PARTICULARITĂŢILE DE CREŞTERE ŞI RODIRE ALE UNOR SOIURI DE MĂR CU REZISTENŢĂ GENETICĂ LA BOLI, CULTIVATE ÎN SISTEM DE MARE DENSITATE
PARTICULARITIES OF GROWTH AND FRUITING OF APPLE VARIETIES WITH GENETIC RESISTANCE TO DISEASES GROWN UNDER HIGH DENSITY SYSTEM

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Abstract

The researches performed at the Research Station for Fruit Growing Voinesti, in the period 2007-2012, had as object the study of 13 disease resistant apple varieties, cultivated in the high density system, grafted on the M 9 rootstock, respectively: 'Ariwa', 'Golden Lasa', 'Goldrush', 'Enterprise', 'Inedit', 'Iris', 'Luca', 'Real', 'Rebra', 'Redix', 'Remar', 'Saturn', 'Voinicel', comparative with the 'Jonathan' variety, taken as control. The trees were planted at a distance of 4 x 1m (2.500 trees/Ha), spindle crown form. With high yield potential remarked themselves the disease resistant apple varieties 'Ariwa', 'Remar', 'Inedit' and 'Saturn', which in the years 4 – 6 after planting realized over 29 t/ha. In the same conditions, the apple varieties 'Real', 'Voinicel', 'Luca' and 'Iris' realized between 23,2 t/ha and 25,5 t/ha. The promotion of the high density apple tree system, in which disease resistant apple varieties are previewed, represents a modality for periodical and rapid replacement of the assortments, leading to the identification of new modern technologies in obtaining productions adapted to the requirements of the European quality standards.

Cuvinte cheie: densitate ridicată, soiuri rezistente la boli, productivitate, calitate
Keywords: high density system, disease resistant varieties, productivity, fruits quality

1. Introduction

The modern apple culture systems, with rapid fruit bearing start and short exploitation duration, represent a modality for the periodical and rapid replacement of the assortments, through this being encouraged the introduction of modern technics and ideas in obtaining productions adapted to the exigencies of the European quality standards.

On the European level, they generalized the use of the reduced vigour rootstock (M9), with tree sustaining and irrigation systems, covering the orchards with an anti-hail net. In the high density fruit trees exploitation in France, Italy, Germany, Spain, Switzerland etc., with densities of 2,500 – 3,000 trees/ha, they obtain remarkable performances, concretized by productions of 40 – 60 t/ha.

The researches performed at the Research Station for Fruit Growing Voinesti in the period 2007 – 2012, were aimed to the increasing of the competitive, corresponding to the principles of the enduring development and of the food security, concretized in the promotion of a high density apple tree culture system, in which are previewed elements specific to the Romanian varieties, comparative with the foreign ones, which will lead in short time to the increasing of the productive performances and of the economic efficiency, as immediate profitability, simultaneously with the implementation at the private producers.

2. Material and methods

The researches, deployed in the period 2007 – 2012, at the Research Station for Fruit Growing Voinesti, had in view the establishing of an apple assortment, destined to the biological production, cultivated in the ecopedoclimatical conditions of the Voinesti zone, being studied 13 genetic disease resistant apple varieties of local and foreign origin, respectively: 'Ariwa', 'Golden Lasa', 'Goldrush', 'Enterprise', 'Inedit', 'Iris', 'Luca', 'Real', 'Rebra', 'Redix', 'Remar', 'Saturn', 'Voinicel', comparative to the variety 'Jonathan', taken as a control. All varieties were grafted on the M9 rootstock.

The trees were planted at the distance of 4 x 1 m (2,500 trees/Ha), spindle crown form.

The soil of the experimental lot was fallow on the interval and maintained clean of weeds on the tree row. It is brown eumezobazic, weakly preudo-glazed, with clayish texture, with a weakly acid pH (5.7–5.9). The content in humus is medium at the surface (2.0–2.9%), medium supplied with nitrogen and weakly supplied with phosphorus and potassium.

For pest combat, 6–8 treatments were applied, only with insecticides. The other works were performed according to the technology specific to the high density apple tree orchards.

At the apple tree assortment used at setting up the orchard, we followed up the vegetative tree growth, the fruit bearing precocity, the production levels, the fruits quality and other culture aspects, which represent factors to be taken into account at the promotion in culture of the high density system apple tree orchards.

