

## Rootstock Influence on Apple Canopy Architecture Under High Radiation and Temperature

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### Abstract

Beside its typical and optimal area of cultivation in the central and northeast Albania, in the last decade, apple cultivation has been spread into the Western Plain, to benefit from the advantages of earliness and vicinity to the main markets. The scope of this research was to study the canopy architecture of five main cultivars grown in this region, 'M. Gala', 'Gold Delicious', 'Starking', 'Fuji' and 'Pink Lady' on M9 rootstock. The study was carried out from 2010-2011 in a 6-year old orchard, located at an altitude of 3 m, with 3.7 x 1.2 m distances in French axe system. The following measurements were made in 5 trees per cultivar: diameter of the rootstock, scion and two main branches at 1.5 m height, number of spurs, bourses and shoots, length of woody shoots and fruit set. Global radiation, temperature and humidity were recorded. The data shows a noticeable difference in rootstock/scion growth between the five cultivars tested. These differences are higher in the combination M9/'M. Gala' and 'M9/'Pink Lady', with an affinity index of 0.49 and 0.52, respectively (< 0.6). The same trend is observed also with the diameter of the main branch, with partial incompatibility, which also modifies the other elements of canopy architecture, vegetation and reproductive growth. Changes are observed in 'M. Gala', with a small diameter of the main branch (14.7 mm), but with a higher number of fruiting shoots (18 fruiting shoots) and fruit set (45.3 fruits/ twig). It is followed by 'Fuji' and 'Gold'. Although 'Starking' has a higher diameter (16.4 mm) of main branches, it forms more vegetation shoots and a small fruit set (20.8 fruits/ twig). There is a significant correlation between the branch diameter and the fruit set per twig. In conclusion, we can state that these cultivars show different behaviour towards M9 rootstock which has a significant effect on the elements of canopy architecture and fruit set.

*Key words:* affinity index, fruit set, vegetation growth, fruit growth, fruit set.

## Introduction

Apple, which is generally cultivated in temperate and cold areas, has had large expansion in the coastal lowlands throughout the last decade, by using clonal rootstocks and mainly M9 – EMLA.

The purpose of this research was to study the behaviour of the five most disseminated cultivars in the Western Plain of Albania, namely ‘M. Gala’, ‘Golden Delicious’, ‘Starking’, ‘Fuji’ and ‘Pink Lady’ on M9 rootstock and the influence of the latter on canopy elements and production. Reciprocal effects are seen in the development of vegetative and reproductive elements, duration of phenological stages as well as the quantity and quality of production. This enables us to broaden our knowledge on rootstock selection and choice of best cultivars for the Lushnja region.

## Materials and methods

The five cultivars chosen for this research, ‘M. Gala’, ‘Golden Delicious’, ‘Starking’, ‘Fuji’ and ‘Pink Lady’ on M9 rootstock are the most common in the coastal lowlands. The orchard was planted in 2006 in Lushnja. It is located at 3 m of altitude, with planting distances 3.7 x 1.2 m. The system is French axe.

Five trees for each cultivar were labelled and the following measurements were carried out: (i) Rootstock and scion diameter (10 cm above and under the grafting line); (ii) Diameter of two main branches at 1.5 m from soil level; (iii) Length of vegetative shoots; (iv) Number of spurs, bourses and brindles; (v) Number of fruits set per branch; (vi) Data were statistically analysed using the Tukey – Kramer test for  $\alpha = 0,05$ .

## Results and discussion

The results show that, five years after planting in the orchard, there is a slight visible difference in development of rootstock/scion for the five cultivars under study (Table 1). The highest change is found in the combination M9/ ‘M. Gala’ and ‘M9/‘Pink Lady’, with affinity indices of 0.49 and 0.52, respectively, which is less than 0.6 (Figures 1 and 2). For the other cultivars, although with different values from each other, the affinity index is above 0.6, which is within the acceptable limits for clonal rootstocks and mainly for M9.

These results clearly show partial incompatibility between the two components, which has an effect on modification of other canopy elements (shoots of different categories) as well as on vegetation and production. The same principle was also observed for the diameter of the main branches, where ‘M. Gala’ is the smallest. Even for this index, no significant differences were observed for cv. ‘Golden Delicious’ and ‘Pink Lady’.

