

STUDY ON IMPROVING THE TECHNOLOGY OF INTENSIVE CULTURE OF APPLE PLANTATIONS IN THE CLIMATIC CONDITIONS OF NE ROMANIA

STUDIU PRIVIND ÎMBUNĂTĂȚIREA TEHNOLOGIEI DE CULTURĂ A MĂRULUI ÎN PLANTAȚII INTENSIVE ÎN CONDIȚIILE PEDOCLIMATICE DIN N-E ROMÂNIEI

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Abstract. For proper application of apple intensive culture technology it is necessary a better knowing of the physiological laws underlying trees growth and fructification, and also their reaction to environmental conditions. Pruning must be applied differently, taking into account trees age, vigor, density and spatial arrangement of the branches, their position, the nature and function of each bearing element. Following the application of foliar fertilization there were achieved increased productions with 7.4 to 12.4 t / ha, depending on the variant of fertilization. The results we obtained concerning the soil system maintenance in intensive apple plantations revealed higher yields when black field was used and also superior quality of fruits and lower maintenance costs for grassed soil variant.

Key words: intensive technology, apple, climatic conditions in north eastern Romania

Rezumat. Pentru aplicarea corectă a tehnologiei de cultură a mărului în plantații intensive este necesar să se cunoască în amănunt legile fiziologice care stau la baza creșterii și rodirii pomilor, precum și comportarea acestora față de condițiile ecologice. Tăierile de rodire trebuie să se aplice diferențiat, ținând seama de vârsta pomilor, vigoarea, desimea și modul de dispunere în spațiu a ramurilor, poziția acestora, natura și funcția fiecărei formațiuni. În urma aplicării fertilizării foliare s-au obținut sporuri de producție de 7,4-12,4 t/ha, în funcție de varianta de fertilizare. Rezultatele obținute privind sistemul de întreținere a solului în plantațiile intensive de măr au scos în evidență producțiile mai mari în cazul ogorului negru și calitatea superioară a fructelor și cheltuieli de întreținere mai reduse la varianta de întreținere interbată a solului.

Cuvinte cheie: tehnologie, sistem intensiv, măr, condiții pedoclimatice, Nord Estul României.

INTRODUCTION

Apple specific growth and fruition conditions, especially in high density culture system, different environmental conditions in which plants develop, higher production levels to be achieved, fruit quality at a low cost price, in terms

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of reduced energy consumption, have imposed more and more the improvement crop technology (Istrate M., Rominger E., 1992; Cârdei E. et al, 2007).

To highlight the influence of soil maintenance system between the rows and row of trees, foliage fertilization and pruning system, during 2006-2008 some researches were carried out in SCDP Iasi at an apple intensive plantation (Istrate M. et al., 2006).

MATERIAL AND METHOD

Experiences were held during 2006 - 2008, at Sârca research and development base of SCDP Iași, and involved five apple varieties: Florina, Generos, Sir Prize, Idared and Jonagold.

Trees were grafted on M 106, planted in 1992 and 2001, at 4 x 3 m, leaded as oblique palmeta.

The experience was conducted on a levigated chernozem, with 2.34% humus content and pH = 6.5 - 7.0, the ground is slightly inclined and soil maintenance system is mixed: one interval between rows with grass and one row remained as black field.

During the experimental period there were performed observations and determinations concerning:

- a. trees growth vigor;
- b. fruit production and quality according to the soil maintenance system in apple plantation.

V1 *black field soil maintenance system*;

V2 *grassing the soil between the rows and working the soil on the row of trees*.

- a. fertilization influence upon the fruit production (**Fertifol 2-2-1**);
- b. pruning influence upon the production.

V1 – thinning and pruning by reducing 1/4 of annual growth

V2 – thinning and pruning by reducing 1/2 of annual growth

V3 – reduction of the annual growth to 3-4 buds and 1/4 of structural branches extension

In the three years of experiment there were applied 9-11 phitosanitary treatments to control apple diseases and pests. The annual programs have been introduced the most effective and efficient plant protection products to the extent of availability of those with a low degree of pollution.

RESULTS AND DISCUSSIONS

Data concerning trees growth vigor at all five studied varieties during 2006-2008, are presented in table 1.

