INFLUENCE OF THE DIFFERENT SLENDER SPINDLE CROWN FORMATION METHODS ON THE PRODUCTIVITY AND APPLES QUALITY

INFLUENŢA DIFERITOR METODE DE FORMARE A COROANEI FUS ZVELT ASUPRA PRODUCTIVITAŢII SI CALITĂŢII MERELOR

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Abstract. *The study was made in a commercial orchard "Codru - St" Ltd. founded in 2000 with bench-grafted marcotes. Apple trees from the varieties Gala Must, Golden Reinders and Idared growth on dwarfing M9 rootstock, the distance of plantation between rows is 4.0 m, and between trees in the row is 1.0 m. From 2003 to 2006 was studied the productivity of the apple orchard, fruit weight and fruit diameter in dependence of slender spindle crown formation methods. It was established that the biggest productivity at the varieties was registered in the variants with minimize of pruning degree at crown formation and design of 2 provisional horizontal branches through fixation on row direction – 33.46-37.72 t/ha. The positive correlation found was between fruits size, fruits weight and crown formation methods.*

Key words: variety, apple, orchard, provisional branches, fruits size.

Rezumat. *Studiul s-a efectuat într-o plantaţie pomicolă a întreprinderii "Codru - St" SRL fondată în anul 2000 cu marcote altoite la masă altoiri la masă. Pomii de măr din soiurile Gala Must, Golden Reinders şi Idared pe portaltoiul cu talie scundă M9, distanţa de plantare dintre rânduri 4.0 m, iar dintre pomi pe rând 1.0 m. Între anii 2003-2006 s-a studiat productivitatea plantaţiei de măr, masa medie a fructelor şi diametrul fructelor în funcţie de metodele de formare a coroanei fus zvelt. Cea mai mare productivitate la toate soiurile s-a înregistrat în varianta cu un grad minimum de tăiere la formarea coroanelor şi proiectarea a 2 ramuri provizorii dirijate către orizontală şi fixate la spalier – 33.46-37.72 t/ha. A fost stabilită o corelaţie pozitivă între masa medie a fructelor, diametrul fructelor şi metodele de formare a coroanei.*

Cuvinte cheie: soi, măr, livadă, ramuri provizorii, diametrul fructelor.

INTRODUCTION

The experience accumulated on the international scale in the fruit growing domain demonstrate that at present the most efficient fruit growing plantations are considered to be the superintensive orchard, planted on cloned rootstocks with a little vigor of growth (Mika A., 2000). In recent years the majority of fruit growing plantations were established with cloned rootstocks with an under- and little vigor that correspond to attributed requirements to intensify the pomology (Sadowski A. et al., 2000; Szczygiel A., Mika A., 2003).

The increase of fruit growing production in Republic of Moldova may be realized only in the conditions of establishing new apple tree plantations. These

plantations have a modern assortment that are grafted on rootstock with under- and small average vigor of growth to plant an optimal number of apple trees per a unit of area and to obtain an early fruit yield (Peşteanu A., Croitoru A., Gudumac E., 2005). The precociousness fructification of these plantations permits to diminish at minimum the non-productive period. The optimum number of plants per a unit of area due to the crown formation after fusiform method permits a more rational use of the plot destined for plantation and guarantees a higher output of production (Croitoru A., 2005; Rutkowski K. et al., 2005; Grădinăriu G. et al., 2000).

There were made essential modifications in recent years regarding the apple trees' formation and pruning in the superintensive system of culture. That is due to the fact of using in culture modern varieties that fructify on annual branches, rootstocks with a low vigor of growth and bigger plantation densities that permits to obtain greater yields of fruits from 2nd - 3rd year after being founded the orchard. These requirements are the most important because at the base of the plantation modern structure it is a compact crown formed by short 2nd order branches and, upper on the central axle, some provisional branches with a more limited period of exploitation (Cimpoieş Gh., 2002; Cepoiu N., 1995).

Only in the conditions of the productive varieties with a rootstock with small vigor of growth, suitable to the pedoclimatic conditions of the country, plantation optimum density and crown compact format systems that permit to obtain stable (35-40 t/ha) and competitive yields (Salvador F et al., 2006; Szczygiel A., Mika A., 2003).

The aim of the research is to optimize the ameliorated slender spindle crown structure to urgent the entrance of apple trees on an earlier production, yield rapid growth and fruit production economic efficiency in the superintensive apple orchards.

MATERIAL AND METHOD

The experimental field is placed in the orchard "Codru-ST" Ltd. near the village Bucovat, district of Straseni. There was established in summer of 2000 a plantation with bench-grafted marcotes. As a biological material were used the apple tree varieties Gala Must, Golden Reinders and Idared grafted on rootstock M9.

The distance of plantation 4x1 m was established in conformity with present recommendations for apple trees grafted on M9, leaded after the slender spindle system (Cimpoieş Gh., 2002; Cepoiu N., 1995).

