Middle East Journal of Agriculture Research
ISSN 2077-4605

Volume : 04 | Issue : 02 | April-June | 2015
Pages: 190-194

Influence of Two Grape Rootstocks on Yield Quantity and Quality of Thompson Seedless

[1]Desouky I.M., [2]Laila F. Haggag, Shahin M.F.M., Fikria H. Khalil and [2]Eman S. El-Hady

[1]*Hort. Dept. Fac. Agric., Ain Shams Univ., Shoubra El-Kheima, Cairo, Egypt.*
[2]*Pomology Dept. National Research Centre, 33 El-Bohouth St., (former El- Tahrir St.,) Dokki, Giza, Egypt. Postal Code: 12622.*

ABSTRACT

The experiment was carried out in a private vineyard at Bani Salama region, Giza Governorate, Egypt, during two seasons (2012 - 2013) on Thompson seedless cultivar grafted onto Salt Creek and Harmony rootstocks. In addition, the same cultivar was grown on own roots and served as control. Data showed that, own rooted Thompson seedless vines resulted in a significant higher values of yield, cluster weight, some physical properties of berries. Chemical berry characteristic including SSC percentage, low acidity and high SSC/acid ratio were generally noted with own rooted vines of Thompson seedless. Thompson seedless cultivar recorded higher fruiting bud percentage with ungrafted vines compared with the other rootstocks. Meanwhile, highest bud burst percentage was obtained when Thompson seedless cultivar grafted onto Salt creek rootstock. Generally, yield, cluster and berry characteristics of own rooted vines of Thompson seedless were best when compared with vines grafted onto rootstocks under this study.

Key words: Grapevine, *Vitis vinifera*, Rootstock, Yield, Fruit quality, Nutrient content.

Introduction

Grape (*Vitis vinifera* L.) is one of the most important and favorable fruit crops in Egypt, it is considered the second fruit crop after citrus. The planted area reached 188543 feddan producing 1378815 tons (Ministry of Agriculture statistics, 2013). The production of grapes increased as a result of introducing of new varieties and rootstocks and improving culture practices.

Rootstocks have been used in vineyards since the second half of 19th century as a consequence of the phylloxera (*Daktulosphaira vitifoliae*) invasion in Europe. Rootstocks, as a link between the soil and the scion, play an important role in vine adaptation with the environmental factors.

Choosing the rootstock is one of the most important decisions when establishing vineyards. Rootstocks are employed in grape cultivation to overcome several biotic stresses (phylloxera, nematodes, root diseases, etc.), a biotic stresses (soil and water salinity, water scarcity, frost effect, etc.), and controlling vegetative growth, precocity and fruit quality. Reynolds and Wardle (2001) outlined some major criteria for rootstocks choice in the order of their importance as phylloxera and nematode resistance, adaptability to high pH soils, saline soils, wet or poorly drained soils and drought. In this respect, Salt creek "Ramsey" rootstock imports great vigor to its scions. It is quite resistant to nematodes and moderately resistant to phylloxera, it is performed well in light sandy soils of low fertility, has good tolerance to salt, perform well in slightly acid and calcareous soils. Harmony (1613C x *V. Champini*), it is moderate in vigor of moderate resistant to phylloxera and highly resistant to nematodes, well adapted to acidic soil, moderate resistant to salinity and highly resistant to drought (Mc Carthy & Cirami, 1990; Mullins *et al.*, 1992; Southey, 1992; Gao *et al.*, 1993; Lider *et al.*, 1995; Kocsis *et al.*, 1998; Sule, 1999; Walker *et al.*, 2002 and Goyzueta& Peniche, 2004).

Rootstocks affect vine growth, yield, fruit quality, cluster weight, berry size and soluble solids content (Grant & Matthews, 1996; Muñoz & Ruiz, 1998; Bavaresco *et al.,* 2003; Nikolaou *et al.,* 2003 and Zhiyuan, 2003).

The aim of the present investigation is to evaluate Thompson seedless grapevine cultivar grafted on the root stocks comparing with the own rooted of this cultivar on some plant and chemical parameters *i.e.* bud burst, fruiting bud, yield, cluster and berry characteristics and mineral content.

