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RESEARCH PAPER

# Grafting of Thompson Seedless Scions onto Hardwood Cuttings of Three Grapevine Cultivars

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**A B S T R A C T:**

In this study, the scions of the Thompson Seedless grape cultivar were grafted onto three local grape cultivars (Chav Ga, Rash Miri and Tre Rash) rootstocks by wedge grafting in 2021-2022. The grafting were made manually on the February 15th by using one-year- old cuttings ( scion and rootstocks). Growth parameters such as shoot length and diameter, dry weight of vegetative growth, number of leaves and leaves dry weight showed significant differences while chlorophyll content showed non-significant differences among the cultivars.

Generally, Thompson Seedless grafted on Rash Miri rootstock gave better results for most of the growth parameters in both seasons, while the grade of callus, rate of graft take, root percentage and root numbers showed significant differences among the cultivars in both two seasons. However, root length showed non-significant difference between all cultivars, moreover in Chav Ga cultivar showed a significant difference in root shoot ratio compared with the other two cultivars. Grade of callus was higher (1.95 and 1.99) in Rash Miri and lower was (1.75 and 1.78) in Chav Ga, for seasons 1 and 2,. Rate of graft take was also higher when Thompson Seedless grafted onto Tre Rash cultivar (88.13 and 89.00 %) and (74.52 and 75.80 %) in Chav Ga rootstock for two experimental seasons, respectively.

KEY WORDS: Keywords Grapevine; Rootstock; Cutting; Grafting; Thompson Seedless.
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## 1. INTRODUCTION :

A scion (shoot system) from one plant and a rootstock (root system) from another plant to which the scion is connected are joined together by combining their vascular and cambial systems in the process of grafting. In addition to allowing European grapes (*Vitis vinifera* L.) to grow in *phylloxera* infested soils, rootstocks for grapevines can provide resistance to other pests and diseases, including root knot and nematodes (Ferris et al., 2012). Grape growers use grafting method of installing grapevines to change the variety, rejuvenate a farm that has been impacted by disease, or progress the vines with age, in the traditional Viticulture, commercial varieties of grapes were grown on their own roots (Satish et al., 2010), despite the fact that using the hardwood stem cutting is the easiest, cheapest, and most successful way to propagate grape vines.

In grapevine grafting, there are three types of vigor responses: the scions own vigor, the rootstock's provided vigor, and the growth corresponding to a specific coupling of rootstock and scion, which they refer to affinity (Lefort and Legisle, 1977). From cultivar to cultivar, there are substantial differences in how rootstock affects growth factors (Kose et al., 2014). Grafting grapevines to a specific rootstock can affect a variety of scion characteristics, including mineral content (Migicovsky et al., 2019 and Gautier et al., 2020). The fact that rootstock selection can alter vine size and productivity is of particular relevance to grape farmers, while other factors such as environment and location have a greater impact on grapevine development than rootstock (Keller, 2020).

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According to Bica et al. (2000) rootstock has a considerable impact on the leaf area, chlorophyll content, stomatal conductance, and quantum yield of Pinot Noir and Chardonnay grapevines, rootstock influences vegetative growth thereby increasing the photosynthesis of vine (Somkuwar et al., 2015). For grape growers, a rise in yield is fascinating; however, increasing plant size or vegetative growth additionally increases the value of managing the vineyard. The Ravaz index, or yield divided by pruning weight from the subsequent dormant season, will be calculated to work out the relative magnitude relation of fruitful to vegetative growth. The impact that rootstocks will wear berry composition is mostly thought to be associate with indirect impact ensuing from their impact on vegetative and reproductive growth, for instance, nutrient uptake or altering water (Mantilla et al., 2018). Understanding rootstock-scion interactions is crucial for choosing the most suitable graft combinations for specific environments and good fruit quality (Rasool *et al*., 2020).

According to Todic *et al*. (2005), there are various degrees of compatibility between grapevine rootstocks and *Vitis vinifera* cultivars. These differences were mostly observed during adaption studies of scion-rootstock combinations carried out in various ecologies.