3. Results and discussions

The growing vigour in the sixth year after planting, the trees being cultivated in the high density system, when the growth potential is well differentiated, shows us that between the apple tree varieties appear significant differences, regarding the trunk thickness growth, the height and the thickness of the fructiferous fence.

The trunk is one of the elements, which characterizes the tree vigour and it is always analyzed and correlated with a series of other biometrical processes and indices.

The values regarding the trunk thickness, registered in the year 5 from planting, are presented in table 1.

In the conditions of grafting on the M9 rootstock, being the most vigorous, resistant apple tree varieties, cultivated in the high density system, are inscribed the varieties: 'Enterprise' (58.28 mm), 'Luca' (58.03 mm), 'Remar' (56.55 mm), 'Golden Lasa' (56.17 mm), 'Redix' (55.83 mm), 'Rebra' (53.33 mm).

Values of the trunk thickness between 40 and 50 mm have been registered by the following apple tree varieties: 'Saturn' (43.00 mm), 'Ariwa' (44.26 mm), 'Real' (44.50 mm), 'Inedit' (47.70 mm), 'Iris' (48.95 mm), 'Voinicel' (50.00 mm).

Values lesser than 40 mm have been registered by the variety 'Goldrush' (38.52 mm).

At the 'Jonathan' variety, taken as control, the trunk diameter in the year 6 after plantinghad an increase of 45.69 mm.

The medium annual growth of the trunk diameter, showed values comprised between 3.95 mm at the 'Goldrush' variety and 7.88 mm at the 'Remar' variety, both varieties being grafted on the M9 rootstock.

The trunk vigour in the year 6 from planting, represented by the trunk cross sectional area (TCSA), registers extreme values, comprised between 11.65 cm^2 at the 'Goldrush' variety and 27.60 cm^2 at the 'Enterprise' variety.

The data, statistically processed as compared to the 'Jonathan' variety, taken as control, point out very significant positive differences at the varieties 'Golden Lasa', 'Enterprise', 'Luca', 'Rebra', 'Redix', 'Remar' and 'Voinicel'. Distinctive significant positive differences were assured by the Iris variety – and very significant negative differences by the 'Goldrush' variety.

Vigour with no significant differences, as compared to the level of the 'Jonathan' variety, have been registered by the varieties 'Ariwa', 'Real' and 'Inedit'.

The tree dimensions and the crown volume registered in the year 6 are presents in table 2. The trees height registers the values comprised between 195 cm at the 'Goldrush' variety and 280 cm 'Luca' variety. The greatest trees height values are registered at the 'Real', 'Enterprise', 'Rebra', 'Redix', 'Golden Lasa', with the dimensions, with over 290 cm. The 'Jonathan' variety had the height of 210 cm.

The fructiferous fence thickness was comprised between 110 and165 cm.

The crown volume per tree, in the year 6 from planting, oscillated between 1.82 cm/tree at the 'Goldrush' variety and 4.12 cm/tree at the 'Luca' variety, comparative to the 'Jonathan' variety, at which 2.52 cm/tree were registered.

Calculated on the surface unit, the crown volume registers values from 4,450 m^3/ha at the 'Goldrush' variety – to 10,300 m^3/ha at the 'Luca' variety.

Lesser values of the crown volume were registered at the varieties: 'Goldrush' (4,450 m^3/ha), 'Inedit' (6,300 m^3/ha) and 'Saturn' (6,500 m^3/ha). At the other varieties, the crown volume, calculated on one Hectar, approaches the value of 6,300 m^3/ha, registered at the 'Jonathan' variety, taken as witness, with the differences are no significant at the majority of the varieties. The statistical calculation registers very significant positive differences only at the 'Luca' variety, distinctive significant positive difference at the Enterprise variety and significant positive differences a the 'Golden Lasa', 'Real' and 'Rebra' varieties, grafted on the M9 rootstock.

The productivity of the genetic disease resistant apple trees was pointed out by annual registering the apple production at variety level.

Among the apple tree varieties cultivated in the apple tree high density system, the 'Iris' variety, grafted on the M9 rootstock, has the tendency to bear fruits already from the year 2 after planting.

From the year 3 after planting, the 13 apple tree varieties with genetic resistance to diseases and the 'Jonathan'/ M9 variety realized satisfactory productions, having in view that we used at planting seedling material from the field II of the nursery, rods, without anticipations, as support of the fruit bearing buds differentiation – already from the planting year.

