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## Branch induction on apple (*Malus domestica* L.) nursery trees: Effects of Perlan (GA<sub>4+7</sub>+6BA) and pinching

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### Abstract

In this research, one-year-old apple (*Malus domestica* L.) nursery trees of several cultivars (Galaxy Gala, Redchief, Scarlet Spur) on MM106 rootstock were used. Following treatments were applied to each cultivar: 1) pinching, 2) pinching+500 ppm Perlan, 3) 500 ppm Perlan (GA<sub>4+7</sub>+6BA). The sapling height, sapling diameter, branch number, branch angle, branch length and sapling quality were investigated, respectively. At the end of the research, sapling length, sapling diameter and branch number of Galaxy Gala cultivar were higher than in the other cultivars. Sapling length was similar at Red Chief and Scarlet Spur cultivars. In terms of Scarlet Spur sapling diameter and number of branches were higher than in Red Chief cultivar. There were no significant differences in branch angles and branch lengths. Perlan application to Galaxy Gala cultivar and pinching application to Scarlet Spur cultivar formed the largest branch angles.

**Key words:** *Malus domestica* L., apple, branch, nursery, growth, Perlan (GA<sub>4+7</sub>+6BA), pinching.

### Introduction

Fruit production should begin as early as possible in the life of an orchard. To this end, planting branched “feathered” apple nursery trees in the orchard in preference to planting unbranched rods is an accepted commercial practice in many countries. “Feathers” provide sites for the first spur blossom clusters and also the primary limbs for future structure of the tree<sup>1,2</sup>. Feathered trees on dwarfing rootstocks are thus higher yielding than rods during the first few years of cherry orchard<sup>2,3</sup> and economic benefits can be significant<sup>4</sup>. A well feathered tree should have at least five branches, each > 20 cm in length. The effect of planting feathered trees on orchard profitability under New Zealand conditions has not been tested, nevertheless, the possible advantages of feathering would appear to be consider.

Most Turkey nurseries supply trees to growers as unbranched rods. For same cultivars such as ‘Red Chief’ natural branching is poor. For others such as ‘Gala’ and ‘Scarlet Spur’ the few branches which are produced are often of little value as they usually develop on the trunk near to the ground and interfere with herbicide and mowing operations.

Lateral budbreak can be enhanced at the desired height on a nursery tree by overcoming apical dominance. Combinations of benzyladenine (BA) and gibberellin (GA<sub>4+7</sub>) have been used overseas with some success to induce feathering for apple cultivars on dwarfing rootstocks and spur type ‘Delicious’ strains<sup>5-7</sup>. Furthermore, sequential applications have been shown to induce more and longer branches than simultaneous applications<sup>7</sup>. As a non-chemical means of feather induction, pinching treatment can also increase lateral branching on nursery stock. However, the effect of these treatments on feather quantity and quality for

cultivars grown in Turkey is less known. The objective of the following study was to compare several methods and combinations of nursery treatments for some apple cultivars grown in Turkey.

### Materials and Methods

All experiments were carried out on a commercial nursery located on the Eğirdir, Apple Agriculture, Food and Agricultural Tourism Transport Industry Trade Limited Company, (latitude 37°54’ N, longitude 30° 43’ E), Isparta, Turkey. Its elevation is 1050 m. The average temperature of 24 years is 12.2°C, the average humidity is 66.5% and the average yearly rainfall is 771.2 mm. The soil type was a loam and trees were planted at 1.0 m x 1.0 m. Uniform 1-year-old apple nursery trees were selected for each experiment in mid December when they were 50-60 cm high.

**Experimental:** In 2008 trees of ‘Galaxy Gala’, ‘Redchief’, and ‘Scarlet Spur’ on semidwarfing MM106 rootstocks were selected for uniform height and the following treatments applied to each cultivar: 1) pinching, 2) 500 ppm Perlan (GA<sub>4+7</sub>+ 6BA), 3) pinching+500 ppm perlan. The most effective GA<sub>4+7</sub>+ 6BA concentration was determined to be 500 ppm according to the literatures about this subject. The non-ionic surfactant was added to the Perlan solution (0.03%). These treatments were applied to one-year-old apple sapling on MM106 apple clonal rootstocks. Perlan treatment was applied on July 7, 2008 when the trees reached a height of 50-60 cm. Perlan solution was sprayed onto the upper 15-20 cm part of the trees for four times<sup>8</sup>. Pinching treatment was applied July 15, 2008. “Pinching” of a plant is done just above the fourth or fifth leaf, so that new shoots develop as closely as

possible to the base of the plant. Pinching treatment was applied June 15, 2008. At the end of the October, the sapling height, sapling diameter, branch number, branch angle and branch length were investigated, respectively.