The variants to modify the methods of ameliorated slender spindle crown formation were established in conformity with the main principles of apple tree crown formation in the culture superintensive and intensive system (Peşteanu A., Croitor A., 2009; Cimpoieş Gh., 2000; Matinger H., Vigl J., 1999), being oriented to optimize to report between vegetative and reproductive organs of growth with the aim to urgent of having an early fruit production of trees.

During the vegetation of 2000 year, the apple trees grew having the form of rods, reaching the height of 1,2 m, that permitted in spring of 2001 to initiate the crown formation of slender spindle type in four variants:

Variant 1 (control variant) – according to present recommendations: the trees with a trunk of 50-55 cm with a well-developed weak zigzagged vertical axle; at the base of the crown 3-4 first order branches shortened of 40-50 cm with angles on

inclination of 60^0 from the vertical one; on the first order branches and above on the axle at an interval of 20 cm radially uniform placed the semi skeleton branches, oriented to horizontal preponderantly by transfer cuttings to lateral branches.

Variant 2. The crown bioconstructive base as a control variant compelled with: rational minimization formation cuttings degree; placement above the crown base of two provisional first order branches alternatively oriented and fixed on espalier in row direction, that after fructification are gradually shortened and being transferred into fructification branches; forced orientation in free space of crown of shoots and branches with a growth to vertical position to transfer them into fructification branches.

Variant 3. The bioconstructive base as in variant 2 with leading the semi skeleton branches to horizontal position by lateral transfer branch cuts.

Variant 4. The bioconstructive base as in variant 2 with renovation of semi skeleton branches by with the aim to obtain shoots from dormant buds.

Every variant includes four repetitions with eight trees, intervals between grassy rows, and the strips into the row are loose and herbicided. The soil is chernozem leachate sloppy with the humus content in 0-40 cm layer from 3,26% to 3,21%. Fertilization system as scheduled harvest. Drip irrigation.

In the years 2003 - 2006 according to approved methods was studied the apples production and quality. After ending the crown formation, based on variant 2 was performed fruition cutting according to the biological features of the studied varieties.

RESULTS AND DISCUSSIONS

The fruit production is one of the main indices taken into account in determining the suitability crown form for superintensive culture system (Peşteanu A., Croitor A., 2009; Sadowski A. et al., 2000).

The apple trees have entered on economic fructification in 2003, the third year after the initiation of crown formation in the orchard. The first economic crop (tab 1) in variant 1 (control) was: 22,22 t/ha in variety Gala Must, 26,65 t/ha in variety Golden Reinders and 20,75 t/ha in variety Idared.

Higher values of fruit harvest this year was registered in version 2, where the varieties taken under the study were obtained, respectively: 28,02 t/ha, 33,07 t/ha and 25,32 t/ha, exceeding the 22%, control – 26%. In variants 3 and 4 the first harvest of fruit varieties studied, overcomes the variant control with 13-16% and 11-14%.

In 2004 fruit harvest in most variants of crown formation is approximately at the same level with the fruit production obtained in 2003, remaining within: 24,00-27,82 t/ha in variety Gala Must, 22, 15-26,50 t/ha in variety Golden Reinders and 21,15-24,72 t/ha in variety Idared. In this limits, lower values belong to variant 1 and to variant 2 –the highest ones, overcoming the variant control, on the varieties, with 14-16%. In variants, 3 and 4 the prevalence of yield to variant control is 6-3% and 3-10%.

In 2005, fruit harvest in variant control majored to: 38,17 t/ha at Gala must variety, 40,83 t/ha at the variety Golden Reinders and 33,43 t/ha at the Idared variety. In variant 2 there have been the greatest values of fruit harvest, being respectively 47,15 t/ha, 48,63 t/ha and 41,11 t/ha overcoming the variant control

with 19-23%. In variants 3 and 4 the fruit harvest is lower than on variant 2, but superior to variant control, being respectively 12-16% and 9,10%.

In 2006, when trees have reached the period of maximum fruition, the fruit harvest for most variants was: 40,75-43,15 t/ha in Gala Must variety, 40,95-43,81 t/ha in variety Golden Reinders and 40,85-42,72 t/ha in variety Idared. Within the limits indicated, higher values were recorded in variant 2, which exceeded the witness according to the fruit harvest with 4-7%. In variants 3 and 4, the harvest fruit was approximately at the level of the control variant.

