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# Winter Grafts as Alternative Methods to T-Budding in Pear (*Pyrus communis* L.) Propagation

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**Abstract**

Traditionally, labour intensive, costly and lengthy method of t-budding is used to propagate pears (*Pyrus communis* L.). To assess whether winter grafts could be used as alternative methods and whether these methods save time in pear propagation, several winter grafting techniques were performed in-door and the success rates of t-budding were compared with that of winter grafts such as splice graft, whip tongue graft and hanging graft. 'Deveci' and 'Santa Maria' cultivars used as scion and 'Quince A' was used as rootstock in all grafting experiments. The highest frequencies of grafting successes (100% and 98%) were obtained from t-budding and all winter grafting techniques gave lower success rates as compared to summer grafts. Summer grafts stimulated plant height and diameter more than winter grafts did. However the overall survival rates of winter grafts were higher than the early summer t-budding. Winter propagation methods are not effective for having taller and ticker plants, but they still yielded comparable grafting successes. Therefore, nursery plants produced by winter grafts still may be useful in establishing new plantation of pears due to their higher root/shoot ratio than the summer grafts.

**Key words:** Pear, propagation, nursery plant, T-bud, winter grafts, splice graft, whip tongue graft, hanging graft.

## INTRODUCTION

Pear (*Pyrus communis* L.) is a member of *Rosaceae* family and one of the most important commercial fruit crops in the world [1, 2]. Traditionally, costly and labour intensive t-bud grafting method is used to propagate the pears [3]. Grafting is a practice used to join parts from two plants so that they can grow as a single plant. Grafting on a specific rootstock may be necessary to solve problems such as soil born diseases. Moreover, the efficiency of certain crops could also be improved by grafting due to the special features of rootstock.

The use of clonally propagated rootstocks by pear growers is becoming more common in developed countries due to their uniformity, ease of propagation, dwarfing effects and shorter juvenile period [4]; on the contrary, the use of seedlings as rootstocks is a more common practice in Turkey [5]. The proportion of seedlings used as rootstocks for pear in Turkey in 2005 was reported as 92% [6]. The rootstock 'Quince A' developed by East Malling research station is the most frequently used dwarfing clonal rootstocks for pear cultivars [7, 8, 9].

There are several factors known to affect grafting success in woody species such as season [10, 11, 13], grafting techniques [11, 12], environment [11], genotype [13, 12], and graft compability between scion and rootstock [14]. Among these factors, grafting seasons and techniques may be very effective in determination of graft success in some genotypes [10, 12].

T-budding is applied to seedlings in summer months and grafted buds force themselves in next spring. In this propagation system, nursery plants can only be offered to pear growers after two or two and half years form the initial starting date of the propagation. Therefore propagation by t-budding is a time consuming and expensive propagation method. Alternatively, nursery plants of apple (*Malus domestica*), a close relative of pear, may become ready for sale in one year if winter grafting techniques are used. Apple nursery plants are commonly produced by winter grafts.

The use of winter grafts in pear nursery plant production may save time and reduce the cost of propagation and may be an alternative propagation method. Therefore, various winter grafting methods were assessed to develop an alternative and efficient propagation system for commercial propagation of pears.

## MATERIAL AND METOD

### Plant material and grafting

T-buddings were performed in July and August. The t-budding performed in August was used as control and this standard application was compared with winter (January) grafts such as splice graft, whip tongue graft and hanging graft, and with t-budding performed in July.

'Santa' Maria and 'Deveci' cultivars were grafted onto previously rooted 'Quince A' rootstock in all experiments. All grafts were wrapped with plastic band. The grafted sections of the winter grafts were dipped into parafilm. These winter grafts were stocked in polyetilen bags

containing turf and then were placed in a cold storage room maintained at +2°C and 90% humidity. Then these grafted plants were transferred to open field at the beginning of the April with 0.2 x 1m intervals.

**Experimental design, data collection and statistical analyisis**

Each treatment had three replicates and each replicate had 25 plants. Data on grafting success, plant heigh, plant diameter and survival rate were collected and subjected to ANOVA and mean speration by LSD using statistical analysis system (SAS) program (SAS Institute, Carry, NC).

## RESULTS AND DISCUSSION

The effects of grafting methods on graft success were significant for both 'Santa Maria' and 'Deveci', but the effects of grafting methods on survival rate was significant for only cv. 'Santa Maria' (Table 1). There was no significant difference between two different t-budding times for both varieties. The highest frequencies of grafting successes (100% and 98%) were obtained from t-budding and all winter grafting techniques gave lower success rates as compared to summer grafts in cultivar 'Deveci' (Table 1). The survival rates of all winter grafts were higher than July t-budding in cv. 'Santa Maria' (Table 1). In 'Deveci', the survival rates obtained from splice graft and hanging graft were slightly higher than that of the July t-budding graft, but the difference was not statistically different (Table 1).

In this study, we have obtained relatively comparable and high rates of successes from winter grafts. In winter grafts, the highest rate of grafting successes for Santa Maria and Deveci were 93.75 and 84.25, respectively. Similarly, it was reported that the success rate of hanging graft in Fuji was % 94.42 and the best time for this grafting technique was reported as the first week of March [10]. Küden ve Kaşka [11] have studied the effects of different grafting techniques on grafting successes in peach, almond, apricot, pear and apple and reported that winter grafts can be very successfully used in apple. Morini [13] used a grafting machine to do winter grafts and evaluated the graft success rates in rooted and un-rooted 'Quince A' cuttings and found that the grafting success was only 42% percent in 'Conference' pear if un-rooted cuttings were used.

