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STUDY ON COMPATIBILTY PARAMETERS BETWEEN THOMPSON SEEDLESS, SUPERIOR, FLAME SEEDLESS AND KING RUBY GRAPE CULTIVARS ONTO HARMONY ROOTSTOCK.

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ABSTRACT

The present study directed in two successive seasons of 2006 and 2007 to assess some of compatibility parameters measured between four commercial Grape cultivars grafted onto Harmony rootstock ; percentage of grafting success, vigor of grafts, lignin content of cell wall at union zone and NPK content of leaf petioles. An apparent increase in values of these characteristics that may be considered as good indicators to the compatibility between Superior cultivar onto Harmony rootstock, Superior surpassed the other grape cultivars and showed more compatibility. Thompson seedless and Flame seedless onto Harmony were intermediate in this respect. However, King Ruby cultivar onto Harmony showed less compatibility. King Ruby/Harmony was the highest in NPK content % in its leaf petioles than other cultivars tested in this study during the two seasons. Moreover, Thompson seedless/Harmony gave significant response in leaf surface area / No. of leaves / shoot, fresh and dry weight/leaves/shoot of graft combinations followed by Superior/Harmony, Flame seedless/Harmony and King Ruby/Harmony during both seasons of study. In addition, both Flame seedless and King Ruby onto Harmony rootstock gave the highest values of lignin content % in union zone.

INTRODUCTION

Grapes are one of the most important and popular fruit crops in Egypt. Vineyard acreage increased rapidly during the last years, it was occupied about 160,000 fed acting 14% from the total fruit crops area which were produced about 1,275,288 tons (The Ministry of Agriculture statistics, 2006). Nowadays there are many cultivars of grapes in Egypt, such as Thompson seedless, Superior, Flame seedless and King Ruby seedless. Grape growers in Egypt are becoming increasingly turning to use grafted transplants with different rootstocks when planting vineyards and aware of the benefits of rootstocks in overcoming some of their current problems, and are now seeking information on the performance characteristics and suitability of grapevine rootstocks to particular soil conditions. Therefore, grafting processes on rootstocks are considered very important to produce nurslings according to the demands of growers for solution their serious problems such as phylloxera insect, nematode, adaptability to high or low pH soils, tolerant to salinity and lime, adaptability to wet or poorly drained soils and adaptability to drought, as well as, their effect on vine growth, yield and fruit quality (Wienberger and Harmon 1966; Winkerler *et al.*, 1974 and Aisha 2007) . The spreading of vineyards in Egypt especially in the new lands demand convenient nursery plants that well adapt along with the present conditions of these soils (El-Shahat *et al*., 2006) Thus, the study aimed to evaluate the

percentage of different grape cultivars tested onto Harmony rootstock in relation to some parameters of compatibility.

MATERIALS AND METHODS

The present study was carried out through two successive seasons of 2006 and 2007 at the nursery of El-Egazy vineyard at Sadat city in Monofia Governorate. Four commercial Grape cultivars (*Vitis vinifera*, L.), Thompson seedless, Superior, Flame seedless, King Ruby were used as a source of scions. These scions were grafted onto rootstock namely, Harmony (*Vitis champini* X 1613C)

Rootstock preparation:

One-year-old mature canes of Harmony rootstock were taken and prepared as rootstock cuttings by removing all buds to avoid sprouting or crown suckers grown on them to prevent competitive between scion buds and rootstock buds during the forming of grapevine nurslings later.

Brief description of used rootstock harmony:

Harmony (*Vitis champini* X 1613C): is considered to be resistant to nematodes (Mullins *et al*., 1992), also Walker *et al*. (2002) reported that harmony is moderated in both vigor and resistant to phylloxera, with high resistance to nematodes, well adapted to acidic soils, moderate tolerance to salinity and also high tolerance to drought.

