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Study on some Soil Maintenance Systems and their Impact upon some Apple Varieties' Quality in Conditions of Timisoara

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Abstract In the fruit total world production, apples occupy a special position because, together with bananas and oranges, they assure 2/3 of the global harvest, each species having an almost equal contribution of almost 40 millions tones. This specie is appreciated due to its plasticity of being cultivated in most parts of the world, having moderate requests for the climatic conditions of the culture area. It is also appreciated for the flavour, juiciness and taste of fruits, being one of the most affordable fruit species on the global market. Due to this and many other aspects, a study was developed in the Agrotechnique Department of Faculty of Horticulture and Forestry of Timisoara upon some apple varieties cultivated in the orchard of the Fruit Culture Department. This paper presents the impact of some soil maintenance systems upon two apple varieties cultivated in the Didactic Station Timisoara: Generos and Pionier, concerning fruits' quality – weight, sugars and acidity content. The experiment is monofactorial, having four experimental variants: V1 – no herbicides, no hoes – control variant; V2 – mulching with mowed grass between the tree rows; V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row; V4 – 2 manual hoes + 2 mechanical hoes. The results show that, for both apple varieties, the best results concerning fruits weight and sugars content were obtained in variants V3 and V2, and the smallest fruits were harvested from variants V1 and V4. On the opposite, the highest content of acidity was determined in variants V1 and V4, also for both varieties.

Key words

apple, soil maintaining systems, weight, sugars, acidity

In the fruit total world production, apples occupy a special position because, together with bananas and oranges, they assure 2/3 of the global harvest, each species having an almost equal contribution of almost 40 millions tones [6, 8]. Among these, considering the edible parts of apples, this specie occupies the first place in the world, more than 80% of its components being eatable [7].

The importance of apple culture is completed by trees' or species' features, having a large number of varieties and rootstocks which assure a high variability considering its vigour, productivity, precocity, longevity. It is a species which has a high ecological adaptability, being resistant to frost during winter and late frosts in spring and it can be cultivated in different culture areas [6, 7, 8].

Apples have a chemical composition, which is very complex and can be consumed fresh or in different products like juice, compote, jam, cookies, etc. and also it can be used in cosmetics, medicinal and other industries. Apple consume has a favourable effect upon healthy, sick or convalescent people [6].

Apples' quality, together with the productivity, represents an important objective for apple growers. This is a genetical feature strongly influenced by the climatic conditions and also by the culture technology [7]. Apple sugars-carbohydrates enter quickly into the bloodstream; they replenish liver glycogen and give a refreshing function. Their acidity stimulates appetite, stops the thirst and does not increase gastric acidity [2].

Materials and Methods

The experiment was placed in the orchard of Fruit Culture Department, which belongs to the Didactic Station Timisoara. The researches were developed for the PhD Thesis entitled: *Studies on the chemical composition of apples and apple products obtained under different agricultural techniques, strategies and measures to reduce contamination of fruits with minimum impact on the environment*.

In the orchard there are cultivated many apple varieties, of which Generos and Pionier represent the biological material for this article. The apple trees were

planted in 1997 as an intensive culture system, they are grafted on MM106 rootstock and the adopted crown system is Palm Spindelbusch.

In the culture area's conditions, these two varieties have their ripening period in September, they are very productive and the fruits are very appreciated for their juiciness, flavour and taste. At the same time, they have some advantages like the fruits can be kept in cold spaces until November-December and that they are both resistant to some specific diseases like scab (*Venturia inaequalis*) or powdery mildew (*Podosphaera leucotricha*) [6].

By this experiment we tested some soil maintenance system and their impact upon some fruits quality aspects. The three soil maintenance systems adopted are less pollutant and some of them have also different benefits upon the whole orchard ecosystem [3,9,10,11]. The experimental variants were established as incomplete blocks, an experimental technique which is very used mainly in those experiments where soil has a great impact upon the culture, because they eliminate errors cause by soil's no homogeneity. By the method of simple balanced grid, the variants meet each other only once [4]. The experimental variants were:

V1 – no herbicides, no hoes – control variant;

V2 – mulching with mowed grass between the tree rows;

V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;

V4 – 2 manual hoes + 2 mechanical hoes.

