

## RESEARCH ARTICLE

**(Open Access)****Effect of rootstock diameter on apple saplings growth**VAHID AVDIU<sup>1\*</sup>, FADIL THOMAJ<sup>2</sup>, SYLË SYLANAJ<sup>1</sup>, ENDRIT KULLAJ<sup>2</sup><sup>1</sup>University of Pristina, Faculty of Agriculture & Veterinary, Department Horticulture, Fruit growing and Viticulture. Str. "Bill Clinton" Pristina, Kosovo<sup>2</sup>Faculty of Agriculture and Environment, Department of Horticulture, Tirana, Albania**Abstract**

This research paper presents the results of a field trial with managed nursery trees including two apple cultivars Golden Reinders and Gala Galaxy on the rootstocks M9 and MM 106.

In April 2011, the saplings (bench grafted in March 2011) were planted in the distance 100 cm x 35 cm in randomized block design in threecombinations of rootstock diameters (5-7 mm, 7-9 mm, 9-11 mm) with threereplications (in total 60 saplings for each apple cultivar-rootstock and combinations) in Mirovica, Kosovo. The following parameters were examined: growth, rootstock diameter, scion diameter, and stocks growth dynamic. The experimental design was a ANOVAs one-way analysing two different factors cultivars, rootstocks types and treatments (three combinations of rootstocks diameter). Significant differences were found in scion thickness and sapling growth among the three different combinations of rootstock diameter, dimensions and cultivars. Insignificant were differences were found within factors as cultivar, rootstock and their combinations

Key words: Amino acids, Moringa oleifera, poultry manure.

**Key words:** *apple saplings, cultivars, diameter of rootstock and stocks, growing.*

**1. Introduction**

Among a series of factors that have great impacton competitive arboriculture productions is saplings quality, especially the production of healthy and standardized planting material. Furthermore, the arboriculture production depends very much on the combination of rootstock, cultivars, location and the cultivation method. Apple cultivars grafted under some conditions and on different rootstocks during the years develop different thicknesses. This difference is of high importance in their lifespan (Sylanaj 2008). In spring, bench grafts are planted into the nursery. The planting distance is 90 x 33 cm (Berg 2003). The rootstock diameter of 8-10 mm it's an average standard for bench grafting (Sylanaj 2010). Rootstock have been found to affect different components of scion shoot growth (Webmaster 2001) Rootstocks are used to propagate scionsof preferred cultivars, improve fruit tree tolerance to environmental stress, and to control tree size (Webmaster 2003). Research on rootstocks – scion interaction have demonstrated that rootstock had more influence than scion on tree weight and growth rate in young apples tree but scion more strongly influencing during the growth (Vyvyan, 1955). The optimum rootstock diameter of budding will be 7-9 mm whereas for bench grafting 9 -12mm (Memic, 2010).

The main aim of our research was to investigate impact quality of basic material for multiply on apple saplings development.

**2. Material and Methods**

The plant material (benchgrafted saplings) was imported from nursery "VocniRasadnik", in Srebrenik, Bosnia and Herzegovina. The company has 36 years experience and capacity of yearly production is half millionof different fruit trees saplings.

The soil in which saplings were planted was of good quality, up to 60 cm deep and in average contained: humus 2.36 %, (moderate) N 0.13 % (moderate), P<sub>2</sub>O<sub>5</sub> 10.69 mg/100g (low), soil, K<sub>2</sub>O 43 mg/100g soil (high), Ca101.73 mg/100g soil (moderate), Mg 47.14 mg/100g soil (moderate). pH value in water was 6.8 whereas in KCl 5.8 (slightly acid)

Ploughing was made at 40 cm depth, organic and mineral fertilizer was distributed in advance: organic 5kg/m<sup>2</sup> and mineral NPK 15:15:15 100g/m<sup>2</sup>. The plot was tilled 5 times, plants were drip irrigated and have received 3 treatments with fungicides and insecticides.

Apple saplings under observation were from cultivars Golden Reinders (GR) and Gala Galaxy (GG), bench grafted on March 2011 on both M9 and MM106 apple rootstocks. The latest were well developed with a length of around 50 cm, were temporary stored in a container with sand and by the beginning of April

\*Corresponding author: Vahid Avdiu, E-mail: vahid\_avdiu@hotmail.com  
(Accepted for publication 20 March 2014)

were planted in open field with a distance of 100 x 35 cm.

