EFFECT OF ROOTSTOCK, TIME AND METHOD OF GRAFTING ON THE PERCENTAGE OF SUCCESS AND BUDLING PERFORMANCE OF GRAPE "SUPERIOR"

By

TAREK RSHAD FADL ABDELBAKY
B.Sc. Agric. Sci. (Horticulture), Fac. Agric., Cairo Univ., 1992

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ABSTRACT

The present study was carried out during the two successive seasons of 2007 and 2008 in a private nursery located at Sids Hort. Res. Station, Beni Suef Governorate, to study the influence of winter and summer grafting for "Superior" grape cultivar grafted onto some grape introduced rootstocks; "Paulsun", "1103", "Salt creek" and "Freedom" in addition the local Romi Ahmer cultivar on percentage of survival, vegetative growth parameters and its chemical content of Superior rooting.

The results showed that "Superior" grafted onto all rootstocks especially "Romi Ahmer", "Salt creek" and "Freedom" were effective in increasing the survival of success grafts (%), achieving the best vegetative growth parameters (i.e. average shoot length, shoot diameter and average leaf area and increasing nutrient content of leaves (i.e. percentages of total nitrogen, phosphorus and potassium) as well as raising indole content and reducing phenol content of union graft between scion and rootstock.

Key words: Grafting, grape, rootling, nitrogen, phosphorus, potassium, rootstock
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INTRODUCTION

Grape (*Vitis vinifera* L.) is considered the first major fruit crop with regard to its production all over the world. In Egypt, grape ranks second after citrus. The total acreage of grape in Egypt exhibited an obvious increase in the recent few years till it reached 170940 feddan with a production of 1.531.418 tons thus exportation quantity 100741.63 tons according to the latest statistics of Ministry of Agriculture (2010).

Rootstocks have recently gained great importance in the only consistently effective and successful strategy in major viticultural countries worldwide (Troncoso, *et al.*, 1999). The importance of rootstocks in viticulture is well documented, they are used not only as an effective means of controlling important biological pests such as phylloxera and nematodes, but they can also be used effectively to regulate nutrient exclusion, uptake of water in the vine (McCarthy *et al.*, 1997; Walker *et al.*, 2000 and Keller 2001). However, the choice of a certain rootstock is becoming increasingly difficult as a result of the availability of numerous new rootstocks (Loreti and Massai, 2006). One of the problems when choosing the right scion/rootstock combination is in predicting how the scion and rootstock genotype will interact (Cus, 2004). Interaction usually results from the mutual translocation of nutrients and growth regulators between the scion and rootstock (Jackson, 2000). Thus, an early and accurate prediction of graft incompatibility in the nursery has great importance for our region because incompatibility could be avoided and compatible genotypes could be selected (Petkou, *et al.*, 2004).
Reynolds and Wordle (2001) outlined seven major criteria for rootstocks choice in the order of their importance as phylloxera resistance, nematode resistance, adaptability to high pH soils, saline soils, low pH soils, wet or poorly drained soils and drought. These effects take place in a more or less indirect manner and are consequences of the interactions between environmental factors and the physiology of the scion and rootstock cultivars employed.

Many investigations proved that rootstocks affect vine growth, yield, fruit quality through the interactions between the environmental factors and the physiology of scions and rootstock cultivars employed. In this respect, Hedberg (1980) found that yields of all grafted cultivars were much higher than those of own-rooted vines, especially those grafted on "Ramsey" and "Dogridge" rootstocks. Fardossi et al (1995) found that shoot growth of "Gruner veltline" was slower on "5C" and "Fercal" but more rapid on "P1103", "725P" and "125AA". Ripening of grapes occurred earlier on "1103P", "G1" and Riparia Sirbu" than on other rootstocks. Bunch quality, bunch weight, berry size and soluble solids content were affected by rootstocks (Zhiyuan 2003). The level of mineral uptake differed according to the rootstocks (Grant & Matthews 1996, Ruhl 2000 and Kocsis & Lehoczky 2002).

The main goal of this investigation was to study the influence of some grape introduced rootstocks; Paulsen 1103 (V. berlandieri x V. rupestris), "Salt creek" (V. champini), "Freedom" ("1613C" x V. champini) and local cultivar Romi Ahmer (Vitis vinifera) (to be used as a rootstock) were at two different times (winter grafting or summer grafting) with two different methods (mechanical or manual) under two
different grafted union covering (waxing or non-waxing) on the percentage of survival, vegetative growth parameters and its chemical content in addition examine the strength fusion between the rootstock and graft by histological section in the graft union of superior cutting or rootling.
REVIEW OF LITERATURE

The available local and foreign reviews dealt with the present study are outlined under the following main topics:

1. **Effect of rootstocks on percentage of survival**

   Factors affecting the success of grafted vines have been studied from old decades. It was illustrated that they includes factors as relative compatibility between stocks and scions, age and vegetative activity of both compatible scion and stock, favourable conditions surrounding the grafts, precise technique of grafting, environmental conditions after planting the grafts, (Harmon and Weinbergar, 1967).