In V2 the grass between the tree rows is made f a mixture of *Lolium perenne* (50%) and *Poa pratensis* (50%), while in variant 3 the mixed *Fabaceae* plants seeded between the tree rows is represented by a mixture of *Trifolium repens* and *Lotus corniculatus*. These plants have more benefits, such as: they improve the quantity of assimilable nitrogen in the soil and at the same time they also can be used as green manure, by incorporating them into the soil in autumn [5].

The fruits were harvested starting with the date of 15th September 2010, there were determined the quantitative features, and then they were taken to the laboratory where biometrical and chemical analyses were done. The weight was determined by weighting a number of 30 fruits and then establishing an average value for each experimental variant. Then a drop of juice was put into the refractometer in order to determine the dry substance (d.s.) content (%), which was used afterwards in the calculation formula for determining sugars in fruit juices [(d.s.x4.25)/4]-2.5. The acidity was determined by titration with HCl 0.1 N [1].

The data obtained were statistically calculated using the variance analyses method.

Results obtained

The average values concerning the weight and chemical composition of apples obtained during the year 2010 for the two studied apple varieties are presented in tables 1-6.

For Generos variety, we observed that, the control variant-V1 has the lowest value, being closely followed by variant 4 (2 manual+2mechanical hoes). An improvement in fruits weight we observed in V2 – mulching, which had weight differences significant positive than the control variant. The largest weight value was obtained in variant 3 – *Fabaceae* mixture +herbicide Roundup – 3l/ha (table 1).

Table 1

Generos variety's fruits average weight (g), 2010

Variant	Average weight (g)	Relative value (%)	Difference to the control (g)	Significance
V1 – no herbicides, no hoes – control variant	177.00	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	182.30	102.99	5.30	*
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	184.50	104.24	7.50	**
V4 – 2 manual hoes + 2 mechanical hoes	178.50	100.85	1.50	-

DL 5%= 4.20 DL 1%= 6.36 DL 0.1%= 10.22

Pionier variety also has the smallest fruits in the control variant-V1. The other three experimental variants have fruits which overpass the weight of 140 g, resulting that the differences to the control were significant. In case of variant 4 (2 manual+2mechanical hoes) the differences were significant positive, while in variants 2 (mulching) and 3 (green manure + herbicide) they were very significant positive, so that the average weight of the apples was of over 147g up to 149.20 g (table 2).

Table 2

Pionier variety's fruits average weight (g), 2010

Variant	Average weight (g)	Relative value (%)	Difference to the control (g)	Significance
V1 – no herbicides, no hoes – control variant	138.00	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	147.40	106.81	9.40	***
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	149.20	108.12	11.20	***
V4 – 2 manual hoes + 2 mechanical hoes	141.70	102.68	3.70	*

DL 5%= 2.79 DL 1%= 4.23 DL 0.1%= 6.79

By analysing total sugars content in fruits of Generos variety, we observed that they had a good percentage of sugars, from 10.36% in V1 up to 11.10% in V3. Variant 4 was the only variant in which the differences to the control were distinct significant positive. The other two variants, having close values, were not statistically assured (table 3).

The situation is different for Pionier variety, where the sugars content in apples of all four varieties was so close to each other, so that the obtained differences were not statistically assured. With all this, by comparing the values, we notice that in the control variant and in variant 4 the value was similar both for Generos and Pionier varieties (tables 3, 4). For all experimental variants of Pionier varieties, the differences of sugars' content were not statistically assured (table 3).