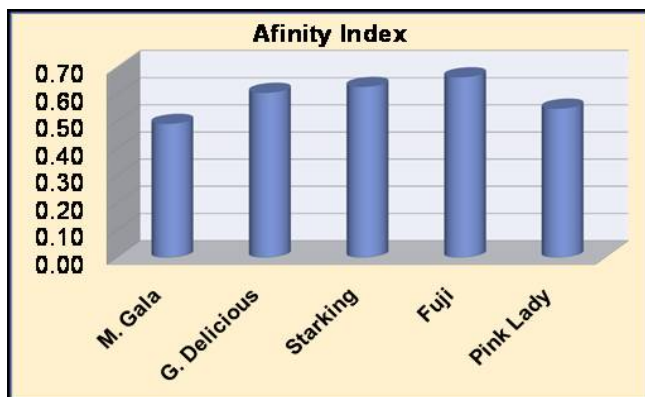


Fig. 1. Afinity index by cv.  
*Indeks afiniteta po sortama*

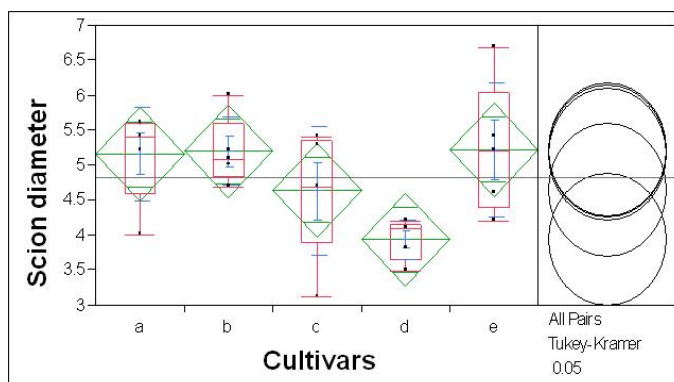


Fig. 2. Scion diameter by cv.  
*Prečnik kalema po sortama*

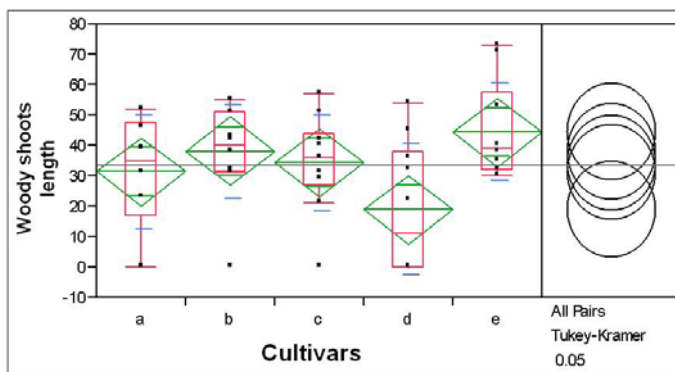


Fig. 3. Comparison of vegetative shoot length by cv.  
*Poređenje dužine vegetativnih izdanaka po sortama*

Tab.1. Biometric measurements of canopy elements  
*Biometrijska mjerenja elemenata krošnje*

Cultivar	Diameter (mm)		Affinity Index	Number of shoots				Woody branches length (cm)	Branch diameter (mm)	Fruits formed
	rootstock	scion		Spurs	Bourses	Brindle	Woody			
'M. Gala'	40	19.7	0.49	79	5	49	5	189	14.7	45.3
'G. Del.'	42.5	25.8	0.61	59	12	50	12	483	15.4	39.8
'Starking'	36.9	23.2	0.63	47	14	31	14	600	16.4	20.8
'Fuji'	39.3	26.1	0.66	48	19	52	19	811	15.7	41.8
'Pink Lady'	47.4	26	0.55	34	16	45	16	660	15.5	27.6

### Vegetative shoots

The dwarfing effect was also observed by the amount of vegetative growth of the trees. The lowest number of vegetative shoots per tree was found in cv. 'M. Gala', while the highest number in cv. 'Fuji' and 'Pink Lady'. Their annual growth follows the same principle, with cv. 'Fuji' and 'Pink Lady' having the highest values. 'Golden Delicious' and 'Starking' showed a similar growth although significantly different from each other, while 'M. Gala' had the weakest growth (Figure 3).

### Fruiting shoots

Modifications of structural elements of the canopy were distinguished by referring to the fruiting shoots; spurs, bourses and brindles. Data shown in Figures 6, 7 and 8 showed that cv. 'M. Gala' forms a much higher number of spurs and bourses, while cv. 'Fuji' and 'Pink Lady' with a higher vegetative growth, had fewer fruiting shoots.

