

**RESEARCH ON THE COMPATIBILITY OF GRAFTING ON DIFFERENT
ROOTSTOCKS OF APPLE VARIETIES**

Sinziana Venera Morarita, Ciobanu Irinel
Valahia University of Targoviste, Bdv Carol I, Nr 2, Romania
E-mail: cristi2morarita@yahoo.com

Abstract

Crop trees and shrubs, part of the horticultural sector and hence the agriculture in Romania, has a long tradition, stemming both from Romanian's love for these species and the need to perform an activity generating livelihoods. Expanding tree culture was and is favored by climate and soil conditions conducive culture of many tree species, including the apple. Achieving high yields of good quality apples involves an ongoing concern, based on science and experience and special emphasis being put :

- *Application technologies, with reference to the choice of varieties, rootstocks, pest and disease control, soil maintenance, recovery mode fruits, etc;*
- *Choosing the appropriate culture systems, productive and low cost, per unit area ha or kg;*
- *Increasing economic service life of apple orchards. Based on rigorous research has been established that for traditional plantations economic fructification period lasts for 45-50 years and 30-32 years for intensive plantations;*
- *Provide technical assistance and materials, highly professional specialists, informing the fruit growers with the latest knowledge on apple culture*

Keywords: variety, rootstock, grafting, grafting percentage fastening.

1. INTRODUCTION

The objective of this study is to establish the behavior of genetically resistant apple varieties to diseases and pests and classic varieties grafting on different rootstocks in the sleeping eyes under the SCDP Voinești - Dâmbovița County.

Voinești town is located in the center of fruit growing basin Dâmbovița.

In this area, the climate is temperate with medium annual temperature of 8.8 ° C and medium annual precipitation amount of 782 mm, with mild winters and cool summers.

Monthly temperatures in this area are favorable to all requirements of the tree species, allowing normal startup growing trees in spring, all the phenophases of reproductive organs browsing, full ripening of fruit and wood.

The least precipitation falls during the winter months. In recent years there has been a change in quantity, but without affecting crop bearing trees in plantations. There has been felt the lack of rainfall in certain periods, especially in young trees where in some cases it was necessary to use irrigation system.

Annual average relative humidity in this area ranged from 75-81. Atmospheric humidity in this area is generally high due to frequent rain and moderate temperatures, ensuring optimal growth and development of trees. With regard to atmospheric drought, it is brief and does not adversely affect vegetation trees. Winds in the study area have an intensity and low frequency, hail falls quite frequently, but has a low intensity.

Regarding soil in the area Voinești identified 4 classes and 9 types of soil: Clay-alluvial soils, Luvisols, Hydromorphic soils; Hidrosols, Cambisols, Undeveloped, battered and truncated soils and Protisols.

From the physico-geographical point of view the terrain of the Station is located in the Southern Sub-Carpathians, small and medium sized hills. From the agropedoclimatic conditions analysis of the area where it is located SCDP Voinești it resulted that are very favorable conditions for growing apple.

2. MATERIAL AND METHODS

Research has been done on Izvoare Farm (fruit tree nursery of SCDP Voinești) the following apple varieties: GENEROS, FLORINA, STARKRIMSON, JONATHAN, GOLDEN SPUR, IDARED, REDIX, CIPRIAN, MUTSU, ROMUS 3, REAL which were grafted on the following rootstocks : M 9, M 26 and MM 106.

Description of varieties:

-GENEROS

It was created in Fruit Research and Development Station of Voinești. Tree is vigorous, fast fructification, capitalizes on short branches (spikes), has an inverted conical crown with solid roofs, well garnished with fruit branches. Polygenic scab resistance, is grown with few treatment plant, including fungicides. Fruit-spherical or slightly flattened spherical, slightly asymmetric, with an average weight of 160 -180 g, smooth, slightly waxy, pale red (on 60-70% of the surface), on yellowish green background. Fine textured yellow flesh, juicy, pleasant, fine aromatic, crispy. Aging and consumption - harvested in late September. Age of riping - from December to February, it can be kept up to early March. Fruit production can reach 25 - 30 t / ha after 7-8 years after planting.