Experimental data highlight Jonagold variety, which proved to be the most vigorous, with a trunk section area average of 9.3 cm² comparing to 7.5 cm² registered at Jonathan variety - considered the control. Sir Prize and Florina varieties follows very close. The least vigorous was Generos variety with an average of trunk section area of 6.3 cm². In the three years of study the highest annual growth in the trunk section occurred VIIth year after planting (2007) at Sir Prize variety - 11.4 cm², and the smallest of only 5.4 cm² at Generos variety in the VIIIth year after planting (2008).

Table 1

**Trees growth vigor (trunk section area cm²)
at studied varieties – 2006 – 2008**

Variety	Growth – cm ²			Growth average 2007-2009	Difference to the control
	2006	2007	2008		
Jonagold	7.2	9.4	11.0	9.3	+1.8
Sir Prize	6.9	11.4	9.4	9.2	+1.7
Florina	7.1	8.4	10.5	8.7	+1.2
Idared	6.8	10.9	7.6	8.4	+0.9
Jonathan (the control)	6.6	7.4	8.6	7.5	0
Generos	6.5	7.1	5.4	6.3	-1.2

Idared variety registered a growth vigor little over the control - 8.4 cm², but achieved the highest average production for the three experimental years - 30.9 kg/tree or 25.7 t/ha comparing to the control Jonathan variety – 21.6 t/ha (table 1).

Varieties that had the largest increases in thickness, and therefore more vigorous, recorded also the lowest average yields per ha, eg Jonagold 21.3 t/ha and Sir Prize 19.2 t/ha, which shows that the vigor of growth is detrimental to the fruit production per hectare.

Productivity and crop quality represent the main objective followed in a tree plantation and which ultimately depends on the economic efficiency of culture.

Studies show that fruit production is influenced by several factors as: variety, age, degree of fruit buds differentiation, fruit binding, crown volume and climatic conditions of the previous year and the harvest year (table 2).

Table 2

Fruit production at studied apple varieties (years VI-VIII after planting)

Variety	Production kg/tree			Years average kg/tree	Years average t/ha	Difference to the control kg/tree
	2006	2007	2008			
Idared	24.3	31.8	36.6	30.9	25.7	+ 5.0
Generos	27.8	29.7	23.5	27.0	22.5	+ 1.1
Florina	19.5	24.7	32.1	26.2	21.8	+ 0.3
Jonathan (the control)	20.4	26.7	30.7	25.9	21.6	0
Jonagold	17.1	30.4	29.6	25.6	21.3	- 0.3
Sir Prize	14.4	26.3	28.3	23.0	19.2	- 2.9

Yields obtained in 2007 and 2008 at all studied varieties ranged from 23.5 to 36.6 t/ha. Very high temperatures and low rainfall in 2006, had huge repercussions on production.

In terms of productivity to be noticed Idared variety, with a three-year average production of 25.7 t/ha followed by Generos variety with 22.5 t/ha.

The results obtained for apples production in the two variants of maintaining soil highlight the superiority of black field system alternative to grassing the intervals (table 3).

Table 3

Soil maintenance system influence upon fruit production and quality

Variety/ variant	Variant 1			Variant 2		
	t/ha average 2006-2008	d.c. quality extra and 1 st		t/ha average 2006-2008	d.c. quality extra and 1 st	
		t/ha	%		t/ha	%
Idared	35.4	31.9	90.1	31.2	25.3	81.0
Florina	31.3	28.9	92.4	27.5	23.4	85.1
Jonagold	29.7	28.3	95.2	23.4	18.8	80.2

Thus the average production for the three experimental years in all three varieties was higher (31.3 to 35.4 t/ha) in the black field variant than the other variant (27.5 to 31.2 t/ha). The most productive variety in both variants was Idared with 31.2 - 35.4 t/ha, followed by Florina with 27.5 - 31.3 t/ha and Jonagold with 23.4 - 29.7 t/ha. The same situation is observed in the case of apple quality ratio, in black field variant there is 90.1 to 95.2% extra and 1st quality fruits compared to 80.2 to 85.1 % in grassing variant.

If we are talking about superior production quantity and quality of black field system variant it is not the same for the maintenance costs per hectare of the orchard (table 4). Financial effort in black field variant is higher with 36.5%. Maintenance costs for 1 ha orchard black field system are worth 1549 lei, to 984 lei at grassing intervals system.