When the same cultivar is grafted on several rootstocks, there will be variations in the stock-to-scion ratio. This must be because the rootstocks' genetic make-up varies. According to Somkuwar *et al*. (2006), the Flame Seedless grafted on 110-R rootstock had a greater stock to scion ratio. The production of Thompson Seedless grapes grafted on various rootstocks in the early years of vineyard formation, according to Satish and Prakash (2006) and Satish *et al*. (2010) was not adversely affected by the stock to scion ratio.
Regional rootstock evaluations are crucial in deciding which rootstock is best suited to a particular area because different soils and climates affect rootstock performance differently (Shaffer, 2002).

There is a knowledge gap in propagating grapevines by grafting from cuttings, the method of propagation used in this study was the combination of cuttings of three local red cultivars of European grapes (Chav Ga, Rash Miri and Tre Rash) as a root stocks, which are prime and popular grape cvs, successfully grown under the environmental conditions of Erbil and Dohuk governorates, they are table grapes used locally to make raisins with Thompson Seedless, the early white seedless cultivar as a scion, which is not widespread in these areas, at the same time, different varieties are grown, but not tested as rootstock, in order to cultivate other varieties that may not be suitable for cultivation in the same conditions as the original varieties.

## 2. MATERIALS AND METHODS

This investigation was carried out in two successive seasons (2021 and 2022), dormant hardwood cuttings of 30–35 cm length of three local table grape cultivars including (Chav Ga, Rash-mire and Tre Rash) as rootstocks and 10-12 cm of Thompson Seedless as the scion, both stocks and scion which have approximately the same diameter with 10–12 mm thick from mature dormant canes were collected from healthy, vigorous vines, and diseases free, doing cutting was based on their uniformity in appearance, cuttings were made manually taken from one year old branches, samples of grape branches for (rootstocks and scions ) were obtained from the same source of vineyard (Directorate of Agriculture Researches, Ankawa – Erbil, Ministry of Agriculture and Water Resources, Kurdistan Regional Government, Iraq), on January 15th , 2021 and 2022, 2-cm vertical cuts were done at the bases of rootstocks for rooting enhancement. All cuttings were stored in refrigerated storage at +4 °C, 70-80% humidity and disinfected with Captan 50% (W. P.).Grafting was performed on February 15, 2021 and February 22, 2022 using the wedge grafting technique, which exposes cambium on two sides so it increases cambial contact and the chance of the cambial layer being matched successfully. It is done in late winter or early spring before the bark begins to slip. The base of the scion is cut into a wedge shape, of the rootstock a vertical cut made into the stem around the depth of the wedge (Hartmann et al., 1990). The surface of the rootstock, scion and cuttings was dipped into aloe vera jell before the grafting procedure (Surjushe et al., 2008), after that, cuttings were air-dried for 5 min and the grafted areas were wrapped with a white adhesive tape, for callusing, the grafted cuttings were placed in plastic boxes filled with peat moss stored at 23-25 °C, 80-85% humidity and 80% darkness for 24 days (Todic et al., 2005). Grafted cuttings were put into black plastic bags (10 kg planting mixture of sand: clay: peat moss at equal proportions by volume). Planting was done inside a plastic house, after planting, the pots where irrigated as needed. Throughout the period of rooting, the mean temperature was fixed at 22 ℃ and the mean moisture was adjusted at 50-55 %. All potted plants after six weeks were transferred to under net-coated tunnels (shading) for adaptation to outdoor conditions. To determine the levels of compatibility and incompatibility of the different rootstock/scion combinations (Celik et al., 2003).

### 2.1. Measurements:

Measurement of growth for grafted cuttings were evaluated for vegetative growth parameters, days taken to sprout, % bud burst, shoot length (cm), shoot diameter (mm), dry weight of vegetative growth (g), leaf numbers, leaves fresh and dry weight (g) and chlorophyll content (SPAD).

Grade of callus development (0–4) at the grafting union; a scale of 1 to 4 was used where: 1=no callus, 2=low, 3=intermediate and 4=high callus formation on graft union surface, rate of graft take (%) which was expressed as the percentage of grafted grapevines that have an adequate callus formation at the level of the graft union, root scale as a scale of 1to 4 was used where: (1=no roots, 2=low, 3=medium, and 4=high) (Dardeniz et al., 2008). Root%, root length (cm), root number and dry weight of root (g).

