

## EFFECT OF GRAFTING ON YIELD OF TWO TOMATO CULTIVARS (*Lycopersicon esculentum* MILL)

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### ABSTRACT

This study was carried out at private farm in Khalabsho and Zian district, Dakahlia governorate, Egypt during the summer seasons for two years (2003 , 2004) to study the effect of grafting of two commercial tomato cultivars (Super marmande and Castle rock) on two tomato rootstocks (Eldorado F<sub>1</sub> and Helper-M F<sub>1</sub>) by using the tongue approach grafting method to avoid Soil borne diseases and Nematodes and increasing the yield .

The results indicated that all grafted plants of two commercial tomato cultivars Super marmande and Castle rock on two different rootstocks Eldorado F<sub>1</sub> and Helper-M. F<sub>1</sub> gave the highest significant values for early yield and total yield per plot and had the lowest infected plants with Nematodes and Fusarium .

Generally the best grafting was Castel rock on Helper-M. F<sub>1</sub> rootstock followed by Super marmande on Eldorado F<sub>1</sub> rootstock for early yield , mid yield and total yield per plot. But all graftings gave increased disease tolerance for Fusarium and Nematodes .

### INTRODUCTION

The area devoted for production in khalabsho and Zian distict was 55000 feddans, it is considered the alone agricultural expanded district in Dakahlia governorate , this district had some problems, the most important of these problems were : it is nearer of the Mediteranean sea, high level of water ground, bad drainage, light soil structure, Neamatodes (4-8 N/C.m<sup>3</sup>) and borne diseases prevailing. While this district is considered the most famous district for production of tomato and watermelon, so each of these challenges can be overcome by grafting two commerical tomato seedlings cultivars (Super marmande and Castle rock) on two different tomato rootstocks (Eldrorado F<sub>1</sub> and Helper -M F<sub>1</sub>).

In the past garfting was used widely with tomato to limit the effects of Fusarium wilt (Schepper, 1957 and lee, 1994), but the raesons for grafting have increased dramatically over the years, for example, grafts have been used to induce resistance against low ( Bulder et al., 1990) and high temperature ( Rivero et al , 2003), against iron chlorosis in calcareous soils ( Romera et al ., 1991), to enhance nutrient uptake ( Ruiz et al., 1997), to increase synthesis of endogenous hormones ( proebsting et al ., 1992), to improve water use (Cohen and Naor , 2002) and to rise thee salt tolerance of tomato ( Maria et al ., 2005). In relation to soil borne disease such as fusarium wilt , bacterial wilt and nematodes grafting gives increased disease tolerance and vigor to crops ( Oda, 1999). Garcia et al., (2004) indicated that by using the tongue approach grafting method of tomato , the graft union is fully functional 8 days after grafting , which coincided with an increase of Peroxidase and Catalase activities . So this work was conducted to study the effect of grafting two commercial tomato cultivars on two rootstocks to avoid soil borne diseases such as Fusarium wilt and Nematodes, finally increasing the yield.

## MATERIALS AND METHODS

This study was carried out at private farm located in Khalabsho and Zian district , Dakahlia Governorate during the summer seasons of 2003 and 2004 .

Two experiments were conducted , the first experiment was consisted of commercial tomato cultivar c.v. Super marmande without grafting and Super marmande was grafted onto two tomato hybrid rootstocks (Eldorado F<sub>1</sub> and Helper - M F<sub>1</sub>) and the second experiment was consisted of commercial tomato cultivar c.v. Castle rock without grafting and Castle rock was grafted onto the same two tomato rootstocks by using the tongue approach grafting method (Wittwer and Honma , 1979 and Yamakawa , 1982 ) . Different steps of grafting procedures are shown in Fig.1 .

The first rootstock was Eldorado F<sub>1</sub> , it is a strong growing rootstock with a high germination and a very uniform plant quality . It has resistance against Tobacco mosaic virus (Tm) , Cladosporium fulvum races ABCDE (CS) pyrenochaeta lycopersici (P) , Verticillium alboatrum (V) , Fusarium oxysporum race 1+2 (F<sub>2</sub>) , Fusarium crown and Root rot (Fr) and resistant to the most occurring pathotypes of Nematodes (N) [The source is Enza Zaden com. Netherlands].

