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Evaluation the effect of rootstocks on postharvest berries quality of 'Flame Seedless' grapes

A.A. Lo'ay[a,*,1], A.Y. El-khateeb[b]

[a] Department of Pomology of Agriculture College, Mansoura University, 35516, El-Mansoura, Egypt
[b] Department of Chemistry of Agriculture College, Mansoura University, 35516, El-Mansoura, Egypt

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ABSTRACT

'Flame Seedless' (Vitis vinifera L.) is one of the most valuable grape cultivars in Egypt. Also, it is one of the earliest ripening red seedless cultivars which appeared in the Egyptian market. The current investigation was conducted during the two season 2013 and 2014 on 8 years old vines in the commercial orchard when soil was sandy. Vines were grafted on four rootstocks Freedom, Ruggeri, Paulson and Flame Seedless. Therefore, this study was conducted to evaluate the effects of different rootstocks on fruit quality attributes during shelf-life. The Paulson rootstock presented highly marketable under Egyptian conditions compared with other rootstocks as to physical and chemical quality characteristics. As the main conclusion, graft Flame Seedless vines onto Paulson rootstock to improved fruit quality and also to enhance economic crop in Egyptian market

1. Introduction

Grape is an old deciduous fruit crop, widespread and highly valuable horticultural vine among the most important crops in the world. Flame Seedless as a promising grapevine cultivar which grown good under Egyptian conditions especially in newly reclaimed areas (El-Gendy, 2013). Flame seedless is the earliest ripening red seedless cultivar. Under high temperature, it tends to develop within sufficient color which is an important quality attribute as a visual acceptability at harvest time for customers (Strydom, 2014).

Rootstocks play very important roles in cultivation feature such as: improving or reducing yield (Jogaiah et al., 2013), also protecting crops against phylloxera and nematode (Köse et al., 2014). Overcoming water and salinity stress in newly reclaimed areas in north and middle of Egypt (El-Gendy, 2013). Adaptability to high and low pH, wet or poorly drained soils and drought (Köse et al., 2014). Moreover, rootstocks affect vine growth, yield, and clusters quality through the interaction between the environmental factors and the physiology of scions and rootstock cultivars as mentioned by (El-Gendy, 2013). Rootstocks Paulsen (*V. Berlandieri* X *V. rupestris*), Ruggeri (*V. Berlan dieri* X *V. rupestris*) and Freedom (1613C X *V. champini*) used as rootstocks in reclaimed lands and evaluated previously (Wolpert et al., 1994). In this respect, Freedom is more resistant to phylloxera, nematode and drought stress (El-Gendy, 2013). Paulsen rootstock is vigor and also resistant to phylloxera and it good for clay and lime soil. It is moderate to salt tolerance and moderate to high drought tolerance. Finally, Ruggeri is resistance to phylloxera high too and is very high vigor plant. Also, it is highly drought and moderate salt tolerance(Wolpert et al., 1994).

Although, many researchers studied the evaluation rootstocks effects on scions growth but they did not figure out the effects of rootstocks on fruits behavior during handling in market or shelf-life. The objective of this study was to evaluate the effects of grafting Flame seedless grapevines on four rootstocks (Flame seedless on own roots, Paulsen, Ruggeri, and Freedom) on berry qualities during shelf-life.

2. Materials and methods

2.1. Plant material and experimental design

The present study was performed during 2013–2014 seasons on 8 years old Flame seedless cv. grafted on different rootstocks such as Freedom, Ruggeri, and Paulsen compared with Flame seedless on the own root (control) in a commercial orchard near Monufia Gov. Egypt. Vines planted at 2 × 3 m in sandy soil under drip irrigation system. The sample was picked when the soluble solid content in berry juice at 16% in average. Upon arrival in pomology Department, the 240 fruit clusters were divided into two batches. The one contents 120 clusters for nondestructive measurements (water loss percentage, rachis browning index and berry shatter percentage). Thereafter, samples were divided into four group, 30 clusters per only each rootstock, were distributed in

* Corresponding author.
E-mail address: loay_Arafat@mans.edu.eg (A.A. Lo'ay).
[1] www.mans.edu.eg.

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three replicates. However, the destructive measurements have the same distribution as described previously. Two cluster sample of each replicate were picked every day for measuring. These batches were stored at ambient air (25 ± 1C and 43 ± 1 air relative humidity during four days).

2.2. Physical quality attributes analysis

Berry firmness was recorded using fruit texture Effegi-penetrometer supplemented with a plunger 2 mm diameter penetrator and separation force was measured using a hook instead of a plunger. Firmness and separation force of berries were expressed an N. Berry shattering percentage and rachis browning index was recorded as described by (Lo'ay, 2011). Water loss percentage was recorded (Artés-Hernández et al., 2006). Stem and rachis browning index as described by (Crisosto et al., 2001)

2.3. Chemical quality attributes analysis

Quality elements were determined, berries were randomly removed from several cluster samples and were divided into three replicates to measure soluble solid content (SSC%) using Carlzeiss hand refractometer, acidity as tartaric acid (TA) was determined by titration with 0.1N NaOH. Ascorbic acid content (vitamin C) was measured by a titrimetric method using 2,6-dichlorophenol indophenol and 6% oxalic acid as substrate according to (AOAC, 1995), SSC/TA ratio was calculated as defined maturity index. Total phenol (TP) in the treated fruits were measured spectrophotometrically using the Folin–Ciocalteu reagent with gallic acid as standard (Singleton and Rossi, 1965). The phenols were measured at the wavelength 750 nm. The results were reported as mg of gallic acid equivalents (GAE) mg 100 g^{-1} FW.