Scion preparation:

The Scion was taken as cuttings 7 cm in length with one eye of selected canes from fruiting vines. It was prepared to leave 5 cm below the eye (to make the mechanical grafting process easier) and 2 cm above it. The scion cuttings were similar with rootstocks in its diameter for successful bench grafting (Winkler *et al*., 1974).

Grafting processes:

Grafting processes were done on 21 January at both seasons of study using an Omega grafting set (bench grafting), after putting them in callusing room (29^{o}C and 85% relative humidity). After achieving grafting process for 21 days, they planted in black sacs full with medium of soil; its analysis was as shown in Table 1 and then later transferred to grow under greenhouse conditions.

This study included 4 graft combinations of four important cultivars of scions (Thompson seedless, Superior, Flame seedless and King Ruby) onto Harmony rootstock. Graft combinations are presented in table 1 and cultivated in medium as shown in table 2. The graft combinations were consisted of 30 grafts divided onto three replicates (10 grafts) in randomized complete design. The graft combinations were received the normal maintenance of nursery processes.

The measurements of graft combinations:

The measurements of graft compatibility degree between the tested scions on rootstock were as follows:

1- Grafting success percentage (take percentage)

The grafting operation was considered successful when the scion was still green for three weeks from graft operation and started sprouting

and continues in growth (Rajput and Haribabu, 1985). Success percentage was recorded on grafts at 9-month-old (October).

2- Take vigor: it was represented by 7 characteristics:

3**- Take length (cm)**: It was recorded on grafts at 9-month-old (October) in cm.

4- Stem diameter (cm): It was recorded on grafts on October (9-month-old) at 2 cm above the graft union zone.

5- Take diameter (cm): It was recorded at 1cm from the basal end of the shoot in cm.

6- Total surface leaf area (cm^2): It was estimated according to the following equation that used by (Jain and Misra, 1966) and recorded as leaf surface area /graft.

Leaf area (cm^2) = 3.14× (leaf diameter) ^{2}

7- Leaf fresh and dry weight/take/graft:

They were determined on October, where fresh and dry weight were determined in g. for shoot/graft.

Table (1): Some chemical and mechanical analysis of the planting medium in black sacs.

Chemical analysis	**Values**
Organic matter	2.53 %
Calcium Carbonate	1.95 %
Saturation percentage	61 %
EC (extraction 1:5)	0.81 $ds.m^{-1}$
pH (suspension 1:2.5)	7.92
Available Macro- Nutrients (ppm)	
N	46
P	3.8
K	325
Mechanical analysis	**Values**
Coarse sand	1.93 %
Fine sand	49.46 %
Silt	39.21 %
Clay	9.40 %
Texture class	Sandy

Table (2): Graft combinations in the experiment.

Scion	**Rootstock**
Thompson seedless	Harmony
Superior	Harmony
Flame seedless	Harmony
King ruby	Harmony

8- Leaf total chlorophyll content (SPAD units):

Leaf total chlorophyll content was determined at 6-month-old (August), where chlorophyll reading was taken in seventh leaf from top of shoots according to the method described by Yadava (1986) that used a Minolata SPAD chlorophyll meter model. The results were expressed as SPAD units/leaves/shoot/graft.

9- Lignin percentage in the cell wall:

It was estimated at 2 cm above and below the graft union on 10-month-old grafts according to Byrd *et al*. (1965). It was based on hydrolysis of the cell wall components by using mixture of 75% sulfuric acid and 89% phosphoric acid at 35 ^{o}C and used the following equation to determine Lignin content.

$$\text{Lignin content \%} = \frac{W\,1\,o - d}{Ww} \times 100$$

Where: W1o – d = weight of lignin oven dried in g.

Ww = extractive – free oven dried weight of piece meal in g.

10- **Leaf content of N, P and K**:

10-1**-** Leaf nitrogen content: It determined according to Pregle (1945).

10-2**-** Leaf phosphorus content: It determined according to Jackson (1967).

10-3**-** Leaf potassium contents: It determined according to Black (1965).