   Mikhail (1976) found that percentage of take off differed according to the rootstocks used, date of grafting and the method of grafting when grafted "Thompson Seedless" and "Italia".

   Moreover, it was found by Moti Singh and Chaudhry (1984), that grafting success was the greatest (100%) with "Pearl of Casba" grafted on "Kandhari" rootstock followed by "Bharat Early" grafted on "Kandhari" rootstock (93.3%) and the success on "Gulobi" ranged from (80 to 83.3%).

   The rooting and grafting ability of 5 commonly used grape rootstocks, Salt Creek, Dog Ridge, P-1103, S-04 and 41-B, were studied in field trials conducted at the Regional Fruit Research Station, Ganeshkent, in 1985/86 and in 1986/87. "Thompson Seedless" was used as the scion. In both growing seasons, rooting of cuttings and grafting success were the best in P-1103. (Bhujbal, 1993).

   Green grafting trials were carried out under greenhouse conditions with grape "Riesling", "Orion", "Trollonger" and "Regent"
and rootstocks Kober 5BB, 26G and 125AA. The presence of the rootstock leaf promoted rooting of the grafts. The scion leaf as important for callus formation and its removal led to a significant reduction in grafting success and survival (Reustl et al., 1993).

In another investigation by Mortensen et al. (1994) they indicated that Florish grape rootstock had a higher percentage of successful grafts and lower tendency to produce sprouts below the graft union than "Dog Ridge" with scions of "Oralndo Seedless", ensuring 92% successful graft unions compared with 64% for "Dog Ridge".

D'Khili et al. (1995) stated that anatomical studies showed that vascular connections were necessary but not sufficient for graft success. Abnormal starch distribution allowed incompatibility characterization but only after its morphological manifestation.

Borgo et al. (1998) stated that good unions were formed, especially when very young tissues were involved. Graft take was greater (65-68%) on "Kober 5BB" than on "1103P." (59%). Plants were ready for transfer to field conditions after 2 months.

Celik (2000) investigated the effect of grafting by cleft-grafting on the successful production of "Amasya Beyaz" and "Alphons Lavallee" grape on "5BB" rootstock. One-year-rooted rootstocks were used. The success of cleft grafting was 81% for "Amasya Beyaz" and 79.75% for "Alphonse Lavallee"

Lu and Ren (2003) evaluated the effect of rootstock on performance and survival in Florida to provide useful information on rootstocks performance for humid tropical and subtropical
environments. "101-14", '5BB", "Ramsey" and "St. George" showed 100% survival, while "Freedom" had 10% vine survival.

Abo El-Wafa (2003) grafted "Thompson seedless" cuttings on different rootstocks ("Salt Creek", "St. George", "ARG1", "Harmony" and "Romi Red"). She found that the highest percentage of takes were attained with Romi Red stock (66.50 and 67.70%) however the lowest ones were found on "Salt Creek" (34.08 and 40.76%) for both seasons respectively.

The rates of the success of the cleft grafting and the affinity values of 5 table grape cultivars on "41B" and "110R" American rootstock was investigated by Isci and Altndisli (2006) they recorded that the best results were obtained by "Trakya Ilkeren" grafted on "41B" (100%) whereas, "Yuvarlak Cekirdeksiz" (Sultana) grafted on "110R" rootstock had the lowest affinity value (77%).

The green grafting method and the conventional woody methods of grafting were compared in grapevines. The former method showed better vascular formation than the latter suggesting more effective transport of substances between the rootstock and the scion (Porro et al., 2006).

Gaser (2007) studied the impact of seven rootstocks ("Dog Ridge", "Salt Creek", "Freedom", "Harmony", "SO4", "Teleki 5C" and "Paulsun" 1103 on the percentage of success of bench grafted "Superior Seedless" scions. Percentage of grafts success ranged between (66.7&86.5%) according to rootstocks and seasons. Grafting "Superior" grape vines on Freedom and Harmony rootstocks recorded the highest
percentage while "Teleki 5C" and "Dog Ridge" rootstock recorded the lowest percentage in both seasons.

During 2006, the Hungarian green grafting method was tested on grapevines in the south of France. Three tests were carried out upon rejuvenated shoots which were split grafted between June and July. Cinsault and "Syrah" were grafted on to rootstock 41B and Viognier was grafted on to Clairette W/110R. The grafts grew quickly and the success rate was satisfactory (Chaudiere, 2007)

Porro et al., (2007). Higher values of percentage of taking roots were detected in grapevines grafts when green grafting was used compared with conventional woody grafting methods also with the "green" technique; a better xylem vascular formation than traditional grafting was also shown by this method, indicating a more effective flow of substances between stock and scion.

Lu and Ren (2008) showed that notable significant variations of vine survival rate were observed after three growing seasons. At the end of 3rd growing season ‘Freedom’, ‘3309C’ and ‘O39-16’ lost more than 50% of their original vines. In the mid-6th growing season, only four rootstocks had more than 70% vines alive, with 100% survival of ‘Ramsey’ rootstocks.

