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THE INFLUENCE OF CLIMATIC FACTORS ON THE PRODUCTION OF APPLE VARIETIES CULTIVATED AT S.C.D.P. VOINEȘTI

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Abstract
The acquisition and expansion of apple varieties genetically resistant to diseases in cultivation have the effect of reducing the number of pesticide treatments, from 14-16 as is done in current plantations with classic varieties, to only 6-8 in orchards with genetically resistant varieties, positively reflecting in the reduction of production costs. Varieties susceptible to diseases, Ionathan, Golden delicious, Grupa Stark, represented the basis of the apple assortment 20-30 years ago, but in recent years, apple varieties with genetic resistance to diseases have increasingly appeared: Prima, Florina, Romus 3, Real, Revidar, Dacian, Inedit, etc., which will quickly enter cultivation and compete with sensitive apple varieties. Apple cultivation in our country has expanded into established fruit-growing areas, where they find the most favorable conditions for growth and fruiting. However, studies must be undertaken to highlight the influence of climatic factors on the quantity and quality of fruit production. In apple, as in other fruit species, a decisive role in increasing production potential is represented by the respect of genetic and technological elements, but also by appropriate zoning, depending on the recommended varieties and crop systems. Therefore, it is necessary to expand the cultivation of apple varieties that behave best with respect to the influence of climatic factors, but also in terms of productivity and fruit quality. Lately, the varieties that are starting to be part of the assortment of newly established orchards are apple varieties with genetic resistance to diseases. The Voinești Fruit Growing Research and Development Station, promoter of the disease-resistant apple variety, through the research undertaken and the newly obtained varieties, creates the premises for the development of modern fruit growing and the expansion of orchards, with possibilities for obtaining productions with reduced phytosanitary product residues, requested by consumers, and for protecting the environment.
Keywords: resistant varieties, climatic factors, quality and quantity of fruits.

1. INTRODUCTION

Research conducted in the field of tree cultivation shows that the orchard, in order to produce fruit at normal quality and quantity parameters, must be located in areas that meet optimal cultivation requirements.
The cultivation requirements of fruit species, including apples, are favorable in established fruit basins, located in the hill area, where fruit cultivation with long traditions, but also particularly favorable climate and soil conditions, favors the growth and fruiting of trees, cultivating varieties that adapt best to climatic factors.
The study of the influence of climatic factors on an orchard must highlight the ability to produce quality fruit, constantly and in large quantities, in order to obtain the best possible income and continue the activity in conditions of economic efficiency.
After 1990, in Romania, through the application of the Land Fund Laws, part of the intensive apple orchards returned to their former owners. Currently, these orchards are aging, over 50 years old and have a low production potential, so these plantations will have to be replaced with modern crop systems and varieties requested by consumers, those of high productivity, with high quality fruits, competitive both on the domestic market and for export.
Regarding the assortment, it should be noted that apple varieties with genetic resistance to diseases are increasingly in demand in cultivation, due to the reduced consumption of pesticide products when carrying out phytosanitary treatments, with a positive influence on reducing production costs, increasing consumer and environmental protection.
In the development of fruit growing, research results have permanently led to the change, renewal and modernization of the fruit-growing heritage, by introducing modern technologies, establishing and promoting the best varieties, developing warning bulletins for phytosanitary treatments, and providing fruit-growing seedlings.
In promoting apple varieties with genetic resistance to diseases, the Voinești Fruit Growing Research and Development Station played an important role, either through its own creations or through the study of foreign varieties, managing to largely change the concept of growers and the gradual change of the assortment.
The research conducted at the Voinești Fruit Growing Research and Development Station has as its main objective the highlighting of the behavior of apple varieties with genetic resistance to diseases in terms of production capacity and fruit quality, with a positive effect in increasing economic efficiency and protecting the environment.
To achieve the main objective, the studies and research will focus on the following specific objectives:
- The influence of climatic factors on the behavior in culture of apple varieties with genetic resistance to diseases;
- Determinations regarding resistance to environmental factors (frost);
- Establishing the particularities of growth and fruiting;
- Establishing the quality parameters of the fruits, with reference to their size and biochemical composition;
- Ripening period and fruit storage duration;
- Highlighting the economic and environmental protection effects.

2. MATERIALS AND METHODS

In order to determine the influence of climatic factors on the quality and quantity of production of some apple varieties cultivated in the Voinești area, research was organized during 2019-2022, in the apple orchards belonging to the Voinești Fruit Growing Research and Development Station.

Given the importance given to apple cultivation in Romania, as well as the change in strategy at local and national level, 7 apple varieties with genetic resistance to diseases, cultivated in an intensive system, were studied, the apple plantation being established in the spring of 2016, within the Experimental Fruit Growing Base no. 1 Voinești.

The apple varieties with genetic resistance to diseases, studied were: Real, Remar, Iris, Romus 3, Inedit, Dacian, Florina, grafted on the MM106 rootstock. The trees are planted at a distance of 4 x 2 m (1250 trees/ha), with a palmate crown shape with oblique arms.

For the apple variety studied, the behavior of the apple varieties was monitored in terms of resistance to low temperatures during the tree's dormant period, recorded in the months of December-March. The development of the flowering phenology was also monitored, depending on the evolution of climatic conditions, the degree of flowering and the recording of climatic accidents recorded until the fruit harvest.

During the study period, the performance characteristics regarding the growth and fruiting potential of apple varieties with genetic resistance to diseases were highlighted, under the conditions of the correct application of the complex of technological measures, in order not to affect the production capacity and the quality of the fruits.

In the orchard, the soil was kept clean of weeds in the row of trees and harrowed at intervals.

The soil in the row of trees was sprayed with herbicides, and in between, the grasses were mechanically mowed 2-3 times, the resulting plant mass remaining as mulch. To combat pests, 6-8 treatments were applied only with insecticides.

The soil in the orchard is brown eumezobasic, weakly pseudogleyed, with a loamy texture with a weakly acidic pH (5.7 - 5.9), the humus content is medium at the surface (2.0 - 2.9%), medium supplied with nitrogen and poorly supplied with phosphorus and potassium.

The apple variety studied

• **REAL**: was approved in 2007.

The tree of small-medium vigor, bears fruit on short formations, twigs and shoots. It is resistant to the attack of the smut (Venturia inaequalis) and weakly attacked by powdery mildew (Podosphaera leucotricha).

It bears fruit without alternation of fruiting.

The fruit weighs 185 g., is truncated, red on 2/3 of the surface. The pulp is yellowish-white, juicy, sweet and sour, good taste.

The harvest maturity takes place at the end of August - beginning of September, being a valuable variety from the group of summer varieties.

Figure 1. Real

• **IRIS**

It was approved in 2005.

The tree has medium - low vigor, very early and productive. It bears fruit on short branches (thorns) as well as on shoots and twigs. It differentiates fruit buds, every year regardless of the amount of fruit produced in the previous year.

It is resistant to the attack of the scabbard and weakly attacked by powdery mildew.

The production potential at the age of 8-10 years is 35-40 t/ha (1250 trees/ha).