Statistical analysis:

The obtained data were subjected to statistical analysis according to package of Gomez, and Gomez (1984) using the New least significant (RLSD) at 5% level of probability.

RESULTS AND DISCUSSION

1- Success percentage of graft combinations (Takes)

Data in table 3 showed that both graft combinations of Superior/Harmony and Flame seedless/Harmony resulted in a significant increase in success percentage during the two seasons of study (45.0- 52.0, 45.0- 52.0) comparing with Thompson seedless/Harmony and King Ruby/Harmony (40.0- 43.0, 35.0- 42.0) in 2006 and 2007, respectively. These results were in agreement with Aisha (2007) who studied the influence of some grape rootstocks on Superior cv by using Omega star grafting onto Dogridge, Salt creek, Freedom, Harmony, SO4, Teleki 5C and Paulsen rootstocks, found that the percentage of success grafts were ranged between (66.7- 86.5%) according to rootstock and scion. Freedom and Harmony rootstocks recorded the highest percentage of success.

Table (3): Success percentage of graft combinations (Takes) between Thompson seedless, Superior, Flame seedless and King Ruby onto Harmony rootstock during 2006 and 2007 seasons

Characteristics / Graft combinations	Success percentage (%)	
	2006	2007
Thompson seedless/ Harmony	40.0	43.0
Superior/Harmony	45.0	52.0
Flame seedless/ Harmony	45.0	52.0
King Ruby/ Harmony	35.0	42.0
RLCD	1.5	2.2

Also, Tangolar *et al*. (1997) observed callus formation in cuttings of 8 grapevine cultivars and 19 rootstocks. The shortest period from planting to the beginning and peak of callus formation were observed in Harmony rootstock. It had the highest formation rate of callus (80- 100 after 19-24 days, respectively).

The highest amount of callus formation was obtained in King Ruby/ Harmony rootstock.

2- Effect of Harmony rootstock on total leaf chlorophyll, shoot length and diameter of Thompson seedless, Superior, Flame seedless and King Ruby graft combinations:

Data in table 4 showed that characteristics of total leaf chlorophyll content, shoot length and diameter for shoots in graft combinations of Superior cultivar onto Harmony rootstock significantly increased in the two seasons of study if compared with the other used cultivars of grapevines in this study (34.0- 35.8 SPAD units, 107.6- 92.5 cm and 0.620- 0.770 cm), following by Thompson seedless, Flame seedless cultivars in total leaf chlorophyll content, shoot length and diameter, while King Ruby cultivar came in the fourth order according to superiority in the previous measurements characteristics (29.4-35.9 SPAD units, 52.8- 61.5 cm and 0.663- 0.700 cm) during 2006 and 2007 seasons, respectively. These results are in agreement with Aisha (2007) who studied the performance of Superior cultivar grafted by bench grafting by using omega-star method onto Dogridge, Salt creek, Freedom, Harmony. The results indicated that vines grow on their own roots gave the lowest average length of shoot and number of leaves/scion/graft in two seasons of study on October month (115.5- 122.0 cm and 29.7- 30.5 leaf), respectively, comparing with tested graft combinations on the Harmony rootstock. In addition, Keller *et al*. (2001) found that chlorophyll content was higher for vines grafted on (K5BB) and lower for (3309C).

Table (4): Effect of Harmony rootstock on total leaf chlorophyll, shoot length and diameter of Thompson seedless, Superior, Flame seedless and King Ruby graft combinations during 2006 and 2007 seasons.

