

## Study of Some Agricultural Technologies Impact upon the Quality Index of Generos Apples in Conditions of Timisoara

Olimpia Alina IORDĂNESCU<sup>1)</sup>, Roxana Elena MICU<sup>1)</sup>, Ersilia ALEXA<sup>2)</sup>, Aurel LĂZUREANU<sup>1)</sup>, Casiana MIHUȚ<sup>3)</sup>, Aurelia BLIDARIU<sup>1)</sup>

<sup>1)</sup> Faculty of Horticulture and Forestry, Banat's University of Agricultural Sciences and Veterinary Medicine Timișoara, 119 Calea Aradului, 300645, Timișoara, Romania;

olimpia.iordanescu@yahoo.com

<sup>2)</sup> Faculty of Agroalimentary Products Technology, Banat's University of Agricultural Sciences and Veterinary Medicine Timișoara

<sup>3)</sup> Faculty of Agriculture, Banat's University of Agricultural Sciences and Veterinary Medicine Timișoara

**Abstract.** This paper deals with the impact of some soil maintenance systems upon 'Generos' apples' quality and production, cultivated in the Didactic Station Timisoara of our University. We studied and experimented less pollutant soil maintenance systems, mainly by using plants as green fertilizers. There were eight experimental variants: V1 – black field (2 manual hoeing + 2 mechanical hoeing) – control, V2 – seeding and incorporation in the soil with green manure (white clover), V3 – seeding and incorporation in the soil with green manure (bird's-foot trefoil), V4 – seeding with grass mixture 1 (2 manual hoeing), V5 - seeding with grass mixture 2 (2 manual hoeing), V6 - seeding with grass mixture + mulching, V7 - seeding with grass mixture + Roundup 360 SL (3 l/ha), V8 – mixed field, Roundup 360 SL (3 l/ha) + mechanical hoeing. There were determined the physical features of apples (average weight, average diameter and average height) the refract meter dry substance and the sugars content, the total acidity (malic acid), the total minerals, the spectrophotometry vitamin C content and the microelements (Fe, Mn, Zn, Cu) through atomic absorption spectrophotometry (AAS), as well as the production obtained. The best results were obtained in those experimental variants where we used green manure (*Trifolium repens* or *Lotus corniculatus*).

**Keywords:** Generos, apples, soil maintaining systems, quality

### INTRODUCTION

The apple culture in Romania occupied the 2<sup>nd</sup> place concerning its cultivation and it represented 30% of the total orchards surface. In the European Union, Romania produces 3.6% of the total apple production. This is due to the richness of apples in vitamins A, B1, B2 and C, but also in other nutrients, such as magnesium, phosphorus, iron and potassium, having many good properties for human health (Baciu, 2005, Iordănescu, 2008, Lee, 1990).

Rational human intervention in the fruit species culture is consciously directing their growth and development through a series of actions, implemented on time, both upon the environment (soil tillage, irrigation, fertilizer application, improved conditions of temperature, light etc.), or directly on fruit species (pruning, treatments, normalization of the fruit load) (Campeanu *et al.*, 2009, Glidemacher *et al.*, 2001).

In this paper we studied the impact of the soil maintenance systems upon 'Generos' apples' quality and production, cultivated in the western part of Romania. We studied and experimented the maintenance of an apple orchard with less pollutant soil maintenance systems (Blosma, 2000, Lăzureanu, 2002, Iordănescu and Micu, 2010), mainly by using

plants as green fertilizers (Petre, 2008).

## MATERIALS AND METHODS

The researches have been done in the Didactic Station Timișoara, in the orchard of the Fruit Culture department from the Faculty of Horticulture and Forestry in Timișoara, the biological material being represented by ‘Generos’ apple tree variety, a variety that has genetic resistance to diseases. The trees were grafted on MM106, the crown system being Palm Spindle bush, while the trees are planted in 1997, being in full production.

By this research, we wanted to improve some technological links of apple culture in conditions of the western part of Romania during the years 2008-2009 and they belong to a Research project IDEI, no. 1078/2009.