-JONATHAN

Tree vigor is middle, early and productive. It is tolerant

to scab, but susceptible to mildew. The fruit is medium red and flavorfull. Peel reveals some rust spots. Fruit shape is spherical to flattened ball. Aging and consumption - the fruit is harvested in late September early October. Completes its characteristics during storage.

-STARKRIMSON

Tree has little vigor and short branches. It's early, moderate fruit bearing and flourishes every year. It has good resistance to mildew, but susceptible to scab. Fruit is elongated, notched, colored red to varying degrees, with sweet pulp, strongly flavored, agreed by a lesser number of consumers.

Age of maturation and storage - matures in October. The fruit is harvested in late September and early October. It is considered the best variety in keeping without loss in storage until April.

Fruit production is slightly more than 30 t / ha.

-FLORINA

Tree vigor is great and good branching and the formation fruition is long and short, with mid-late flowering. Resistant to scab, but has a slight susceptibility to powdery mildew.

Fruit is medium to large (150-180g), slightly tapering, with yellowish green skin, covered with orange red on 2/3 of the surface, flesh is firm, juicy, slightly acid, with specific flavor and taste good.

Age of maturation and storage – is harvested in late September or early October and may be kept until March-April next year, with reduced losses in storage. Production is constant and can reach 30 -40 t / ha.

-REDIX

Was obtained at Fruit Research and Development Station of Voinești of sexual hybridization by Golden Spur ×Prima and was approved in 2004. The tree has medium vigor, the port exhibited and fruiting type spur. It is resistant to attack by *Venturia inaequalis* and *Podosphaera leucotricha*, but also from *Erwinia amylovora*.

Flowering is medium, simultaneous to pionier and generos varieties.

The variety has good production capacity from 7-10 t / ha in the first years of fruitfulness. The fruit is 160 g on average, is conical, similar to the variety Starkrimson, green, covered in 2/3 of the area with red-purple. The flesh is greenish-white, juicy, sweet acidulous and tastes good.

Harvest maturity occurs in late September or early October, and the optimal consumption is in February-March.

-IDARED

The variety was produced in the USA, by the crossing Jonathan × Wagner, and the culture was introduced in 1942. In our country it was authorized in 1979. The tree is of medium vigor, branched port, flowering in early stages but very productive and fairly constant. The variety is quite sensitive to scab and mildew, as well as bacterial burning.

Fruit is over medium and large (160-180 g), spherical slightly flattened, yellow green, covered with red 1/2 of

the area. The flesh is yellowish white, crispy, acidulous, good quality.

Age of maturation and storage: fruit is harvested in late September and early October. It is considered the best variety of storage without loss in storage until April. Fruit production is slightly over 30t/ha with good results both on MM 106 rootstock and M9.

-MUTSU

Variety produced in Japan, by sexual hybridization of varieties Golden Delicious and Indo being introduced as a variety in 1949, and in our contry after 1970. Tree has great vigor, diffuse crown with simultaneous flowering of Golden Delicious. Flourishes more, but not constantly and is very susceptible to scab. It is a triploid variety, bad pollinator and therefore not recommended for this.

The fruit is very large (over 250 g), spheroid, green - yellow with slight pinkish tinge on the sunny side. The flesh is yellowish white, crispy, acidulous, slightly fragrant, very good quality.

Age of maturation and storage: the beginning of October to April, with very good retention.

-GOLDENSPUR

Variety produced in the U.S. as a mutation type spur of Golden Delicious, then selected in 1959, in Yakima, Washington.

Reduced tree vigor, with the spikes fruition, come later on fruit and produce more, but alternating. Suitable for high density planting and fencing leads fruit. Variety is susceptible to scab.

Fruit is over medium of 160-180 g, slightly elongated or truncated spherical, yellow-green or yellow when ripe, the skin is often partially covered with roughness. Flesh is yellowish-white, dense succulent, sweet slightly acid, with a great taste.

