

STUDY OF THE AGRICULTURAL TECHNOLOGIES IMPACT UPON THE QUALITY INDEX OF JONATHAN APPLES IN CONDITIONS OF TIMISOARA

STUDIUL INFLUENȚEI TEHNOLOGIILOR AGRICOLE ASUPRA INDICILOR CALITATIVI AI FRUCTELOR DE MĂR LA SOIUL JONATHAN IN CONDIȚIILE TIMIȘOAREI

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Abstract. *In this paper we studied the impact of the soil maintenance systems upon Jonathan apples' quality and production, cultivated in the western part of Romania. 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. At the same time, there were determined the physical features of apples (average weight, average diameter and average height) the refractometer 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. In conclusion, the experimental variants where we used green manure (*Trifolium repens* or *Lotus corniculatus*) gave the highest productions, higher weight of fruits and higher content of sugars and minerals.*

Key words: Jonathan, apples, soil maintaining systems, quality

Rezumat. *In această lucrare a fost studiată influența sistemelor de întreținere a solului asupra calității și producției de măr, soiul Jonathan, cultivat în zona de vest a României. Prin aceste cercetări s-a urmărit întreținerea unei plantații de meri, într-un mod cât mai puțin poluant în ceea ce privește sistemul de întreținere a solului, prin folosirea îndeosebi de plante pentru îngrășăminte verzi. S-au stabilit 8 variante experimentale: V1 – ogor negru (2 prașile manuale + 2 prașile mecanice) – martor, V2 – înierbare și încorporare cu plante pt. îngrășământ verde (trifoi alb), V3 – înierbare și încorporare cu plante pt. îngrășământ verde (ghizdei), V4 – înierbare cu amestec de graminee 1 (2 prașile manuale), V5 – înierbare cu amestec de graminee 2 (2 prașile manuale), V6 – înierbare cu amestec de graminee și mulcire pe rândul de pomi, V7 – ogor erbicidat înierbare pe interval cu amestec de graminee + erbicidare pe rând cu Roundup 360 SL (3 l/ha), V8 – ogor*

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combinat erbicidare pe rând Roundup 360 SL (3 l/ha) + prașile mecanice pe intervale. Experimental s-au determinat proprietățile fizice ale merelor (masă medie, diametru, înălțime), substanța uscată și conținutul în zaharuri prin metoda refractometrică, aciditatea exprimată în acid malic, substanțele minerale totale, conținutul de vitamina C spectrofotometric și microelementele (Fe, Mn, Zn, Cu) prin spectrofotometrie de absorbție atomică (SAA), precum și producția. În concluzie, variantele experimentale ce au folosit îngrășământul verde (ghizdei sau trifoi alb) au condus la producții ridicate, o masă a fructelor mai mare și un conținut în zaharuri și substanțe minerale sporit.

Cuvinte cheie: Jonathan, mere, sisteme de întreținere a solului, calitate

INTRODUCTION

In Romania apple tree culture occupied the IInd 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. Rich in vitamins A, B1, B2 and C, but also in other nutrients, such as magnesium, phosphorus, iron and potassium, the apples have many good properties for human health (Baciu A., 2005; Grădinariu G. et al., 1998; Iordănescu Olimpia, 2008).

In this paper we studied the impact of the soil maintenance systems upon Jonathan apples' quality and production, cultivated in the western part of Romania. We studied and experimented. By this research we studied and experimented the maintenance of an apple orchard in a less pollutant soil maintenance systems (Blosma J., 2000; Lăzureanu, A., 2002; Iordănescu Olimpia Alina, Micu Roxana Elena, 2010), mainly by using plants as green fertilizers (Petre Gh., Petre Valeria, 2008).

MATERIAL AND METHOD

The researches were done in the didactic orchard of Fruit Culture department from the Faculty of Horticulture and Forestry in Timișoara, the biological material being represented by Jonathan apple tree variety. The trees were grafted on MM106, the crown system being Palm Spindelbusch, while the trees were planted in 1997, being in full production.

By this research we proposed improving some technological links of apple culture in conditions of the western part of Romania and they belong to a Research project IDEI.

The experimental variants were: V1 – 2 manual hoes + 2 mechanical hoes – control variant, V2 - *Trifolium repens* on the interval, V3 – *Lotus corniculatus* on the interval, V4 - cover crops on the interval mixture 1 (2 manual hoes), V5 - cover crops on the interval mixture 2 (2 manual hoes), V6 - cover crops on the interval, mixed grass, and mulching, V7 - Roundup 360 SL (3 l/ha), cover crops on the interval, V8 - 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 atomical absorption spectrophotometry.