Characteristics / Graft combinations	Total leaf chlorophyll (SPAD units)		Take length (cm)		Take diameter (cm)	
	2006	2007	2006	2007	2006	2007
Thompson seedless/ Harmony	34.0	35.8	107.6	92.5	0.620	0.770
Superior/Harmony	30.8	39.1	110.8	85.1	0.723	0.770
Flame seedless/Harmony	32.4	33.2	80.3	64.2	0.540	0.720
King Ruby/Harmony	29.4	35.9	52.8	61.5	0.663	0.700
RLCD	0.76	1.9	6.9	7.5	0.066	0.040

3- Effect of Harmony rootstock on NPK in petioles and lignin at graft zone of Thompson seedless, Superior, Flame seedless and King Ruby graft combinations:

Data presented in table 5 revealed that King ruby onto Harmony rootstock was the highest in NPK content % in its leaf petioles compared with other cultivars of grapevines during the two seasons, therefore it gave significant increase in PK content % and N content % in the second season only, as well as it gave the highest values of N content % in average (2.82-2.82, 0.34-0.33 and 1.59-1.58%), followed by Flame seedless onto Harmony (2.80- 2.79, 0.32- 0.32 and 1.56-1.54), Superior onto Harmony (2.82- 2.76, 0.33- 0.31and 1.57-1.49) and Thompson seedless onto Harmony (2.79- 2.71, 0.30- 0.29 and 1.45- 1.40). This may lead to consume the NPK in Superior and Thompson seedless cultivars onto Harmony rootstock more than King Ruby and Flame seedless cultivars onto Harmony rootstock in its parameters vegetative growth such as take length and diameter, total leaf chlorophyll, leaf surface area/shoot, fresh and dry weight/leaves/shoot. There were considerable differences among the rootstocks tested for K concentration, where Brancadoro and Valenti (1995) grafted grape cv Croatina onto 20 different rootstocks and found that K content of must leaves was affected significantly by rootstocks and Ruhl (1991) also suggested that K accumulation in scions is affected by rootstock genotypes.

Table (5): Effect of Harmony rootstock on some macronutrients Content % in leaf petioles and lignin % at graft zone of Thompson seedless, Superior, Flame seedless and King Ruby graft combinations during 2006 and 2007 seasons.

Characters / Graft combinations	N %		P %		K %		Lignin %	
	2006	2007	2006	2007	2006	2007	2006	2007
Thompson seedless/ Harmony	2.79	2.71	0.30	0.29	1.45	1.40	48.7	55.0
Superior/ Harmony	2.82	2.76	0.33	0.31	1.57	1.49	39.0	54.7
Flame seedless/ Harmony	2.80	2.79	0.32	0.32	1.56	1.54	55.7	56.0
King ruby/Harmony	2.82	2.82	0.34	0.33	1.59	1.58	46.7	63.0
RLCD	NS	o.03	0.01	0.01	0.05	0.03	6.35	8.08

As for lignin content in union zone between scion and rootstock, data tabulated in table 4 showed that lignin contents % in four graft combinations had not taken fixed trend, where Flame seedless onto Harmony rootstock in the first season had significant increased of lignin % comparing with King Ruby/Harmony and Superior/Harmony and gave relatively increase than Thompson seedless/Harmony. While in the second season of study, King Ruby/Harmony had significant increase in lignin content % in union graft compared with Superior/Harmony and had an obvious increase than Flame seedless/Harmony and Thompson seedless/Harmony. Many authors mentioned that lignin formation at interface between scion and rootstock is very important in graft combinations; Buchloh (1960) reported that the lignification of the adjoining cell walls at the union zone is responsible for the formation of strong union in graft combinations.

4- Effect of Harmony rootstock on leaf area, fresh and dry weight of Thompson seedless, Superior, Flame seedless and King Ruby graft combinations:

Data presented in table 6 showed that some characteristics that affect with Harmony rootstock and gave significant response in leaf surface area/leaves/shoot and fresh and dry weight/leaves/shoot of graft combinations for Thompson seedless cultivar (194.27-175.13, 35.2- 35.0 and 4.34- 5.25), followed by Superior cultivar, Flame seedless and King ruby cultivars (120.5-96.17, 16.0- 16.4 and 1.24-2.55), respectively, in graft combinations during the two seasons of study 2006 and 2007.