The fruit is 150g., spherical, slightly flattened with a yellow-greenish skin covered on 2/3 of the surface with carmine red. The pulp is yellowish white, juicy, sweet and sour, with a good taste.

The harvest maturity takes place in mid-September, and the consumption maturity extends until the end of November.

Figure 2. Iris

• **REMAR**

It was approved in 2008.

A medium-vigorous tree with a spreading habit, bears fruit on twigs, shoots and thorns.

It bears fruit early, grafted on MM 106, bears fruit from the third year after planting.

The variety is genetically immune to scab (Venturia inaequalis) and weakly attacked by powdery mildew (Podosphaera leucotricha).

The fruit is large, weighing over 180 g (Starkrimson type), truncated, yellowish-green background color, covered on 2/3 of the surface with dark red, white pulp, juicy, good taste.

The ripening period is from the second decade of September. In storage with natural cooling it is kept until October.
It is distinguished by its precocity of fruiting, fruit quality, constant fruiting. It is recommended for apple orchards intended for organic production.

Figure 3. Remar

• INEDIT
It was approved in 2009.
The tree of medium-small vigor, with a spreading habit, bears fruit on thorns and twigs.It bears fruit early, grafted on MM 106, bears fruit from the third year after planting. The variety is genetically immune to scab and very weakly attacked by powdery mildew.
The fruit is medium-sized, conical-globose, the background color is yellowish-green, covered on 2/3 of the surface with bright red (attractive), the pulp is yellowish-white, juicy, good taste.
The ripening period is starting with the second decade of September. In storage with natural cooling it is kept until January.It is noted for its precocity of fruiting, fruit quality, storage capacity over winter. It is recommended for high-density apple orchards, intended for organic production.

Figure 4. Inedit

• DACIAN
It was approved in 2009.
The tree is of medium vigor. Resistant to the attack of the leafhopper (Venturia inaequalis) and to powdery mildew (Podosphaera leucotricha).
The fruit is large, 195-230 g, spherical in shape, slightly asymmetrical towards the calyx, the background color is yellowish-green, covered on the entire surface with orange; the pulp is cream-colored, juicy, medium firm, good taste.
Production potential 25-30 t/ha. Consumption maturity end of September-end of January.

Figure 5. Dacian

• ROMUS 3
Origin: obtained by hybrid selection in the USA, at Rutgers University, homologated in 1984. Fruit Size: medium (125 – 135g. Shape: elongated spherical - conical.
Epidermis: semi-thick, bright red on 2/3 of the surface, very attractive. Peduncle: medium. Pulp: white, medium consistency, juicy, good taste.
The tree is of medium vigor, the crown is spherical – globose, bears fruit predominantly on spikes, semi-spur. The tree has genetic resistance to scab and powdery mildew. Agronomic characteristics: enters fruiting in the 2nd year after planting; fruit production is constant around 25 t / ha; good resistance to frost and spring frosts, as well as to drought. Ripening period: first decade of August. It is considered the most valuable of the summer varieties, intended for fresh consumption.

Figure 6. Romus3

• FLORINA
The variety was obtained in Angers in France and introduced into cultivation in 1977.
In Romania it is cultivated throughout the country, being a basic variety. It is resistant to diseases, early and extremely productive.
The fruit is medium to large (150-180 g), spherical-flattened, striated in color, light red with whitish dots all over the surface, similar to freckles.

The pulp is juicy, moderately sweet and slightly acidic, crispy, very pleasantly aromatic, but becomes floury when overripe.
Maturity for consumption at the end of October, the fruits can be preserved until March.

Figure 7. Florina

Working methodology
In order to highlight the growth and fruiting potential of the apple varieties with genetic resistance to the diseases under study, observations and determinations were made regarding the growth in trunk thickness, tree crown dimensions, flowering phenology, recording of production and fruit quality, as well as the ripening period and fruit storage capacity.
The growth in trunk thickness was determined by biometric measurements of the trunk at a height of 30 cm from the ground level. The tree crown dimensions resulted from the tree height and the thickness of the fruit hedge, based on which the crown volume per tree and per unit area was calculated.
The flowering phenology was established by recording calendar data regarding the appearance of the first open flowers, mass flowering and the end of flowering. Based on these data, the duration of flowering was determined, simultaneously with the establishment of its intensity, being assessed with notes on a scale from 1 to 5. At harvest, the fruit ripening period was also recorded.
The production potential of the apple varieties studied was highlighted by the annual recording of production per tree, the data being used to calculate and express production per unit area.
Depending on the date of fruit ripening, their storage duration was determined, the apple varieties being classified as: summer varieties, summer-autumn varieties, autumn varieties and winter varieties.
The quality of the fruits was highlighted by their biomass, expressed in grams, the firmness of the pulp, expressed in kgf/cm^2, and the dry matter content expressed in percentages.
The behavior of the attack of scab and powdery mildew was determined by observations made on fruits and shoots, the attack being expressed by their frequency.
The economic and environmental protection effects resulted from the reduction in the quantities of pesticides used in phytosanitary treatments on apple varieties with genetic resistance to diseases, compared to the sensitive variety cultivated in the area.

3. RESULTS AND DISCUSSION

For apple cultivation in our country, the promotion of apple varieties with genetic resistance to diseases represents the possibility of periodic and rapid replacement of the assortment in accordance with market requirements and alignment with EU quality standards. Apple cultivation systems based on varieties with genetic resistance to diseases, grafted onto vegetative rootstocks, represent a novelty for the vast majority of fruit growers who practice apple cultivation in established areas, being interested in promoting the new.
The natural framework very conducive to tree cultivation, in established areas, the tradition and the need to use the land more intensively, by producing fruit in large and quality batches, create the premises for the development of a modern fruit cultivation in Romania.
At the same time, it should be noted that, in Romanian fruit growing, after 1989, some negative aspects were recorded (systematic decrease of the fruit heritage, reduction of total fruit production, decrease of domestic consumption of fresh fruit, as well as of industrial processing and storage activity, sharp decrease of fruit export, reduction of young plantation areas, etc.). By promoting apple varieties with resistance to diseases, the economic efficiency of the crop system increases because a reduced number of phytosanitary treatments are carried out only with insecticides. By promoting apple varieties with genetic resistance to diseases, the quantity of apples on the market increases, with fruits with low levels of pesticides, due to the reduction of the quantity of pesticide products when carrying out phytosanitary treatments by 50-55%. By reducing the costs of carrying out phytosanitary treatments, additional income for apple producers increases by at least 20%.

Determinations regarding resistance to environmental factors (frost)
During the vegetative dormancy period of the trees in the study years 2019-2022, temperatures and their influence on the damage to fruit buds were recorded:
• *Year 2019*
The climatic conditions in December 2018 started with low temperatures, recording absolute maximum temperatures of -6°C…-8.5°C in the first 3 days, with a daily average of -8.5°C recorded on 01.12.2018. After the first 3 days of December, which were quite cold, the absolute maximum temperatures became positive, as did the daily average recorded in 20 days of December, so that the average daily temperatures were 0.5 °C higher than the normal for the area of 0 °C. Cold nights with negative temperatures of -0.2 °C…-8.2 °C and even -8.6 °C (01.12.2018), kept the fruit buds in a state of deep dormancy.
January 2019 remained quite cold, with both average and absolute minimum temperatures below freezing until mid-month, with average temperatures ranging from -0.2 °C to -7.9 °C with the lowest absolute minimum of -13.0 °C recorded on 08.01.2019.