From the data presented in table 3, results that from the studied apple tree assortment, the Romanian varieties, those early and productive, were: 'Real' (7.5 t/ha), 'Inedit' (6.5 t/ha), 'Iris' (6.3 t/ha), 'Remar' (3.8 t/ha).

From the foreign varieties, we point out, with their productions in the year 3 after planting: 'Saturn' (5.8 t/ha), 'Ariwa' (5.5 t/ha), 'Golden Lasa' (5.5 t/ha), 'Goldrush' (5.0 t/ha).

At the 'Jonathan'/ M9 variety, taken as control, we obtained in the year 3 after planting 3.5 t/ha.

Analyzing the mean production of the years 4 - 6 from planting, we observe that from the 13 apple tree varieties with genetic resistance to diseases, cultivated in the high density system, the most productive are the apple tree varieties: 'Ariwa', 'Remar', 'Inedit' and 'Saturn', at which we obtained over 29 t/ha. Appreciated with high potential are also the apple tree varieties, which registered medium productions of over 23 t/ha, like: 'Real' (25.0 t/ha), 'Voinicel' (23.2 t/ha), 'Luca' (25.35 t/ha), 'Iris' (25.5 t/ha). The Jonathan variety, taken as control, registered as a 3 years average a production of 21.4 t/ha.

The statistically calculated data confirm very significant positive differences, as compared to the Jonathan variety, taken as control, at the majority of the studied genetic disease-resistant apple tree varieties.

The productions registered at the 'Golden Lasa', 'Goldrush', 'Rebra' and 'Redix' apple tree varieties.

The studied apple tree varieties with genetic disease resistance, cultivated in the high density system, manifested a very good resistance against scab (*Venturia inaequalis)* and an increased resistance degree against mildew (*Podosphaera leucotricha*), with no significant values, comprised between 0 and 6.5%.

The medium value of the fruits weight at variety level, in the period 2009–2011, shows that the 'Golden Lasa', 'Enterprise', 'Luca', 'Real', 'Rebra', 'Redix', 'Remar' and 'Saturn' varieties have the potential to assure the suitable fruits size, which shall compete on the market, the fruits framing in the big fruits class – and the other varieties frame in the medium fruits group.

The tree assortments are in a permanent change, the place of the varieties, presenting inferior commercial qualities, being taken by the new homologated varieties, which correspond to a higher degree to the consumers' continuously increasing requirements.

The apple tree varieties, which were studied, can cover a great part of the consumption season, besides some of the genetic disease resistant varieties, multiplied in culture, already known and appreciated on the market by the consumers.

4. Conclusions

The growing in the sixth year after planting, cultivated in the high density, system, represented of the trunk cross sectional area, registered extreme values comprised between, 11.65 cm^2 at the 'Goldrush' variety and 27.60 cm^2 at the 'Enterprise' variety.

The crown volume, calculated on the surface unit, oscillated between 4,450 m^3/ha, at 'Goldrush' variety and 10,300 m^3/ha at 'Luca' variety.

The highest production potential on the surface unit was realized in the years 4 - 6 from planting at the 'Ariwa', 'Inedit' and 'Saturn' apple tree varieties, with over 29 t/ha, but also at the 'Real', 'Voinicel', 'Luca', and 'Iris' apple tree varieties, at which we realize between 23.2 t/ha and 25.5 t/ha.

The studied genetic disease -resistant apple tree varieties, cultivated in the high density system, manifested a very good resistance to scab (*Venturia inaequalis*) and an increased resistance degree to mildew (*Podosphaera leucotricha*), with no significant values comprised between 0 and 6.5%.

The apple tree varieties, recently homologated at R.S.F.G. Voinesti, and also other studied foreign varieties, cover a great part of the consumption season, besides some genetic disease-resistant varieties already known and appreciated on the market by the consumers – these framing in differently in the conveyor recommended for the Dâmboviţa tree growing region.