Table (6): Effect of harmony rootstock on total surface leaf area, fresh and dry weight of Thompson seedless, Superior, Flame seedless and King Ruby graft combinations during 2006 and 2007 seasons.

Haracters / Graft combinations	Total surface leaf area(cm^2)		Fresh weight (g)		Dry weight(g)	
	2006	2007	2006	2007	2006	2007
Thompson seedless/Harmony	194.27	175.13	35.2	35.0	4.34	5.25
Superior/Harmony	162.9	116.6	30.6	32.5	3.94	5.18
Flame seedless/Harmony	123.2	108.67	19.9	21.0	2.53	1.84
King ruby/Harmony	120.5	96.17	16.0	16.4	1.24	2.55
RLCD	29.4	5.2	0.56	1.4	1.95	6.6

In the same line of the present results, Downton (1985) studied the growth and mineral composition of the Sultana grapevine as influenced by rootstocks, where Sultana grapevine was grown on its own root system or grafted onto Dogridge, 1613, Harmony, Ramsey rootstocks. He found that self-rooted vines and scions onto Harmony rootstock gave greatest growth comparing with Dogridge, Ramsey and 1613 rootstocks. In addition, nitrogen content in leaf petioles did not change with rootstocks, while Dogridge and Harmony rootstocks led to very high concentrations of potassium in leaf petioles of Sultana grapevine.

In conclusion, recommendations that should be carry out to study the influence of different rootstocks of grapevine with each cultivar and study its effect on the yield and fruit quality in the future.

REFERENCES

Aisha, G. S. A. (2007). Impact of some rootstocks on performance of Superior grape cultivar. J. Agric. Sci. Mansoura Univ. 32 (11): 9347-9375.

Black, C.A. (1965). Methods of soil analysis. Part 2 Amer. Soci. Of Agri. Publisher, Madison, Wisconsin.

Byrd, V. L.; F. L. Ellwood; R. G. H. Thing and A. C. Bare-Foot., (1965). Wood characteristics and Kraft paper properties of four selected Loblolly Pimes. For prod. J. 15(15): 313- 320.

Buchloh, G. (1960). The lignification in stock- scion junctions and its relation to compatibility. In: Pidham, J. B. (ED.), Phenolics in Plant in Health and Disease. Pergamon Press, p. 67.

Brancadoro, L. and A. L. Valenti (1995). Rootstock effect on potassium content of grapevine. Acta Hort. 383: 115- 124.

El-Shahat, S. S.; G. E. El- Banna, El. T. El-Baz and Th. S. A. Abo El-Ulaka (2006). Production of Thompson seedless grape transplants by grafting on different rootstocks . J. Agri. Sci. Mansoura Univ. 31(7): 4537- 4549.

Downton, W. J. S. (1985). Growth and mineral composition of the Sultana grapevine as influenced by salinity and rootstock. Australian Journal of Agricultural Research. 36(3):425-434. Thieme verlage stuffgart. BRD.

Gomez, K.N**.** and A.A. Gomez (1984) .Statistical Procedures for Agricultural Research .John Wiley and Sons, New York, 2nded., P68.

Jakson, M.L. (1967). Soil chemical analysis. Printic-Hall of India private Limited. New Delhi., PP., 144- 197.

Jain, T.C. and Misra, D.K., (1966). Methods of estimation of leaf area in crop plants. India. J. Agron. Vol. (3).

Keller, M., M. Kummer, and M. C. Vasconclos., (2001). Soil nitrogen utilization for growth and gas exchange by grapevines in response to nitrogen supply and rootstock. Austral. J. Grape and Wine Res. 7: 2-11.

Mullins, G.M., A. Bouquet, and L.E. Williams. (1992). Biology of the Grapevines. Cambridge University Press, NY.

Rajput, C. B. S. and R. S. Haribabu (1985). Citriculture. 1st Ed., Kalyani, New Delhi-Ludhiance, India, PP, 368.

