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Study on some Apple Varieties' Quality under the Impact of some Soil Maintenance Systems Used in the Orchard of the Didactic Station Timisoara

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Abstract 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. Apple culture is very complex, so improving the technological links of this process was, is and always will be of great importance. In order to improve some of these, 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: Jonathan and Florina. The article presents the impact of three soil maintenance systems upon fruits' quality, meaning weight, sugars and acidity content. The monofactorial experiment has 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 Jonathan and Florina 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.

Key words

apple, varieties, soil, mulching, green manure, hoeings, weight, sugars, acidity

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 [5, 6, 7].

The main tasks of agrotechnique in fruit culture technology are: to obtain constant yields increasing quantitatively, but especially qualitatively, to maintain fruit species in good conditions and to assure their longevity concerning the productivity and also a proper and rational maintenance of orchards in order to reduce fruit ecosystem contamination with pollutants [2, 8].

Modern and durable fruit culture means improved technologies, in this purpose aiming at rational and systematic human intervention in the life of fruit species, during their entire period of growth and individual development [4, 6].

The existence of weeds in orchards, as in any other cultures, is a very important problem for fruit growers because they can produce damages to the trees such as: competition for water and nutrients absorption, hosts for different pests and diseases and decrease of fruit production [2, 11, 12]. Weed filing is necessary in order to know the floristic compositions in orchards so that fruit growers will apply the most efficient control measures [8, 9].

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 by the culture technology [6].

Materials and Methods

This article presents the impact of three soil maintenance systems upon fruits' quality, meaning weight, sugars and acidity content.

In this purpose, some 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*.

The experiment was placed in the orchard of Fruit Culture Department, which belongs to the Didactic Station Timisoara.

The biological material consists of two apple varieties: Jonathan and Florina, varieties which have their ripening period in October, are very good as taste, flavour and juiciness and also they are very cultivated in the orchards of Western Romania [5]. The apple trees were planted in 1997, being established an intensive culture system, they were grafted on MM106 rootstock and the adopted crown system is Palm Spindelbusch.

The soil maintenance systems were chosen so that they would be less pollutant and efficient considering the costs. 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 [3]. 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 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 [4, 10].

The fruits were harvested starting with the date of 5th October 2010, being determined first 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 total 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 Jonathan 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. All four varieties had fruits with a weight higher than the one in the control variant, so that their differences were very significant positive (table 1).

Table 1

Jonathan 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	138.90	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	156.50	112.67	17.60	***
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	159.30	114.69	20.40	***
V4 – 2 manual hoes + 2 mechanical hoes	150.20	108.14	11.30	***

DL 5%= 2.84 DL 1%= 4.30 DL 0.1%= 6.90

Florina variety also has the smallest fruits in the control variant-V1. The other three experimental variants have fruits which overpass the weight of 170 g, resulting that the differences to the control were significant. In case of variants 4 (2 manual+2mechanical hoes) and 2 (mulching) the differences were distinct significant positive, while in variant 3 (green manure + herbicide) they were very significant positive, so that the average weight of the apples was of over 170g up to 174.80 g (table 2).

Table 2

Florina 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	163.20	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	172.30	105.58	9.10	**
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	174.80	107.11	11.60	***
V4 – 2 manual hoes + 2 mechanical hoes	170.40	104.41	7.20	**

DL 5%= 4.13 DL 1%= 6.25 DL 0.1%= 10.04

By analysing total sugars content in fruits of Jonathan variety, we observed that they had a good percentage of sugars, from 10.25% in V1 up to 11.21% in V3. Variant 4 was the only variant in which the differences to the control were significant positive. The other two variants, having higher values, gave distinct significant positive differences to the control variant (table 3).

Table 3

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

Variant	Average content (%)	Relative value (%)	Difference to the control (%)	Significance
V1 – no herbicides, no hoes – control variant	10.25	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	11.10	108.29	0.85	**
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	11.21	109.37	0.96	**
V4 – 2 manual hoes + 2 mechanical hoes	10.78	105.17	0.53	*

DL 5%= 0.41 DL 1%= 0.62 DL 0.1%= 0.99

The situation is different for Florina variety, where the sugars content in apples of all four varieties did not overpass 10.89% (V3). In the control variant there was determined a small amount of sugars of only 10.03%. With all this, by comparing the values, we notice that V3 and V4 had distinct significant positive differences than the control, while for V4 the differences of sugars' content were not statistically assured (table 4).

Table 4

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

Variant	Average content (%)	Relative value (%)	Difference to the control (%)	Significance
V1 – no herbicides, no hoes – control variant	10.03	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	10.78	107.48	0.75	**
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	10.89	108.57	0.86	**
V4 – 2 manual hoes + 2 mechanical hoes	10.36	103.29	0.33	-

DL 5%= 0.39 DL 1%= 0.59 DL 0.1%= 0.94

Considering the acidity in fruits, this parameter had the highest values in the control variant, of 0.21 g/l malic acid. Variants 2 and 3 had the same average values, of 0.18 g/l malic acid, so that the differences obtained were significant negative (table 5), while V4 was not statistically assured. For acidity differences, the negative significances represent a good and favourable thing, as the fruits were not too sour, but they were sweet-sour, sufficient for satisfying the thirst and also with a good taste. On the other hand, high acidity values do not mean that the apples were very sour, because they had good sugars' content, being more refreshing.

Table 5

Acidity's average content in Jonathan 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	0.21	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	0.18	85.71	-0.03	0
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	0.18	85.71	-0.03	0
V4 – 2 manual hoes + 2 mechanical hoes	0.19	90.48	-0.02	-

DL 5%= 0.03 DL 1%= 0.04 DL 0.1%= 0.07

Florina apples had also the highest content of acidity in the control variant, of 0.19 g/l malic acid, but this time, the same average value, was determined also in V3. Variant 3 had 0.17 g/l malic acid and variant 4 had 0.18 g/l malic acid, and the differences to the control significant negative (table 6). It is important that acidity would not have too small values, but to exist a good balance between acidity and sugars, because then the fruits would be too sweet and less refreshing.

Table 6

Acidity's average content in Florina 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	0.19	100.00	0.00	mt
V2 – mulching with mowed grass between the tree rows;	0.17	89.66	-0.02	0
V3 – mixed *Fabaceae* plants seeded between the tree rows + Roundup (3l/ha) on the tree row;	0.19	100.00	0.00	-
V4 – 2 manual hoes + 2 mechanical hoes	0.18	91.38	-0.02	0

DL 5%= 0.02 DL 1%= 0.03 DL 0.1%= 0.05

Conclusions

Soil maintaining system in an orchard is very important due to the fact that the treatments, pruning and other technological links are better done on a seeded soil than on a perfectly clear one, and at the same time, a good orchard floor management determines an increase of production.

Orchard floor management represents an important technological link, due to the facts that:

-weeds always compete with the tress for water and nutrients and sometimes they are also hosts for different diseases and pests;

-seeding plants which fix nitrogen in the soil and then incorporating them in the soil as green manure improve soil's chemical features, which have a direct impact upon flowers buds' differentiation, fruit binding, fruits development and finally fruits qualities

-using less pollutant methods for weeds' control, 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, will not destroy the orchard's ecosystem, but in some cases it will have a favourable impact upon it.

The results obtained for both apple varieties show that the highest weight of apples were determined in variants where weeds were controlled by mulching – source of humus (V2) and green manure plants of *Fabceae* family+ 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 the use of specific doses of pesticides, the reduced number of treatments with herbicides, the use of organic soil maintenance systems in apple orchards, because they have favorable effects for good and high quality apples.

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