THE INFLUENCE OF MODE OF "KNIP-BAUM" CROWN FORMATION ON APPLE TREE PRODUCTIVITY AND QUALITY IN THE FRUIT NURSERY

INFLUENȚA MODULUI DE FORMARE A COROANEI „KNIP-BAUM" ASUPRA RANDAMENTULUI ŞI CALITĂȚII POMILOR DE MĂR ÎN PEPINIERĂ

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Abstract. *In the period of 2006-2007 in Ltd. „Fruit Nurseries" were made some investigations referring to the influence of three modes of „knip-baum" crown formation on the apple tree productivity and quality in the second field of the fruit nursery. For „knip-baum" crown formation were used three methods: „Knip-baum" with a free growth (control variant), „Knip-baum" with periodical remove of the apical leaves of the axle offshoot and „Knip-baum" with the application of biological active substances of the axle offshoot. As a rootstock served the M 9 type and as graft were used Golden Reinders, Jonagored and Idared varieties. The best results obtained for the apple tree productivity and quality were registered at the „knip-baum" crown basis formation by periodical remove of the apical leaves from the axle's offshoot.*

Rezumat. *În perioada anilor 2006-2007 în SRL „Fruit Nurseries" a fost studiată influența a trei moduri de formare a coroanei „knip-baum" asupra randamentului şi calității pomilor de măr în câmpul doi al pepinierei pomicole. Pentru formarea coroanei „knip-baum" au fost folosite trei metode: „Knip-baum" cu creşterea liberă (martor), „Knip-baum" cu ruperea periodică a frunzelor apicale ale lăstarului axului şi „Knip-baum" cu aplicarea substanțelor biologic active pe lăstarul axului. Ca portaltoi a fost folosit tipul M 9, iar ca altoi – soiurile Golden Reinders, Jonagored şi Idared. Cele mai înalte rezultate obținute asupra randamentului şi calității pomilor de măr au fost înregistrate la formarea bazei coroanei „knip-baum" prin ruperea (eliminarea) periodică a frunzelor apicale ale lăstarului axului.*

Strategy of pomology development till 2020 foresees the gradual replacement of the actual orchards with new ones that are modern of an intensive type on a surface of about 100.000 ha. In the new plantations, the apple trees represent 44% of the total area and 60% of the global fruit production (3).

The greatest importance when establishing high productive orchards is that of the high quality planting material (2, 6, 8).

At present the intensive and superintensive apple tree orchards in the republic of Moldova are planted with uncrowned apple trees (rods) in the fruit nursery.

The researches from the countries that have an advanced pomology (1, 6, 7, 8, 9), confirm that the plantation in the orchard of well-developed apple trees, rationally crowned in the second field of the fruit nursery, especially of those that are bench grafted, considerably contribute to the emerging of plantation, beginning early fructification and increase of qualitative fruit yield.

In the Republic of Moldova were made not many investigations referring to the production of apple trees that are crowned in the field of the fruit nursery, especially those obtained by bench grafting.

On the basis of the data mentioned above, the technology of apple tree crowning in the second field of the nursery, including the bench grafted apple trees, too, that is referring to an early fructification and yield increase in a very short time, presents a very actual problem for apple tree culture intensification in the Republic of Moldova.

MATERIAL AND METHOD

The researches were made in the period of 2005-2007 years in the fruit nursery of the mixed industrial unit "Fruit Nurseries" founded on the basis of collaboration between the joint- stock company "Codru-ST" and the Dutch "Van Rijn International". The first field was established on the second part of April with bench grafts made in March using the method of perfected copulation with detached branch.

As a rootstock was used the biotype M9, and as a graft the variety Idared in the Republic of Moldova and the long-term varieties: Golden Delicious Reinders, Jonagored. For grafting were used layers (marcottes) with a diameter of 10.0 mm and graft branches with high biological qualities taken from Holland.

The place of grafting was tied with special film, the graft was paraffined. The grafts obtained have been stratified by placing them vertically in containers, in the way that the basic part of the layer (20-25 cm) should be in a wet and moist stratum of sand. The temperature of stratification in the refrigerator is +2…4 ^{0}C. The distance of plantation of the grafted plants is 90x35 cm.

