

Using Hawthorn as a Promising Rootstock for Plums



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Abstract:

This study was conducted during 2011, at Darbandi Zirgwez, locating between some peaks of Gilazarda mountain, Sulaymaniyah, Kurdistan Region-Iraq. The local variety of plum (Haluzha Qadiri) was used as scion and hawthorn trees grown naturally in the region as rootstock. Two budding methods (T-budding and pipe-budding) performed during three dates (mid May, early June and mid June). A factorial randomized complete block design with three replications, twenty buds per replication and the least significant difference test (LSD, $P \leq 0.05$) were used for means separation. The percents of bud-take successes were recorded after two months from budding times, whereas the observations on subsequent growth parameters were recorded at the end of the season. Pipe budding gave the higher significant values of budding success (67.82%) and scion growth diameter (8.88 mm). Budding on mid-May resulted in significant values of budding success (65.42%), scion growth length (15.75 cm) and the number of leaves per scion growth (14.57). The maximum value of percent budding success (81.8%) was recorded when pipe-budding was done on mid-May. In addition, significant differences in the length (16.2 cm) and diameter (8.93 mm) of scion growths, and the number of leaves per scion growth (16.03) were resulted from the same interaction.

Keywords: Pipe-budding, T-budding, plum, hawthorn, natural rootstock.

I. Introduction:

Hawthorn (*Crataegus spp.* L.) belongs to the subfamily Maloideae in the Rosaceae family [1], this genus is a complex group of trees and shrubs native to northern temperate zone [2], mostly between latitudes 30° and 50° N [3]. There are about 250 currently recognized species, most native to the New World (about 200 species) and the remainder native to the Old World [4, 5]. 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 [2, 6, 7, 8]. Because only a partial understanding of the taxonomy of native populations of hawthorns now existed, it is likely that 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 [9, 10, 11, and 12].

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 [13].

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. Most of the trees bear weak yields and no pleasant small fruits with low sugar contents [14]. On the other hand, the production of plums under irrigation systems all over the world require high costs and much labor, in addition of their vulnerability to diseases and drought, 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 [15]. This range was not available for a longer period of years in Sulaymaniyah region and is not predicted to be available in the next years according to [16] who had concluded from the distribution of annual precipitation from 1942-2008 in Sulaymaniyah meteorological station with forecasting for 10 years from 2008 to 2018 which indicates the probability of 6 drought years, in addition to 1-3 drought years are occurred every 5-7 years in which precipitation declines to less than 500 mm (Figure 1). Hence, the present investigation was, therefore, conducted with a view to evaluate the performance of pipe-budding [17] in comparison with the traditional methods of vegetative propagation i.e. T-budding, for raising percent budding success, and to graft plums on hawthorn trees under rain-fed condition, this is

considered as an important process due to the low cost of production and less affected by diseases, as well as to exploit the natural resources, in which, these naturally prevailed trees that tolerate drought might be used as a promising rootstock for the different other commercial fruit species within the Rosaceae family.

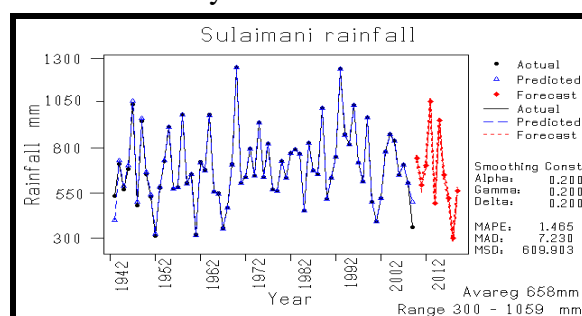


Fig. 1 A ten year forecast results of rainfall at Sulaimani meteorological station from 1942-2008.