Materials and Methods

This study was carried out through two successive seasons (2012 and 2013). In a private vineyard at Bani Salama region, Giza Governorate, Egypt. The experiment included Thompson cultivar grafted only onto Salt creek and Harmony rootstocks. In addition, the same cultivar was grown on own roots and served as control. Vines were two years old and grown in a sandy soil and drip irrigated. The Spanish Barron system was used as a

Corresponding Author: Eman S. El-Hady, Pomology Dept. National Research Centre, 33 El-Bohouth St., (former El- Tahrir St.,) Dokki, Giza, Egypt. Postal Code: 12622.
E-mail: eman_elhady_79@yahoo.com

trellising system. Twelve vines was selected and arranged into three similar groups according to rootstock type, each group involved four vines. The experimental vines were arranged in complete randomized design with four replicates for each treatment, each replicated was represented by one vines.

Vines were cane pruned (120 eyes/vine were left, 10 canes x 12 buds /vine). In each season, clusters were thinned to 25-30 cluster per vine. All cultural practices were applied according to the recommendations of the Ministry of Agriculture.

The following determinations were studied:-

Bud burst

Bud burst percentage was calculated by dividing bursted buds on total number of bud and multiplied by 100

Flowering buds

Fruiting buds percentage was calculated by dividing fruiting buds on total number of bursted buds and multiplied by 100

Total yield

Clusters were harvested in each season when SSC was 16 %. Yield per vine (kg) were recorded.

Cluster and berry physical properties:

Four cluster/vine were pecked to determine average cluster weight (gm), cluster length and width (cm), then 100 berries/cluster were used to determine, average berry weight (g), berry size (cm^3), berry length/ diameter ratio and Juice volume of 100 berry (cm^3).

Fruit chemical properties:

100 berries/sample were used to determine, soluble solids content (SSC %) using a hand refractometer. Total titratable acidity (as grams tartaric acid per 100 milliliters of juice) was carried out by titration (A.O. A. C. 1980). SSC/acid ratio was calculated.

Chemical determinations:

Chlorophyll a, b content:

Samples of fresh leaves (0.5 g) were taken to determine chlorophyll a, b according to Von-Wettstien (1957).

Mineral analysis:

For the determination of nutrient content, samples from 5-7th nodes from vine shoot top were selected (Shawky *et al.,* 1996). Leaves were removed them petioles were dried and grinded, then appropriate weight of 0.5 g was digested using a mixture of perchloric acid and sulphoric acid as; 1:4 (v/v) until clear solution was obtained. The digested solution was quantitatively transferred to 100 ml volumetric flask and increased with deionized water to standard volume. Thereafter, contents of different elements for each sample were determined as the following methods: N% as Pregl, 1945, P% as Jackson, 1958, K and Na % as Brown and Lilleland, 1946 finly Ca% as Barrows and Simpson, 1962.

Statistical analyses:

The data were subjected to analysis of variance and Duncan's multiple rang test was used to differentiate means at 5% (Duncan, 1955).

Results and Discussion

Yield and physical characteristics of clusters:

Table (1) show yield, cluster weight and length/ width ratio of cluster as affected by different tested rootstocks during 2012 and 2013 seasons. It could be seen a high significant increase in the yield per vine with own rooted vines followed by Harmony rootstock, while, Salt Creek rootstock gave the lowest values in both seasons of the study.

Similar results were obtained for physical characteristics of clusters (cluster weight and length/width of cluster) which showed appreciable increased in ungrafted vines (own rooted) followed by grafted on Harmony rootstock, whereas, vines grafted on Salt Greek rootstock gave the lowest values in both seasons of study.

The obtained results are similar to those achieved by Boselli *et al.* (1992) they recorded negative or indifferent effects of rootstocks on scion vigour and yield. Chardonnay vines grafted on rootstocks 5C, Kober 5 BB, Gl3, Teleki 8B, S04, l103P and 41B had no significant effect on yields when compared to that from own rooted vines. On the other hand, Ferree *et al.* (1996) reported that an increase in the yield was obtained in grafted ‘Cab. erent Franc’ and ‘White Riesling’ than own rooted vines. Also, Lovicu *et al.* (1999) observed significant differences among rootstocks, yield of Chardonnay and Tocai cultivars being highest when grafted on 420 A rootstock, followed by the same cultivars on Rupestris du Lot rootstock.

Table 1: Yield as kg /vine, cluster weight (gm) and length / width of cluster of Thompson as affected by different tested rootstocks during 2012-2013 seasons.

Rootstocks	Yield (kg) /vine	Cluster weight (gm)	Length of cluster (cm)	Width of cluster (cm)
2012				
Salt Creek	5.0 c	200.0 c	26.1 b	24.9 ab
Harmony	8.3 b	330.5 b	29.6 a	26.2 a
Own rooted	12.3 a	485.6 a	28.3 ab	23.2 b
2013				
Salt Creek	7.9 c	313.8 c	21.4 b	14.3 ab
Harmony	10.5 b	417.7 b	25.9 a	16.6 a
Own rooted	11.5 a	458.3 a	23.6 b	12.1 b

Means having the same letters within a column are not significantly different at 5% level.