It was interesting to find that cv. 'Starking', which is known for its reduced growth, had more vegetative shoots than 'Golden Delicious' and less than 'Fuji' and 'Pink Lady' under high radiation and temperature regime in Lushnja. In this context, it has fewer bourses and brindles, while having the same number of spurs like cv. 'Fuji'. In other conditions, on the same rootstock (M9), cv. 'Starking' has reduced vegetative growth and high reproductive growth (Figure 4).

### Fruit set

The development of more fruiting elements in the entire canopy was reflected in the quantity of fruits set per cultivar. Data shown in Figures 5 and 6 prove the same principle. Significant changes are seen at 'M. Gala', with a smaller diameter of the main branch, but with more fruiting shoots and fruit set (45.3 fruits/branch), followed by 'Fuji' and 'Golden Delicious' cultivars. 'Starking', although with a higher diameter of the main branches, forms more vegetative shoots and fewer fruit sets (20.8 fruits/branch) (Figure 5, 6).

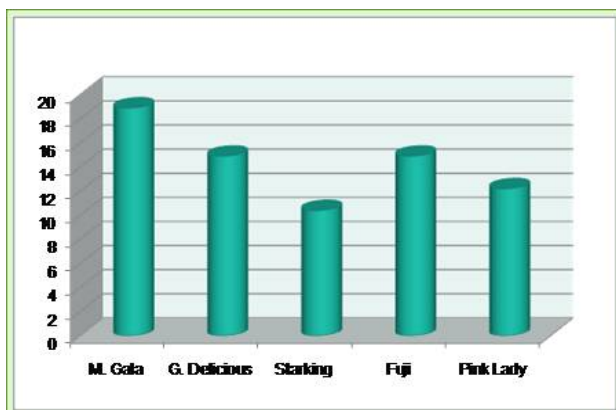


Fig. 4. Number of fruiting shoots by cv.  
*Broj rodnih izdanaka po sortama*

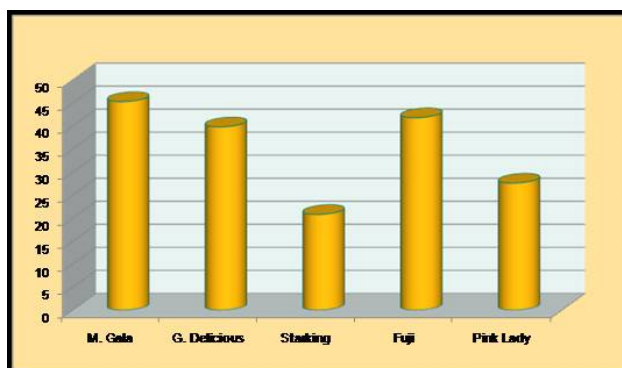


Fig. 5. Number of fruits set by cv.  
*Broja zametnutih plodova po sortama*

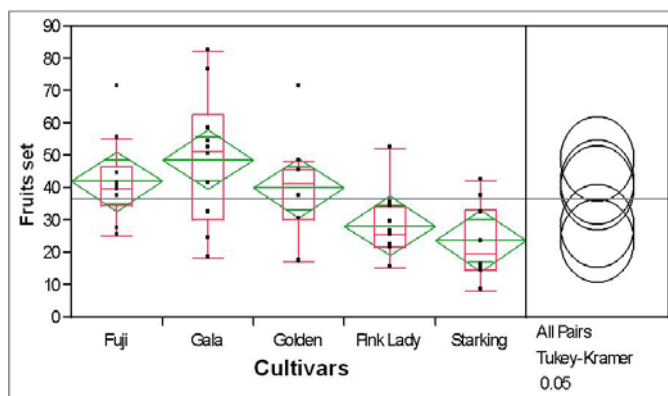


Fig. 6. Variability level for fruit set index by cv.  
*Nivo varijabilnosti za indeks zametanja ploda po sortama*

The correlation between the fruiting shoots diameter and fruit set is interesting (Figure 7). The cultivar that forms stronger branches ('Starking' in our case) has fewer fruits.