Table 3

Total sugars' average content in Generos apples (%), 2010

Variant	Average content (%)	Relative value (%)	Difference to the control (%)	Significance
V1 – no herbicides, no hoes – control variant	10.36	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	10.57	102.03	0.21	-
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	11.10	107.14	0.74	**
V4 – 2 manual hoes + 2 mechanical hoes	10.46	100.97	0.10	-

DL 5%= 0.40 DL 1%= 0.60 DL 0.1%= 0.97

Table 4

Total sugars' average content in Pionier apples (%), 2010

Variant	Average content (%)	Relative value (%)	Difference to the control (%)	Significance
V1 – no herbicides, no hoes – control variant	10.36	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	10.68	103.09	0.32	-
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	10.78	104.05	0.42	-
V4 – 2 manual hoes + 2 mechanical hoes	10.46	100.97	0.10	-

DL 5%= 0.50 DL 1%= 0.76 DL 0.1%= 1.23

Considering the acidity in fruits, this parameter had the highest values in the control variant, of 0.20 g/l malic acid. Variants 3 and 4 had values close to the control variant, meaning that they were not statistically assured, while in V2 – mulching, this parameter had a value of only 0.14 g/l malic acid, so that the differences obtained were distinct significant negative (table 5). In this case, the negative significances of the differences to the control variant are favourable, meaning that the fruits were not too sour, but they were sweet-sour, sufficient for satisfying the thirst and also with a good taste. This does not mean that the higher values in the other variants determined sour fruits, because they had good sugars' content, but they were more refreshing.

Table 5

Acidity's average content in Generos apples (g/l malic acid), 2010

Variant	Average content (g/l malic acid)	Relative value (%)	Difference to the control (%)	Significance
V1 – no herbicides, no hoes – control variant	0.20	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	0.14	70.00	-0.06	00
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	0.19	96.67	-0.01	-
V4 – 2 manual hoes + 2 mechanical hoes	0.18	90.00	-0.02	-

DL 5%= 0.03 DL 1%= 0.05 DL 0.1%= 0.08

Pionier apples had also the highest content of acidity in the control variant, of 0.20 g/l malic acid, but as variants 3 and 4 had 0.18 g/l malic acid and variant 2 had 0.17 g/l malic acid, the differences to the control were too small, so that they were not statistically assured (table 6). It is important that acidity would not have too small values, because then the fruits would be too sweet and the refreshing property of apples would disappear.

Table 6

Acidity's average content in Pionier apples (g/l malic acid), 2010

Variant	Average content (g/l malic acid)	Relative value (%)	Difference to the control (%)	Significance
V1 – no herbicides, no hoes – control variant	0.20	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows	0.17	85.00	-0.03	-
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row	0.18	91.67	-0.02	-
V4 – 2 manual hoes + 2 mechanical hoes	0.18	90.00	-0.02	-

DL 5%= 0.04 DL 1%= 0.06 DL 0.1%= 0.09

Conclusions

Improving the soil maintenance systems in an orchard is one of the very important links of the culture technology. Soil maintaining system in the orchard not only helps the growers to maintain the orchard (the treatments, pruning and other technological links are better done on a seeded soil than on a perfectly clear one), but at the same time, indirectly it determines the increase of production. This is done by keeping it clear of weeds, which compete with the tress for water and nutrients and which are also hosts for different diseases and pests; by improving soils' chemical features – plants which fix nitrogen and finally by using less pollutant methods of controlling weeds, such as mulching with mowed grass or using rationally the herbicides, after preliminary observing the weeding degree and the floral composition, in order to use the most efficient product.

The results obtained for both varieties show that the highest weight of apples were determined by mulching (V2) and green manure plants + herbicide Roundup 3 l/ha (V3), and the smallest fruits were obtained in the control variant (V1), followed by variant 4 (2 manual + 2 mechanical hoes).

Sugars' content was also higher in variants 2 and 3, showing that the organic soil maintenance systems (mulching, green manure) can influence, at some point, the increase of total sugars in apples. In opposition, acidity was higher in variants 1 and 4 than in the other two variants, keeping a good balance, showing that a soil full of weeds, when these plants can sometimes get to half of trees' height, or soils completely clean of weeds, both determine the increase of acidity in fruits.

We recommend for apple orchards, that the soil would be kept clean of weeds by mulching, while the tree rows to be seeded with small height monocotyledonous species; or by the use of herbicides specific for the floral composition on the tree rows, while the interval between the tree rows to be seeded with green manure plants which fix nitrogen into the soil and then get incorporated, as a source of humus.

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