# Utilization of Wild Hawthorn Rootstock for Water Harvesting under Rainfed Condition in Sulaimani Governorate

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## Abstract

A study was conducted during two successive growing seasons 2009 and 2010 at Azmar mountain, Sulaimani city, Kurdistan Region-Iraq. The commercial cultivar of loquat was used as scion and hawthorn trees of 25-30 years old, grown naturally in the region were used as rootstock. The treatments consisted of three dates (mid May, early June and mid June) of grafting loquats onto wild howthorn trees during two successive seasons (2009 and 2010). The experiment was laid out in a factorial randomized complete block design with three replications and twenty buds per replication. Least significant difference (LSD, $P \leq 0.05$) was used for mean separation. The percents of bud-take successes were recorded after two months of the budding operations, whereas the observations on different growth parameters were recorded at the end of the seasons. Significant influence of the interaction of budding season and budding time on budding success percentage and subsequent growth characteristics of loquat budded on hawthorn rootstock were observed. The maximum value of percent

budding success (80.00%) was recorded when budding was done on mid-May 2010, followed by budding on mid-May 2009 (79.30%). Budding time-season interaction also resulted in the occurrence of highly significant differences in the length, budshoot diameter and the number of leaves per budshoot. Budding performed on mid-May 2010 gave the higher values of budshoot length and the number of leaves per budshoot (19.3 cm and 20.1), respectively. However, the higher value of budshoot diameter (12.2 mm) was obtained from budding performed on mid-May 2009.

The results show that it is possible to graft irrigated economical fruit such as loquat which require about 700 mm rainfall /year or 7000 m3 water /ha/year on natural wild hawthorn rootstock under rain fed conditions without irrigations which means entirely depending on rainfall. Consequently the graftage results in water harvesting of about 7000 m3 water /ha/year and makes people more interested in using wild hawthorn rootstocks which resist severe ecosystems of shallow and rocky soils for fruit production under rain fed conditions .At the same time, it encourage people to maintains the natural plant resources of the region which is one of the greates national resources in the Iraqi – Kurdistan region. Moreover expanding of horticultural area is possible in margining area of the region.

**Keywords:** Budding time, budding season, loquat, hawthorn, budding success, water harest.

## INTRODUCTION

Hawthorn (*Crataegus spp.* L.) belongs to the subfamily Maloideae in the Rosaceae (Phipps *et al.* 1991). This genus is a complex group of trees and shrubs native to northern temperate zone (Mabberley, 1997), mostly between latitudes 30° and 50° N (Phipps, 1983). There are about 250 currently recognized species,

most native to the New World (about 200 species) and the remainder native to the Old World (Phipps *et al.*, 1990 and Christensen, 1992). Around the world, hawthorns are used for a wide range of purposes, many hawthorn species are grown for their edible fruits in Asia, Central America and various Mediterranean countries (Usher, 1974; Everett, 1981; Guo and Jiao, 1995 and Mabberely, 1997).The only a partial understanding of the taxonomy of native populations of hawthorns now existed, because the identities of many naturally grown species may be either incorrect or imprecisely defined.

Hawthorns are recommended commonly by professionals as landscaping and shelterbelt plants that can attract wildlife (Elias, 1987; Petrides, 1988; Foote and Jones, 1989; Bir, 1992 and Morgenson, 1999). Hawthorn can also be used as a rootstock in the practice of grafting. It is graft-compatible with *Mespilus* (medlar), and with pear, and makes a hardier rootstock than quince, but the thorny suckering habit of the hawthorn can be problematic (Phipps *et al.*, 2003).

In Kurdistan Region-Iraq, hawthorn tree is one of the most genera which are naturally grown and this genus is of the second rank in population after the genus *Quercus*. The deeply grown root system and rigid wood made the trees hardy. On one hand , most of the trees bear weak yields and no pleasant small fruits with low sugar contents (Abdullah, 1988). On the other hand, the production of loquats under irrigation systems allover the world require high costs and much labor. In addition to vulnerability to diseases, it can grow and produce fruits successfully under even 400-450 mm rainfall. This range is not sufficient for almost the majority of fruit crops under rainfed condition. Furthermore, other fruit crops require more than 700 mm as irrigation in summer season regardless to the amount of precipitation. The present investigation was, therefore,

conducted with a view to evaluate the performance of hawthorn as an implement for water harvest toward reducing water consumption. Generalization of loquat culture in plain regions faces the problem of rainfall fluctuation and hence water shortage due to the reduced capacity of springs and wells which considered as the only means of irrigation yet due to non-regulated water resources such as Sirwan and the Little Zab rivers. So, the utilization of wild plant resources such as wild hawthorn might play an important role in enhancing water harvest technique (Muhammad Ali, 2008).