In the study, the trees with at least 10 cm length laterals were considered to be branched, and the number, length and angle of laterals were expressed as average per treatment. Applications were performed with three replications in a randomized block design, and each replication contained 15 trees. The data were carried out by random lots test pattern<sup>8</sup>. Mean separation was performed according to LSD multiple range test at the 5% level of significance.

### Results

Our study was exercised according to random lots test pattern and statistical results are presented at graphics<sup>8</sup>. At the end of the study statistical analysis was made and comparing with the varieties ANOVA test was applied for independent variables, if  $p < 0.05$ , differences were significant. One-way ANOVA for applications and LSD (Least Significant Difference) test to compare the differences of groups were made. If  $p < 0.05$  differences were significant.

**Sapling length:** At Galaxy Gala cultivar, in terms of sapling length (Fig. 1), Perlan application and control were statistically similar, Perlan+pinching and pinching applications were different from each other and another Perlan+pinching had shortest sapling length, opposite, Perlan application had tallest sapling length.

The applications at Red Chief and Scarlet Spur varieties did not affect sapling length and there were no difference among applications. A sequence of cultivars, Galaxy Gala, Red Chief and Scarlet Spur, there were statistical differences among varieties.

**Sapling diameter:** Perlan applied to Galaxy Gala cultivar increased sapling diameter (Fig. 2), control followed Perlan application and finally pinching and Perlan+pinching applications. There was no statistical difference among applications at Red Chief cultivar. Sequence at Scarlet Spur cultivar from thick to slim was Perlan, Perlan+pinching, pinching applications and finally control (Fig. 2). In a comparison among cultivars, Galaxy Gala had the highest sapling diameter, followed by Scarlet Spur and Red Chief. There were statistical differences among cultivars.

**Number of branches:** In Galaxy Gala cultivar, Perlan+pinching and pinching applications caused more branches to be formed, Perlan application followed these and the least number of branches was in control (Fig. 3). In Red Chief cultivar, most branching occurred at Perlan application. Perlan+pinching and pinching applications caused less branch formation than Perlan application, control had least branch formation. Most branching at Scarlet Spur was by pinching application and Perlan+pinching, Perlan and control followed. Number of branches showed discrepancy among cultivars, differences were significant among ‘Galaxy Gala’, ‘Scarlet Spur’ and ‘Red Chief’.

**Branch length:** There was no difference in varieties and applications in terms of branch length. There was no statistical difference between varieties and applications (Fig. 4).

**Branch angle:** The largest branch angel was obtained by Perlan application at Galaxy Gala cultivar and pinching application at

Scarlet Spur (Fig. 5). The other applications had similar statistical results. There were no statistical differences among cultivars.

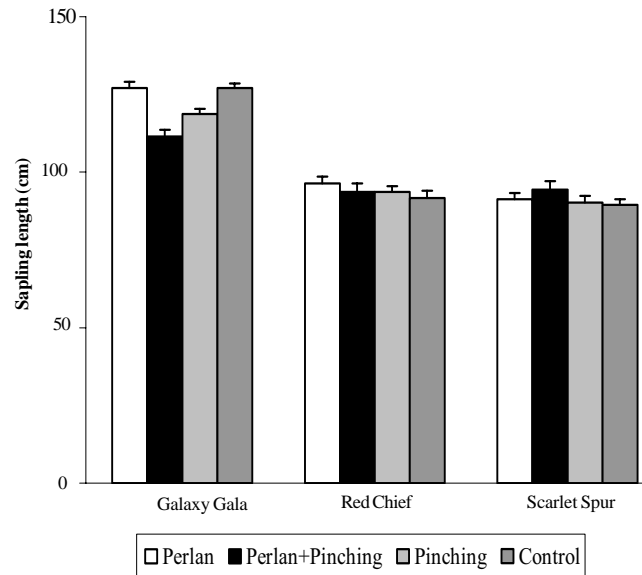


Figure 1. Treatment effect on sapling length.

