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PRELIMINARY RESULTS REGARDING YIELD AND FRUIT QUALITY OF SOME APPLE CULTIVARS IN ECOLOGICAL SYSTEM

Viorel STOICA, Dorel HOZA

University of Agronomic Sciences and Veterinary Medicine of Bucharest,
59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: dhoza@gmail.com

Abstract

The aim of this study was to assess the yield and fruits quality of apple produced in ecological system. In 2022 the influence of different fertilizers on yield and fruits quality at three apple cultivars was carried out. The trees were planted in a spacing of 3 x 2 m, according to the following experimental scheme: Factor A - cultivar, with three graduation (a1 - 'Romus 3', a2 - 'Idared' and a3 - 'Golden delicious'); Factor B - fertilization variant, with four graduations (b1 - Biohumus - 0.5 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; b2 - Biohumus - 0.7 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; b3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; b4 - 'Unfertilized'). As results of the investigations we found that the highest fruit yield and fruits quality was obtained at 'Idared' (28.66 kg/tree, respectively 215.66 g) cultivar in fertilization variant 3.

Key words*: apple, cultivar, fertilizers, yield, fruits quality.*

INTRODUCTION

In the last decade, consumers started to look to ecological products which have lower environmental impacts and higher nutritive values (Amarante et al., 2008, Cuevas et al., 2015; Butac & Chivu, 2020).

In ecological agriculture, the use of synthetic pesticides and fertilizers is not allowed, but only organic ones such as animal and green manure, compost, sulfur and copper products, pheromone traps and other biological control methods (Holb et al., 2003; Peck et al., 2006; Jonsson, 2007; Amarante et al., 2008; Butac et al., 2021).

Ecological apple production is still quite limited in most European countries, due to the reduced possibilities to control the diseases and pests (Jönsson, 2007; Amarante et al., 2008), as well as due to the lack of organic fertilizers (McArtney & Walker, 2004), which limits profitability of ecological apple orchards.In Romania, ecological agriculture included, at the level of 2019, an area of approximately 395,228 ha, respectively 2.9% of the agricultural area. Fruit trees occupy only 15,905 ha, i.e. a share of 4.0% of the total organic agriculture at national level (Butac et al., 2021). The objective of this paper was to evaluate yield and some important quality parameters of three apple cultivars from orchards managed under ecological system in Maracineni - Arges area, Romania.

MATERIALS AND METHODS

The experience was carried out in a demonstrative plot established in 2010 at Maracineni, in a private farm from Arges county, Romania. The trees were planted in a spacing of 3 m between the rows and 2 m between trees, according to the experimental scheme from Table 1.

Table 1. Experimental scheme

Factor	Variant/Origin	Doses and method of application
A - Cultivar	V1. Romus 3 -Romania	-
	V2. Idared - USA	-
	V3. Golden delicious -USA	-
B - Feritilizati on variant	V1. Biohumus + Macys BC 28 + Cifamin BK	- 0.5 L/tree, soil - 2 L/ha, foliar - 1 L/ha, foliar
	V1. Biohumus + Macys BC 28 + Cifamin BK	- 0.7 L/tree, soil - 2 L/ha, foliar - 1 L/ha, foliar
	V1. Biohumus + Macys BC 28 + Cifamin BK	- 0.9 L/tree, soil - 2 L/ha, foliar - 1 L/ha, foliar
	V4.	Unfertilized

The determinations were carried out in 2022 year. Biohumus fertilizer was applied in spring before the start of vegetation and in autumn after the fall of the leaves. Macys BC 28 and Cifamin BK fertilizers were applied after flowering and in the young fruit phase. The experiment was carried out in a randomized block design, in 3 replicates with 3 trees per plot.

In these experimental variants we carried out the following parameters: fruits yield in kg/tree; fruits weight in g; fruits soluble solids content with a digital refractometer in ºBrix; pH of fruits with the device Minititrator Hanna Instrument 84532; fruits firmness was measured with non-destructive penetrometer Qualitest HPE.

The results of the experiment were analyzed statistically using Duncan's multiple range test at a 0.05% significance level.

RESULTS AND DISCUSSIONS

Fruits yield. Between the fertilized and unfertilized variants there are significant differences of fruits yield. The 'Idared' cv. registered the highest fruit production (24.83 kg/tree) significantly exceeding the 'Romus 3' (20.33 kg/tree). With the increase of Biohumus doses, the production of fruits also increases (from 23.11 kg/tree in V1 to 25.77 kg/tree in V3) (Table 2).

Table 2. Influence of the fertilizers on the yield (kg/tree)

Cultivar	Fertilization variant*				
	V1	V2	V3	V4	Average**
Romus 3	21.33	21.66	22.00	16.33	**20.33 b**
Idared	24.66	27.66	28.66	18.33	**24.83 a**
Golden delicious	23.33	24.33	26.66	18.66	**23.24 a**
Average**	**23.11 b**	**24.55 ab**	**25.77 a**	**17.77 c**	

*V1 - Biohumus - 0.5 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V2 - Biohumus - 0.7 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V4 - Unfertilized

**Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

The fertilization variant 3 determined a higher fruit production than the other variants, respectively 25.77 kg/tree, exceeding the fruits production obtained in V1 with 2.66 kg/tree, with 1.22 kg/tree in V2 and with 8.00 kg/tree in unfertilized variant. In conclusion, it can be said that among all the 3 varieties studied, the highest fruit production was obtained in the fertilization variant 3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application (Table 2).