Physical characteristics of berries:

Data in Table (2) show the physical characteristics of berries i.e. berry weight (g), berry size (cm^3) length/diameter ratio of berry, firmness values (g/cm^2) and juice volume of 100 berry of Thompson as affected by different tested rootstocks during 2012 and 2013 seasons. The results indicated a significant increase in the weight, size of berry and juice volume of 100 berries of own rooted followed by Harmony rootstock, while, Salt Creek rootstock gave the lowest values. Concerning length/diameter ratio of berry, the results cleared an insignificant differences between own rooted and both rootstocks, while, Harmony rootstock gave a high significant value comparing with Salt Creek.

Table 2: Some physical characteristics of berries of Thompson as affected by different tested rootstocks during 2012-2013 seasons.

Rootstocks	Berry weight (gm)	Berry size (cm3)	Length/ diameter of berry	Juice volume of 100 berry (cm3)
2012				
Salt Creek	1.20 c	1.12 c	1.10 b	70.10 c
Harmony	1.54 b	1.45 b	1.19 a	105.50 b
Own rooted	2.12 a	2.05 a	1.16 ab	141.30 a
2013				
Salt Creek	1.01 c	0.89 c	1.08 b	86.20 c
Harmony	1.57 b	1.46 b	1.21 a	114.45 b
Own rooted	1.98 a	1.75 a	1.15 b	150.50 a

Means having the same letters within a column are not significantly different at 5% level.

Chemical characteristics of berries:

Data in Table (3) shows that, chemical characteristics of berries i.e. SSC, acid content and SSC/ acidity ratio of Thompson as affected by different tested rootstocks during 2012 and 2013 seasons. The above parameters were significantly affected by the kind of rootstock. Own rooted vines gave a higher percentage of SSC and SSC/ acidity ratio and lower acid content followed by vines grafted on Harmony rootstock, whereas, vines grafted on Salt Greek rootstock gave the lowest values in both seasons of the study. Concerning acid content, the results obviously showed a significant increase with Harmony rootstock compared with Salt Creek rootstock and Own rooted in both seasons of the study.

The present results are in harmony with the findings of Reynolds and Wardle (2001) through working on grafting nine wine grape cultivars on four different rootstocks, they found few significant differences in titratable acidity among rootstocks over eight years.

Table 3: Some chemical characteristics of berries of Thompson as affected by different tested rootstocks during 2012-2013 seasons.

Rootstocks	SSC %		Titratable acidity %		SSC/ acidity ratio	
	2012	2013	2012	2013	2012	2013
Salt Creek	15.20 c	15.50 c	0.61 a	0.75 a	24.92 c	20.67 c
Harmony	16.10 b	16.40 b	0.46 b	0.67 b	35.00 b	24.03 b
Own rooted	17.50 a	17.20 a	0.45 b	0.62 b	38.39 a	26.45 a

Means having the same letters within a column are not significantly different at 5% level.

Bud burst and flowering buds percentage:

Data in Table (4) show bud burst and flowering bud percentage of Thompson as affected by different tested rootstocks during 2012 and 2013 seasons. it was noticed a significant increase in Bud burst percentage of Thompson grafted onto Salt Creek rootstock (77.60 & 82.50 %) comparing with grafted on Harmony rootstock and own rooted (69.50, 66.20%) and (75.40, 70.20 %) in the first and second seasons, respectively. On the contrary, the own rooted vines recorded the highest flowering bud percentage (40.25 & 37.03%) comparing with the two other rootstocks which gave (22.18, 31.38 & 20.14, 28.10 %) for Salt Creek and Harmony in the first and second seasons, respectively.

Table 4: Bud burst percentage and flowering bud percentage of Thompson as affected by different tested rootstocks during 2012 and 2013 seasons.

Rootstocks	Bud burst (%)		Flowering buds (%)	
	2012	2013	2012	2013
Salt Creek	77.60 a	82.50 a	22.18 c	20.14 c
Harmony	69.50 b	75.40 b	31.38 b	28.10 b
Own rooted	66.20 c	70.20 c	40.25 a	37.03 a

Means having the same letters within a column are not significantly different at 5% level.