The saplings were planted in a randomized block design, with 20 saplings in each plot and three replications, in total 60 plants per cultivar/rootstock combination (2 cultivars, 2 rootstocks and 3 different combinations of rootstocks thickness, in total 720 saplings)

During the vegetative period, the following parameters were examined:

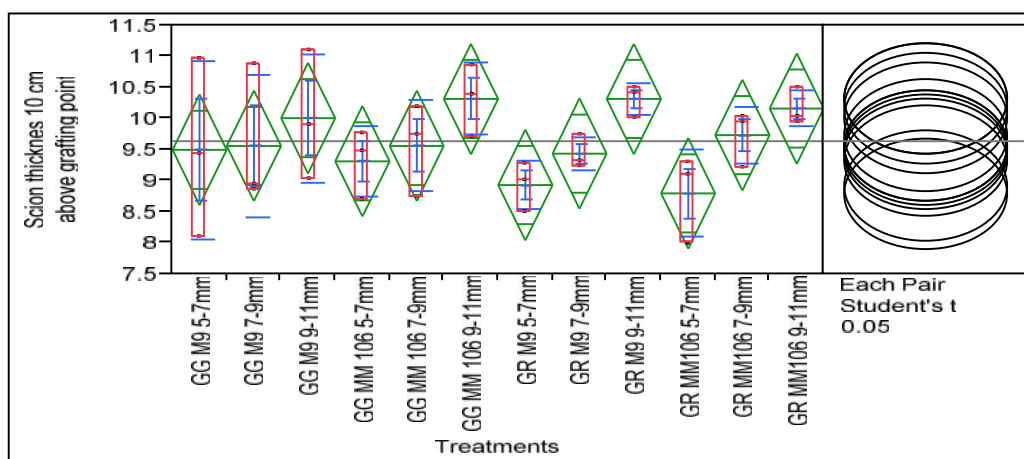
- Rootstock thickness measured 10 cm below the grafting point before planting and classified in three different combinations of thickness: 5 – 7 mm, 7 – 9 mm and 9 – 11 mm.
- Diameter of the grown scion, measured 10 cm above the grafting point at the end of the vegetative period
- Highest growth of saplings above the grafting point

- Dynamic of saplings growth from the beginning of May up to the end of vegetative period
- Results obtained were analyzed using “ANOVA” one-way, JMP program and comparisons for all pairs using Tukey-Kramer HSD 0,01

### 3. Results and discussions

Table 1 shows the effect of three different combinations of rootstock’ thickness on the scion thickness for each rootstock – scion combination. Comparisons for each pairs using Student’s “t”. The combination of rootstock thickness 9 – 11 mm had a higher effect significantly influencing the scion diameter thickness of cultivars Golden Reinders of two rootstocks on M9 and MM 106 (10.31 and 10.16mm) and Gala Galaxy on rootstock M9 (10.31mm) compared with combinations of rootstock thickness 5 – 7 mm of Golden Reinders on rootstocks M9 and MM 106 (8.93; 8.79 mm). Other factors, like difference in cultivar, rootstock and their treatment were not statistically significant.

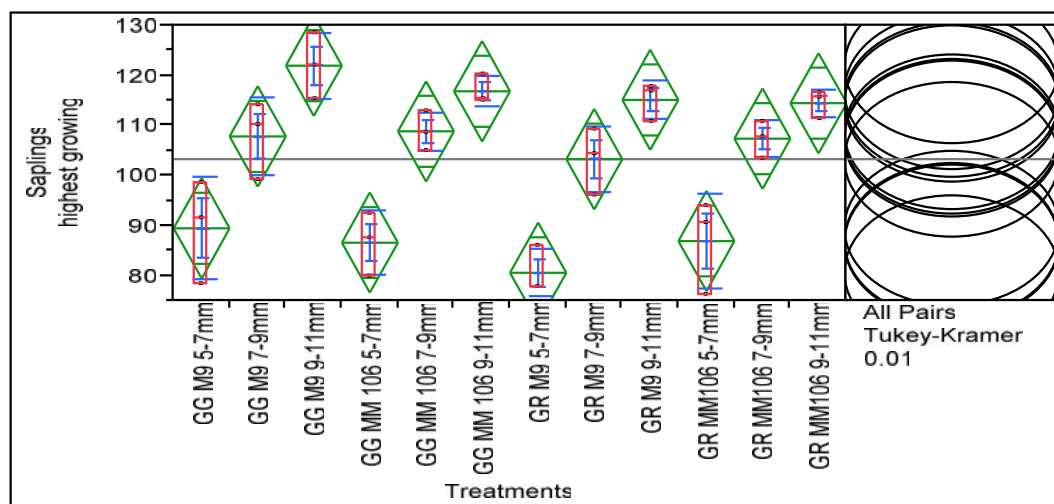
**Figure 1.** Average results of apple saplings development – scion thickness (mm)