Fruits weight. The 'Idared' cv. registered the highest fruit weight (215.16 g) significantly exceeding the 'Romus 3' (121.91 g) and 'Golden delicious' (185.33 g). With the increase of Biohumus doses, the fruits weight also increases (from 178.00 g in V1 to 213.55 g in V3).

The fertilization variant 3 determined a higher fruit weight than the other variants, respectively 213.55 g, exceeding the fruits weight from V1 with 35.55 g, with 42.99 g in V2 and with 79.22 g in unfertilized variant. In conclusion, it can be said that among all the 3 varieties studied, the highest fruit weight was obtained in the fertilization variant 3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application (Table 3).

Table 3. Influence of the fertilizers on the fruits weight (g)

Cultivar	Fertilization variant*				
	V1	V2	V3	V4	Average**
Romus 3	120.66	108.66	150.00	108.33	**121.91 c**
Idared	212.00	223,33	271.33	154.00	**215.16 a**
Golden delicious	201.33	180.00	219.33	140.66	**185.33 b**
Average**	**178.00 b**	**170.66 b**	**213.55 a**	**134.33 c**	

*V1 - Biohumus - 0.5 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V2 - Biohumus - 0.7 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V4 - Unfertilized

**Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

Fruits soluble solids content. On average of the experimental variants, the highest soluble solids content was recorded on the 'Golden delicious' cv. (12.75ºBrix), followed by the 'Idared' cv (12.19ºBrix).

The highest fruits soluble solids content was obtained in the fertilization variant 3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application (12.68º Brix) (Table 4).

Table 4. Influence of the fertilizers on the fruits soluble solids content (° Brix)

Cultivar	Fertilization variant*				
	V1	V2	V3	V4	Average**
Romus 3	11.33	12.06	11.53	11.56	**11.62 b**
Idared	12.16	11.90	13.06	11.63	**12.19 ab**
Golden delicious	11.36	12.80	13.46	13,40	**12.75 a**
Average**	**11.62 c**	**12.25 b**	**12.68 a**	**12.20 b**	

*V1 - Biohumus - 0.5 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK – 1 L/ha, foliar application; V2 - Biohumus - 0.7 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V4 - Unfertilized
**Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

Fruits pH. On average of the experimental variants, the highest value of fruits pH was obtained on the 'Golden delicious' cv. (4.22), which indicates sweeter fruits compared to the 'Romus 3' (3.86) and 'Idared' (3.92) cultivars. The highest value of fruits pH was obtained in the unfertilized variant (4.02) and the lowest pH value of the fruits was obtained in variant 3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application (3.99) (Table 5).

Table 5. Influence of the fertilizers on the fruits pH

Cultivar	Fertilization variant				
	V1	V2	V3	V4	Average**
Romus 3	3.76	3.95	3.83	3.89	**3.86 b**
Idared	3.85	3.90	3.92	4.02	**3.92 b**
Golden delicious	4.38	4.15	4.23	4.14	**4.22 a**
Average**	**4.00 a**	**4.00 a**	**3.99 a**	**4.02 a**	

*V1 - Biohumus - 0.5 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V2 - Biohumus - 0.7 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V4 - Unfertilized
**Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

Fruits firmness. On average 'Idared' cv. had firmer fruits than 'Romus 3' and 'Golden delicious' cvs., between these cultivars being differences but not statistically assured (Table 6).
The fruits of all cultivars studied had higher flesh firmness at harvest time in all fertilization variants than unfertilized variant (Table 5), results confirmed by other authors as well DeEll and Prange (1992), Reganold et al. (2001), Weibel et al. (2004), Peck et al. (2006) at apple.

Table 6. Influence of the fertilizers on the fruits firmness (HPE units)

Cultivar	Fertilization variant*				
	V1	V2	V3	V4	Average**
Romus 3	68.63	75.66	69.23	69.06	**70.64 a**
Idared	73.60	71.10	71.13	70.23	**71.52 a**
Golden delicious	73.30	72.66	70.96	65.06	**70.50 a**
Average**	**71.84 a**	**73.14 a**	**70.44 b**	**68.12 c**	

*V1 - Biohumus - 0.5 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V2 - Biohumus - 0.7 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V3 - Biohumus - 0.9 L/tree, soil application + Macys BC 28 - 2 L/ha, foliar application + Cifamin BK - 1 L/ha, foliar application; V4 - Unfertilized
**Duncan multiple ranges test. Mean values followed by the same letter within a column are not significantly different (P≤0.05).

CONCLUSIONS

The culture of fruit trees in an ecological system has a positive influence both on the environment and on the fruits yield and their quality.
The results of our study showed that the production and fruits quality had higher values in the case of the fertilized variants compared to the unfertilized variant.
Also, with the increase of Biohumus doses, the production and fruits quality increases at all cultivars studied.

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