II. Materials and methods:

The study was conducted during the growing season 2011, at the Valley of Zirgwez village (Darbandi Zirgwez) locating between some peaks of Gilazarda-Baranan mountains, south of Sulaymaniyah city, Kurdistan Region-Iraq. The local variety of plum (*Prunus domestica* L. var. Qadiri) was used as scion and the rootstock was the wild hawthorn (*Crataegus azarolus* L.) trees grown naturally and densely prevailed in Gilazarda mountain mixed with several other *taxa* existed in the natural forests of these mountains. The treatments consisted of two budding techniques, T-budding and pipe-budding (Figure 2) performed during three dates (mid May, early June and mid June). Hawthorn trees of 25-30 years old were selected for the study; these old trees were

headed back during March, 2011, leaving 50 cm stubs on side branches (Figure 3). 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. The percents of bud-take

successes were recorded after two months of the budding operations (July 16th, August 2nd, August 18th) of the three times, respectively, whereas the observations on different growth parameters (scion growth length, scion growth diameter and the number of leaves per scion growth) were recorded at the end of the growing season, November 1st, 2011, just before leaf fall. Scion growth length was measured with measuring tape, while, scion growth diameter was measured with an electronic vernier.

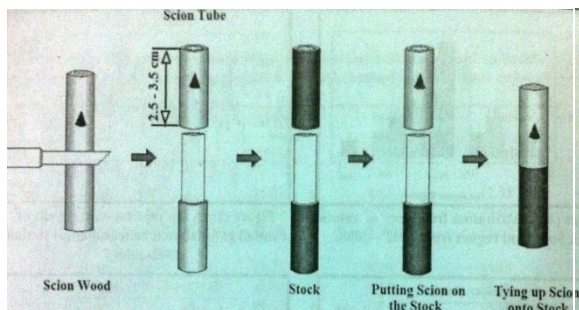


Fig. 2 Pipe-budding method, used in the study to be compared with the traditional T-budding method (cited from Ali *et al.*, 2011).



Fig. 2 A) Heading back of the hawthorn rootstock for stimulating new growths. B) The plum budshoot emerged after 2 months from budding onto hawthorn rootstock.

III. Results and discussion:

Data presented in (Table 1) highlights the existence of significant differences in the values of budding success and subsequent growth parameters resulted from budding method, that is, pipe budding was superior on T-budding in the majority of budding growth characteristics since it gave the higher significant values of budding success (67.82%) and scion growth diameter (8.88 mm), with non-significant higher values of each scion growth length (14.6 cm) and the number of leaves per scion growth (13.38) compared to T-budding which gave (44.71%, 8.26 mm, 13.97 cm and 12.64), respectively for the same parameters.

These results were in confirmation with the findings of [18] who also observed the superiority of pipe budding over T-budding method that signified differences in budding growth parameters of loquat budded onto hawthorn rootstock. This may be due to the greater protection of the bud provided by the pipe shaped piece taken in pipe budding method with a greater chance of fixing in

place which had been coincided appropriately with the growth and performance of the bud and its subsequent activities [19]. Budding time also resulted in the existence of highly significant differences in the values of plum-hawthorn graftage characteristics under study. In the majority of these characteristics, mid-May budding time showed higher significant values, in which budding success (65.42%), scion growth length (15.75 cm) and the number of leaves per scion growth (14.57) were resulted with a non-significant higher value of scion growth diameter (8.82 mm) that obtained from the same treatment, followed by early-June time in budding performance and the latter was significantly superior over the third date of budding (mid-June). These results emphasize that, the earlier the budding time in the growth season, the greater the performance of budding operations indicating that budding time played a significant role in the enhancement of percent budding success and subsequent growth characteristics, this may

be attributed to the proper environmental conditions such as temperature and humidity during this time with a greater chance for union formation as compared to other dates [20]. These findings were in agreement with those of [15, 21, 22].

As shown in (Table 2), there were significant influences of the interaction of budding method and budding time on budding success percentage and subsequent growth characteristics of plum budded on hawthorn rootstock. The maximum value of percent budding success (81.8%) was recorded when pipe-budding was done on mid-May, which was superior in a highly significant manner over the other interactions followed by pipe-budding on early-June (65.97%) and then pipe-budding on mid-June (55.7%). This indicates that budding method had played a significant role in the enhancement of percent budding success, in which pipe-budding gave the greater values compared to T-budding in all three times. This

Table. I: Effect of budding time and budding method on some growth characteristics of plum on hawthorn rootstocks.