Starting in the second half of January, temperatures began to rise, with the daily average ranging between 1.1 and 6.0 °C on most days, with absolute maximums of up to 10.2 °C. Absolute minimums were generally negative, but the maximum was 4.8 °C on 22.01.2019.

Compared to the area's normal of -2.7 °C, the average monthly temperature was only -0.7 °C, but with quite cold nights that kept the fruit buds dormant.

In the last 3 days of January and in the following 3 decades of February, maximum absolute positive temperatures ranging from 1.6 °C to 19 °C were recorded, which allowed the beginning of fruit bud swelling, activating the start of tree vegetation.

Temperatures in the last decade of February dropped drastically, so that, on 23 and 24.02.2019, absolute minimum temperatures of -12.8°C-14.0°C were recorded, with average daily temperatures of -7.1 °C-7.5 °C.

The decrease in temperatures during this period was also accompanied by a layer of snow that on 23.02.2019, reached 12cm, but in the following 2 days, the snow melted and temperatures began to rise.

The month of March is characterized by positive average daily temperatures, reaching values of 13.9°C and absolute maximum temperatures of 24.2 °C (18.03.2019). Under these conditions, the trees begin to grow, which by the last decade of March reach the leafing phase of the fruit buds, more or less advanced depending on the variety.

The data presented show that the absolute minimum of -13.0 °C recorded on 08.01.2019 and even the absolute minimum temperature of -14.0 °C recorded on 24 February 2019, did not cause frost damage to the fruit buds of the apple varieties studied.

• *Year 2020*

In December 2019, daytime temperatures reached 10-1 °C and even 15-16°C, without precipitation, favoring the swelling of fruit buds in some apple varieties, without an evolution in the advanced vegetation phase, as a result of the negative temperatures recorded at night.

Positive daytime temperatures were also maintained in the first half of January and February, with values that did not exceed 10 °C, more frequent being 4 to 6 °C. Cold nights, with negative temperatures at -5….-6 °C and even -10 °C, accompanied by frost and frost on the ground, stopped the swelling of fruit buds and even their return to their original form.

March also started with positive temperatures, especially during the period 10-18.03.2020. Temperatures, without precipitation, favored the swelling of fruit buds in early apple varieties, without an evolution in the advanced vegetation phase, compared to late varieties that remained in the swelling phase of fruit buds. Therefore, the negative temperature of -4 °C recorded on 17.03.2020 did not affect the fruit buds in apple trees.

During the period 19-23.03.2020, no absolute minimum temperatures were recorded that would affect the fruit buds, even though on 23.03.2020, a snow layer of 8-10 cm was recorded, which melted almost completely on the day it fell.

After a period with maximum positive temperatures of 12-14 °C, on 31.03.2020 the temperatures dropped drastically, the absolute minimum being -2 °C, and the absolute maximum temperature during the day was 4 °C. However, on 31.03.2020 it rained lightly at night, and after 900 it started to snow, the snow layer deposited of 5-6 cm, did not melt on the same day, influencing the temperatures of the next day. Therefore, on 01.04.2020, the absolute minimum temperature dropped between 4-6 am to -5 °C.

The snow layer deposited on the newly formed leaves had a favorable effect, being protected from the low temperature of -5 °C. On 01.04.2020 the snow melted, and on the night of 02.04.2020, the absolute minimum temperature was -3 °C. The colder period lasted until 08.04.2020, after which the absolute maximum temperatures ranged between 18 and 24 °C, with absolute positive minimums between 3 and 8°C.

The temperatures triggered after 08.04.2020 determined the acceleration of the apple tree phenophase vegetation, moving from the leafing phase to the spreading, pink bud or first open flowers phases, under normal conditions.

• *Year 2021*

The temperatures in December 2020 started with lows between -1 and -5 °C, with highs of 4-8 °C keeping the fruit buds in vegetative dormancy.

Even though the first snow fell on December 8, 2020, reaching 2-3 cm, it melted from the first day, as a result of precipitation that accumulated over 45 l/sq m over 3 days. The minimum temperatures during this period were 4-5 °C, with maximums of 6-8 °C, temperatures that were maintained with small differences until almost the end of December 2020.

During the period 26-29 December 2020, rain returned in quantities that totaled over 30 l/m2, and after that the maximum temperatures were between 9 and 14 °C, maintaining them in the first days and in January 2021, against a background of minimum temperatures of 3-4 °C, which did not allow the trees to reactivate and start growing, the fruit buds of all fruit species remained in the vegetative dormancy stage.

After January 6, 2021, the weather entered a cooling process, transforming the rain into snow, which on January 11, 2021 was deposited in a 12 cm layer of snow. The influence of the snow cover and the clear sky favored the establishment of a thermal regime with negative values, with minimum temperatures ranging between -5 and 8 °C, with the lowest recorded on January 18 and 19, 2021, respectively -10 and -15 °C. During this period, maximum temperatures also had negative values of -1… -2 °C.

By the end of January 2021, temperatures were within limits that did not favor the swelling of fruit buds, which remained in vegetative dormancy.

February began with positive temperatures until the 11th, with minimums of 1-5 °C and maximums of 4-13 °C, which did not favor the swelling of fruit buds, maintaining the buds in vegetative dormancy, a phenophase that extended until the last days of the month, as after February