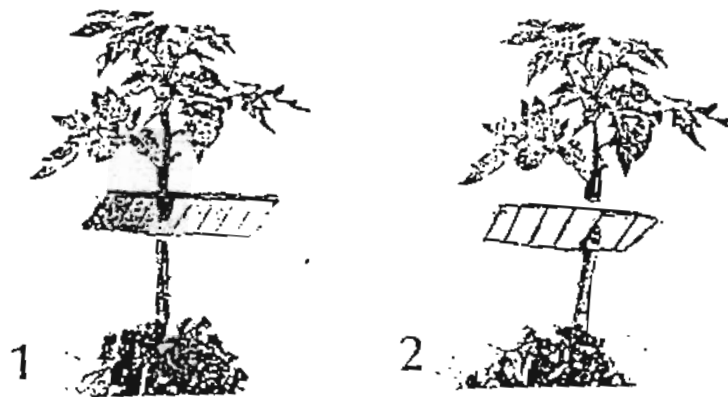
The second rootstock was Helper-M F<sub>1</sub> , it has resistance against scab (B) , verticillium alboatrum (V), Fusarium oxysporum race 1 (F<sub>1</sub>) , Fusarium oxysporum race 1+2 (F<sub>2</sub>) and resistant to the most occurring pathotypes of Nematodes (N) [ The source is Takii seed com. Japan ] .

Seedlings of tomato grafted and non grafted were transplanted on one side of the ridge on 3 February (first season) and 15 February (second season).The ridges were 10 meter long and 1.5 meter wide . plant spacing was 50 cm . A randomized complete block design with four replicates was used . Each plot contained five rows with an area of 75 m<sup>2</sup> . Data recorded were No. of success seedlings after 7 days of transplanting , No. of branches after 75 days of transplanting , No. of infected plants with Nematodes, No. of infected plants with Fusarium after the end of the harvest , early yield per plot , mid yield per plot , late yield per plot , total yield per plot and fruit weight . Analysis of data was done by IBM computer using anova program for statistical . The differences among means for all traits for significance according to Cochran and Cox (1957).

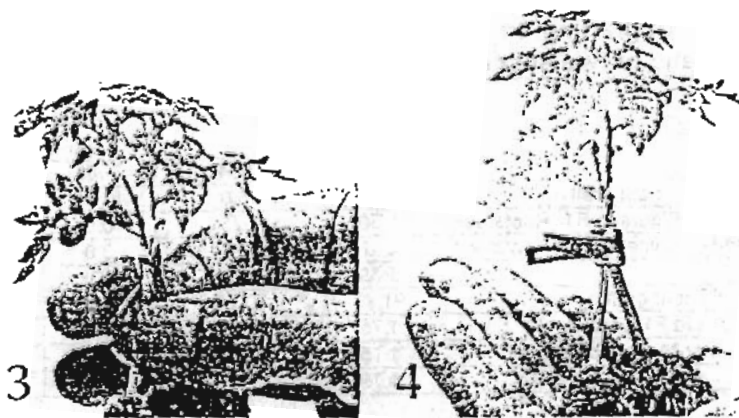
## RESULTS AND DISCUSSION

### 1- Effect of grafting on vegetative growth :

Data presented in Table(1) revealed that no constant response to grafting treatments in both seasons on vegetative growth except in the case of Castle rock grafted on helper-M F<sub>1</sub> rootstock, increased number of branches after 75 days from transplanting compared to Castle rock without grafting.



1. Scion variety seedling  
Cut hypocotyle to upwards by sharp knife.
2. Rootstock seedling  
Cut hypocotyle to downwards.



3. Join scion variety seedling onto rootstock.
4. Fix the joint part by grafting clip.

Fig. 1. Different steps of grafting procedure .