Chemical characteristics of leaves:

Data in Table (5) show some chemical characteristics of leaves of Thompson as affected by different tested rootstocks during 2010, 2011 and 2012 season. The highest leaf chlorophyll (a) content was obtained with vines grafted on Harmony rootstock (0.45, 0.62 and 0.67 mg/gm fresh wt.) for the three years, respectively. While ungrafted gave the lowest values of leaf chlorophyll (a) content (0.29, 0.43 and 0.44 mg/gm fresh wt.) for the three years, respectively. Whereas leaf chlorophyll (b) content had no significant differences between vines grafted on Salt Creek and Harmony rootstocks, while ungrafted vines gave the lowest values in three years.

This result was supported by Bica *et al.* (2000) who indicated that rootstock was significantly affected chlorophyll content of vine leaves. Also, Keller *et al.* (2001) reported that chlorophyll content was the highest for vines grafted on K5BB rootstock and the lowest for 330ac rootstock.

Concerning the effect of the type of rootstock on leaf mineral content, Table (5) showed that Salt Creek rootstock gave the highest nitrogen percentage but gave intermediate value potassium content. While Harmony rootstock ranked the highest one in potassium content as compared to own rooted vines, which had lower value than grafted vines in assimilating the mineral in three seasons of this study. In regards phosphorus content, there was no statistically significant difference between the rootstocks. From the previous results, it was noticed that the differences in nutrient uptake and distribution could be attributed to the genotype of rootstock, which gives different absorption capability or tendency for some specific minerals. These results in most cases are in partial agreement with those found by Tangolar and Ergenoglu (1989) who grafted Gruner Veltliner onto 10 rootstocks and concluded that leaf N levels were similar for scions on all rootstocks. While the leaf K+ was found to be the highest in vines grafted on Rupestris du Lot and 110R rootstocks, with respect to leaf P was the highest in vines grafted on 110 R rootstock. In addition, whereas, Brancadoro and Valenti (1995) grafted Croatina onto 20 different rootstocks and they found that vines K content of must and leaves was significantly affected by rootstocks and they suggested that K deficiency should be improved by choosing an appropriate rootstock.

N, P, K in dry weight petioles leaves.

Generally, the obtained results proved that own rooted vines of Thompson cultivar was better compared with the other rootstocks under this study, Thompson cultivar needs more studies and evaluation on another type of rootstocks.

Table 5: Some chemical characteristics of leaves of Thompson as affected by different tested rootstocks during 2012-2013 seasons.

Rootstocks	Leaf chlorophyll (a) mg/g fresh wt.	Leaf chlorophyll (b) mg/g fresh wt.	Leaf Nitrogen content (%)	Leaf Phosphorus content (%)	Leaf Potassium content (%)
2010					
Salt Creek	0.40 b	0.12 a	2.29 a	0.32 a	0.84 b
Harmony	0.45 a	0.13 a	1.65 b	0.30 a	1.13 a
Own roots	0.29 c	0.08 b	0.79 c	0.29 a	0.75 c
2011					
Salt Creek	0.53 b	0.14 a	2.38 a	0.36 a	1.63 b
Harmony	0.62 a	0.15 a	1.99 b	0.35 a	1.95 a
Own roots	0.43 c	0.10 b	1.20 c	0.30 a	0.99 c
2012					
Salt Creek	0.55 b	0.16 a	2.40 a	0.51 a	0.81 b
Harmony	0.67 a	0.16 a	2.07 b	0.49 a	1.11 a
Own roots	0.44 c	0.12 b	1.58 c	0.40 a	0.73 c

Means having the same letters within a column are not significantly different at 5% level.

References

A.O.A.C., 1980. Official and Tentative Methods of analysis Association of official Agricultural Chemists. Washington, D. C. U. S. A.

Barrows, L. H. and E. C. Simpson, 1962. An EDTA method for the direct routine determination of calcium and magnesium in soil and plant tissues. Soil Science Society American. Proc., 26: 443.

Bavaresco, L., E. Giochino and S. Pezzutto, 2003. Grapevine rootstock effects on lime-induced chlorosis, nutrient uptake, and source-sink relationships. Journal Plant Nutr. 26: 1451-1465.

Bica, D., G. Gay, A. Morando, E. Soave and B. A. Bravdo, 2000. Effect of rootstock and *Vitis vinifera* genotype on photosynthetic parameters. Acta Horticultural, 526: 373-379.

Boselli, M., M. Fregoni, A. Vercesi and B. Volpe, 1992.Variation in mineral composition and effects on the growth and yield of Chardonnay grapes on various rootstocks. Agricoltura Ricerca 14: 138-139.

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

Brown, J. D, and O. Lilleland, 1946. Rapid determination of potassium and sodium in plant material and soil extracts by flame photometry. Proceedings of the American Society for Horticultural Science, 48: 341-346.