12, temperatures dropped below the freezing limit, the minimum being up to -10 °C (13.02.2021).
The colder period recorded on 12-17.02.2021 with minimum temperatures of -6 ... -10 °C, did not affect the fruit buds of the apple tree, as they were still in the vegetative dormancy phase. After February 22, the maximum daily temperatures were 12-16 °C, but the minimums were 1-4 °C, with frost on the ground, which caused the fruit buds to be in an incipient swelling phase.
March was quite cold with negative minimum temperatures of up to -2 °C and with maximums on most days of 4-6 °C and with a snow layer that on 10-11.03.2021 reached 17-18 cm.
The temperatures triggered after 27.03.2021 and further, in April, caused the acceleration of the apple phenophase vegetation, moving from the swelling, leafing phase, to the spreading, pink bud or first open flowers phases in the last days of April, without damage, taking place under normal conditions.
• *Year 2022*
The temperatures in December 2021, with daily minimums that ranged between 4 and 9 °C, but the cold nights with temperatures of -1 and 2 °C, or those recorded between December 21 and 24 of -4 .....-8 °C, kept the fruit buds of all fruit species in the vegetative dormancy stage phase.
Starting with the last 2 days of December and the first 6 days of January 2022, the maximum temperatures reached values of 14 - 16 °C, with minimums of 3 - 6 °C, determined a beginning of swelling of the fruit buds of the apple tree, but which returned to the initial stage as a result of the decrease in temperatures in the following period.
After 07.01.2022, the temperatures recorded during the night were negative between -1 °C and -10 °C, with daily maximums that did not exceed 7 °C, except in the last 4 days of January, when the maximum temperatures reached 8 °C, but at night the minimum negative temperatures were between -4 and -6 °C.
We mention that, in January, during the period 8 -11, precipitation was reported in the form of snow, with a layer of 5-6 cm, which on January 13 decreased to 1-2 cm, but still determined the decrease in the absolute minimum temperature to the value of -10 °C, without affecting the fruit buds.
In the first half of February, the maximum daily temperatures oscillated between 8 and 9 °C, with absolute minimum temperatures of -3...-5 °C. After February 15, 2022, the maximum daily temperatures began to increase by the end of the month to values of 10-12 °C, with minimum night temperatures of -1... -3 °C, which did not favor the swelling of fruit buds on apple trees, both due to low temperatures at night, but also due to very low precipitation.
The month of March 2022 began with negative minimum temperatures of -1... -3 °C, so that, during the period 1-20 of the month, only negative temperatures between -1 and -7...-8 °C and even -10 °C on 10.03.2022 were recorded, and during the day the maximum temperature did not exceed 5 °C, only on 14 and 15.03.2022, respectively 8 – 10 °C.
After the cooling weather, on March 5-7 and 8, 2022, it snowed, the deposited snow layer reached a thickness of over 10cm on March 8, 2022, causing the absolute minimum temperature to drop to -10 °C on March 10, 2022.
The fruit buds, being still in the vegetative dormancy stage, were not affected by the temperature of -10 °C, recorded on March 10, 2022.
After 21.03.2022, the daily absolute maximum temperatures began to increase from 12 – 15 °C, reaching values of 18 – 21 °C towards the end of March on 27 – 30.03.2022, influencing the swelling of apple buds as early as 23.03.2022, even though on some days night temperatures reached values of -1 °C.
The temperatures of 18 °C recorded after 27.03.2022, even though they occurred during a dry period of over 2 weeks, accelerated the swelling of fruit buds, influencing the appearance of leaflets, first in the hair on 28.03.2022 and then in the apple on 30 – 31.03.2022, first in early flowering apple varieties.
The temperatures triggered after 31.03.2022 and onwards, in April, accelerated the start of apple phenophase vegetation, moving from the swelling, leafing phase to the spreading, pink bud or first open flowers in the last days of April.
Therefore, in the analyzed period, 2019-2022, the minimum temperatures recorded during the trees' dormant period and until their start of vegetation, or even the appearance of the first flowers, were within limits that did not affect the fruit buds of the apple varieties studied.

Peculiarities of vegetative growth of the apple varieties studied

Trunk diameter and vegetative growth of trees

Tree growth is determined by a series of biological factors, such as: variety and rootstock, but also technological: fruit load, ensuring optimal technological measures, as well as the food and water conditions necessary for the development of physiological processes.
The vigor of trees in apple varieties with genetic resistance to diseases, taken into study, is expressed quantitatively by the volume of vegetative growth accumulated annually through the dimensions of the trunk, the height and size of the tree crown, this being dependent on the vigor of the varieties, corroborated with the degree of soil fertility, planting distance, etc., the unchanged factor is the rootstock.
The growth in diameter of the tree trunk, apple varieties with genetic resistance to diseases, cultivated in an intensive system, grafted on the MM 106 rootstock: Romus 3, Real, Remar, Inedit, Iris, Dacian and Florina, has different values.
Under the conditions of grafting the trees onto the MM 106 rootstock and at a planting distance of 4x2m (1,250 trees/ha), in the 4th year after planting, the most vigorous apple varieties proved to be Remar, Real, Dacian and Florina, in which the trunk diameter recorded values between 33.3 and 39.9 mm, followed by the Inedit variety, with a trunk size of 28.7 mm, and those with less vigor being the Romus 3 and Iris varieties, in which the trunk

size at 30 cm from the ground level was recorded as 25.5 – 26.7 mm. The growth increment of the trunk reached values of 6.1 – 13.7 mm, the smallest being recorded in the Inedit variety and the largest in the Dacian variety, being the most vigorous variety.

The number of annual increments, in the 4th year after planting, ranged between 18.0 and 40.0 increments/tree, the most being recorded in the Florina, Dacian and Real varieties with over 29.5 annual increments on average per tree.

Analyzing the average length of the annual increments, it is found that they reached 75.7 cm in the Real variety, followed by the Dacian variety with 70.2 cm. The other varieties record annual increments that exceed 49.2 cm on average, the respective value being recorded in the Iris variety, motivated by the fact that it is of lower vigor, but also the fact that in the 4th year after planting it recorded a higher production compared to the other varieties studied.

In the 5th year after planting, the most vigorous apple varieties were Remar, Real, Dacian and Florina, with trunk diameters between 49.6 and 51.8 mm, followed by the Inedit variety with a trunk size of 43.1 mm, and the less vigorous varieties were Romus 3 and Iris, with trunk diameters at 30 cm from the ground of 37.7 – 41.8 mm. The trunk growth rate reached values of 10.3 – 16.7 mm, with the lowest being recorded for the Iris variety and the highest for the Dacian variety, which is one of the most vigorous varieties.

The number of annual increments, in the 5th year after planting, ranged between 29.3 and 51.7 increments/tree, most being recorded in the Florina, Dacian and Real varieties with over 43.7 annual increments on average per tree.

Analyzing the average length of the annual increments, it is found that they reached 77.2 cm in the Real variety, followed by the Florina and Dacian varieties with 67.0 cm and 66.7 cm, respectively. The other varieties record annual increments that exceed 43.0 cm on average, the respective value being recorded in the Romus 3 and Iris varieties, motivated by the fact that they are of lower vigor.

In the 6th year after planting, the most vigorous apple varieties proved to be Remar, Real, Dacian and Florina, with trunk diameters between 59.7 and 65.4 mm, followed by the variety: Inedit with a trunk size of 54.3 mm, and the varieties with less vigor were Romus 3 and Iris, with trunk sizes at 30 cm from the ground of 46.1 - 49.7 mm. The trunk growth rate reached values of 7.9 - 14.4 mm, with the lowest being recorded for the Iris variety and the highest for the Dacian variety, which is one of the most vigorous varieties. From the 6th year after planting, the tree crowns have united, so the dimensions of the tree crowns were recorded, through the height and thickness of the fruit hedge, based on these data calculating the crown volume in cubic meters/tree and cubic meters/ha.

The volume of the tree crown ensures the supporting structure of the branches, leaves and fruits. Depending on the type of orchard, the volume of the crown differs, both at the tree level and at the level of the surface unit. Through its structure, the volume of the crown must ensure the penetration of light to all the semi-skeleton elements, the essential condition to maintain its covering with fruit branches in order to have the highest possible productive volume.

The volume of the crown depends on the dimensions of the trees, which is largely influenced by the vigor of the variety. Based on the vigor data of the trees, the crown volume was calculated at the tree level and in relation to the surface unit.