Ruhl, E. H. (1991). Effect of potassium supply on cation uptake and distribution in grafted *Vitis champini* and *Vitis berlandier* X *Vitis rupestris* rootstocks. Austral. J. Exp. Ag. 31: 119- 125.

Pregle E. (1945): "Quantitave organic micro-analysis" Lth Ed. J. Chudrial, London.

Tangolar, S. et al., (1997). Research on determination of callus formation capacity in different grape rootstocks and cultivars. Adana, Turkey. Acta Horticulturae. Proceedings of the fifth international symposium on temperate zone fruits in the tropics and subtropics,

Walker, R.B., D.H. Blackmore, R. P Clingeleffer, and C.L. Ray., (2002). Rootstock effects on salt tolerance of irrigated field-grown grapevines (*Vitis vinifera* L. cv. Sultana). I. Yield and vigor inter- relationships. Austral. J. Grape and Wine Res. 8:3-14.

Weinberger, J. H. and F. N. Harmon (1966). Harmony, a new nematode and phyloxera resistant rootstock for vinifera grapesfruit. Fruit Vars Hort. Diest, 20: 63- 65.

Winkler, A.J.; Cook, J.A., Kliewer, W.M. and L. A., Lider., (1974). General Viticulture. 3rd Ed. Univ. of Calif. Press. Berkely. Los Angles, USA.

Yadava, U.L. (1986). A rapid and non-destructive method to determine chlorophyll in intact leaves, HortScience. 21:1449-1450.

دراسة بعض معالم التوافق بين أصناف العنب البناتى ، السبيريور، الفليم سيد ليس والكينج روبى على أصل الهارمونى.

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أجريت هذه الدراسة خلال موسمى ٢٠٠٦, ٢٠٠٧ بمشتل مزرعة العجيزى بمدينة السادات لدراسة بعض صفات التوافق بين أصناف العنب الأكثر إنتشاراً فى مصر (العنب البناتى- السبيريور- الفليم سيدليس- الكينج روبى) على أصل الهارمونى، وكانت هذه الدراسة تشتمل على عدة قياسات تخص مواصفات المجموع الخضرى مثل المساحة الورقية مع وزن الأوراق الناتجة على الطعم النامى الطازج والجاف بجانب طول وسمك نمو الطعم الناتج على الأصل. بالإضافة إلى محتوى الكلوروفيل الكلى بأوراق الطعم النامى. كذلك التقدير الكيماوى لمحتوى أعناق الورقة من العناصر الكبرى مثل النتروجين والفسفور والبوتاسيوم ، وايضا محتوى اللجنين فى منطقة الإلتحام بين الطعم والأصل.

وقد أوضحت النتائج المتحصل عليها:

١- فرخ طعم السبيريور على أصل الهارمونى أعطى قيما معنوية فى محتوى أوراق فرخ الطعم من الكلوروفيل وكذلك طولة وقطرة خلال موسمى الدراسة بالمقارنة مع أصناف العنب الأخرى المختبرة.
٢- زيادة محتوى NPK فى أعناق الورقة للكينج روبى على الهارمونى بالمقارنة ببقية التطعيمات المدروسة.
٣- تفوق التطعيمات من العنب البناتى والسبيريور على الهارمونى فى المساحة الورقية للأوراق الناتجة لفرخ الطعم وكذلك الوزن الطازج والجاف لهذه الأوراق.
٤- زيادة محنوى اللجنين فى منطقة الألتحام بين الطعم والأصل من هذه النتائج يمكن الإستنتاج أن المواصفات الجيدة للشتلات المطعومة الدالة على التوافق حصل عليها من العنب السبيريور على أصل الهارمونى فى المشتل.

ونوصى بمزيد من الدراسة فى المستقبل لموضوع التوافق وتأثير التراكيب التطعيمية المستعملة على المحصول وخواص الثمار وجودتها.