**Table 1.** Average results of apple saplings development – scion thickness (mm)

| Level                 | Mean (mm) |
|-----------------------|-----------|
| GG MM 106 9-11mm A    | 10.313333 |
| GR M9 9-11mm A        | 10.313333 |
| GR MM106 9-11mm A B   | 10.160000 |
| GG M9 9-11mm A B C    | 10.006667 |
| GR MM106 7-9mm A B C  | 9.733333  |
| GG M9 7-9mm A B C     | 9.560000  |
| GG MM 106 7-9mm A B C | 9.560000  |
| GG M9 5-7mm A B C     | 9.496667  |
| GR M9 7-9mm A B C     | 9.436667  |
| GG MM 106 5-7mm A B C | 9.313333  |
| GR M9 5-7mm B C       | 8.930000  |
| GR MM106 5-7mm C      | 8.796667  |

Levels not connected by same letter are significantly different,  $t^*2,063$ , **Alpha** 0.05, GG (Cultivar Gala Galaxy on rootstocks M9 or MM106), GR (Cultivar Golden Reinders on rootstocks M9 or MM 106)

**Figure 2.** Average of apple saplings development – saplings highest growing (cm)**Table 2.** Average of apple saplings development – saplings highest growing (cm)

| Level            | Mean (cm) |           |
|------------------|-----------|-----------|
| GG M9 9-11mm     | A         | 121.94000 |
| GG MM 106 9-11mm | A         | 116.85000 |
| GR M9 9-11mm     | A         | 115.13667 |
| GR MM106 9-11mm  | A         | 114.45000 |
| GG MM 106 7-9mm  | A B       | 108.82333 |
| GG M9 7-9mm      | A B C     | 107.82333 |
| GR MM106 7-9mm   | A B C     | 107.36333 |
| GR M9 7-9mm      | A B C     | 103.27333 |
| GG M9 5-7mm      | B C D     | 89.48000  |
| GR MM106 5-7mm   | B C D     | 86.93333  |
| GG MM 106 5-7mm  | C D       | 86.62000  |
| GR M9 5-7mm      | D         | 80.58000  |

Levels not connected by same letter are significantly different,  $q^*4.31702$ , **Alpha 0.01**,

GG (Cultivar Gala Galaxy on rootstocks M9 or MM106),

GR (Cultivar Golden Reinders on rootstocks M9 or MM 106)

The effect of three different combinations of rootstocks thickness on the saplings height are shown using comparisons of all pairs with Tukey-Kramer test.

The rootstocks with thickness 9 – 11 mm had the highest effect on the saplings maximum growth in cultivars Gala Galaxy on rootstocks M9 and MM 106 (121.94 and 116.85cm) compared to two other different combinations of rootstock thickness 7 – 9 mm (107.82 and 108.82cm) and 5 – 7 mm (89.48 and 86.62 cm). Similar results were found on Golden Reinders on rootstocks M9 and MM 106 (115.13 and 114.45) compared to combinations of rootstock thickness 7 – 9 mm (103.27 and 107.36 cm) and 5 – 7 mm (80.58 and 86.93 cm).

Our findings are similar with those of Berg. (2003). In the first year the shoot grow to a height of 120 to 150

cm depending on the variety. The diameter at that height must be at least 10 mm.

According to Ristevski and Simovski (1978) and Zajmi et al. (2002) (cit Syllanaj et al. 2010) the thickest rootstocks with the best root system are formed by most developed trees as they possess more than 340 vessels in  $\text{mm}^2$  through which pass great amounts of water and minerals having a direct effect on scion growth.

The growing dynamic of saplings length along all the growing season was steady. The overall sapling length was bigger in cultivar Gala Galaxy on M9 and combination of rootstock diameter 9 – 11 mm (121.94 cm). It was also founded that the smallest scions belonged to the cultivar Golden Reinders on M9 and rootstock diameter combination 5 – 7 mm (80.58 cm).