### 2.2. Statistical analysis

The experimental was carried out according to Simple Complete Randomized Design (CRD), including 3 cultivars with three replicates for 2 years. The data was analyzed using the SAS statistical tool (SAS 2003), and when distinction is made, the means were suitably isolated and mean values were examined using Duncan's Multiple Range Test ($P \leq 0.05$) (Mead et al., 2017).

## 3. RESULTS AND DISCUSSION

### 3.1. Rootstock influences on scion growth vigor:

In this respect days taken to sprout, bud burst, shoot length, its diameter, dry weight of vegetative growth, number of leaves, and its fresh and dry weight of scion were the investigated scion growth measurements pertaining their response to the evaluated three grape rootstocks. Data obtained during both 2020-21 and 2021-22 experimental seasons are presented in (Table 1).

It is quite evident as shown from (Table 1) that the scion growth measures generally followed the same trend of reaction to the three grape rootstocks under investigation, the rate of response to three evaluated rootstocks varied from a given scion growth measurement to another. Hence, Chav Ga rootstock resulted in days taken to bud burst (22.00 and 21.22) in two experimental seasons respectively, The days taken for bud sprouting after grafting and the grafting success percentage were significantly influenced by the rootstocks under investigation, buds of all tested grafted plants opened within 14 to 22 days after grafting (Table1). Thompson Seedless grafted onto Tre Rash rootstock was earlier to sprout than the grafting performed on Rash Meri and Chav Ga rootstocks. The bud sprouting was observed from (14.40 and 15.34 days) in the scion grafted on Tre Rash rootstock to (22.00 and 21.20 days) in the Chav Ga rootstock during two experimental seasons, respectively. The reason may be due to the effect of the rootstock, because the Chav Ga is a later cultivar than Tre Rash.

Hence the difference in response to the grape rootstocks was more pronounced with the shoot length, where Rash Miri rootstock resulted significantly superior on the Chav Ga rootstock (16.96 and 17.34 cm), (14.31 and 15.11 cm) during 2020-21 and 2021-22 experimental seasons, respectively. Meanwhile, Tre Rash rootstock ranked statistically 2nd (15.10 and 16.32 cm) during 1st and 2nd seasons respectively, The Chav Ga rootstock was heavily associated with the least values of the aforementioned scion growth measurements. Differences in shoot diameter of Thompson Seedless graft (scion) pointed out that the heights quantity was once significantly coupled with Rash-meri rootstock (5.63 and 6.53 mm). On the contrary, the opposite was found with Chav Ga, while on Tre Rash was found between them. Such trend was true during both seasons and differences were significant except with comparing those on Rash Miri and Chav Ga rootstock.

Table (1) reveals obviously that the highest significant value of vegetative dry weight was in concomitant to those on Tre Rash rootstock (2.57 and 3.00 g), as compared to those on Chav Ga (1.63 and 1.76 g) during both experimental seasons, respectively.

Meanwhile, the number of leaves per each scion (shoot) pointed out that the highest number was significantly coupled with the Thompson Seedless grafted on Rash Miri rootstock, the opposite was found with Chav Ga, while on Tre Rash was in between. Such trend was true during both seasons and differences were significant except with comparing those on Tre Rash and Chav Ga rootstock with the analogous ones on either.

For leaf chlorophyll content the data in (Table 1) showed that variances didn't reach level of significance during two experimental seasons. However, among all the cultivars, maximum graft success was recorded in Thompson Seedless grafted onto Rash Miri and minimum was which grafted onto Chav Ga rootstock.

Overall, Rash Miri cultivar showed the highest vigorous scion development based on shoot length, shoot diameter and dry weight of vegetative growth and number of leaves, whereas the less vigorous scion development was observed in the Chav Ga cultivar.