The experimental variants are: V<sub>1</sub> – 2 manual hoes + 2 mechanical hoes – control variant, V<sub>2</sub> - *Trifolium repens* on the interval, V<sub>3</sub> – *Lotus corniculatus* on the interval, V<sub>4</sub> - cover crops on the interval mixture 1 (2 manual hoes), V<sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes), V<sub>6</sub> - cover crops on the interval, mixed grass, and mulching, V<sub>7</sub> - Roundup 360 SL (3 l/ha), cover crops on the interval, V<sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval. Each variant had 10 trees planted at the distance of 2 m on the row and 4 m between the rows. Experimentally, there were determined the physical features of apples (average weight, diameter and height) and the chemical features (dry substance and the content of sugars by refractometric method, the acidity – g/l malic acid, minerals, the content of vitamin C by spectrophotometry), but also the microelements content of apples (Fe, Mn, Zn, Cu) by atomically absorption spectrophotometry.

## RESULTS AND DISCUSSION

The results obtained concerning the physical features of ‘Generos’ apples in the two years of experiment are presented in Tab. 1 and 2.

In 2008, the biggest fruits were obtained in those variants where we used green manure, respectively variants V<sub>2</sub> (*Trifolium repens* on the interval) and V<sub>3</sub> (*Lotus corniculatus* on the interval), followed by variant 1 where there were done 2 manual hoes and 2 mechanical hoes in order to destroy the weeds (Tab. 1).

Tab. 1

Physical features of ‘Generos’ apples in 2008

Variant	Big diameter (cm)	Small diameter (cm)	Height (cm)
V <sub>1</sub> - 2 manual hoes + 2 mechanical hoes – control variant	8.2	8.0	7.9
V <sub>2</sub> - <i>Trifolium repens</i> on the interval	8.2	8.1	7.9
V <sub>3</sub> - <i>Lotus corniculatus</i> on the interval	8.1	8.1	8.0
V <sub>4</sub> - cover crops on the interval mixture 1 (2 manual hoes)	8.0	8.0	7.8
V <sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes)	8.1	7.9	7.8
V <sub>6</sub> - cover crops on the interval, mixed grass, and mulching	8.1	7.8	7.2
V <sub>7</sub> - Roundup 360 SL (3 l/ha), cover crops on the interval	8.1	7.9	7.9
V <sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	8.0	7.7	7.3

In 2009, the fruits had very close size indexes in the studied variants, but among them we remark variant 6 (cover crops on the interval, mixed grass, and mulching) and the variants with plants used as green manure, the same as in the previous year (Tab. 2).

Without question, the size of fruits is a parameter depending on the variety and less on other factors, but out of our researches, we observed that in the variants where plants for green manure and also mulching were used, the physical features of fruits were better comparative with the other studied variants.

Tab. 2

Physical features of ‘Generos’ apples in 2009

Variant	Big diameter (cm)	Small diameter (cm)	Height (cm)
V <sub>1</sub> - 2 manual hoes + 2 mechanical hoes – control variant	8.8	8.1	7.0
V <sub>2</sub> - <i>Trifolium repens</i> on the interval	8.6	8.5	7.6
V <sub>3</sub> - <i>Lotus corniculatus</i> on the interval	8.4	8.4	7.6
V <sub>4</sub> - cover crops on the interval mixture 1 (2 manual hoes)	8.3	8.1	7.4
V <sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes)	8.3	8.0	7.2
V <sub>6</sub> - cover crops on the interval, mixed grass, and mulching	9.0	8.5	7.7
V <sub>7</sub> - Roundup 360 SL (3 l/ha), cover crops on the interval	8.6	8.3	7.1
V <sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	8.4	8.0	7.3

The results obtained concerning the chemical features of ‘Generos’ variety apples in the two studied years are presented in Tab. 3 and 4.

Tab. 3

The chemical features of ‘Generos’ apples in 2008

Variant	Minerals (%)	C vitamin (mg/100 g fruit)	Dry substance (%)	Sugar (%)	Acidity (g/l malic acid)
V <sub>1</sub> - 2 manual hoes + 2 mechanical hoes – control variant	0.13	7.76	12.3	10.57	0.173
V <sub>2</sub> - <i>Trifolium repens</i> on the interval	0.12	7.21	13.8	12.16	0.210
V <sub>3</sub> - <i>Lotus corniculatus</i> on the interval	0.14	7.30	13.6	11.95	0.198
V <sub>4</sub> - cover crops on the interval mixture 1 (2 manual hoes)	0.21	7.40	12.7	10.99	0.277
V <sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes)	0.19	7.56	12.5	10.78	0.195
V <sub>6</sub> - cover crops on the interval, mixed grass, and mulching	0.16	8.11	12.4	10.68	0.131
V <sub>7</sub> - Roundup 360 SL (3 l/ha), cover crops on the interval	0.17	7.79	13.6	11.95	0.244
V <sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	0.15	7.89	12.4	10.68	0.193