RESULTS AND DISCUSSIONS

The results obtained concerning the physical features of Jonathan fruits in the two years of experiment are presented in tables 1 and 2.

In 2008, the biggest fruits were obtained in those variants where we used green manure, respectively variants V₂ and V₃, followed by the variants where there were used grass cover crops and the control variant (table 1).

In 2009, the fruits had very close side indexes in the studied variants, but among them we remark the variants with plants used as green manure, the same as previous year (table 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 were used, the physical features of fruits were better comparative with the other studied variants.

Table 1

Physical features of Jonathan apples in 2008

Variant	Big diameter (cm)	Small diameter (cm)	Height (cm)	Size index
V ₁ - 2 manual hoes + 2 mechanical hoes – control variant	8,1	7,9	7,0	7,66
V ₂ - <i>Trifolium repens</i> on the interval	8,1	8,1	7,2	7,80
V ₃ - <i>Lotus corniculatus</i> on the interval	8,0	7,9	7,3	7,73
V ₄ - cover crops on the interval mixture 1 (2 manual hoes)	8,0	8,0	7,1	7,70
V ₅ - cover crops on the interval mixture 2 (2 manual hoes)	7,9	7,8	7,3	7,66
V ₆ - cover crops on the interval, mixed grass, and mulching	8,0	7,8	6,8	7,53
V ₇ - Roundup 360 SL (3 l/ha), cover crops on the interval	8,0	7,8	6,9	7,56
V ₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	7,8	7,7	7,0	7,50

Table 2

Physical features of Jonathan apples in 2009

Variant	Big diameter (cm)	Small diameter (cm)	Height (cm)	Size index
V ₁ - 2 manual hoes + 2 mechanical hoes – control variant	7,9	7,5	7,0	7,47
V ₂ - <i>Trifolium repens</i> on the interval	8,1	7,9	7,6	7,87
V ₃ - <i>Lotus corniculatus</i> on the interval	8,0	8,0	7,6	7,87
V ₄ - cover crops on the interval mixture 1 (2 manual hoes)	8,0	8,0	7,1	7,70
V ₅ - cover crops on the interval mixture 2 (2 manual hoes)	8,0	7,9	7,4	7,77
V ₆ - cover crops on the interval, mixed grass, and mulching	8,0	8,0	7,2	7,73
V ₇ - Roundup 360 SL (3 l/ha), cover crops on the interval	8,0	7,8	7,0	7,60
V ₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	7,9	7,9	7,6	7,80

The results obtained concerning the chemical features of Jonathan apples in the two studied years are presented in tables 3 and 4.

Table 3

The chemical features of Jonathan apples in 2008

Varianta	Minerals (%)	Vitamin C (mg/100 g fruit)	Dry substance (%)	Sugar (%)	Acidity (g/l malic acid)
V ₁ - 2 manual hoes + 2 mechanical hoes – control variant	12,8	11,10	0,210	7,21	0,12
V ₂ - <i>Trifolium repens</i> on the interval	13,9	12,27	0,193	7,40	0,19
V ₃ - <i>Lotus corniculatus</i> on the interval	13,1	11,42	0,195	7,56	0,16
V ₄ - cover crops on the interval mixture 1 (2 manual hoes)	12,9	11,21	0,173	7,15	0,14
V ₅ - cover crops on the interval mixture 2 (2 manual hoes)	12,6	10,89	0,131	7,30	0,13
V ₆ - cover crops on the interval, mixed grass, and mulching	12,8	11,10	0,156	7,15	0,17
V ₇ - Roundup 360 SL (3 l/ha), cover crops on the interval	13,7	12,06	0,193	7,30	0,21
V ₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	12,7	10,99	0,210	7,51	0,15

In general, in apples, the content of sugars varies between 7.59% and 16.40% for 100 g of fruit. Out of table 3 we can see that in the climatic conditions of 2008 in Timisoara, the sugars content varied between 10.89% for variant V₅ - cover crops on the interval mixture 2 (2 manual hoes) and 12.27% in variant V₂ - *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 varying between 7.15 mg/100 g fresh fruit in variants V₄ and V₆ till 7.56 mg/100g fresh fruit in V₃ - *Lotus corniculatus* on the interval.