**Table (1)** Rootstock influences on scion growth vigor.*

| Characteristics / Root stocks | Thomson Seedless grapevine scion | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Days taken to sprout** | **Bud burst %** | **Shoot length (cm)** | **Shoot diameter (mm)** | **Dry weight of vegetative (g)** | **No. leaves** | **Leaves fresh weight (g)** | **Leaves dry weight (g)** | **Chlorophyll Content (SPAD)** |
| **Experimental season 2020-2021** | | | | | | | | | |
| **Chav Ga** | 22.00 a | 12.32 b | 14.31 b | 3.60 b | 1.63 b | 8.08 b | 1.97 a | 0.66 a | 15.31 a |
| **Rash Miri** | 18.60 b | 13.34 a | 16.96 a | 5. 60 a | 2.48 a | 11.33 a | 1.85 b | 0.56 b | 15.92 a |
| **Tre Rash** | 14.40 c | 13.89 a | 15.10 ab | 4.00 ab | 2.57 a | 8.43 b | 1.83 b | 0.53 ab | 15.71 a |
| **Experimental season 2021-2022** | | | | | | | | | |
| **Chav Ga** | 21.20 a | 14.00 b | 15.00 b | 3.90 b | 1.76 b | 8.43 b | 2.00 a | 0.68 a | 15.34 a |
| **Rash Miri** | 17.00 b | 15.00 a | 17.34 a | 6.50 a | 2.54 ab | 11.70 a | 1.95 ab | 0.60 b | 16.0 0 a |
| **Tre Rash** | 15.00 c | 15.50 a | 16.32 ab | 4.03 ab | 3.00 a | 9.00 ab | 1.87 ab | 0.56 c | 15.89 a |

*Values within each column followed by the same letter are not significantly different from each other according to Duncan's Multiple Range Test ($P \leq 0.05$).

### 3.2. Influence of scion on rootstock growth vigor:

In grapevine callus formation is one of utmost importance for stock and scion to be compatible and grafting to be successful, it was found that it is not the graft take rates but the status of callus formation which is an indicative of compatibility between the stock and scion. The rootstocks showed significant effect in callus formation among the rootstocks studied. In Thompson Seedless grafted on Rash Miri rootstock maximum callus grad development was recorded (1.95 and 1.99), while Chav Ga rootstock recorded minimum value (1.75 and 1.78) during two experimental seasons, respectively.

Moreover, percentage of graft take showed that the Tre Rash (88.13 and 89.00 %) and Rash Miri (84.08 and 86.60 %) rootstocks have the highest graft take percentages during two experimental seasons respectively as shows in (Tables 2). Percentage of graft take shows a highly positive relation with callus quality at different rootstock grafting cultivars.

As a result of this study, different levels of graft- compatibility were recorded between rootstock/scion combinations. The cultivars had significantly greater root scale but the variations between them not reached significantly in the first season, while Tre-rash root stock was positively affected significantly ( 3.75 ) in second season compared to Rash Miri cultivar (3.57), (Table 2).

Rootstock was once additionally found to have an effect on root growth, with significant differences observed in root percentage, number of roots and dry weight of roots (P≤0.05) of grafted grapevines among rootstock genotypes (Table 2). The Tre-rash rootstock had the higher root percentage (55.43 and 55.66%), followed by the Rash Miri rootstock (52.04 and 52.45 %), whereas the Chav Ga rootstock had the lowest value (49.06 and 50.03%) during two experimental seasons, respectively.

Root length of grafted grapevines was varied but not reached significantly among rootstock cultivars in both seasons.The highest root number and root dry weight were found in the Tre Rash rootstock (14.92, 15.21) and (0.61, 0.63 g), whereas the lowest root number and root dry weight averages were found in Chav Ga grafted grapevines (10.67, 10.76) and (0.52, 0.53 g) for each seasons, respectively.

Significant high grade of root per shoot ratio had been reported Table (2) among the three cultivars were used as a rootstocks for grafting, the grafts made on Chav Ga cultivar showed highest root/shoot ratio (0.32 and 0.31), while the lowest ratio was recorded in cuttings grafted on Rash Miri (0.20 and 0.21) in two seasons, respectively, whereas, no significant effect was found between Tre Rash and Rash Miri cultivars.