Maturing and consumption span from late September to March.

-CIPRIAN

Variety is obtained from crossing of varieties Prima × Starkrimson and approved in 1998.

Tree vigor is medium, with short branches predominantly fructification, input bearing in the third year after planting. Constant yielding over 30 t / ha and total resistance to scab is comparable to the variety of Florina.

It is grown without fungicide treatments. The fruit has an average weight of 165g, is conical, similar in form to Starkrimson variety of dark red all over the fruit with creamy white flesh, juicy and medium firmness, tastes good.

Maturation age – IIIrd decade of September, in the same time with Generos and Florina, kept until March.

-REAL

This variety was obtained from the Research and Development Station for Fruit of Voinești, approved in 2007.

The tree is medium to small in vigor with exposed port, with fruiting on short branches, rods and shoots. Constant fruit-bearing is 25-30 t / ha. It is resistant to

scab and poorly attacked by mildew. It is grown without fungicide treatments.

The fruit is conical, weighing about 185 grams, covered with red on 2/3 of the area.

It is a kind of summer type fruit, ripening in late August or early September.

-ROMUS3

This variety was obtained from a hybrid selection in the U.S., Rutgers University and tested with good results to us, so that was approved in 1983.

Tree vigor is middle, flourishes predominantly spikes and spurs, semispur, fruiting in the 3rd year from planting, genetically resistant to scab treated with 6-8 annual treatments without fungicides. Pollinators to it are the varieties Romus 2, Voinea, Generos.

The fruit is medium of 125-135 g, ovoid, red colored on 2/3 of the area, very attractive.

The flesh is white, juicy, with a great taste. It is considered one of the most valuable varieties of summer group.

It's consumption time is in the 1st decade of august and preserved up to 2 weeks.

Fruit production is constantly around 25 t / ha.

Characteristics of used vegetative rootstocks:

M. 9 rootstock gives varieties little vigor, early fruition, good quality fruit, color and size superior to other rootstocks. It has a shallow rooting which requires the installation of support in orchards and of irrigation. It is susceptible to attack by the woolly lice (*Eriosoma lanigerium*). It is recommended for plantations with the super-intensive system.

M.26 gives the grafted varieties intermediate vigor between types M 9 and MM 106 and is better than that rooting M 9 and little sensitivity to attack by woolly lice. It is destined to super intensive orchards and also to columnar varieties. Not recommended for triploid varieties (eg Ionagold) due to lower affinity with them.

M. 106, better known as the original MM 106 rootstock is most prevalent in the nurseries of our country. It has a good rooting, does not require installation of means of support. It is ideal for intensive plantations in combination with low vigor varieties, even for the super-intensive ones. Performs well in layer place and nursery and has good resistance to woolly lice.

As a working method was used grafting with buds (eyes) sleeping.