Table 4

The chemical features of Jonathan apples in 2009

Varianta	Minerals (%)	Vitamin C (mg/100 g fruit)	Dry substance (%)	Sugar (%)	Acidity (g/l malic acid)
V ₁ - 2 manual hoes + 2 mechanical hoes – control variant	12,7	11,00	0,193	7,19	0,14
V ₂ - <i>Trifolium repens</i> on the interval	13,0	11,32	0,173	7,56	0,13
V ₃ - <i>Lotus corniculatus</i> on the interval	13,2	11,53	0,182	7,37	0,17
V ₄ - cover crops on the interval mixture 1 (2 manual hoes)	12,5	10,79	0,139	7,01	0,17
V ₅ - cover crops on the interval mixture 2 (2 manual hoes)	12,2	10,47	0,171	6,98	0,21
V ₆ - cover crops on the interval, mixed grass, and mulching	13,2	11,53	0,143	7,72	0,16
V ₇ - Roundup 360 SL (3 l/ha), cover crops on the interval	12,7	11,00	0,216	7,24	0,18
V ₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	12,4	10,68	0,190	7,21	0,14

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, 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 also lower than in 2008, the values varying between 6.98 mg/100 g fresh fruit in V₅ - cover crops on the interval mixture 2 (2 manual hoes) and 7.72 mg/100 g fresh fruit in V₆ - cover crops on the interval, mixed grass, and mulching on the tree row.

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

Table 5

Metals content in Jonathan apples in 2008

Varianta	Fe ppm	Mn ppm	Zn ppm	Cu ppm
V ₁ - 2 manual hoes + 2 mechanical hoes – control variant	5.33	0.73	1.83	1.83
V ₂ - <i>Trifolium repens</i> on the interval	5.33	0.86	2.00	2.16
V ₃ - <i>Lotus corniculatus</i> on the interval	6.83	1.00	1.83	2.50
V ₄ - cover crops on the interval mixture 1 (2 manual hoes)	7.00	0.71	2.50	3.33
V ₅ - cover crops on the interval mixture 2 (2 manual hoes)	7.50	0.98	1.66	1.83
V ₆ - cover crops on the interval, mixed grass, and mulching	7.66	1.01	2.16	2.83
V ₇ - Roundup 360 SL (3 l/ha), cover crops on the interval	7.00	0.85	3.00	3.16
V ₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	6.33	0.86	1.66	2.33

Table 6

Metals content in Jonathan apples in 2009

Varianta	Fe ppm	Mn ppm	Zn ppm	Cu ppm
V ₁ - 2 manual hoes + 2 mechanical hoes – control variant	6.00	0.71	2.00	1.66
V ₂ - <i>Trifolium repens</i> on the interval	5.33	0.85	2.16	2.16
V ₃ - <i>Lotus corniculatus</i> on the interval	6.33	0.91	2.50	2.00
V ₄ - cover crops on the interval mixture 1 (2 manual hoes)	6.83	0.86	1.83	2.50
V ₅ - cover crops on the interval mixture 2 (2 manual hoes)	7.50	1.00	1.66	1.50
V ₆ - cover crops on the interval, mixed grass, and mulching	7.00	0.81	2.16	2.16
V ₇ - Roundup 360 SL (3 l/ha), cover crops on the interval	7.66	0.88	3.00	2.50
V ₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval	8.00	0.85	3.16	3.00

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, the zinc had the lowest values in V₅ - cover crops on the interval mixture 2 (2 manual hoes) and in V₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval. The highest content of zinc was determined in the apples of variant V₇

and V₄. Cooper's dynamic in fruits was almost similar to the one of zinc element, the highest value being observed in V₄, while the lowest value was observed in the control variant and V₅ - cover crops on the interval mixture 2 (2 manual hoes).

In 2009, for zinc and also for copper V₅ - cover crops on the interval mixture 2 (2 manual hoes) had the lowest values. The highest content of these elements were registered in variants V₇ and V₈, which are the variants where we used herbicides.

The highest content of iron and manganese, in 2008, was obtained in the apples of V₆ - cover crops on the interval, mixed grass, and mulching (7.66 ppm), while in 2009 the highest content of iron was determined in the apples of variant V₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval and of manganese in the apples of variant V₅ - cover crops on the interval mixture 2 (2 manual hoes).

CONCLUSIONS

1. 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 V₈ - Roundup 360 SL (3 l/ha) + mechanical hoes on the interval.

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

3. 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.

4. 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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