroma components. Grafting led to sharp changes in the aroma components of Galia F1 fruits to be 53.7% hydrocarbons, 29.9% aldehydes and 13.2% esters when grafting on *Cucurbita ficifolia*, 59.8% hydrocarbons, 17.7% alcohols and 13.6% ethers when grafting on hybrid No.6, 55.1% esters, 20.3% ethers and 13.1% nitrogenous components when grafting on Butter nut squash and 34.3% alcohols, 34.3% esters and 24.9% hydrocarbons when grafting on Shammam Eljordon. So, the changes in

aroma composition were so sharp that some compounds which were not existed in Galia F1 fruits, were found in fruits obtained from grafted plants. The example of these compounds was ethers which constituted 20.3% and 13.6% in fruits got from grafting on Butter nut squash and hybrid No.6, respectively. Other compounds greatly increased, such as esters which increased 11 and 7 fold in fruits obtained from grafted plants on Butter nut squash and Shammam Eljordon, respectively. It was reported that ethyl esters are very important compounds for the melon flavour and could be considered as an index of good quality aroma. So the amount of esters could be considered as a marker for good quality of melon aroma (Senesi *et al*., 2002). On the contary, the main components of Galia F1 fruits i.e. hydrocarbons, alcohols and acids, were reduced 11,6 and 3.6 fold in fruits gained from grafted plants on Butter nut squash. Meanwhile, Butter nut squash, which reduced the hydrocarbons in Galia F1 fruits by 11 hold, increased such hydrocarbons in Kahera 6 fruits by 3 hold. Such results indicated the interaction effect between the rootstocks and scions on aroma composition of melon fruits.

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تأثير عملية التطعيم على المركبات الطيارة فى صنفى شمام

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أجرى تجربة داخل الصوب البلاستيكية وذلك بمحطة بحوث قها – محافظة القليوبية خلال موسم الشتاء لعام 2004 .

- وأجريت هذه الدراسة لتوضيح تأثير عملية التطعيم على المركبات الطيارة فى ثمار صنفى شمام القاهرة 6 وهجين الجاليا على بعض الأصول هى الكوسة الفيسيفوليا *Cucurbita ficifolia* وهجين رقم 6 Hybrid No. والكوسة الشتوى Butter nut squash وشمام الأردن Shammam Eljordon فوجد أن ثمار صنف القاهرة 6 تحتوى على 34.6% كحول ، 32.5% أسترات و 20.9% هيدروكربون و 10.5% الدهيدات . بينما صنف الجاليا يحتوى على 24.5% كحولات و5% أسترات و36.9%هيدروكربونات و 15.9% أحماض و 9% مركبات هيدروجينية .
- وأدى التطعيم على أصول مختلفة الى أختلافات فى النسبة المئوية للمركبات الطيارة بالإضافة إلى إنتاج مركبات جديدة ، التى قد تكون قدانتقلت من الاصل الى الطعم اوتكونت داخل ثمارالنباتات المطعومة .

كذلك اعتمدمحتوى الثمار المطعومة على التفاعل بين الاصل والطعم وبالتالى فأن الدراسة الحالية اوضحت ان التطعيم يؤثرعلى النكهة فى الثمار المطعومة.

Table 1: Fruit volatile components (%) of different rootstocks, scion and grafted plants.

	Kahera 6 Scion	C.F	K/C.F	No.6	K/No.6	B.N	K/B.N	Ordon	K/ordon	Galia F1 Scion	G/C.F	G/No.6	G/B.N	G/Ordon
Hydrocarbons	20..91	69.2	15.88	18.53	18.42	89.38	56.76	51.96	19.67	36.92	53.71	59.82	3.41	24.96
Alcohols	34.61	11.37	42.62	-	39.89	4.10	14.11	20.08	17.06	24.45	1.37	17.7	3.84	34.32
Aldehydes	10.53	13.97	4.52	42.49	6.51	4.98	2.92	-	8.30	7.20	28.94	2.08	-	4.25
Ketones	-	-	-	6.30	-	-	3.35	10.05	8.10	1.82	-	-	-	-
Acides	-	-	-	-	6.83	-	-	5.31	8.58	15.62	2.05	-	4.25	0.76
Esters	32.46	2.44	35.23	17.90	19.34	0.35	21.77	7.33	25.42	4.99	13.19	6.76	55.12	34.34
Companals nitrogenus	1.49	-	-	4.67	9.01	0.37	1.09	-	12.87	9.00	-	-	13.05	0.43
Companals sulfur	-	-	-	10.11	-	-	-	2.76		-	-	-	-	-
Ethers	-	3.20	1.75	-	-	-	-	2.51		-	0.75	13.64	20.33	0.94
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

C.F. = *Cucurbita ficifolia*
K/C.F = Kahera 6 onto *Cucurbita ficifolia*
No.6 = Hybrid No.6
K/No.6 = Kahera 6 onto Hybrid No.6
B.N = Butter nut squash
K/B.N = Kahera 6 onto Butter nut squash
Ordon = Shammam Eljordon
K/Ordon = Kahera 6 onto Shammam Eljordon
G = Galia F1