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Tables

Table 1. Trunk thickness growth in the year 6 from planting, at the genetic disease-resistant apple tree varieties, cultivated in the high density system (year 2012)

Nr.	Variety/ Rootstock	Diameter in the year 6, 2012 (mm)	Medium growth increase (mm)	TCSA in the year 6, 2012 (cm^2)	Differences ± versus Control (cm^2)	Significance
1	Ionathan/ M9 (Wt)	45.69	6.12	16.39	-	-
2	Ariwa/ M9	44.26	4.95	15.38	- 1.01	N
3	Golden Lasa/ M9	56.17	6.10	24.78	+ 8.39	***
4	Goldrush/ M9	38.52	3.95	11.65	- 4.74	000
5	Enterprise/ M9	59.28	6.75	27.60	+ 11.21	***
6	Inedit/ M9	47.70	5.35	17.87	+ 1.48	N
7	Iris/ M9	48.95	5.95	18.82	+ 2.43	**
8	Luca/ M9	58.03	7.35	26.45	+ 10.06	***
9	Real/ M9	44.50	5.30	15.55	- 0.84	N
10	Rebra/ M9	53.33	6.45	22.34	+ 5.95	***
11	Redix/ M9	55.83	7.65	24.48	+ 8.09	***
12	Remar/ M9	56.55	7.80	25.12	+ 8.73	***
13	Saturn/ M9	43.00	5.30	14.52	- 1.87	0
14	Voinicel/ M9	50.00	5.10	20.43	+ 4.04	***

DL 5% = 1.651 cm^2; DL 1% = 2.22 cm^2; DL 0.1% = 2.97 cm^2

Table 2. Tree crown dimensions and volume at the studied apple tree varieties in the year 6 from planting (2012)

Nr.	Variety/ Rootstock	Tree Dimensions (cm)		Crown Volume (m^3)			
		Height	Fruits fence thickness	Per tree	Differences ± versus control	Signifi-cance	Per Ha
1	Ionathan/ M9 (Mt)	210	140	2.52	6.300	-	
2	Ariwa/ M9	240	140	2.94	7.350	+ 1.050	N
3	Golden Lasa/ M9	260	150	3.45	8.625	+ 2.325	*
4	Goldrush/ M9	195	110	1.82	4.450	- 1.850	0
5	Enterprise/ M9	265	160	3.76	9.400	+ 3.100	**
6	Inedit/ M9	210	140	2.52	6.300	0	-
7	Iris/ M9	230	140	2.80	7.000	+ 700	N
8	Luca/ M9	280	165	4.12	10.300	+ 4.00	***
9	Real/ M9	270	140	3.36	8.400	+ 2.100	*
10	Rebra/ M9	265	140	3.29	8.225	+ 1.925	*
11	Redix/ M9	260	136	3.10	7.750	+ 1.450	N
12	Remar/ M9	245	145	3.12	7.800	+ 1.500	N
13	Saturn/ M9	230	130	2.60	6.500	+ 200	N
14	Voinicel/ M9	210	140	2.52	6.300	0	-

DL 5% = 1.729 mc; DL 1% = 2.336 mc; DL 0.1% = 3.117 mc

Table 3. Fruits production realized at the apple tree varieties with genetic resistance to diseases, cultivated in the high density system (2,500 trees/Ha)

No.	Variety/ Rootstock	Production obtained in the year (t/ha)				Average of the years 4 – 6 (t/ha)	Differences ± versus control	Significance
		3 2009	4 2010	5 2011	6 2012			
1	Ionathan/M9 (Mt)	3.5	15.8	24.0	21.5	21.4	-	
2	Ariwa/M9	5.5	21.9	42.0	39.0	34.3	+ 12.9	***
3	Golden Lasa/M9	5.5	19.4	29.8	19.5	22.9	+ 1.5	N
4	Goldrush/M9	5.0	20.8	29.5	17.0	22.4	+ 1.0	N
5	Enterprise/M9	1.3	12.5	28.5	31.5	24.2	+ 2.8	**
6	Inedit/M9	6.5	18.5	42.2	26.2	29.0	+ 7.6	***
7	Iris/M9	6.3	20.4	33.0	23.0	25.5	+ 4.1	***
8	Luca/M9	2.8	16.4	35.3	20.0	23.9	+ 2.5	**
9	Real/M9	7.5	18.8	29.3	27.0	25.0	+ 3.6	***
10	Rebra/M9	3.0	10.7	31.0	25.3	22.3	0 0.9	N
11	Redix/M9	2.8	16.6	23.0	21.0	20.2	- 1.2	N
12	Remar/M9	3.8	19.8	32.0	38.0	29.9	+ 8.5	***
13	Saturn/M9	5.8	21.6	42.5	31.5	31.9	+ 10.5	***
14	Voinicel/M9	4.3	18.6	29.8	21.3	23.2	+ 1.8	*

DL 5% = 1.67 t/ha; DL 1% = 2.25 t/ha; DL 0.1% = 3.01 t/ha