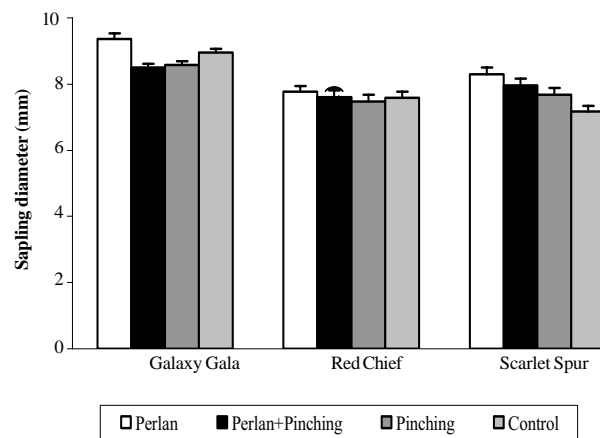


Figure 2. Treatment effect on sapling diameter.

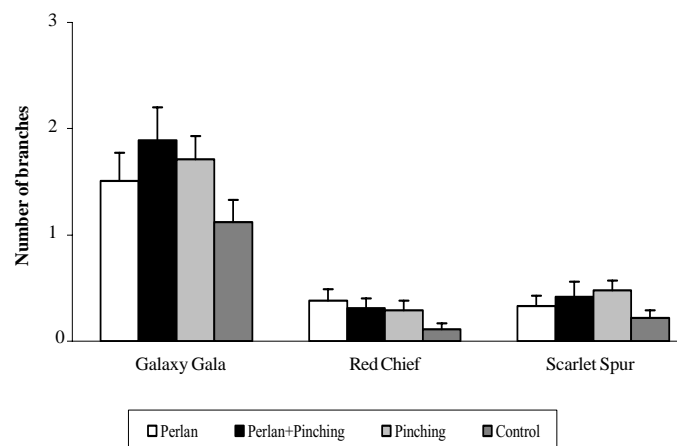


Figure 3. Treatment effect on branch number.

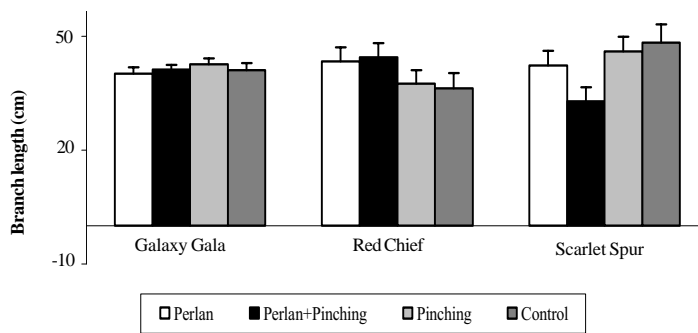


Figure 4. Treatment effect on branch length.

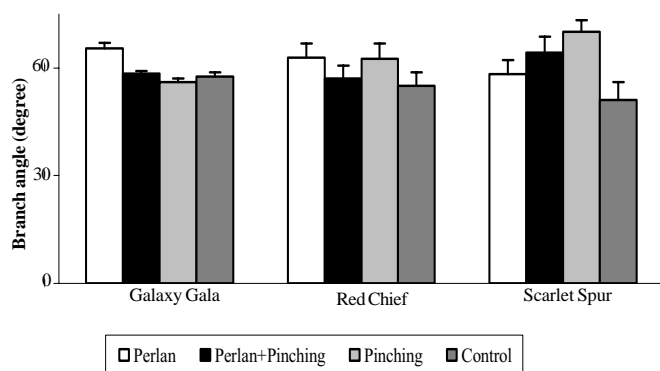


Figure 5. Treatment effect on branch angle.

### Discussion

In the end of our study, sapling length and diameter and number of branches of Galaxy Gala cultivar were higher than the other cultivars. Sapling length was similar at Red Chief and Scarlet Spur cultivars. Sapling diameter and number of branches in Scarlet Spur cultivar were higher than in Red Chief cultivar. There were no significant differences in branch angle and branch length. Perlan application to Galaxy Gala cultivar and pinching application to Scarlet Spur cultivar formed the largest branch angles. This result was similar to Wertheim and Estabrooks study<sup>8</sup>.