In general, in apples, the content of sugars varies between 7.59% and 16.40% for 100 g of fruit. Out of Tab. 3 we can see that in the climatic conditions of 2008 in Timisoara, the sugars content varied between 10.57% for variant V<sub>1</sub> – the control variant and 12.16% in variant V<sub>2</sub> - *Trifolium repens* on the interval, all of the other variants having middle values.

The content of vitamin C in apples is normally of 1-47 mg/100g fresh fruit (mg %),

while in our experiment the values varied between 7.21 mg/100 g fresh fruit in variant V<sub>2</sub> and 8.11 mg/100g fresh fruit in V<sub>6</sub>- cover crops on the interval, mixed grass, and mulching.

Tab. 4

The chemical features of 'Generos' apples in 2009

Variant	Minerals (%)	Vitamin C (mg/100 g fruit)	Dry substance (%)	Sugar (%)	Acidity (g/l malic acid)
V <sub>1</sub> - 2 manual hoes + 2 mechanical hoes – control variant	0.19	7.54	12.1	10.36	0.171
V <sub>2</sub> - <i>Trifolium repens</i> on the interval	0.14	7.79	13.1	11.42	0.173
V <sub>3</sub> - <i>Lotus corniculatus</i> on the interval	0.17	7.40	13.0	11.32	0.181
V <sub>4</sub> - cover crops on the interval mixture 1 (2 manual hoes)	0.13	7.30	12.5	10.79	0.213
V <sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes)	0.15	7.21	12.7	11.00	0.212
V <sub>6</sub> - cover crops on the interval, mixed grass, and mulching	0.23	8.05	12.1	10.36	0.130
V <sub>7</sub> - Roundup 360 SL (3 l/ha), cover crops on the interval	0.16	7.60	12.9	11.21	0.212
V <sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	0.19	7.56	12.4	10.68	0.187

In 2009, the content of sugars had lower values than in the past year due to the climatic conditions in the period of apples' growth and maturation. Concerning variants' impact upon sugars content in fruits, we observed that in those variants where plants for green manure were used there were registered the higher values (11.42% in V<sub>2</sub> and 11.32% in V<sub>3</sub>), while the lowest values were obtained in the apples of those variants where we used grass cover crops.

The content of vitamin C in 2009 was the same as in 2008, the values varying between 7.21 mg/100 g fresh fruit in V<sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes) and 8.05 mg/100 g fresh fruit in V<sub>6</sub> - cover crops on the interval, mixed grass, and mulching on the tree row.

The results obtained concerning the metal content in Generos apples in the two studied years are being presented in Tab. 5 and 6.

Tab. 5

Metals content in 'Generos' apples in 2008

Varianta	Fe ppm	Mn ppm	Zn ppm	Cu ppm
V <sub>1</sub> - 2 manual hoes + 2 mechanical hoes – control variant	6.33	0.71	3.16	2.83
V <sub>2</sub> - <i>Trifolium repens</i> on the interval	7.66	0.73	2.50	3.22
V <sub>3</sub> - <i>Lotus corniculatus</i> on the interval	7.66	0.88	2.83	2.50
V <sub>4</sub> - cover crops on the interval mixture 1 (2 manual hoes)	8.16	0.86	2.16	2.66
V <sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes)	8.33	0.81	1.66	3.16
V <sub>6</sub> - cover crops on the interval, mixed grass, and mulching	7.66	0.73	1.83	3.33
V <sub>7</sub> - Roundup 360 SL (3 l/ha), cover crops on the interval	8.33	0.78	2.50	2.50
V <sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	6.83	1.01	1.66	1.83