In spring, in the second field, the annual trunk was cut at the height of 50-60 cm from the graft's place. At the same time with the growth of lateral shoots was made the clear up of the trunk leaving only the terminal one. With a view to the branch stimulation and offshoot growth in the crown zone, were applied three methods:

V1 – knip-baum with a free growth (control variant);

V2 – knip-baum with periodic remove of the apical leaves of the axle;

V3 – knip-baum with the application of biological active substances.

The aerial part was palisated on a stick of bamboo.

As a biological active substance to stimulate the branching, was used the preparation Ecostim with a concentration of 0,25 ml to 1 liter of water.

The usual black soil, the content of humus is 2,6 %, that is maintained as cultivated field, irrigation is made by sprinkling, keeping the soil wet at 75-80% from the capacity of field.

The aim of investigations made is the determination of optimum method of "knip-baum" crown formation and its influence on apple tree productivity and quality in the fruit nursery.

The investigations were made in field and laboratory conditions after accepted methods of making researches with fruit-growing plants. The obtained results were subject to statistic processing according to dispersioned analysis (5).

RESULTS AND DISCUSSIONS

The researches that were made show that the development of apple trees at the end of both periods of vegetation in the fruit nursery depended on the varieties taken into the study.

At the end of the first period of vegetation in fruit nursery the height of the graft (figure 1) is between the limits of 106 cm (Idared) and 122 cm

(Jonagored), with a greater diameter of 10 cm from the place of grafting of 9,6-11,0 mm. The leaf surface of a tree is between 0,17-0,20 m^2/tree or, if to calculate per hectare, then it would be 5,39-6,34 thousand m^2/ha.

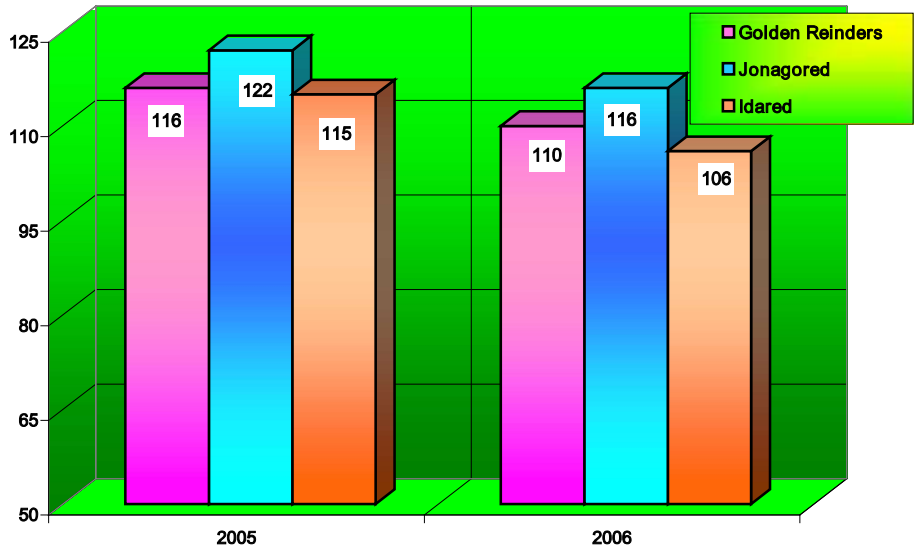

Fig. 1. - **Graft height at the end of the period of vegetation in the first field of the fruit nursery,** cm.

In the second field, during the spring period, all the technological operations taken on the apple trees lead to the methods studied on the crown formation of "knip-baum" type.

At the end of the second period of vegetation in the fruit nursery (table 1), the way of crown formation has not essentially influenced the tree's height at the variety Golden Reinders that is between the limits of 165,0-177,7 cm, and the trunk diameter is 15,2-15,8 mm. In 2006 the number of branches in the control variant is 13,1 pieces/tree, which decreases to 12,0 pieces/tree in the third variant with crown formation of "knip-baum" type with the application of biological active substances to stimulate the branching. But in 2007 the number of lateral branches in the crown zone increases from 6,2 pieces/tree in the first variant to 8,5 pieces/tree in the second variant.

The average length of a lateral branch that increases with about 5-23% in comparison with the control variant in the variant when the crown of "knip-baum" type is forming itself through the periodical remove of apical leaves, being 37, 9 cm (2006) and 46,9 cm (2007), with an angle of branching of 69,0-75,3^0. The leaf surface of a tree in this variant has maximum values and constitutes 0,56-0,59 m^2/tree.