**Table 3.** Average growing dynamic of the sapling lengths (cm)

| Cultivars       | Rootstocks | Dates | Rootstocks diameter 10 cm below grafting point |        |        |
|-----------------|------------|-------|------------------------------------------------|--------|--------|
|                 |            |       | 5-7mm                                          | 7-9mm  | 9-11mm |
| Golden Reinders | M9         | 5.06  | 7.65                                           | 9.81   | 10.94  |
|                 |            | 10.07 | 27.33                                          | 35.03  | 39.05  |
|                 |            | 12.08 | 47.12                                          | 60.39  | 67.33  |
|                 |            | 9.09  | 69.30                                          | 88.81  | 99.02  |
|                 |            | 3.11  | 80.58                                          | 103.27 | 115.14 |
|                 | MM 106     | 5.06  | 7.98                                           | 9.85   | 10.29  |
|                 |            | 10.07 | 29.56                                          | 36.50  | 38.12  |
|                 |            | 12.08 | 50.11                                          | 61.86  | 64.61  |
|                 |            | 9.09  | 74.79                                          | 92.33  | 96.43  |
|                 |            | 3.11  | 86.93                                          | 107.36 | 114.45 |
| Gala Galaxy     | M9         | 5.06  | 7.46                                           | 8.99   | 10.02  |
|                 |            | 10.07 | 29.83                                          | 35.94  | 40.09  |
|                 |            | 12.08 | 52.33                                          | 63.05  | 70.33  |
|                 |            | 9.09  | 76.95                                          | 92.73  | 103.43 |
|                 |            | 3.11  | 89.48                                          | 107.82 | 121.94 |
|                 | M106       | 5.06  | 6.36                                           | 8.33   | 8.22   |
|                 |            | 10.07 | 25.45                                          | 33.34  | 38.88  |
|                 |            | 12.08 | 49.91                                          | 65.36  | 74.48  |
|                 |            | 9.09  | 74.49                                          | 97.56  | 101.23 |
|                 |            | 3.11  | 86.62                                          | 108.82 | 116.85 |

#### 4. Conclusions

Based on the investigation of the influence of rootstock diameter on the development of apples saplings was found out that:

- The rootstocks used for bench grafting with different thickness diameter had an impact on sapling growth.
- Among the different rootstocks diameter thickness which were tested (5 – 7 mm; 7 – 9 mm; 9 – 11 mm), the highest effect on the scion diameter thickness of cultivars were found in combination 9 – 11 mm of cultivar Golden Reinders on two rootstocks, M9 and MM 106 (10.31 and 10.16 mm) and Gala Galaxy on rootstock M9 (11.31 mm).
- High effect was shown also to the maximum saplings growth were the combination of rootstock diameter thickness 9 – 11 mm to cultivars Golden Reinders on two rootstocks,

M9 and MM 106 (115.13 and 114.45) and Gala Galaxy on rootstocks M9 and MM106 (121.94 and 116.85).

- At the end of the growing season the grown scions showed a length between 80.58 cm (to the cultivar Golden Reinders on M9 and combination rootstock diameter 5 – 7) and 121.94 cm (to the cultivar Gala Galaxy on M9 and combination of rootstock diameter 9 – 11 mm)
- During the first vegetation period apple saplings cultivated in two different cultivars and rootstocks and three combinations of rootstocks thickness were very well developed according to the contemporary standards for permanent planting, however to get a final conclusion, second vegetation period has to be assessed, too.

## 5. References

1. Berg, A. 2003. Certified nursery tree production in Holland. The compact fruit tree. 36(2): 43 – 45.  
Memic,S., Drakenda.P, Kojic.A. Proizvodnja vocnog i loznog sadnog materiala: Poljoprivredni – prehrambeni fakultet,Sarajevo; 2010.
2. Sylanaj, S., Spornberger.A. 2010. Organic nursery of scab resistant apple cultivars. Edition scientific Research. Agriculture Research Cooperation. University of Pristina and Boku – University, Viena. P. 78 – 85.
3. Sylanaj, S., Shoshi. R. 2008. Comparison of two methods of bud and scion grafting on apple rootstock. Zbornik referatov 2 slovenske gasodjerskega kongresa medunarodna udeležbo,31 January – 02 February. P 487 – 492. Kriško.
4. Vyvyan, M.C., 1955. Interrelation of scion and rootstock in fruit-trees. I.Weights and relative weights of young trees formed by the reciprocalunions, as scion and rootstock, of three apple rootstock varieties: M.IX,M.IV, and M.XII. Ann. Bot. 75, 401–423.
5. Webster, A.D., 2001. Rootstocks for temperate fruit crops: current uses, futurepotential and alternative strategies. In: Palmer, J.W., Wunsche, J.N. (Eds.).Proceedings of the Seventh International Symposium on Orch.& Plant Syst. Acta Hort. 557, 25–34.
6. Webster, A.D., Wertheim, S.J., 2003. Apple rootstocks. In: Ferree, D.C.,Warrington, I.J. (Eds.), Apples: Botany, Production and Uses. CABInternational, Cambridge, MA, pp. 91–124.