Regarding the crown volume recorded in the 6th year after planting, at tree level, it ranged from 1.87 m3/tree for the Romus 3 variety and 2.64 m3/tree for the Florina soil, the apple varieties being grafted onto the MM 106 rootstock. The crown volume calculated per unit area generally follows the same classification of the varieties' vigor, considering the planting density of 1,250 trees/ha for all varieties.

Thus, the highest crown volume was recorded for the Florina, Real, Remar, Dacian and Iris varieties with values of 2,725 - 3,300 m3/ha, compared to the Romus 3 and Inedit varieties, which recorded a productive volume of 2,337 - 2,475 m3/ha.

In the 7th year after planting), the most vigorous apple varieties proved to be Remar, Real, Dacian and Florina, in which the trunk diameter recorded values between 70.7 and 78.1 mm, followed by the Inedit variety with a trunk size of 64.3 mm, and those with less vigor being the Romus 3 and Iris varieties in which the trunk size at 30 cm from the ground level was recorded as 55.3 - 56.4 mm. The growth increment of the trunk reached values of 6.7 - 12.7 mm, the smallest being recorded in the Iris variety and the largest in the Dacian variety, being one of the most vigorous varieties.

Regarding the crown volume recorded in the 7th year after planting, at tree level, it ranged from 2.09 m3/tree for the Inedit variety and 2.64 m3/tree for the Florina and Real varieties, the apple varieties being grafted onto the MM 106 rootstock. The crown volume calculated per unit area generally follows the same classification of the varieties' vigor, considering the planting density of 1,250 trees/ha for all varieties. Thus, the highest crown volume was recorded for the Florina, Real, Remar, Dacian and Iris varieties with values of 5,850 - 6,600 m3/ha, compared to the Romus 3 and Inedit varieties, which recorded a productive volume of 5,225 - 5,400 m3/ha. From the point of view of vegetative growth, the apple varieties studied are suitable for expansion in intensive orchards, with a planting distance of 4x2 m, at a density of 1,250 trees/ha.

Centralizing the data, depending on the growth in diameter of the tree trunk, after 7 years from planting, apple varieties with genetic resistance to diseases, cultivated in an intensive system, grafted on the MM 106 rootstock, have different values.

Under the conditions of grafting the trees onto the MM 106 rootstock and at a planting distance of 4x2m (1,250 trees/ha), in the 7th year after planting, the most vigorous apple varieties proved to be Remar, Real, Dacian and Florina, in which the trunk diameter recorded values between 70.7 and 78.1 mm, followed by the variety: Inedit

with a trunk size of 64.3 mm, and those with less vigor being the varieties Romus 3 and Iris in which the trunk size at 30 cm from the ground level was recorded as 55.3 – 56.4 mm. The average annual growth rate of the trunk reached values between 9.32 mm in the Romus 3 variety, up to 13.30 mm in the Real variety.

Fruiting characteristics of the apple varieties studied

Phenological phases of fruiting bodies

Depending on the evolution of climatic conditions, the observations regarding the development of the phenophases of the fruiting bodies referred to the beginning of flowering, mass flowering and the end of flowering.

From the recorded data, there is a variability regarding the beginning of flowering, being genetically determined, developing year after year in a certain sequence, always the same regardless of the evolution of climatic conditions from the beginning of vegetation.

Depending on the climatic conditions of the year, namely very early or very late spring, the same succession of varieties is observed, usually in the months of April - May. Knowledge of the phenophases of flowering is necessary for grouping varieties in order to ensure mutual pollination.

In 2019, the rather low temperatures in February, but especially those in the last decade, when the absolute minimum temperatures of 12.9 °C.... 14.0 °C recorded on 22 and 24.02.2019, kept the fruit buds of apple trees in vegetative dormancy. The beginning of the swelling of the fruit buds and the activation of the start of the vegetation of the trees took place starting with the first decade of March when the absolute maximum temperatures exceeded 14°C, reaching even 24.2°C on 13.03.2019.

A sharp activation of the vegetation of the trees, starting with the triggering of the leafing of the fruit buds of apple trees, takes place after 01.04.2019, when the absolute maximum temperatures in the first decade are between 14 and 21.1 °C.

The absolute maximum temperatures of 23.0 - 26.1° C recorded during the period 25 - 30.04.2019, determined a rapid evolution of the phenophases of the fruit buds, triggering the flowering of the apple trees, through the appearance of the first flowers and mass flowering.

The first flowers opened in the Iris apple variety, on 22.04.2019, followed by the Romus 3 variety after 2 days, respectively on 24.04.2019. In the other varieties, flowering was triggered during the period 28-30.04.2019. Due to the absolute maximum temperatures of 23.0 - 26.1°C, mass flowering is recorded 2-3 days after the beginning of flowering, respectively on 24-26.04.2019 for the Iris and Romus 3 varieties and on 26-28.04.2019 for the other varieties. The end of flowering is recorded in the first days of May, respectively on 02.05 - 05.05.2019, with a flowering duration of between 7 and 11 days.

The intensity of flowering, according to the degree of flowering, is assessed with grades of 4 and 5, with the guarantee of achieving normal fruit production.

In 2020, temperatures from January to March with minimums below the threshold for trees to start growing and even negative, with frost, snow and ground frost, but also the negative temperatures of -5°C on 01.04.2020, kept the fruit buds in the early stages of vegetation.

The activation of the trees to start growing takes place after the first decade of April when the absolute minimum temperatures were 18-24°C, which determined a rapid evolution of the phenophases of the fruit buds, triggering the flowering of the apple trees, through the appearance of the first flowers and mass flowering.

The plantation with the apple varieties studied, being located closer to the Dâmboviţa riverbed and with the differentiation of the fruit buds on the annual branches, recorded a later flowering.

Therefore, the first flowers opened in the Iris apple variety on 18.04.2020, followed one day later by the Romus 3 variety, respectively on 19.04.2020. In the other varieties, flowering was triggered with a delay of 4-8 days due to the low minimum temperatures during the night, which were 6 - 7° C.

The absolute maximum temperatures of 23.0 - 24 °C accelerate mass flowering, so that in the Iris and Romus 3 varieties it is recorded on 18.04.2020 and on 24 and 25.04.2020 and on 26.04 - 03.05.2020 in the other varieties, practically after 4-6 days from the first flowers opened. The end of flowering occurs for the Iris and Romus 3 varieties towards the end of April, on 28 and 30.04.2020, and at the beginning of May for the other varieties, on 02-07.05.2020. Given the rather fluctuating temperatures during the flowering period, with absolute minimums of 1 - 6 °C and absolute maximums of 14 - 24 °C, the flowering period was extended, reaching 9-11 days, with 9 days for the Remar, Inedit and Dacian varieties and 10-11 days for the other varieties: Real, Iris, Florina and Romus 3.

The intensity of flowering, according to the degree of flowering, is assessed with grades of 3 and 5, with the guarantee of achieving normal fruit production with appropriate binding of the apple varieties studied.

In 2021, the temperatures in January-March, with minimums below the threshold for trees to start growing and even negative, with frost, snow and frost on the ground, but also the negative temperatures recorded throughout almost the entire month of March, the lowest being -3 °C on 9 and 24.03.2021, kept the fruit buds in the early stages of starting to grow.