The variety Jonagored, which has better biological features of growing the trees and with a higher capacity of forming lateral shoots, registered higher values at principal indicators of growing the aerial parts of trees, bench grafted in the fruit nursery, taken into comparison with the other two varieties being also studied.

The way of forming the crown, practically, doesn't influence the height of trees that is between the limits of 179,0-194,4 cm, or has increased with 9-18% the value of the index in comparison with the variety Golden Reinders, as well as the trunk diameter that is between the limits of 15,0-15,7 mm.

Table 1

The main indicators of trees growing and crown structure depending on the way of its formation

Way of crown formation	Tree height, cm	Trunk diameter, mm	Number of branches in the crown, pieces/tree	Average length of a branch, cm	Angle of ramifi-cation, ^{0}	Leaf surface, m^2/tree
Golden Reinders						
2006						
V-1	165,0	15,8	13,1	30,9	70,5	0,52
V-2	167,9	15,2	12,7	37,9	75,3	0,56
V-3	171,7	15,4	12,0	35,5	80,1	0,54
DI $_{0,05}$	*2,78*	*0,18*	*0,53*	*3,71*	*4,62*	*0,02*
2007						
V-1	177,7	15,2	6,2	45,2	65,7	0,53
V-2	171,7	15,5	8,5	46,9	69,0	0,59
V-3	177,2	15,4	6,5	45,2	60,8	0,54
DI $_{0,05}$	*5,51*	-	*0,55*	-	-	*0,03*
Jonagored						
2006						
V-1	194,4	15,7	12,0	48,9	84,8	0,62
V-2	181,1	15,4	10,0	54,2	91,5	0,67
V-3	187,4	15,3	11,1	50,6	79,8	0,70
DI $_{0,05}$	*6,00*	*0,28*	*0,67*	*3,44*	*4,13*	*0,03*
2007						
V-1	184,2	15,2	6,2	52,9	71,7	0,44
V-2	179,0	15,2	8,2	55,4	84,5	0,50
V-3	182,4	15,0	6,7	53,4	71,1	0,48
DI $_{0,05}$	*6,64*	-	*0,85*	-	-	*0,02*
Idared						
2006						
V-1	191,7	15,6	6,0	29,8	69,1	0,47
V-2	179,9	16,0	8,6	34,2	73,0	0,50
V-3	186,4	15,8	7,5	32,6	65,7	0,52
DI $_{0,05}$	*5,23*	*0,21*	*1,06*	*2,41*	*3,29*	*0,02*
2007						
V-1	155,2	15,0	5,2	35,1	63,8	0,37
V-2	153,7	15,5	6,4	40,2	71,4	0,41
V-3	153,7	15,4	5,7	38,7	59,7	0,39
DI $_{0,05}$	*5,10*	-	*0,67*	*3,44*	-	*0,04*

The average number of branches in the crown, depending on the method of crown formation, varies from 8,2-10,0 pieces/tree in the second variant to 6,2 pieces/tree in 2007 and 12,0 pieces/tree (2006) in the control variant. The average length of a lateral branch in the control variant has increased given to the variety Golden Reinders by 58-71% and is 48,9-52,9 cm, which depending on the crown formation of "knip-baum" type, has increased, respectively, to 54,2-55,4 cm or by 5-11% in comparison with the control variant in the variant of crown formation of "knip-baum" type with periodical remove of apical leaves and an angle of branching ramification of 84,5-91,5^0. The leaf surface increases from 0,44-0,62 m^2/tree in the control variant to 0,70 m^2/tree in the variant with

crown formation of "knip-baum" type with the biological active application of substances for stimulating the growth of branches.

The height of tree of variety Idared, depending on the way of formation the crown of "knip-baum" type, is between the limits of 153,7-191,7cm, the trunk diameter being 15,0-16,0 mm. The average number of branches in the crown at the variety Idared is influenced by the capacity of forming sylleptic shoots which at the given variety are weak and constitutes 5,2-8,6 pieces/tree.