## MATERIALS AND METHODS

The study was conducted during two growing seasons 2009 and 2010, at Azmar mountain, north of Sulaimani city, Kurdistan Region-Iraq. The commercial cultivar of loquat (*Eriobotrya japonica* L.) was used as scion and the rootstock was the wild hawthorn (*Crataegus azarolus* L.) trees grown naturally and densely prevailed in Azmar mountain mixed with several other *taxa* existed in the natural forests of these mountains. The treatments consisted of three dates (mid May, early June and mid June) of grafting loquats onto wild howthorn trees during two successive seasons (2009 and 2010). Hawthorn trees of 25-30 years old were selected for the study; these old trees were headed back during March, leaving 50 cm stubs on side branches. When new shoots emerged on the stubs, 3-4 of them were selected from the outer periphery and the remainders were thinned out soon after their emergence and undesired shoots were removed from time to time. The experiment was laid out in a factorial randomized complete block design with three replications and twenty buds per replication. Least significant difference (LSD, $P \leq 0.05$) was used for mean separation and since the interaction means gave the greater values for all studied characteristics, only the interaction means were presented, while the

single factors were discarded. The percents of bud-take successes were recorded after two months of the budding operations, whereas the observations on different growth parameters were recorded at the end of the season.

**RESULTS AND DISCUSSION**

Data presented in Table (1) highlights the high significant influence of the interaction of budding season and budding time on budding success percentage and subsequent growth characteristics of loquat budded on hawthorn rootstock. The maximum value of percent budding success (80.00%) was recorded when budding was done on mid-May 2010, which was superior in a highly significant manner over the other interactions except that of budding on mid-May 2009 (79.30%), followed by budding on early-June 2009 and 2010, and the lower significant values of budding success percentages were obtained from budding on mid-June performed in both seasons.. This indicates that budding time plays a significant role in the enhancement of percent budding success, in which mid-May budding gave the greater values compared to the other two later dates (Figure 1). This may be due to the proper environmental condition such as temperature and humidity during this time of budding with a greater chance for union formation as compared to other dates (Hartman *et al.* 2002). These confirms with the reports of (Pathak, 1991) and with the results of (Hama Salieh, 2004).

Budding time-season interaction resulted in the occurrence of highly significant differences in the length of budshoots, in which, budding performed on mid-May 2010 and 2009 gave the higher value (19.3 and 19 cm), respectively which were significantly superior over the other interactions. It indicating that the length of produced budshoots was mostly affected by budding time other than budding season, the earlier the budding performed, the longer the

budshoots produced. This may be caused by the greater chance of budshoots having a longer period of time during the growing season (Figure 1). The result is in conformity with the results of many works (Dwivedi and Singh, 1999; Hama Salieh, 2004 and Noori, 2008).

Budshoot diameter was also affected in a high significant way by the interaction of budding time and budding season. The higher value of budshoot diameter (12.2 mm) was obtained from budding on mid-May 2009, which was significantly higher than budshoot diameter values of the remainder interactions except that of budded on mid-May 2010 (11.7 mm). These show that there was a great role of budding time during growing season in producing thicker and stronger budshoots, and this may be attributed to a faster sprouting and hence a greater chance of the buds to grow quickly during the growing season. These came in agreement with those of (Dwivedi and Singh, 1999).

The number of leaves produced by budshoots was also affected by budding time-season interaction in a high significant manner, that is, the higher value of the number of leaves per budshoot (20.1 and 19.7) were obtained from budshoots grafted on mid-May 2010 and 2009, respectively. These were significantly similar to each other, while they were different from the other treatment combinations. Of course, the budshoot which gave the higher values of each budshoot length and diameter, gave the higher values of the number of leaves and the same reasons mentioned above had affected these results, this is in agreement with the results of (Howard, 1978, Skene *et al.*, 1983, Hama Salieh, 2004 and Noori 2008).