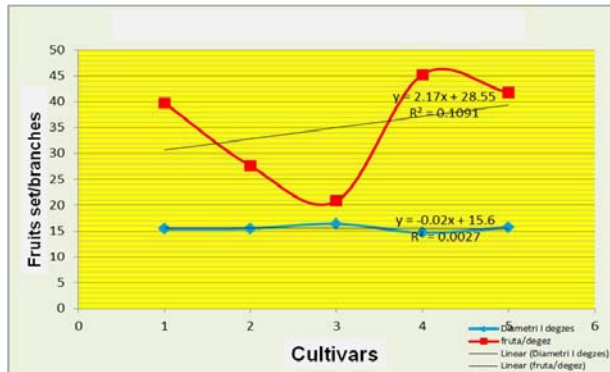


Fig. 7. Correlation between shoot diameter and fruit set  
*Korelacija između prečnika izdanka i zametanja ploda*

## Conclusion

In conclusion we can state that:

- M9 rootstock has a significant effect on the architectural elements of the canopy as well as productivity.
- In combination with 'M. Gala', the dwarfing effect is higher, accompanied by reduced vegetative growth and higher development of fruiting shoots in the first years of the orchard.
- Cv. 'Starking' in Lushnja on M9 has good vegetative growth but delays the formation of fruiting shoots.
- For all cultivars, there is a significant correlation between the diameter of the main branches and fruiting.

## References

1. Erez, A. (1999) Sviluppo delle radici in giovani piante nell'alta densità di piantagione. Agri Cesena.
2. Loreti, F. et al. (1999) Valutazione dei portinnesti dei fruttiferi. *L'Informatore agrario* no. 6.
3. Missere, D. et al. (2000) Scelta del portinnesto in relazione ai suoli. *Riv. Notizario Tecnico* 4
4. Sansivini, S. et al. (2002) Modelli d'impianto, portinnesti e forme d'allevamento per la melicoltura di pianura.
5. Sansivini, S. et al. (2005) Nuovi portinnesti europei del melo: primi risultati di una prova di confronto in ambienti di montagna e pianura. *Riv. Frutticoltura* nr. 11.

# Uticaj podloge na oblik krošnje jabuke pod visokim zračenjem i temperaturom

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## Sažetak

Pored tipičnog i optimalnog regiona za uzgoj voća u centralnoj i sjeveroistočnoj Albaniji, u toku posljednje dekade se uzgoj jabuka proširio na Zapadno polje kako bi se iskoristile prednosti rane berbe i blizine glavnih tržišta. Cilj ovog istraživanja bio je da se ispita oblik krošnje kod pet glavnih sorti ovog regiona i to: 'M. Gala', 'Zlatni delišes', 'Starking', 'Fuji' i 'Pink Lady' na M9 podlozi. Istraživanje je sprovedeno u periodu od 2010–2011. godine u voćnjaku starom 6 godina i smještenom na visini od 3 m, sa razmakom sadnje 3,7x1,2m, sa vertikalnim vretenom kao uzgojnim oblikom. Obavljena su sljedeća mjerenja na 5 stabala po sorti: prečnik podloge, kalema i dvije glavne grane na visini od 1,5m, broj izdanaka i lastara, dužina drvenastih izdanaka i zametnutih plodova. Praćeni su globalno zračenje, temperatura i vlažnost. Podaci pokazuju primjetnu razliku u rastu podloge/kalema između pet ispitivanih sorti. Ove razlike su veće za kombinaciju M9/'M. Gala' i 'M9/'Pink Lady', sa indeksom afiniteta od 0,49 i 0,52, (< 0.6). Isti trend je registrovan i za prečnik glavne grane, sa djelimičnom nekompatibilnošću, koji takođe modifikuje druge elemente oblika krošnje, vegetativnog i reproduktivnog rasta. Promjene su primjećene kod sorte 'M. Gala', sa malim prečnikom glavne grane (14,7 mm), ali sa velikim brojem rodni izdanaka (18 rodni izdanaka) i zametnutih plodova (45.3 plodova/ grančici). Zatim slijede sorte 'Fuji' i 'Gold'. Iako sorta 'Starking' ima veći prečnik (16,4 mm) glavnih grana, ona formira više rodni izdanaka i manji broj zametnutih plodova (20,8 plodova/ grančici). Postoji značajna korelacija između prečnika grane i zametanja plodova po grančici. Može se zaključiti da se ove sorte različito ponašaju prema M9 podlozi koja ima znatan uticaj na elemente oblika krošnje i zametanje ploda.

*Ključne riječi:* indeks afiniteta, zametanje ploda, vegetativni rast.

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