At the crown formation of "knip-baum" type through periodical remove of apical leaves, the average length of a lateral branch is 34,2-40,2 cm, which increases with about 14-15 % in comparison with the control variant that is 29,8-35,1 cm, having an angle of ramification of 71,4-73,0^0. The leaf surface at the variety Idared, as well as at the variety Jonagored, increases from 0,37 m^2/tree to 0,52 m^2/tree in the third variant, and in the second variant were obtained the best growing tree indicators in the second field of both years of the fruit nursery and constitute 0,41-0,50 m^2/tree.

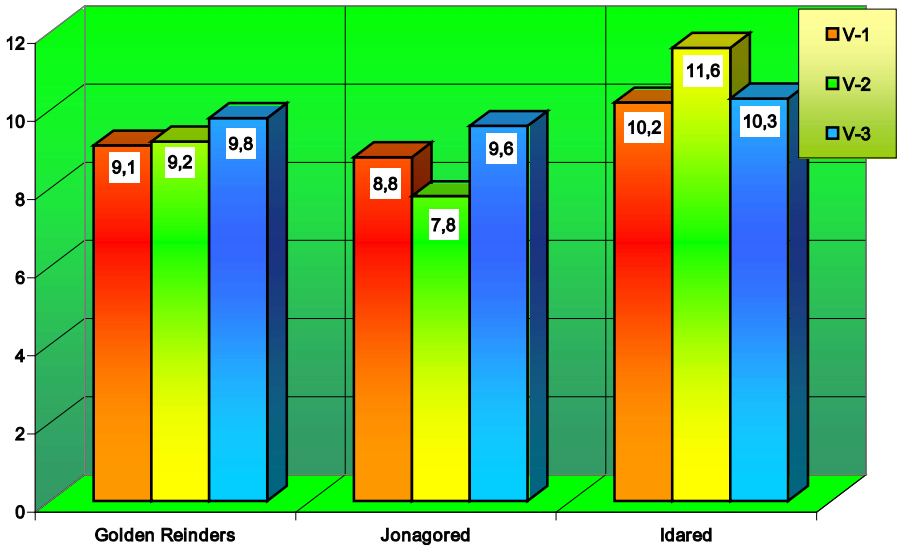

Fig. 2. - **Number of fruit buds of apple trees in the second field in dependence on the mode of "knip-baum" crown formation,** piece/tree (*average of 2006-2007*).

The intense and extended growth of shoots creates a higher leaf surface and is detrimental to the differentiation of fruit buds (4). The number of bud fruits (figure 2) of the apple trees in the second field, according to the way of "knip-baum" crown formation, in average, during the period of investigations, is between the limits of 9,1-9,8 pieces/tree for Golden Reinders variety, 7,8-9,6 pieces/tree (Jonagored) and 10,2-11,6 pieces/tree (Idared).

In both years of investigation, the apple tree productivity and quality have been directly influenced by the mode of "knip-baum" crown formation (table 2). In the case of apple tree crowning by periodical elimination of apical leaves from the axle offshoot, it was registered the greatest number of apple trees of first quality that are between the limits of 26,49-30,31 thousand pieces/ha, and is greater with 7-10% than that of the control variant and 5-9% in the case of apple trees' crowning by the application of biologic active substances on the axle offshoot.

Table 2

Apple tree productivity and quality in the second field, according to the mode of "knip-baum" crown formation

Way of crown formation	2006		2007	
	productivity, thousand pieces/ha	**1st quality,** thousand pieces/ha	**productivity,** thousand pieces/ha	**1st quality,** thousand pieces/ha
Golden Reinders				
V-1	30,50	28,32	28,59	26,26
V-2	31,04	29,80	29,46	28,63
V-3	30,82	27,71	28,71	26,57
Jonagored				
V-1	28,98	26,31	29,95	27,64
V-2	29,77	28,68	30,74	30,31
V-3	29,39	27,04	30,15	27,36
Idared				
V-1	28,19	24,80	30,99	27,24
V-2	29,11	26,49	31,19	28,95
V-3	28,60	25,74	31,04	27,58

CONCLUSIONS

1. The most favorable equilibrium between growth indicators of apple trees and crown basis formation in the second field of the fruit nursery has been registered in the variant with crowning of "knip-baum" type by periodical remove (elimination) of apical leaves of the axle offshoot of 5-6 times.

2. Superior productivity of apple trees of first category, crowned in the second field of the fruit nursery was obtained in the case of apple tree formation according to "knip-baum" type by periodical remove of apical leaves of the axle offshoot.

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