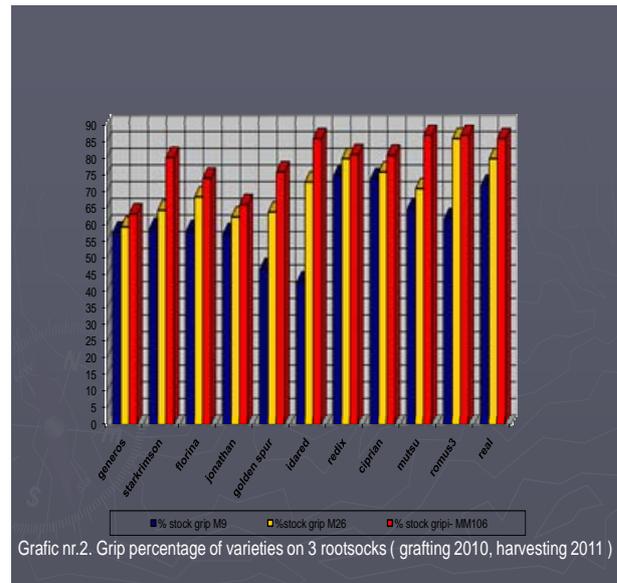
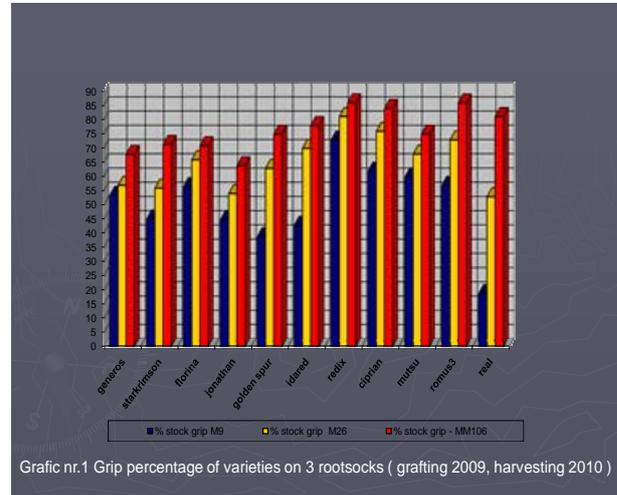
Grafting were performed for two consecutive years: 2009 harvesting trees in 2010 and 2010 harvesting trees in 2011. Grafting period ranged from 1 to 31 August. Bud grafting with sleeping includes four main operations namely: cutting and peeling bark of rootstock, scion bud posting the little shield with the introduction of the little shield into place on the rootstock and tying the two partners.

3. RESULTS AND DISCUSSIONS

All the studied apple varieties (GENEROS, FLORINA, STARKRIMSON, JONATHAN, GOLDEN SPUR, IDARED, REDIX, CIPRIAN, MUTSU, ROMUS 3,

REAL) were grafted on the following rootstocks: M 9, M 26 and MM 106.

Within the study which began in 2009 (the first year of grafting) there was followed in each variety depending on the rootstock used, the number of trees and number of trees grafted delivered. In chart 1 and chart. 2, are collected all data obtained during the study.



4. CONCLUSIONS

The analysis of climatic conditions where it is located Voinești Research Station following results:

1. The resort is located in the center of fruit growing basin Dâmbovița with favorable conditions and representative trees.
2. Area occupied by orchards is so well placed and organized that allows execution of all mechanical works.
3. Climatic conditions are favorable for apple culture:
 - Average annual temperature 8.8 ° C, sufficient rainfall

(over 700 mm per year) ensures optimal growth and fruitfulness of trees;

- Low temperatures occurring during winter and spring frosts affects only a small extent for fruit production;
- The Dâmbovița River valley is located between the hills, is protected from winds;
- Hail cause damage in orchards especially when it occurs during July-August. Also these are very rare weather phenomena in this area.

Based on the analysis of climate and tradition can say that in this area the apple finds favorable conditions for growth and fruitfulness. From 2009 until 2011, within Farm 2 - Nursery Fruit of SCDP Voinești there was organized a study on the compatibility of 11 varieties of apple grafting on 3 rootstocks (M9, M26, MM106).

Varieties grafted on these rootstocks were Generous, Starkrimson, Florina, Jonathan, Golden Spur, Idared, Redix, Ciprian, Mutsu, Romus3, Real.

To obtain conclusive data, grafting were performed for two consecutive years: 2009 harvesting trees in 2010 and 2010 harvesting trees in 2011.

To summarize the data obtained from this study will present the results by year, depending on the rootstock used. (Table 1)..

Table 1. The percentage of gripping after grafting in these years

Variety	M9		M26		MM106	
	2009-2010	2010-2011	2009-2010	2010-2011	2009-2010	2010-2011
Generous	53,5	57,9	57	59,5	67,9	63,4
Starkrimson	45,2	59,1	56	64,5	71,4	80,3
Florina	56,6	58,4	66	68,5	70,9	74,1
Jonathan	45	57,5	54,1	62,5	63,9	66,2
Golden spur	39	47	63	64	75	76
Idared	43	43	70	73	78	86
Redix	73	75	81,2	80	86	81,2
Ciprian	62	74	76	76	84	81
Mutsu	60	65	68	71	75	87
Romus 3	57	62	73	86	86	87
Real	19	72	53	80	81,2	86

As follows:

1.For varieties grafted in 2009 and harvested in 2010, the percentage depending on the stock grip was as follows:

- M9 rootstock - the maximum gripping percentage was 73% for the variety Redix and minimum gripping percentage was 19% for Real variety.