Duncan, D. B., 1955. Multiple range and multiple "F" tests. Biometrics, 11: 1- 42.

Ferree, D. C., G. A. Cahoon, M. A. Ellis, D. M. Scurlock and G. R. Johns, 1996. Influence of eight rootstocks on the performance of White Riesling and Cabernet France over five years. Fruit Varieties Journal, 50: 124 - 130.

Gao, X. P., X. W. Guo, K. Wang and W. H. Fu, 1993. The resistance of grape rootstocks to cold and crown gall. Acta Horticultural Sinica, 20:313-318.

Goyzueta, M. D. V. and R. M. l. Peniche, 2004. Quality and storage potential of 'Ruby Seedless' table grape established on eight rootstocks. Revista Fitotecnia Mexicana, 27:69-76.

Grant, R. S. and M. A. Matthews, 1996. The influence of phosphorus availability, scion, and rootstock on grapevine shoot growth, leaf area, and petiole phosphorus concentration. Am. Journal Enol. Vitic, 47: 217- 224.

Jackson, M. L., 1958. Soil Chemical Analysis. Constable and Co. Ltd. London. 498.

Keller, M., M. Kummer and M. C. Vasconcelos, 2001. Soil nitrogen utilization for growth and gas exchange by grapevines in response to nitrogen supply and rootstock. Australian Journal Grape and Wine Res., 7: 2-11.

Kocsis, L., E. Lehoczky, L. Bakonyi, L. Szabo, L. Szoke and E. Hajdu, 1998. New lime and drought tolerant grape rootstock variety. Acta Horticultural, 473: 75-82.

Lider, L. A., M. A. Walker and J. A. Wolpert, 1995. Grape rootstocks in California vineyards: the changing picture. Acta Horticultural, 388:13-18.

Lovicu, G.; M. Pala and M. Farci, 1999. Effect of rootstock on the vegetative productive performance of Cannonau. Informatore Agrario 55: 87-90.

Mc Carthy, M. G. and R. M. Cirami, 1990. The effect of rootstocks on the performance of Chardonnay from a nematode-infested Barossa Valley vineyard. American Journal Enology Viticulture, 41: 126 -130.

Ministry of Agriculture statistics, A. R. E., 2013. Economic Agriculture, Department of Agriculture Economic and Statistics.

Mullins, G. M.; A. Bouquet and L. E. Williams, 1992. Biology of the grapevines. Cambridge University Press, NY.

Muñoz, J. and R. Ruiz, 1998. Influencia de diferentesportainjertos de vides sobreaspectos de crecimiento, producción y nutricionales en el cultivar Red Globe. ACONEX 58: 5-9.

Nikolaou, N.; K. Angelopoulos and N. Karagiannidis (2003): Effects of drought stress on mycorrhizal and non-mycorrhizal Cabernet Sauvignon grapevine, grafted onto various rootstocks. Exp. Agricultural, 39: 241- 252.

Pregl, F., 1945. Quantitative organic micro analysis. 4th, Ed. J.A. Cheerehill, Lth, London

Reynolds, A. G. and D. A. Wardle, 2001. Rootstocks impact vine performance and fruit composition of grapes in British Columbia. Horticultural Technol., 11: 419 - 427.

Shawky, I., Abou Rawash Zeinab Behairy; M. Salama and Maryam Mostafa, 1996 Growth and chemical composition regimes. 6th Conf. Agricultural Dev. Res., Ain Shams University, Cairo, Egypt. De. 17-19. Annals Agricultural Science, SP. Issue, 187-201.

Southey, J. M., 1992. Root distribution of different grapevine rootstocks on a relatively saline soil. South African J. Enol. Viticul. 13:1-9.

Sule, S., 1999.The influence of rootstock resistance to crown gall (*Agrobacterium spp.)*on the susceptibility of scions in grapevine. Proceedings of New Aspects of Resistance Research on Cultivated Plants: Bacterial Diseases. 5:32-34.

Tangolar, S. and F. Ergenoglu, 1989. The effects of different rootstocks on the levels of mineral elements in the leaves and the carbohydrate contents of the canes of some early maturing grape cultivars. Doga, Turk Tarim ve Ormancilik Dergisi., 13(3): 1267-1283.

Von-wettstein, D., 1957. Chlorophyll – letale und der submikroskopische formwechsel der piastiden. Exp. Cell Res. 12: 427- 506.

Walker, R. R., 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. Australian Journal Grape and Wine Research, 8: 3-14.

Zhiyuan, Y., 2003. Study on the rootstocks for Fujiminori grape variety, South China, 32: 57-58.