**Table (2)** Influence of scion on rootstock growth vigor.*

| Characteristics / Root stocks | Thomson Seedless grapevine scion | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | **Grade of callus development (0–4)** | **Rate of Graft take (%)** | **Root scale (0-4)** | **Root %** | **Root length (cm)** | **No. roots** | **Dry weight of root (g)** | **Root/ shoot** |
| | | | | **Experimental season 2020-2021** | | | | |
| **Chav Ga** | 1.75 b | 74.52 b | 3.60 a | 49.06 b | 6.26 a | 10.67 b | 0.52 b | 0.32 a |
| **Rash Miri** | 1.95a | 84.08 a | 3.50 a | 52.04 ab | 6.95 a | 13.69 a | 0.53 b | 0.20 b |
| **Tre Rash** | 1.89 a | 88.13 a | 3.70 a | 56.43 a | 6.85 a | 14.92 a | 0.61a | 0.24 b |
| | | | | **Experimental season 2021-2022** | | | | |
| **Chav Ga** | 1.78 b | 75.80 b | 3.62 ab | 50.03 b | 6.33 a | 10.76 b | 0.53 b | 0.31 a |
| **Rash Miri** | 1.99 a | 86.60 a | 3.57 b | 52.45 ab | 6.99 a | 13.87 ab | 0.54 b | 0.21 b |
| **Tre Rash** | 1.94 a | 89.00 a | 3.75 a | 56.66 a | 6.89 a | 15.21 a | 0.63 a | 0.22 b |

*Values within each column followed by the same letter are not significantly different from each other according to Duncan's Multiple Range Test (P≤0.05).

The variation in time taken for bud sprout might be due to the availability of storage material in the rootstock that has helped to supply for early bud sprout. A higher survival rate may be caused by the rootstock and scion both exhibiting an active growing meristematic stage, which promotes callus production and increases grafting success (Stino et al., 2011).

The shoot thickness plays an important role in storing the food material required while bud sprouting and leaf emergence. Thicker shoots will be capable of storing larger amounts of stored food, a positive elation between shoot length and leaf numbers indicated that vigorous rootstock greatly influences the shoot growth of scion that graft incompatibility occurs due to anatomical, physiological and genetic reason (Hartmann et al., 2002).

There is an improvement in overall vegetative growth thereby leading to higher nutrient ion accumulation resulting in higher plant biomass (Csikasz-Krizsics and Diofasi, 2008).

Stino et al., (2009) emphasized variation in percentages success and survival of grape grafting due to the use of rootstocks. A higher percentage of survival might be due to active growing meristematic stage exhibited by both the rootstock and scion, which facilitates callus formation and thereby enhance grafting success (Stino et al., 2011). Jackson (2000) reported that the interaction usually results from the mutual translocation of nutrients and growth regulators between the scion and rootstock.

Strong correlations between shoot growths, stock to scion ratios, and callus development suggest that rootstock genotype and callus development grades may have an impact on how grafted grapevines grow (Celik, 2000) and genotype of rootstock (Yetisir et al., 2007).

Somkuwar et al. (2006) showed that Flame Seedless grapes grafted on several rootstocks had a higher stock: scion ratio, while Satish *et al*. (2010) discovered that Thompson Seedless grapes are unaffected by different rootstocks.

The changes in the stock: scion ratio of the same cultivar grafted on diverse rootstocks may be the result of these rootstocks' differing physiologies and reactions to varying soil conditions.

## 4. CONCLUSIONS

The present study clearly indicated that the sprouting of scion was late when grafted on Chav Ga rootstock, the vegetative growth was slow resulting in reduced shoot growth scion and other vegetative growth parameters.

Rash Miri cultivar rootstock showed the highest percentage of bud burst and it improved the best vegetative growth parameters, the highest vigorous scion development based on shoot length, shoot diameter and dry weight of vegetative growth and number of leaves, whereas the less vigorous scion development was observed in the Chav Ga cultivar. In conclusion, Tre Rash and Rash Miri cultivars rootstock presented a good compatibility with Thompson Seedless scion, these may be considered as suitable local cultivars selected as evaluated rootstocks. In contrast, and due to their poor performance and low success, combinations of Chav Ga is not recommended. Further investigations are needed in order to continue observation on compatibility and effects on yield and quality.

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