**Table 1.** Effects of different grafting treatments on grafting successes and survival rates in 'Deveci' and 'Santa Maria' Pears (*Pyrus communis* L.) grafted on 'Quince A' rootstock

| Treatment | 'Santa Maria' | | 'Deveci' | |
|---|---|---|---|---|
| | Graft success (%) | Survival (%) | Graft success (%) | Survival (%) |
| T-budding-July19 | 100.00 a | 72.00 b | 98.00 ab | 87.00 a |
| T-budding-Aug19 | 100.00 a | 93.00 a | 98.00 ab | 93.00 a |
| Splice graft | 93.75 ab | 93.30 a | 83.25 cd | 92.24 a |
| Whip tongue graft | 90.50 bc | 92.75 a | 77.75 d | 86.16 a |
| Hanging graft | 93.50 ab | 92.07 a | 84.25 cd | 91.40 a |

When the results from both varieties were combined and analysed together, the effects of grafting methods on graft success and survival rate were both significant (Table 2). Results from the current study indicate that summer grafting significantly increases the grafting success of pear cultivars. Similar results on the effectiveness of summer grafting on grafting success were reported by Küden et al. [12]. The summer grafting performed on July 19 yielded significantly lower survival rate than the winter grafting techniques (Table 2).

The effects of grafting techniques on plant length and plant diameter were significant for both varieties tested. Grafting technique affected plant length and plant diameter significantly. The tallest and thickest plants were obtained by summer grafts in both varieties. No significant differences were observed between summer grafts with respect to plant diameter in 'Santa Maria' and 'Deveci', however summer grafts yielded significantly taller plants than the winter grafts. Shoot length and diameter of both varieties were significantly affected by the grafting techniques. Summer grafts stimulated

**Table 2.** Combined results on the effects of different grafting treatments on grafting successes and survival rates in pears (*Pyrus communis* L.) grafted on 'Quince A' rootstock (the numbers represent the averages of the results obtained from cultivars 'Deveci' and 'Santa Maria')

| Treatment | Graft success (%) | Survival (%) |
|---|---|---|
| T-budding-July19 | 99.00 a | 79.50 b |
| T-budding-Aug19 | 99.00 a | 93.00 a |
| Hanging graft | 88.87 b | 91.77 a |
| Splice graft | 88.50 b | 92.77 a |
| Whip tongue graft | 84.12 b | 89.45 a |

plant height and diameter more than winter grafts. In agreement with our results, summer grafts were also yielded taller and ticker shoots than the winter grafts and winter grafting caused significant reduction in plant length and diameter (Küden et all., 1997).

Genotypic differences are also known to influence grafting successes. In our study, frequency of grafting success varied between the varieties tested. Overall, 'Santa Maria' gave higher grafting success (95.5%) rate than cv. 'Deveci' (88.25%). Similarly, the observed grafting succeses in *Prunus* spp. and *Malus* spp. were genotype dependant [13, 12].

Most of the pears and apples are propagated using t-budding which is a lengtly and expensive way of propagation. To comply with the demands of the pear growers and to cut the production cost in pear nursery plant propagation, alternative and cost effective propagation methods are to be developed [15].

**Table 3.** Effects of different grafting treatments on nursery plant quality (length and diameter) in 'Deveci' and 'Santa Maria' pears (*Pyrus communis* L.) grafted on Quince A rootstock

| Treatment | 'Santa Maria' | | | 'Deveci' | | |
|---|---|---|---|---|---|---|
| | Length from grafting point (cm) | Length from ground (cm) | Diameter of nursery plant (mm) | Length from grafting point (cm) | Length from ground (cm) | Diameter of nursery plant (mm) |
| T-budding-July19 | 89.94 a | 99.40 a | 10.84 a | 78.66 a | 89.78 a | 10.35 a |
| T-budding-Aug19 | 98.69 a | 110.82 a | 10.80 a | 88.44 a | 100.89 a | 9.77 a |
| Splice graft | 41.92 b | 67.77 b | 5.84 b | 20.07 b | 54.50 b | 4.10 bc |
| Whip tongue graft | 34.38 b | 59.67 b | 5.11 b | 27.94 b | 45.29 b | 4.55 b |
| Hanging graft | 19.90 c | 31.41 c | 3.50 c | 16.82 b | 33.31 c | 3.30 c |

Although any of the winter propagation methods is not as effective for having taller and ticker plants as summer grafting methods, they still may be very useful in establishing new plantation of pears. The winter grafts are useful for several strategies in propagation of pears such as saving time and expenses. Moreover, use of winter grafts would lead to more successful pear plantations since they have a higher root/shoot ratio. However, to make more clear conclusions further experiments needs to be conducted to compare the performance of plantations set up with summer grafts and winter grafts. Since there is no better alternative way to cut the propagation cost and time and due to the relatively high success rate of winter grafts, setting up pear plantations using plants propagated through winter grafts appear as a promising method. This report demonstrates that winter grafts had relatively comparable grafting success rates to summer grafts.

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