2. Effect of rootstocks on vegetative growth parameters

The vigour of vegetative growth of the scion as affected by different rootstocks was early reported by Sullivan (1965) who found that Freedom is a more vigorous cultivar than Concord, but both cultivars appeared to be weak and chlorotic on their own-roots. However,
grafting both cultivars together, each of them grew more vigorous and did not appear chlorotic. While, Salt Creek stock produced the most vigorous vines, and Solonis stock the least vigorous. Vines of Cardinal (Vitis labrusca) and "Thompson seedless" on "Dog Ridge" and "Salt Creek" rootstocks produced more pruning wood weight than own-rooted vines, and both rootstocks increased the vigour of "Thompson seedless" cultivar.

Sauer (1972) found that Sultana grape vines grafted on two "V. champini" stocks were more vigorous than other vines. Vegetative growth was greater on "Dog Ridge" than on "Salt Creek" rootstocks.

"Dog Ridge," Lake“ Emerlad," "W38 "and "W1521" rootstocks were grafted with five different scions i.e Norris, Stover, Blue Lake, "FESA3-34" and "FESA3-600" cultivars.Scions on "Dog Ridge" rootstock were the most vigorous (Mortensen,1973).

Raski et al. (1973) noted that "Dog Ridge" and "Salt creek" rootstocks grafted with Granech scions were equally vigorous and productive.

Grafting grapevine, Seneca, "Florida," "Compbell" Early, Concord," Early Niabell," Veeport, Vinered, Iona and Delaware onto "Dog Ridge" rootstock improved effectively the growth of the scions compared with ungrafted vines grown on their own roots (Antcliff, 1979)

Growth vigour of own rooted cuttings was slightly altered when grafting was carried out on different rootstocks (Crescimanno et al. 1981)
Graprindashvili and Tsertsevaoze (1981) found that the grapevine cv. Krakhuna had the largest leaf surface area/vine when it was grafted on Chasselas x Berlandier rootstock.

Mortensen and stover (1982) found that scion vigour was greater on Tampa than "Dog Ridge," Lake" Emerald "or "Blue Lake" rootstocks.

High pruning weight was noted when grafting was carried out on" 1613-C" and"Dog Ridge"(Sarooshi et al.,1982).

Pongrancy (1983) studied the effect of grafting on leaf area and observed that there was a great variation in leaf area of scions due to different grape rootstocks.

. Shiraz grapes were grown on its own-roots or grafted onto the following 6 rootstocks: "Ramsey" and "Dog Ridge," "Teleki 5A," Schwarzman," Richter 110" and "1613." Viens on rootstocks "Ramsey" and "Dog Ridge" had more vigour vegetative growth (Hedberg et. al,.1986)

In an investigation carried out to study the vegetative growth of 4 seedlings rootstocks i.e (ARG, Berlandieri x" Reparia," "Romi Red "and Couderc 1202), El-Hawary (1987) found that longest shoots were attained by "ARG " rootstock and "Romi Red "cultivar, while Couderc 1202 had the shortest ones. Whereas the largest leaf area was that of Berlandieri x Reparia rootstock and "Romi Red " cultivar. ARG attained the smallest leaf area.

Southey and Fuche (1991) reported that when cv. Chenin Blanc grapes was grafted on" 99 Richter," Constantia Metallica," Dog Ridge", "Ramsey" and "101-14 Mgt", pruning mass (t/ha) was the highest with
"143-BMgt", "Dog Ridge," "Constautia Metallica" and "Ramsey rootstocks. While, the crop: pruning mass ratio of "143-BMgt" was lower, than the other rootstocks.

Gaser (1992) investigated the vegetative growth of seedlings of 6 grapevine rootstocks and cultivar ("Thompson Seedless", St.George, "Dog Ridge", "ARG1", "Couderc" 1202, "Couderc 1613" and Couderc 1616) She found that the longest shoot and the highest number of leaves were attained by "Couderc 1616" rootstock followed by "Couderc 1613" then the other rootstocks or cultivars. The largest leaf area was attained by "Thompson Seedless" cultivar followed by "Couderc 1613.Whereas" St.George attained leaves with the smallest area.

In a trial to study the effect of rootstocks on vine vigour, productivity and quality of Anab-e-Shahi grapes on the rootstocks "St. George," "Teleki 5-A," "Dog Ridge", "1616", "1613" and "Gulabi" compared with the own-rooted vines Reddy (1992) reported that rootstocks "Dog ridge" and "1616" increased the vegetative parameters; shoot length, internode length, leaf number and leaf area/shoot, petiole length and leaf surface area of Anab-e-Shahi scion. "Dog Ridge" stock increased the trunk girth and subsequently the pruning wood weight.

Sallam (1992) reported that grafting Thompson seedless or "Romi Red" grape on their own roots gave higher shoot length than grafting on "LN33" or "Dog Ridge." Whereas, grafting "Thompson seedless" cv. on "Dog Ridge" significantly increased the shoot length, fresh and dry weight of shoot, number of leaves per transplant, fresh weight of the leaves and leaf area than grafting it on" LN33" rootstock.