Treatments	Budding success (%)	Budshoot length (cm)	Budshoot diameter (mm)	No. of leaves per budshoot
Budding method				
<i>T-budding</i>	44.71 b	13.97	8.26 b	12.64
<i>Pipe budding</i>	67.82 a	14.60	8.88 a	13.38
Significance	**	n.s.	*	n.s.
Budding time				
<i>Mid-May</i>	65.42 a	15.75 a	8.82	14.57 a
<i>Early-June</i>	55.62 b	14.2 b	8.52	12.95 b
<i>Mid-June</i>	47.77 c	12.9 b	8.37	11.52 c
Significance	**	*	n.s.	**
LSD _{0.05}	2.988	1.398	0.455	1.405

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

†† *, **: Significant ($P \leq 0.05$), Highly significant ($P \leq 0.01$), respectively as resulted from analysis of variance (ANOVA).

Table.II: The interaction effect of budding time and budding method on some growth characteristics of plum on hawthorn rootstock.

Treatments	Budding success (%)		Budshoot length (cm)		Budshoot diameter (mm)		No. of leaves per budshoot	
T-budding								
<i>Mid-May</i>	49.03	d†	15.30	ab	8.70	a	13.10	b
<i>Early-June</i>	45.27	e	14.03	bc	8.17	b	12.63	b
<i>Mid-june</i>	39.83	f	12.57	d	7.90	b	12.20	bc
Pipe-budding								
<i>Mid-May</i>	81.80	a	16.20	a	8.93	a	16.03	a
<i>Early-June</i>	65.97	b	14.37	bc	8.87	a	13.27	b
<i>Mid-june</i>	55.70	c	13.23	cd	8.83	a	10.83	c
Significance	** ††		*		*		**	
LSD _{0.05}	2.988		1.398		0.455		1.405	

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

†† *, **: Significant ($P \leq 0.05$), Highly significant ($P \leq 0.01$), respectively as resulted from analysis of variance (ANOVA).

may be due to the greater protection of the bud provided by the pipe shaped piece taken to perform the pipe-budding with a greater chance of fixing in place and the less area of the wound subjected to improper environmental conditions, and then a greater chance for union formation as compared to T-buds. These came in confirmation with the reports of [21] and with the results of [15, 17, 18, and 19].

Budding time-method interaction resulted in the occurrence of significant differences in the length of scion growths, in which pipe-budding performed on mid-May gave the higher value (16.2 cm) which was significantly superior over the other interactions, indicating that the length of produced scion growths was mostly affected by budding time other than budding method, the earlier the budding performed, the longer

the scion growths produced. This may be caused by the greater chance of scion growths having a longer period of time during the growing season. The result is in conformity with the results of many works [15, 17, 18, 19, and 22].

Scion growth diameter was also affected significantly by the interaction of budding time and budding method. The higher value of scion growth diameter (8.93 mm) was obtained from pipe-budding on mid-May, followed by the average (8.87 mm) which was shown by pipe-budding on early-June, these were significantly similar values shown by each T-budding on mid-May and pipe-budding on mid-May and mid-June. All of these were significantly higher than the two remainder treatments; T-budding on early-June and mid-June. These show that there was a great role of budding method in

producing thicker and stronger scion growths, in which all three times of pipe-budding were equivalent, if not more, to the earliest time of T-budding (mid-May), and this may be attributed to a faster sprouting of pipe-budding and hence a greater chance of the buds to grow quickly during the growing season. These came in agreement with those of [17, 19].

[High significant differences occurred in the number of leaves per scion growth due to the interaction of budding time-method, in which the maximum number of leaves (16.03) was obtained when pipe-budding was done on mid-May, which was higher than all other interactions in a highly significant way. This may be caused by the fact that the same treatment gave the higher significant averages of each budding success, scion growth length and diameter,

and hence giving the higher number of leaves on the scion growths due to the greater chance of nutrients uptake resulted in a faster and more uniform growth [23] as a result of quick and strong union formation [24] in pipe-budding.

IV. Conclusion:

All the above results emphasize the suitability of hawthorn trees to be used as compatible and proper rootstocks for budding plums and production of this fruit under rainfed condition in one hand and on the other hand, the capability of this technique as a challenge for facing drought currents which is continuously and frequently occurred in Kurdistan region in general and Sulaymaniyah governorate in particular.