**Table (1): The interaction effect of budding time and budding method on some growth characteristics of loquat on hawthorn rootstock.**

| Treatments | Budding success (%) | Budshoot length (cm) | Budshoot diameter (mm) | Number of leaves per budshoot |
|---|---|---|---|---|
| 2009 | | | | |
| Mid-May | 79.3 a† | 19.0 a | 12.2 a | 19.7 a |
| Early-June | 72.0 b | 13.7 b | 10.1 b | 16.6 b |
| Mid-june | 63.7 d | 11.0 c | 8.6 d | 14.6 c |
| 2010 | | | | |
| Mid-May | 80.0 a | 19.3 a | 11.7 a | 20.1 a |
| Early-June | 71.7 b | 14.0 b | 9.9 c | 16.7 b |
| Mid-june | 66.0 c | 10.7 c | 8.4 d | 13.4 c |
| Significance | ** †† | ** | ** | ** |
| $LSD_{0.05}$ | 1.113 | 1.282 | 1.010 | 1.194 |

† Numbers with the same letters within a column are not different significantly by LSD ($P \leq 0.05$).

**: Highly significant ($P \leq 0.01$), as resulted from analysis of variance (ANOVA).

From the results of this study, it is concluded that in spite of the difference between growth habits of the two genera used in this study, hawthorn which is a deciduous tree and loquat which is an evergreen tree, there were no signs of graft incompatibility between them, since there were a good union between them from the first step of the study until after about two years. Another important view point of this study, it was revealed that in the late season (mid October) of second year, all budshoots had flowered either grafted in June of the previous year (after 15 months), or grafted in June of the same year (after 4 months). This is regarded as the most important point since plants that are grown from other vegetative

propagation methods such as cuttings for example, will be able to flower after at least 3 years and under nursery conditions.

Finally, it can be concluded that wild hawthorn which tolerates many environmental stresses such as drought and unfavorable soil conditions, can be used as a promising rootstock for loquat production either as a dwarfing rootstock for high density orchard plantation, or as a drought resistant rootstock for being exploited against ongoing drought condition nowadays allover the world. Here, propagation of wild hawthorn in fruit nurseries is highly recommended (Muhammad Ali *et al.*, 2010) as a mean of water harvest which is capable of utilizing the less amount of available water. This makes difference of about 300 mm between normal cultivation of loquats which needs more than 700 mm and loquats grafted onto wild hawthorn trees.

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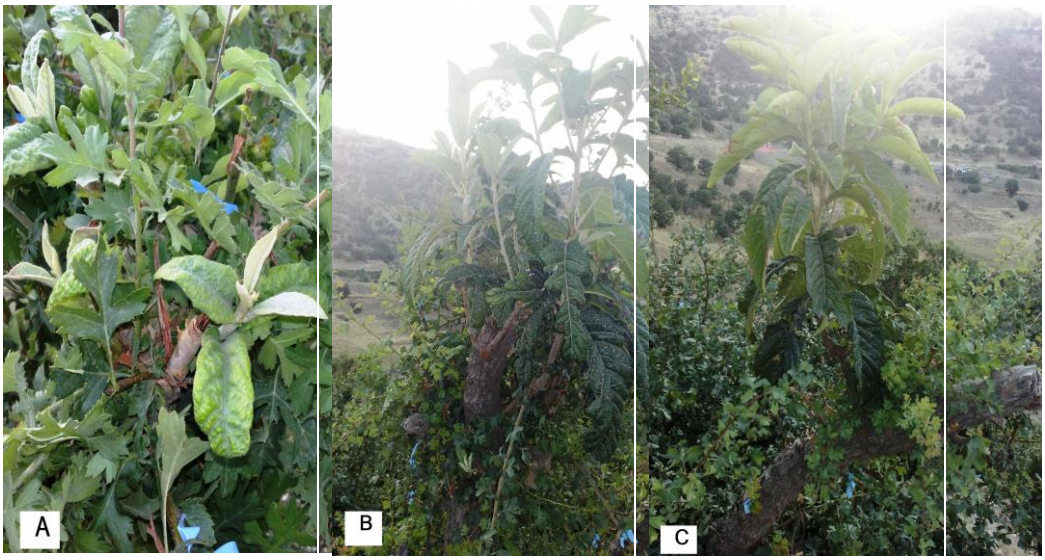