Tab. 6

Metals content in 'Generos' apples in 2009

Varianta	Fe ppm	Mn ppm	Zn ppm	Cu ppm
V <sub>1</sub> - 2 manual hoes + 2 mechanical hoes – control variant	6.83	0.73	2.16	2.66
V <sub>2</sub> - <i>Trifolium repens</i> on the interval	7.50	0.81	1.83	3.00
V <sub>3</sub> - <i>Lotus corniculatus</i> on the interval	8.16	0.91	1.66	3.22
V <sub>4</sub> - cover crops on the interval mixture 1 (2 manual hoes)	8.83	0.86	2.50	2.50
V <sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes)	8.33	0.83	2.83	3.00
V <sub>6</sub> - cover crops on the interval, mixed grass, and mulching	7.50	0.78	2.16	2.66
V <sub>7</sub> - Roundup 360 SL (3 l/ha), cover crops on the interval	8.16	0.80	2.50	3.50
V <sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	8.66	0.90	3.00	3.33

The content of Zinc and Copper in both years, for all the experimental variants was under the maximum admissible limit 5.0 mg/kg, limit determined for the ecological culture of apple trees (Government Decision no. 189/2002).

In 2008, zinc element had the lowest values in V<sub>5</sub> - cover crops on the interval mixture 2 (2 manual hoes) and in V<sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval, of 1.66 ppm. The highest content of zinc was determined in the apples of variant V<sub>1</sub> the control, of 3.16 ppm. Cooper's dynamic in fruits was the highest in V<sub>6</sub> (3.33 ppm), while the lowest value was observed in V<sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval, of 1.83 ppm.

In 2009, for zinc variants V<sub>2</sub> and V<sub>3</sub> had the lowest values, of 1.83 ppm, respectively 1.66 ppm. For copper, the highest content of this element was registered in variants V<sub>7</sub> and V<sub>8</sub>, which are the variants where we used herbicides.

The highest content of iron and manganese in 2008, was obtained in the apples of V<sub>5</sub> and V<sub>7</sub> (8.33 ppm), while in 2009 the highest content of iron was determined in the apples of variant V<sub>4</sub> – 8.83 ppm. The content of manganese had the highest value in the apples of variant V<sub>4</sub>– 1.01 ppm, in 2008 and of 0.91 ppm in V<sub>3</sub>, in 2009.

## CONCLUSIONS

The experimental variants where we used plants for green manure, such as *Trifolium repens* and *Lotus corniculatus*, gave higher quality fruits (a higher content of sugars and minerals), than in variant V<sub>8</sub> - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval.

The use of plants for green manure, but also of some other soil maintaining systems in apple orchards is favorable for obtaining good quality fruits.

The content of microelements for all studied variants was under the maximum admissible limit for the ecological culture of apple trees

The use of recommended doses and reducing the number of treatments with herbicides in apple orchards have favorable effects for obtaining apples at the standards required by the European Community.

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## REFERENCES

1. Baci, A. (2005). Pomicultură generală. Editura Universitaria. Craiova
2. Blosma, J. (2000). Soil Management in Organic Fruit Growing. Proceedings of the Conference Organic Fruit – Opportunities and Challenges. Ashford. UK. 16.-17.10.00
3. Campeanu, Gh., G. Neata and G. Darjanschi (2009). Chemical Composition of the Fruits of Several Apple Cultivars Growth as Biological Crop. Notulae Botanicae Horti Agrobotanici. Vol. 37 (2): 161-164, Cluj-Napoca
4. Glidemacher, P., F. van Alebeek and B. Heijne (2001). Farming System Comparison in Integrated Apple Growing. IOBC (International Organization for Biological Control) Bulletin, Vol. 24 (5): 21-26 Lleida, Spain
5. Lăzureanu, A. (2002). Agrotehnică și Herbologie. Editura Agroprint. Timișoara
6. Lee, Susan. (1990). Metals in foods. A literature survey. No.12, The British Food Manufacturing Industries Research Association, Survey, UK
7. Iordănescu, O. (2008). Pomicultură. Editura Eurobit. Timișoara
8. Iordănescu, O. and E. R. M (2010). Researches concerning the use of some herbicides in apple orchards in conditions of the Didactic Station Timișoara. Journal of Horticulture, Forestry and Biotechnology. Vol. 14: 113-116. Timișoara
9. Petre, Gh. and V. Petre (2008). Soil Maintaining Methods Implied in the Apples Quantity and Quality Increase in the Intensive Orchards. Lucrări Științifice. Seria B. LII, București: 55-60