2.4. Statistical analysis

Data for the evaluation of effects of rootstocks on fruits behavior during shelf-life were analyzed using two ways incomplete block randomize analysis. An ANOVA for each quality attribute was performed and value at shelf-life during four days was compared with 5% to find significant among rootstocks. Linear regression analysis and ANOVA were analyzed at 5% probability level. The statistical software package GenState ver. 11 (Lawes Agricultural Trust, Rothamsted Experimental station, UK) was used.

3. Results and discussion

3.1. Effect of rootstocks on physical quality attributes: water loss%, rachis browning index (RBI) and berry shatter% (BS)

Table 1 shows a significant at $P < 0.05$ when the rootstocks were considered as a factor. It is clear that the Paulson rootstock is more effective to reduce water loss compared to other rootstocks. The lowest percentage of water at 2nd day of shelf life. Paulson (4.74%) is a three-fold less than Freedom (12.31%), Ruggeri (12.49%) and is a one-fold of Flame Seedless (9.36%). Water loss increases gradually up to 4th day of shelf life. The lowest water loss value was observed with Paulson rootstock at 4th day (17.50%) than other rootstocks (Freedom:20.60%; Ruggeri: 31.87 and Flame seedless: 30.71%). At harvest time, there was no evidence for RBI and BS before the 2nd day of shelf life time. In this case, both RBI and BS were detected at 2nd day. Paulson rootstock presents lowest RBI incidences on the 2nd day (1.13 close to healthy) and increases gradually up to a 4th day (2.17 slight browning) compared to other rootstocks. While SB was recorded at 2nd day (0.28%) and it increased gradually up to end of shelf life period (3.81%) compared to other rootstocks.

Taken as a whole these results show that the physical quality attributes can be affected differ. It seems plausible that Paulson rootstock effects on water loss during shelf life. Basically, berries have a somewhat, thick epidermis, covered with waxes layer on berries surface, acting as a protective layer against dehydration. It could be that the Paulson rootstock reduces the water loss during shelf life by increasing accumulation waxes on berry surface during berry development. Also, it acts as a protective layer against dehydration (Elboudwarej et al., 1990; Lo'ay, 2011). The symptoms of such state include skin discoloration with increased susceptible to fungi contamination and decrease in shelf-life (Rogiers et al., 2004). While the lowest rachis browning incidences were found on the vine that grafted on Paulson rootstock. It suggested that Paulson rootstock present high content of ascorbic acid content in fruit cluster by which it may be protected rachis as a scavenger of active oxygen species during shelf life stress (Lo'ay, 2005). Basically, browning incidence relates to the oxidation of phenolic compounds by polyphenol oxidase (PPO) (Lo'ay, 2011). Finally, the lowest SB% of Paulson rootstock, is clearly that the berry losses from bunches are mainly caused by a combination of physiological sensitivity and mechanical force of handling (Lydakis and Aked, 2003). So, the susceptibility berry to shatter, has been suggested that the pedicel and brush of berry behave in a climacteric process, showing respiration and ethylene peaks (Ge et al., 1997), with increasing water losses (Rogiers et al., 2004), and abscission layer formation at the distal end of the pedicel of berry (Crisosto et al., 2001). It could be in this case that Paulson rootstock provides resistance to cluster during shelf life stress.

Table 1
Nondestructive measurements, water losses%, rachis browning index and berry shatter% of Flame seedless grapevine was grafted on four rootstocks, Freedom, Ruggeri, Paulson and Flame seedless during four days of shelf-life at ambient air during two seasons (2013–2014).

Rootstocks	Shelf-life time (Days)											
	Weight losses%				Rachis browning index				Berry shatter%			
	D1	D2	D3	D4	D1	D2	D3	D4	D1	D2	D3	D4
Freedom	0.00	12.31	15.99	20.60	0.00	1.33	2.65	4.61	0.00	0.29	2.70	4.04
Ruggeri	0.00	12.49	24.36	31.87	0.00	1.45	2.65	3.94	0.00	0.93	5.63	9.34
Paulson	0.00	4.74	11.91	17.50	0.00	1.13	1.91	2.17	0.00	0.28	1.33	3.81
Flame	0.00	9.36	18.97	30.71	0.00	1.43	3.10	4.23	0.00	1.41	8.31	13.04
LSD	–	3.56	5.87	5.58	–	0.21	0.42	0.96		0.49	2.19	2.45

Means in a column are significantly different at ($P < 0.05$) according to LSD. Each value represent mean of 3 replicates during two seasons of 2013 and 2014.
Rootstocks as treatments: Freedom, Ruggeri, Paulson and Flame seedless.
Rachis browning was used to determine stem condition (1 = cap stem healthy; 2 = cap stem slightly brown; 3 = cap stem and secondary stem moderately brown; and 4 = cap stem, sever brown, and 5 = primary stem fully brown).