The activation of the trees to start growing takes place after the first decade of April, when the absolute minimum temperatures were 18 - 24 °C, these determined a rapid evolution of the phenophases of the fruit buds, triggering the flowering of the trees in the apple species, through the appearance of the first flowers and mass flowering.

The data on the registration of flowering phenophases in apple varieties cultivated in an intensive system, located within the Experimental Base no. 1 Voinești, are presented in table 4.9.

The first flowers opened in the apple variety Romus 3, on 28.04.2021, followed one day later by the Inedit and Iris varieties, respectively on 29.04.2021. In the other varieties, flowering was triggered with a delay of 4-5 days, being influenced by the evolution of temperatures, but also genetically determined, taking place annually in

a certain sequence. The absolute maximum temperatures of 23.0 - 25 °C, recorded in the first days of May, accelerate mass flowering, so that in the Iris and Romus 3 varieties it is recorded on 02 - 03.05.2021 but also in the Inedit variety.
For the other apple varieties, mass flowering is recorded on 08-07.05.2021 at an interval of 5 - 7 days from the first open flowers. The end of flowering occurs for the Iris and Romus 3 varieties towards the end of the 1st decade of May on 08 - 09.05.2021 and on 11 - 13.05.2021 for the other varieties. Given the quite fluctuating temperatures during the flowering period, with absolute minimums of 2 - 10 °C and absolute maximums of 18 - 24 oC, with cloudy skies on certain days, the flowering period was extended, reaching 11-13 days, with 11 days for the Romus 3, Real and Iris varieties, 12 days for the Remar, Dacian varieties and 13 days for the Inedit and Florina varieties.
The intensity of flowering, after the flowering period, is assessed with grades of 3, 4 and 5, with the guarantee of achieving normal fruit production with appropriate binding of the apple varieties studied.
In 2022, the temperatures in January-March, with minimums below the threshold for trees to start growing and even negative, with frost, snow and frost on the ground, but also the negative temperatures recorded in almost the entire month of March, the lowest being -10 °C on 10.03.2022, kept the fruit buds in the early stages of starting to grow.
The activation of the start of tree vegetation takes place after 21.03.2022, when the maximum daily absolute temperatures began to increase from 12 - 15 °C, reaching values of 18 - 21 °C towards the end of March, on 27 - 30.03.2022 and especially in April, determining a more accelerated evolution of the phenophases of the fruit buds, deceasing the flowering of the apple trees, through the appearance of the first flowers,
The first flowers opened in the apple varieties Romus 3, Iris and Florina, on 01.05.2022, followed 1-3 days later by the varieties: Inedit, Dacian, Real and Remar, respectively on 02-04.05.2022.
The absolute maximum temperatures of 18.0 - 20 °C, recorded in the first days of May, accelerate mass flowering, so that for the Iris and Romus 3 varieties it is recorded on 04.05.2022, followed by the other apple varieties. Mass flowering is recorded on 04 - 07.05.2022 at an interval of 5 - 7 days from the first open flowers. The end of flowering occurs for the Iris, Dacian and Florina varieties, on 11.05.2022.
Considering the quite fluctuating temperatures during the flowering period, with absolute minimums of 5 - 7 °C and absolute maximums of 18 - 22 °C, with cloudy skies on certain days, the flowering period was extended, reaching 10-12 days, with 10 days for the Remar and Dacian varieties, 11 days for the Real and Iris varieties, and 12 days for the Romus 3 and Inedit varieties.
The flowering intensity, according to the degree of flowering, is assessed with grades of 3, 4 and 5, with the guarantee of achieving normal fruit production at a proper setting of the apple varieties studied.
Centralizing the data, the following can be noted:
- From the data recorded between 2019 and 2022, the first flowers opened in the apple varieties Iris and Romus 3 in the years with the onset of early vegetation in mid-April (18-19.04), and in the years when the trees start vegetation later, flowering began towards the end of April (22-24.04) and even the beginning of May (01.05)
- The end of flowering ends in the varieties Iris and Romus 3, in the years with the onset of early vegetation, in the last days of April and until the last days of the first decade of May, in the years with the onset of delayed vegetation. For the other apple varieties studied: Real, Remar, Inedit, Dacian, Florina, the end of flowering is recorded in the first days of the first decade of May until May 10-13.
- The duration of flowering recorded in the years 2019-2022 was generally between 7-13 days depending on the evolution of climatic conditions, with the specification that, in all years of study, the apple varieties had conditions for proper fruit setting, conditioned by the degree of flowering appreciated with grades, generally of 4-5, except for the Dacian variety with grades of 3-4.
It is appreciated that the apple varieties with genetic resistance to diseases, studied, partially or totally overlap during flowering, with the possibility of grouping them in a single plot for mutual pollination.

Ripening period and fruit storage period
The range of apple varieties, including apple varieties with genetic resistance to diseases, must ensure fresh fruit for consumption for as long as possible.
One of the important characteristics taken into account when establishing the assortment is the storage capacity. This characteristic is important because the producer has the opportunity to offer fruit on the market in the cold season, when the price is higher, on the one hand, and on the other hand, it ensures an extension of the consumption period, when there are no more fruits in the orchard.
The 7 apple varieties with genetic resistance to diseases, taken into study, have different ripening and consumption periods. The ripening period is staggered from the first decade of August to the beginning of October, and the consumption period from September to March.
Depending on the ripening and storage period of the fruits, apple varieties with genetic resistance to diseases are grouped as follows:
- summer varieties, with fruit ripening during 01-31.08, with fruit storage for 15-30 days: Romus 3, Real;
- summer-autumn varieties, with fruit ripening during 01-10.09, with fruit storage for 40-50 days: Remar;
- autumn varieties, with fruit ripening during 15-25.09, with fruit storage for 70-105 days: Iris, Dacian;
- winter varieties, with fruit ripening during 25-30.09, with fruit storage for 145-150 days: Inedit, Florina.
- Having in culture apple varieties with genetic resistance to diseases, both creations of S.C.D.P. Voinești, as well as those from abroad, can provide fresh fruit for consumption from the first decade of August until March, with winter varieties being stored in warehouses with natural cooling.

Production potential

One of the priority objectives of the study undertaken is the assessment of production capacity, being the most important characteristic in promoting varieties for the establishment of new commercial plantations.

The high productive potential, associated with superior fruit quality, expresses to the highest degree the ability of the apple varieties with genetic resistance to diseases under study to assimilate and capitalize on the ecological conditions of the area in which they are cultivated. The productivity of apple varieties with genetic resistance to diseases, which is the subject of the present study, is a complex characteristic, genetically determined by the hereditary base from which it comes, but is influenced by the interaction between the soil and the climatic conditions of the cultivation area. Other factors that contribute to shaping this characteristic of the apple varieties with genetic resistance to diseases studied are related to the precocity of fruiting, the type of fruiting, the technology applied, resistance to diseases and pests, compatibility with grafting and pollination, planting density and the rootstock used. Based on the studies addressed, it is established which of the apple varieties with genetic resistance to diseases meet the optimum expression of the biological production potential, under the climatic conditions of the Dâmboviţa Fruit Basin.