References

- [1] J. B. Phipps, K. R. Robertson, J. R. Rohrer and P. G. Smith. "Origins and evolution of subfamily Maloideae (Rosaceae)" *Systematic Botany* 16: 303-332, (1991).
- [2] D. J. Mabberley "The plant-book: a portable dictionary of the vascular plants. 2nd ed." Cambridge, UK: Cambridge University Press. 858 p. (1997).
- [3] J. B. Phipps "Biogeographic, taxonomic, and cladistic relationships between east Asiatic and North American *Crataegus*" *Annals of the Missouri Botanical Garden* 70: 667-700, (1983).
- [4] J. B. Phipps, K. R. Robertson, P. G. Smith and J. R. Rohrer "A checklist of the subfamily Maloideae (Rosaceae)". *Canadian Journal of Botany* 68: 2209-2269, (1990).
- [5] K. I. Christensen "Revision of *Crataegus* Sect. *Crataegus* and *Nothosect. Crataeguineae* (Rosaceae-maloideae) in the Old Worl" *Systematic Botany Monographs* 35: 1-199, (1992).
- [6] G. Usher "A dictionary of plants used by man" London. Constable. 619 p, (1974).
- [7] T. H. Everett "The New york Botanical garden illustrated encyclopedia of horticulture" Vol. 3, Cha-Di. New York: Garland Publishing: 705-1058, (1981).
- [8] T. Guo and P. Jiao "Hawthorn (*Crataegus*) resources in China" *HortScience* 30: 1132-1134, (1995).

- [9] T. S. Elias “The complete trees of North America: field guide and natural history” New York: Gramercy Publishing Co. 948 p, (1987).
- [10] G. A. Petrides “A field guide to eastern trees: eastern United States and Canada” Boston. Houghton Mifflin. 272 p, (1998).
- [11] L. E. Foote and S. B. Jones, Jr. “Native shrubs and woody vines of the southeast: landscaping uses and identification” Portland, OR: Timber Press. 199 p, (1989).
- [12] R. E. Bir “Growing and propagating showy native woody plants” Chapel Hill: University of North Carolina Press. 192 p, (1992).
- [13] J. B. Phipps, R. J. O’Kennon and R. W. Lance “Hawthorns and medlars” Royal Horticultural Society, Cambridge, U.K. (2003).
- [14] Y. S. Abdullah “Fundamentals of Silviculture” Ministry of Higher Education and Scientific Research. University of Mosul. Iraq (In Arabic) (1988).
- [15] J. J. M. Ali, F. M. H. Salieh and I. M. Noori “Utilization of wild hawthorn rootstock for water harvesting under rainfed condition in Sulaimani governorate” Tikrit University Journal for Humanities. 19 (5): 121-133, (2012).
- [16] S. Makridakis, S. C. Wheelwright and R. J. Hyndman “Forecasting Methods and Application” Third Edition. John Wiley and Sons. Inc. NY, USA. (1997).
- [17] J. J. M. Ali, F. M. H. Salieh and I. M. Noori “Investment of natural plant resources for water harvest by invention of a new grafting technique” Journal of Koya University. No. 20, September 2011: 3-18, (2011).
- [18] J. J. M. Ali, F. M. H. Salieh and I. M. Noori “Utilization of wild pears rootstocks as a natural resource for loquat production under rainfed condition in Sulaimani governorate” Tikrit University Journal for Humanities. 19 (3): 1-11, (2012).
- [19] S. K. Dwivedi and B. Singh “Studies on the topworking of apricot (*Prunus armeniaca* L.) in Ladakh” Prog. Hort. 31 (1-2): 29-31, (1999).
- [20] H. T. Hartman, D. E. Kester, F. T. Davies, Jr. and R. L. Geneve “Plant Propagation. Principles and Practices. 7th ed.” Prentice Hall, Englewood Cliffs. New Jersey. USA. (2002).
- [21] R. K. Pathak “Propagation of Fruits Plants. ICAR-New Delhi (in Indian) (1991).
- [22] I. M. Noori “Studies on seed germination, seedling growth and budding of some stone fruits (*Prunus spp.*)” Ph.D. Dissertation. University of Sulaimani. Sulaimani-Iraq, (2008).
- [23] B. H. Howard” Chip budding in fruit and ornamental trees” Proc. Int. Plant Prop. Soc. 27: 357-364, (1978).
- [24] D. S. Skene, H. R. Shepherd and B. H. Howard “Characteristic anatomy of union formation in budded fruit and ornamental trees” J. Hort. Sci. 58 (3): 295-299, (1993).