Table 1

Average fruit yield according to variety's biological particularities and crown formation mode, t/ha

Method of crown formation	2003	2004	2005	2006	Cumulative harvest
Gala Must variety					
Variant 1(control)	22,22	24,00	38,17	40,75	125,40
Variant 2	28,01	27,82	47,15	43,15	146,13
Variant 3	25,77	26,07	42,47	42,37	136,68
Variant 4	25,32	25,90	42,10	41,15	134,47
$LSD_{0,05}$	*0,75*	*0,45*	*0,55*	*0,95*	-
Golden Reinders variety					
Variant 1(control)	26,65	22,15	40,83	40,95	130,58
Variant 2	33,07	25,37	48,63	43,81	150,88
Variant 3	30,10	26,50	46,34	42,17	145,11
Variant 4	29,30	22,87	44,57	41,76	138,50
$LSD_{0,05}$	*1,35*	*0,85*	*1,20*	*0,77*	-
Idared variety					
Variant 1(control)	20,75	21,15	33,43	40,85	116,18
Variant 2	25,32	24,72	41,11	42,72	133,87
Variant 3	23,65	23,90	37,33	41,91	126,79
Variant 4	23,02	23,42	37,09	41,95	125,48
$LSD_{0,05}$	*1,10*	*0,95*	*1,15*	*0,92*	-

There were small differences of production than the variant control because, with advancing age trees, it was made reduction cuts of semi-skeleton branches and decreased the number of horizontalized shoots by tilt to avoid crown thickening, which achieved a maximum relative size. Simultaneously with entering trees on the full fruition in 2005 partially and completely in 2006, it was started to cut the fructification, made with all variations by the principle of rejuvenation that have fructified with the cycle of 3-4 years (Cimpoieş Gh., 2002).

In conclusion, the effect of minimizing, the cutting level of forming the crown in ensemble by placing two 1st degree branches above the crown basis, shots and branches orizontalization by forced inclination into free space, is significantly manifested. In this variant the total fruit harvest on the years 2003-2006 was of 146,13 t/ha at Gala Must variety, 150,88 t/ha in variety Golden Reinders and 133,87 t/ha in variety Idared. Production fruit harvest to control

variant the amount of variant four-year study on the varieties are, respectively: 20,73 t/ha, 20,30 t/ha and 17,69 t/ha or 16,5%, 15,5 % and 15,2%.

The main indicators of fruit quality are considered: the representative aspect, in particular, shape, color, size characteristic of the variety (Jamba A., Carabulea B., 2002). The degree of manifestation of these properties is influenced by environmental factors, rootstock, applied technology, including system management and pruning trees (Jamba A., Carabulea B., 2002; Takacs F., 2004).

In accordance with European standards apples fruited big issue characteristic representative variety, diameter 70 mm and higher grade are reported to "Extra" and with diameter of 65-69 cm - to 1st class.

On the average at varieties, the variants of crown formation and years taken into the study, the diameter is within the limits of: Gala Must variety - 71,1-72,7 mm, the variety Golden Reinders 70,2-72,5 mm and Idared variety 75,5-76,9 mm, exceeding the dimensions set for the “extra”. This is due to load regulation of fruit trees, linked together with cuts in green and final correction after physiological fruit fall by hand thinning as scheduled and high quality crop of apples.

In variant 1 (control) fruit weight class “extra” 70 mm and larger diameter is within the limits: 57-62% at Gala Must variety, 67-69% at Golden Reinders variety and 84-86% at Idared variety. Apples of 1st class constitute respectively on varieties: 33-38%, 23-26% and 12-14% and less than 65 mm in diameter 0-6%, 4-5% and 0% at Idared variety.

In version 2, where the harvest is higher, the average diameter of apple varieties and years under study, is lower than variant control with 1,6-2,3 mm or about 3-4%. Apples of “extra” class in this variant are: 57-62% at Gala Must variety, 67-69% at Golden Reinders and 84-86% at Idared variety. Share apples diameter was 60-65 mm, respectively varieties, 3-7%, 5-6% and 0%.

In variant 3 and 4 the quota of apples of “extra” class, I and a smaller diameter than 65 mm is approximately at the level of the control variant.

In conclusion, the quality of apple varieties, methods of forming the crown and years of education is high. Higher indices of fruit diameter were recorded at Idared variety of “extra” class and 84-88% and 12-16% of 1st class, followed by Golden Reinders variety with 69-72% of “extra” class and 26-27 % of 1st class. Indices for smaller fruit diameter, but generally higher, were registered at Gala Must variety 61-67% of “extra” class and 35-39% of 1st class. In the limits indicated for each variety, values lower with about 4-6% were registered in variant 2, where the harvest of fruit trees is higher with 20-23% compared with the variant control.

CONCLUSIONS

1. Minimizing the pruning degree of crown formation and placement of two 2nd order branches above its base, influence the fruit harvest. The average amount of fruit production during 2003-2006 was of 36,53 t/ha in variety Gala Must, 37,72 t/ha in variety Golden Reinders and 33,46 t/ha in variety Idared. Increasing

the fruit harvest to the control variant the amount in sum for four years it will constitute on the variety: 16,5%, 15,5% and 15,2%.

2. The methods of formation have not essentially influenced the fruit quality. Depending on the variety's biological peculiarities, higher indices of fruit diameter were recorded at Idared variety 84-88% of "extra" class and 12-16% class I, followed by 69-72% with the variety of Golden Reinders "extra" class and 26-27% class I, and 61-67% of Gala Must variety of "extra" class and 35-39% class I.

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