Figure (1): Loquats grafted on hawthorn rootstock; a newly grown shoot grafted on mid-May 2009 (A), fully grown loquat buds on hawthorn grafted on mid-May 2010 (B and C). Loquat/hawthorn budshoot grafted in 2009 after 1 year (D) and loquat/hawthorn budshoot grafted on mid-May 2010 and flowered at the same season 2010.

## الخلاصة

**اجريت هذه الدراسة خلال موسمي النمو ٢٠٠٩ و ٢٠١٠ في منطقة جبال أزمر القريبة من مدينة السليمانية، اقليم كوردستان– العراق. استعملت طعوم من الينكي دنيا التجاري المنتشر في المنطقة لتطعيم اشجار الزعرور البري بعمر ٢٥-٣٠ سنة في غابة أزمر الطبيعية. تضمنت الدراسة ثلاث مواعيد التطعيم ( منتصف مايس و بداية حزيران و منتصف حزيران ) في موسمي النمو المتعاقبين ٢٠٠٩ و ٢٠١٠. صممت التجربة وفق تصميم تجربة عاملية ذات القطاعات العشوائية الكاملة و بثلاث مكررات و تضمنت كل وحدة تجريبية ٢٠ طعما ، وتمت مقارنة متوسطات بأستعمال اقل فرق معنوي عند احتمال ٥ % . سجلت بيانات نسب نجاح التطعيم بعد شهرين من اجراء عملية التطعيم، بينما اخذت البيانات المتعلقة بالصفات الاخري في نهاية كل موسم. لوحظ وجود تأثيرات معنوية للتداخل بين موسمي التطعيم و مواعيدها المختلفة في نسبة نجاح التطعيم والصفات الاخرى لطعوم الينكي دنيا المطعمة على اصل الزعرور البري.**

**سجل اعلى نسبة نجاح التطعيم ( 80% ) من معاملة تداخل موعد التطعيم (منتصف مايس) اجريت في موسم ٢٠١٠ متبوعا بالتداخل بين التطعيم في (منتصف مايس) اجريت في ٢٠٠٩ (٩٧,٣%) . وان التداخل بين موسم النمو ومواعيدها انتجت ايضا وجود فروقات عالي المعنوية في اطوال و اقطارنموات الطعوم وعدد الاوراق المتكونة على هذه النموات، اذ ان التطعيم الذي اجري في منتصف مايس ٢٠١٠ اعطت اعلى قيم لاطوال نموات الطعوم وعدد الاوراق المتكونة عليها (١٩,٣ سم و ٢٠,١ ) على التوالي، بينما كانت اعلى قيمة اقطار النموات ( ١٢,٢ملم) نتيجة التطعيم في منتصف مايس ٢٠٠٩.**

**تشير نتائج هذه الدراسة اللى انه من الممكن استثمار اصل الزعرورالبري لأنتاج الفواكة ذات الطبيعية الأروائية كالبشملة تحت الضروف الديمية (بدون ري) فى المناطق الجبلية فى اقليم كوردستان العراق ومن شانها التوسع فى زراعته وهذا يشجع المواطنين على حماية النباتات الطبيعية من القطع والتى تعد ثروة قومية مهمة .علاوة على ذلك من الممكن استثمار االصل الزعرورالبري كاصل للبشملة فى انتاج بعض الفواكه ذات الطبيعة الأروائية عند استثمار البيئات القاسية في المناطق الهامشيه كالهضاب و التلول الغير الصالحة لزراعة المحاصيل الحقلية وهذا بدورها يساهم فى حصاد الماء بنحو ٧٠٠٠م$^3$ ماء / هكتار / سنة .**

الكلمات المفتاحية : موعد التطعيم – موسم التطعيم – الينكي دنيا – الزعرور – نجاح التطعيم – حصاد الماء.