The tallest sapling length at applications were seen at Perlan applied saplings, and after that, respectively, control, pinching and Perlan+pinching applications. This result was compatible to the studies of Keever *et al.*<sup>9</sup> and Ono *et al.*<sup>10</sup>.

The results of sapling diameter were similar to sapling length. These results were compatible to the studies of Hrotko *et al.*<sup>11</sup> and Wertheim, S. J., Estabrooks<sup>8</sup>. The highest sapling diameter formed at perlan application, and control, pinching and Perlan+pinching followed Perlan application.

In terms of number of branches, Galaxy Gala cultivar was best, and Scarlet Spur and Red Chief cultivars followed this. Galaxy Gala cultivar gave best results in number of branches at Perlan+pinching application, followed by pinching, Perlan and control treatments. The best result at Red Chief cultivar was at Perlan application, after that Perlan+pinching, pinching and control were in sequence. At Scarlet Spur cultivar the sequence was pinching, Perlan+pinching, Perlan and control. According to Akgül<sup>12</sup>, promalin application increased shoot growth, when 0-500 ppm BA+GA<sub>4+7</sub> solution was used on one-year old spur saplings. The best concentration was 100 ppm but 500 ppm was best for Red Chief cultivar. In the study of Musacchi and Costa<sup>13</sup>,

1000 ppm promalin increased number of branches but branches were small at Red Chief cultivar. For this reason suitable dose must be found and increase sapling quality.

In 'Red Boskoop' apple grafted on M9 rootstock by T-budgraft method in August 1991, 6-benzyladenine (BA) was applied 4 and 8 times as 50, 100, 200 and 400 ppm in a week<sup>8</sup>. Applications started 9 July and was made one time in 7 days. Higher concentrations and application numbers of BA treatment increased number of branches. This study supports our project, 500 ppm dose and application numbers may be increased. In contrast, 450-900 ppm BA and promalin decreased shoot length<sup>9</sup>. In terms of branch angle, our applications were more effective than control. This result was compatible with Gürz<sup>14</sup>. In terms of branch length, there were similarity among cultivars.

Similarly the results of branch length were affirmative. The best application was Perlan+pinching, the shortest branches were in control. This result was compatible with Gürz<sup>14</sup>.

### Suggestions

Using well branched saplings is compulsive in intensive planted dwarf apple growing. However, nurseries offer branchless sapling sales in our country. Young shoots that produced below branches break off at production level. This application provides length sapling but causes deficient branching production.

Clonal rootstock production needs to increase in Turkey. By this way, sapling import is prevented. Apple cultivar demand changes constantly and new cultivars are produced by grafting and place on sale. On the other hand, there is not enough supervision and control at sapling import. This may cause disease and harmful entrance risk<sup>15</sup>. In respect to ecological conditions almost all fruits are grown except tropic fruits in our country. Sapling production must become true in world standards<sup>16</sup>.

At the present time, use of quality saplings and suitable growing conditions increase yield. Increasing number of fruit gardens and vineyards in our country needs quality fruit and vine saplings<sup>17</sup>.

In our search, grafted on MM 106 rootstock, Galaxy Gala, Red Chief and Scarlet Spur apple cultivars were used. To stimulate of branching Perlan application was made on one-year old saplings of this cultivars. At the end of our study, sapling performance increased by Perlan application in measured criteres. Pinching applications were not enough effective. Perlan dose may be increased and 2-years studies carried out to follow branching.

Forming of large angle branch by Perlan application may cause easy growing and earlier fruit production. Therefore, apple gardens should be established with saplings treated by Perlan and the other 6BA+GA<sub>4+7</sub> and search yield performances. Dwarf apple growers must be inform about BA applications in our country.

Every year, sleek, disease resistant, good storable quality apple cultivars are developed<sup>18</sup>. To accord these changes, branched saplings have to be used. Towards our project, branched sapling production may increase in sapling growing regions of our country.

Applications of pruning and growing systems starts from planting year in new established gardens. With suitable branched saplings at planting garden becomes uniform.

The gardens established using branched saplings are productive from first years, so youth infertility shorts and establishing costs realize at minimum level. When a garden is established by the saplings branched at particular height, support system application is easier and also fertilization is easier and effective. Likewise

cultural processes are more effective and need shorter time, and production cost and labor force need decrease.

### Acknowledgements

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