Table 4

The expenses for soil maintenance – lei

Works/ Variant	Lei/ha	
	Variant 1	Variant 2
- fall plowing	290	-
- disc harrow on trees interval	155	-
- working the soil with the grower on the intervals (3 times)	540	-
- disc harrow VELOX – (2 times)	280	280
- chopping branches	200	200
- chopping herbs (3 times)	-	420
- manual herbicide	50	50
- herbicide – Roundup 1 l/ha	34	34
TOTAL	1549	984

Obtaining quality fruit, according to trading standards and uniformity of their size is achieved by applying foliar fertilization, technological sequence that must be integrated part of fruit production technology.

Foliar fertilization is a complementary measure, having the advantage that the fertilizing products, more quickly enter the metabolic cycle of the

plant comparing with the radicular fertilization but can not replace it. Foliar fertilizers are applied in the same time with phito sanitary treatments avoiding the interference with copper-based products.

Observations on fertilization considered the influence upon fruit average weight and size and also on their storage capacity.

Analyzing the data in table 5, we can see that after fertilization with Fertifol in different concentrations, treated variants recorded higher values than the control samples both in terms of production and average fruit weight.

Table 5

The influence of fertilization with Fertifol upon the production and fruit quality

Variety		V 1 Fertifol 0,2%			V 2 Fertifol 0,3%		
		t/ha	difference + -	Fruit average weight -g-	t/ha	difference + -	Fruit average weight -g-
Generos	treated	41.9	+5.7	179	44.6	+7.4	182
	untreated	36.2	0	162	37.2	0	160
Florina	treated	30.4	+6.9	150	31.1	+12.4	152
	untreated	23.5	0	142	18.7	0	139
Idared	treated	40.7	+8.9	168	42.3	+8.6	174
	untreated	31.8	0	157	33.7	0	161

Following the observations and measurements that have been made results that Fertifol fertilizations of 0.2 and 0.3% concentration have positive influence on increasing fruit production in all three varieties.

Thus, in V1 - 0.2% variant production increase is from 5.7 to 8.9 t/ha, and at V2 - 0.3% increase is from 7.4 to 12.4 t/ha. Generos variety stands up by the highest yields per hectare in both variants: 41.9 and 44.6 t/ha, but the biggest difference between treated and untreated variety has registered Florina variety - 12.4 t/ha, which also proves that it reacted most favorably to fertilizer factor.

There are also noted the differences, although not significant, for fruit weight, the average weight for each variety in fertilized variant was higher than in the controls. In conclusion we can say that Fertifol fertilizer has positive influences on vegetative increases, production quantity and quality if it is applied during shoots and fruits intense growth. No phytotoxic effects were found on leaves or fruits.

The results concerning the influence of the pruning system on fruit production level in three varieties are shown in table 6.

Fruit quantity per tree and also per hectar highlighted the superiority of variant V1 (reducing $\frac{1}{4}$ of annual growth).

At Idared variety there were registered 49.3 t/ha to the 42.9 t/ha at V3 (thinning and reducing annual growth to 3-4 buds) and 40.1 t/ha in V2. The biggest difference between the variants of (12.9 t/ha) has been registered at Sir Prize, where in V1 was obtained 43.7 t/ha, and at V3 - 30.8 t/ha.

Table 6

Pruning influence on apple production (average for 2006 – 2008)

Variety / variant	Idared		Jonagold		Sir Prize	
	kg/tree	t/ha	kg/tree	t/ha	kg/tree	t/ha
V1- fruit thinning and pruning by reducing 1/4 of annual growth	59.2	49.3	41.3	34,4	43.7	36.4
V2- fruit thinning and pruning by reducing 1/2 of annual growth	48.1	40.1	35.8	29,8	36.9	30.8
V3- reduction of the annual growth to 3-4 buds and ¼ of structural branches extension	51.5	42.9	31.4	26.2	30.8	25.7

In an overview is found that all three pruning variants ensures good and very good productions (between 26.2 and 59.2 t/ha), but particularly outlined in variant V1 - thinning and reducing ¼ of annual branches length.

CONCLUSIONS

1. Black field soil maintenance system variant provides higher average yields of 4-6 t/ha to grassing the interval between the rows variant. Maintenance expenses for grassing the intervals is smaller with 36.5% than black field variant (984 lei/ha grassing; 1549 lei/ha - black field).

2. Effect of Fertifol foliar fertilizer was materialized in an increased production between 5.7 and 8.9 t/ha in 0.2% concentration variant and 7.4 -12.4 t/ha 0.3% concentration variant.

3. All three types of production pruning provides significant increases compared to the control, but noted in particular variant V1 – reducing ¼ of branches length where there were registered productions of 41.3 to 59.2 t/ha.

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