The recording of apple production at ground level, in the years 2019 - 2022 nominates the earliest varieties grafted on a medium-vigorous rootstock (MM106), but also their production capacity.

In apple varieties with genetic resistance to diseases, cultivated in an intensive system, grafted on the MM 106 rootstock, the first harvest in modest quantities was recorded in the 4th year after planting, the highest being in the Iris and Inedit varieties, of 5.4 - 6.2 t/ha.

In the 5th year after planting, the highest productions were recorded in the Real and Remar varieties, with 11.1 - 12.9 t/ha and satisfactory productions, ranging between 5.3 and 8.2 t/ha, in the other apple varieties. In the 6th year after planting, the highest productions were recorded for the apple varieties Florina (20.3 t/ha), Remar (19.2 t/ha), Inedit (17.4 t/ha) and Real (16.0 t/ha). Satisfactory productions were recorded for the varieties: Romus 3, Dacian and Iris ranging between 8.1 and 9.3 t/ha.

In the 7th year after planting, the highest productions were recorded for the apple varieties Florina (26.2 t/ha), Remar (24.5 t/ha), Real (20.5 t/ha) and Inedit (19.5 t/ha). Satisfactory productions were recorded for the varieties: Romus 3, Dacian and Iris ranging between 12.0 and 16.5 t/ha. Analyzing the average of the 4 years of study, it is found that the Real, Remar, Inedit and Florina apple varieties stand out from the other varieties, with average productions of 12.6 – 14.5 t/ha being recorded.

Fruit quality parameters

Apples intended for fresh consumption or processing must be healthy, have reached commercial or consumer maturity and have organoleptic properties specific to the variety. In order to sell apples at higher prices, they must meet the standards imposed by the market and maintain their quality both after harvest and during storage and delivery. Fruit quality is genetic in nature and is influenced by the variety, the degree of maturation, the action of environmental factors, as well as technological factors. The effects of the interaction of these factors materialize by obtaining fruits with special qualities or can be negatively influenced to lower qualities.

Vegetative rootstocks of reduced vigor contribute significantly to increasing the quality of apples, if the varieties are cultivated under appropriate ecological conditions and some technological performance measures are applied. Average weight and size are important elements in assessing the commercial quality of the fruits. These constitute varietal characteristics and can be influenced to a greater or lesser extent by the quantity of production, the age of the tree, the applied cultivation technology and the climatic conditions of the year.

The interest in obtaining large fruits, with high commercial value, represents one of the major objectives in the pomological appreciation of the variety.

It is known that in European standards, the dimensions of the apples are much superior to those obtained in Romania. Under these conditions, it is necessary to be exact when choosing varieties to promote them in commercial crops and to apply an adequate technology to achieve this objective.

The size of the fruit associated with an intense and uniform color (Ionathan type red or Golden delicious type yellow) and a symmetrical shape, gives the fruit the necessary appearance and attractiveness. The study conducted on apple varieties with genetic resistance to diseases, cultivated in a high-density system, reveals a genetic variability regarding the size of the fruits.

A variability of the size of the fruits was found between the apple varieties studied. During the study period 2019 – 2022, in trees cultivated in an intensive system, at the age of 4 – 7 years, the biomass of the fruits fluctuated from year to year within more or less limits, from variety to variety . In varieties with smaller fruit sizes such as the Romus 3, Inedit and Iris varieties, the biomass of the fruits fluctuated from 145 to 160g, with an average for years 4 – 7 of 146 – 158g. In the varieties: Real, Remar, Dacian and Florina, the fruits exceeded 165g, reaching up to 230g in the Dacian variety with a 4-year average of 168 - 212g.

The classification of apple varieties with genetic resistance to diseases, taken into study, depending on the biomass of the fruits, results from the average weight, respectively: with the largest fruits, the varieties Real, Remar, Dacian stand out, with fruits of 168 - 212g.

The smallest fruits are recorded in the varieties: Romus3, Inedit and Iris with fruit size of 146 - 158g.

Analyzing the quality parameters of the fruits, in the period 2019 - 2022, in the apple varieties with genetic resistance to diseases, taken into study, they have different values depending on the variety.

The firmness of the fruit pulp is considered appropriate when it is compact, crispy or fine, with a uniform color. A low firmness (mealiness) is considered inappropriate and is generally found in overripe fruits.

A hard, coarse consistency, with areas of glassiness, is also negatively assessed.

Under the conditions of the years 2019 - 2022, the firmness of the fruit pulp at harvest recorded values between 8.2 kgf/cm2 and 11.8 kgf/cm2. The lowest values were recorded for the apple varieties Romus 3 and Iris with 8.2 - 8.5 kgf/cm2, presenting a less dense pulp at harvest, also as a result of the shorter storage period of the fruits.

The highest values are attributed to the Remar, Real, Inedit, Dacian and Florina varieties with values of over 9.8 kgf/cm2 to 11.8 kgf/cm2.

Analyzing the average values of pulp firmness, it is found that the Remar, Real, Inedit, Dacian and Florina varieties record values of 10.3 – 11.1 kgf/cm2, compared to the Romus 3 and Iris varieties with values of 8.9 – 9.4 kgf/cm^2.

The dry matter content of apple varieties with genetic resistance to diseases, in the period 2019 - 2022, was maintained within limits between 11.3 and 15.5%.

The apple varieties with the lowest values reported on average for the years 2019 - 2022 were Romus 3 and Real with 12.0 – 12.9% and with higher values the apple varieties Remar, Inedit, Iris, Dacian, Florina with 13.0 – 14.4%.

In the Dâmbovița Fruit Basin, which also includes the Voinești fruit growing area, there are favorable conditions for both apple cultivation and specific conditions for the development of diseases, especially apple scab (Venturia inaequalis).

In order to ensure an appropriate phytosanitary condition, in apple orchards with varieties susceptible to diseases (Jonathan, Goldspur, etc.), a number of 12-14 interventions with phytosanitary products are applied, especially to combat scab and powdery mildew attacks.

The high costs recorded in carrying out phytosanitary treatments to obtain quality fruits have led to the introduction of valuable, but more resistant or tolerant varieties into the crop, representing a step forward in solving this problem for fruit producers.

Under the specific conditions of the study years, when 7-8 sprayings were carried out only with insecticides, the behavior of the disease-resistant apple varieties grown in the orchard, taken into study, to scab and powdery mildew attacks, was evaluated.

Research and observations carried out in the orchard on the 7 apple varieties studied highlight that, in apple varieties with genetic resistance to diseases, which have as a source of resistance the Vf gene - Venturia floribunda 821, both on leaves and especially on fruits, it did not allow infection with scab (attack degree = 0); all apple varieties with genetic resistance to diseases studied show field resistance to scab.

In the case of powdery mildew attack, a degree of attack on the leaves was recorded in the percentage of 0.6 - 6.5%, with the Remar, Iris and Inedit varieties being more resistant to powdery mildew.