- M26 rootstock - the maximum gripping percentage was 81.2% for the variety Redix and minimum gripping percentage was 53% for the Real variety.

- MM106 rootstock - the maximum gripping percentage was 86% for the variety Redix, Romus 3 and minimum gripping percentage of 63.9% was recorded by Jonathan variety.

2. For the varieties grafted in 2010 and harvested in 2011, the percentage depending on the stock grip was as follows:

- M9 rootstock - the maximum gripping percentage was 75% for the variety Redix and minimum gripping percentage was 43% for Idared.

- M26 rootstock - the maximum gripping percentage was 86% for the variety Romus 3 and minimum gripping percentage was 59.5% for the variety Generos.

- MM106 rootstock - the maximum gripping percentage was 87% for Mutsu, Romus 3 and minimum gripping percentage was 63.4% for the variety Generos. Analyzing the data obtained during the study, we can draw conclusions on the grafting compatibility of each variety individually depending on the rootstock used.

As follows:

• Generous variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (67.9% → 2009 to 2010, 63.4% → 2010 to 2011);

• Starkrimson variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (71.4% → 2009 to 2010, 80.3% → 2010 to 2011);

• Florina variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (70.9% → 2009 to 2010, 74.1% → 2010 to 2011);

• Jonathan variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (63.9% → 2009 to 2010, 66.2% → 2010 to 2011);

• Golden Spur variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (75% → 2009 to 2010, 76% → 2010 to 2011);

• Idared variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (78% → 2009 to 2010, 86% → 2010 to 2011);

• Redix variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (86% → 2009 to 2010, 81.2% → 2010 to 2011);

• Ciprian variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (84% → 2009 to 2010, 81% → 2010 to 2011);

• Mutsu variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (75% → 2009 to 2010, 87% → 2010 to 2011);

• variety Romus 3: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (86% → 2009 to 2010, 87% → 2010 to 2011);

• Real variety: the highest percentage of fruit harvested was recorded at grafting on rootstock MM106 (81.2% → 2009 to 2010, 86% → 2010 to 2011);

By comparison of the varieties studied all these years on the grafting percentage attachment, we can emphasize the variety Redix as the variety with the highest grafting compatibility on all three rootstocks used (percentage between 73% and 86%).

The poor compatibility in grafting on all three rootstocks showed variety Jonathan (percentage clamping between 45% and 66.2%).

Highest percentage of fruit harvested was recorded for all 11 apple varieties studied, the grafting on rootstock MM106.

5. ACKNOWLEDGMENTS

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6. REFERENCES

- [1] Bordeianu T. , Ștefan N. , Moldovan I., Bodi I., Liacu A., Tudosescu O. – "Tree nursery", Editura Agrosilvică București, 1980
- [2] Ghena Nicolae, Braniște N. – "Special Culture trees", Ed. Matrix Rom, București, 2003
- [3] Isac Ilarie - "Technical and economic management of the holding fruit", Editura Pământul, Pitești, 2002
- [4] Isac Ilarie - "Small growers guide ", Editura Pământul, Pitești,
- [5] Mihăescu Grigore - Guide to being a growers, Editura Ceres București, 1987
- [6] Milițiu Ioan, Popescu M., Mihăescu Gr., Cîreașă V., Godeanu I., Drobotă Gh., Cepoiu N. - General and special fruit ", Editura Didactică și Pedagogică București, 1982.
- [7] "Fruit - Practical Works", Institutul Agronomic București, 1992
- [8] 'Fruit Research Station and Production Voinești the anniversary of 50 years of research and development (1950 - 2000) ", Editura Domino, Târgoviște.