**Table 1: The effect of grafting on vegetative growth of Super marmande and Castle rock cultivars.**

Treatments	No. of success seedlings after 7 days of grafting.		No. of success seedlings after 21 days of transplanting .		No. of branches after 75 days of transplanting .	
	2003	2004	2003	2004	2003	2004
1- Super marmande without grafting	100.0	100	98.0	97.0	25.50	25.0
Super marmande / Eldorado F1 (Rootstock)	93.50	92.50	85.50	84.75	19.0	18.50
Super marmande / Helper M F1 (Rootstock)	92.50	91.50	87.50	86.50	20.75	20.25
LSD at 5 %	5.68	2.23	6.34	5.48	3.12	2.90
2- Castle rock without grafting	100.0	100.0	92.0	91.0	17.75	7.25
Castle rock / Eldrado F1 (Rootstock)	93.50	92.50	85.75	85.0	14.75	14.25
Castle rock / Hepler-M.F1 (Rootstock)	93.0	92.0	88.25	87.25	26.5	26.0
LSD at 5%	4.79	2.38	3.61	3.04	1.61	1.12

**2- Effect of grafting on Nematodes and Fusarium infection:**

Data in Table (2) indicated that grafted plants had more resistant of Nematodes and Fusarium than non grafted plants with significant differences in all cases in both seasons. Similar results were found by oda (1999).

**Table 2: Effect of grafting on infection with Nematodes and Fusarium at the end of two successive seasons .**

Treatments	No of infected plants with Nematodes		No. of infected plants with Fusarium	
	2003	2004	2003	2004
Super marmande with out grafting	85.75	85.0	12.75	12.25
Super marmande / Eldorado F1 (Rootstock)	1.50	1.25	0.0	0.0
Super marmande / Helper M F1 (Rootstock)	2.0	1.75	0.0	0.0
LSD at 5 %	5.39	4.58	4.98	4.03
2- Castle rock without grafting	91.75	90.75	9.0	8.5
Castle rock /Eldrado F1 (Rootstock)	1.75	1.50	0.0	0.0
Castle rock /Hepler-M.F1 (Rootstock)	1.75	1.50	0.0	0.0
LSD at 5%	4.79	3.35	2.57	1.91

**3- Effect of grafting on yield and fruit weight :**

With respect to early yield per plot , Table (3) cleared that Super marmande grafted on Eldorado F<sub>1</sub> gave the highest significant values (91.60 & 90.68 k.g) over the ungrafted Super marmande (58.75 & 58.15 k.g) and Super marmande grafted on Helper-M. F<sub>1</sub> (84.98 & 84.13 k.g) in both seasons , followed by Super marmande grafted on Helper-M. F<sub>1</sub> rootstock.

Castle rock grafted on Helper-M F<sub>1</sub> rootstock gave the highest significant values (99.40 & 96.25 k.g) over the ungrafted Castle rock (56.40 & 55.83 k.g) and Castel rock grafted on Eldorado F<sub>1</sub> (88.38 & 87.50 k.g) in both seasons .

Table 3 :The effect of grafting on yield and fruit weight of Super maramnde and Castle rock cultivars for two successive seasons 2003 and 2004.

Treatments	Early yield/plot K.g		Mid yield/plot K.g		Late yield/plot K.g		Total yield / plot K.g		Fruit weight g.m	
	2003	2004	2003	2004	2003	2004	2003	2004	2003	2004
	Super maramnde without grafting	58.75	58.15	89.85	88.95	27.53	27.25	176.25	174.50	138.00
Super maramnde / Eldorado F1 (Rootstock)	91.6	90.68	147.60	146.13	37.05	36.68	276.25	273.50	116.25	115.00
Super maramnde / Helper M.F1 (Rootstock)	84.98	84.13	134.13	132.78	35.90	35.55	255.00	252.50	130.00	128.75
LSD at 5 %	5.11	4.20	6.25	5.33	NS	NS	14.06	11.52	9.37	8.67
2- Castle rock without grafting	56.40	55.83	89.10	87.75	23.25	23.00	168.75	167.00	115.75	114.50
Castle rock /Eldrado F1 (Rootstock)	88.38	87.50	143.20	141.78	32.68	32.35	265.00	262.25	105.00	104.00
Castle rock /Hepler-M.F1 (Rootstock)	99.40	98.25	162.75	161.13	30.43	30.13	300.50	297.50	113.75	112.50
LSD at 5%	5.82	4.32	12.33	11.36	NS	NS	15.99	11.76	5.37	5.35

Concerning mid yield per plot , Table (3) revealed that Castle rock grafted on Helper-M F<sub>1</sub> gave the highest significant values (162.75 & 161.13 k.g) compared with ungrafted plants , followed by Super maramnde grafted on Eldorado F<sub>1</sub> (147.6 & 146.18 k.g) in both seasons .

From the Table (3) , the differences between the late yield per plot for grafted and ungrafted plants seemed to be insignificant differences in both seasons.

With respect to total yield per plot , Table (3) cleared that all grafted plants gave the highest significant values compared with ungrafted plants (control). Castle rock grafted on Helper-M F<sub>1</sub> gave the highest significant values (300.50 & 297.50 k.g) for total yield per plot , followed by Super maramnde grafted on Eldorado F<sub>1</sub> rootstock (276.25 & 273.5 k.g) in both seasons . These results are in agreement with those of Oda (1999), who reported that grafting gives increased disease tolerance and vigor to crops .

It is noticed from Table (3) that the ungrafted Super maramnde gave the highest significant values for fruit weight (138.0 & 136.5 g.m) compared with Super maramnde grafted on Eldorado F<sub>1</sub> (116.25 & 115.0 g.m) and insignificant compared with Super maramnde grafted on Helper-M. F<sub>1</sub> (130.0 & 128.75 g.m) . Castle rock without grafting gave the highest significant values (115.75 & 114.50 g.m) compared with Castle rock grafted on Eldorado F<sub>1</sub> and insignificant (105.0 & 104.0 g.m) compared with Castle rock grafted on Helper-M. F<sub>1</sub> (113.75 & 112.50 g.m). Table (3) cleared also that Super maramnde grafted on helper-M. F<sub>1</sub> gave the highest significant values (130.0 & 128.75 g.m) for fruit weight compared with other grafted plants, followed by Super maramnde grafted on Eldorado F<sub>1</sub> (116.25 & 115.0 g.m) rootstock and Castle rock grafted on Helper-M, F<sub>1</sub> (113.75 & 112.50 g.m) rootstock .

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## تأثير التطعيم على الإنتاج لصنفين من الطماطم

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أجريت هذه الدراسة في منطقة قلبشو وزيان بمحافظة الدقهلية بهدف زيادة الإنتاج ومقاومة أمراض التربة مثل الفيوزاريوم والنيماطودا حيث تعاني هذه المنطقة من مشاكل كثيرة منها قربها من البحر الأبيض المتوسط وبالتالي زيادة مستوى الماء الأرضي وزيادة الملوحة وسوء الصرف وخفة قوام التربة وكذلك انتشار أمراض التربة مثل الفيوزاريوم والنيماطودا - وتبلغ مساحة هذه المنطقة حوالي ٥٥ ألف فدان وهي منطقة شهيرة بزراعة البطيخ والطماطم . لذلك تم تطعيم صنفين تجاريين من الطماطم وهما Super marmande and Castle rock على أصليين مقاومين للفيوزاريوم والنيماطودا وهما Eldorado F<sub>1</sub> and Helper-M. F<sub>1</sub>. وكانت أهم النتائج المتحصل عليها ما يلي :

- ١- كانت جميع التطعيمات أكثر مقاومة للفيوزاريوم والنيماطودا بالمقارنة بالأصناف الغير مطعمة
- ٢- أثر التطعيم على زيادة الإنتاج زيادة كبيرة بالنسبة لجميع التطعيمات الخاصة بالصنفين . وكانت أهم التطعيمات من ناحية الإنتاج هي Castle rock على الأصل Helper M- F<sub>1</sub> ، يليه Super marmande على الأصل Eldorado F<sub>1</sub> .
- ٣- أثر تطعيم الصنفين Super marmande and Castle rock على الأصل F<sub>1</sub> Eldorado على متوسط وزن الثمار بالنقص وكان التأثير معنوياً لكلا الصنفين في موسمي الزراعة .