Compared to the established controls (Jonathan and Golden delicious), it appears that all apple varieties with genetic resistance to diseases studied proved superior in terms of resistance to scab and powdery mildew (Table 4.15).

Following the observations made, it results that the apple varieties with resistance to diseases, taken into study, presented maximum resistance to scab, materialized in the total absence of attack on the leaves, therefore they are field-immune to scab, and were affected in a reduced percentage by the powdery mildew attack.

Economic and environmental protection effects

Apple cultivation represents one of the profitable sides of horticulture, but this depends largely on the variety used, the type of orchard and the extent to which the cultivation technology is respected.

It is appreciated that the introduction of apple varieties with genetic resistance to diseases into cultivation is increasingly necessary, as a result of both economic efficiency, but also the fact that they represent the main factor in obtaining healthier and more environmentally friendly productions.

Voinești Resort has been and remains the promoter of disease-resistant varieties, both through its own creations and those introduced from abroad, with productive varieties and quality fruits, which lead to an increase in the competitive level on the Romanian market and the development of organic fruit production according to consumer requirements.

By promoting apple varieties with genetic resistance to diseases in culture, the new plantations established constitute links of efficient and more ecological economic technology, with immediate effect by completely or partially eliminating fungicide spraying.

The data obtained demonstrate that, between the resistant and sensitive apple varieties, there are significant differences regarding the total number of warned treatments required during a year, the quantities of pesticides applied per hectare and the related costs.

From the data presented, it results that in the orchard with susceptible varieties (Ionathan, Golden delicious) the number of treatments performed during the vegetation period was 14, while in the orchard with resistant varieties it was 8. The economic effects are felt as follows: in the orchard with resistant apple varieties, by eliminating fungicides in a proportion of 68% and reducing those with insecticides - acaricides by about 20%, the costs of pesticide products when performing phytosanitary treatments are reduced by 56%, compared to sensitive varieties. This means that in orchards with disease-resistant varieties, 42.9% fewer sprayings can be applied, and their costs are almost 50% lower compared to orchards with classic, sensitive varieties. Also, diesel consumption is reduced by 42.9%, by reducing the number of passes in the orchard for phytosanitary treatments.

In conclusion, the almost complete elimination of fungicide products and the use of insecticides with a high degree of selectivity, correlated with the quality and productivity of the apple varieties with genetic resistance to diseases studied, justifiably support the economic and environmental protection effects. Research conducted at the Voinești Fruit Growing Research and Development Station during 2019-2022 focused on studies on the influence of climatic factors on the production and

performance characteristics of some apple varieties with genetic resistance to diseases, cultivated in an intensive system, grafted on the MM 106 rootstock, drawing a series of useful conclusions and recommendations for apple growers in the Dâmbovița Fruit Growing Basin.

4. CONCLUSIONS

1. From the analysis of the climatic factors recorded in the Voinești area, in the 4 years of study (2019-2022): temperature, precipitation, atmospheric humidity and duration of sunshine, ensure the growth and fruiting of the apple tree in optimal conditions, with some insignificant deviations that are not likely to calamitate production, phenomena that did not occur during the study period.
2. In the years 2019 - 2022, the minimum temperatures recorded during the dormant period of the trees and until they start growing, or even when the first flowers appear, were within limits that did not affect the fruit buds of the apple varieties with genetic resistance to the diseases studied.
3. Under the conditions of grafting trees onto the MM 106 rootstock and at a planting distance of 4x2m (1,250 trees/ha), in the 7th year after planting, the most vigorous apple varieties proved to be Remar, Real, Dacian and Florina, in which the trunk diameter recorded values between 70.7 and 78.1 mm, followed by the variety: Inedit with a trunk size of 64.3 mm, and those with less vigor being the varieties Romus 3 and Iris in which the trunk size at 30 cm from the ground level was recorded as 55.3 – 56.4 mm. The growth increment of the trunk reached values of 6.7 – 12.7 mm, the smallest being recorded in the Iris variety and the largest in the Dacian variety, being one of the most vigorous varieties.
4. The average growth rate for the period 2018 – 2022, at the age of trees 3 – 7 years, was between 9.32 and 9.60 mm for the Romus 3 and Iris varieties, being the varieties with the lowest vigor, among the disease-resistant apple varieties studied, and 12.12 – 13.30 mm for the varieties: Florina, Dacian and Real, being the most vigorous. Intermediate values of the growth rate are recorded for the Inedit and Remar varieties, respectively 10.42 – 10.62 mm.
5. The number of annual increments, in the 3rd year after planting, ranged between 5.8 and 11.3 increments/tree, the most being recorded for the Florina, Dacian, Real, Inedit and Iris varieties with over 7 annual increments on average per tree.
6. The number of annual increments, recorded in years 4 - 5 from planting, ranged from 18 to 40 increments/tree, in year 4 and from 37.7 - 51.7 increments/tree in year 5 from planting, their number being correlated with the growth vigor of the apple varieties studied.
7. The average length of the annual increments, recorded in years 3 - 5 from planting, has values of 31.6 - 60.1 cm in year 3 from planting and 43.0 - 77.2 cm in years 4 - 5 from planting, higher values being attributed to apple varieties with more vigorous growth.
8. In the 6th – 7th year after planting, the tree dimensions reached values specific to fruit hedges, both in height and thickness, but also in the union of the crown between 2 trees, determining a continuous fruit hedge and a crown volume differentiated in size.
9. The crown volume calculated per unit area generally follows the same classification of the vigor of the varieties, considering the planting density of 1,250 trees/ha for all varieties.
Thus, the highest crown volume, in the 7th year after planting, was recorded for the Florina, Real, Remar, Dacian and Iris varieties with values of 5,850 – 6,600 m^3/ha, compared to the Romus 3 and Inedit varieties, for which a productive volume of 5,225 – 5,400 m^3/ha was recorded, being doubled compared to the 6th year after planting, ensuring a production potential corresponding to the age of the trees.
10. From the data recorded between 2019 and 2022, the first flowers opened on the Iris and Romus 3 apple varieties in years with early vegetation onset in mid-April (18-19.04), and in years when the trees start vegetation later, flowering began towards the end of April (22-24.04) and even the beginning of May (01.05).
11. The end of flowering for the Iris and Romus 3 varieties, in years with early vegetation onset, is in the last days of April and until the last days of the first decade of May, in years with late vegetation onset. For the other apple varieties studied: Real, Remar, Inedit, Dacian, Florina, the end of flowering is recorded in the first days of the first decade of May until May 10-13.
12. The flowering duration recorded in the years 2019 – 2022 was generally between 7 – 13 days depending on the evolution of climatic conditions, with the specification that, in all years of study, the apple varieties had conditions for proper fruit setting, conditioned by the degree of flowering appreciated with grades, generally 4 – 5, except for the Dacian variety with grades of 3 – 4.
13. The apple varieties with genetic resistance to diseases, taken into study, overlap partially or totally during flowering, with the possibility of grouping them in a single plot for mutual pollination.
14. The 7 apple varieties with genetic resistance to diseases, taken into study, have different ripening and consumption periods, ripening periods that are staggered starting with the first decade of August until the beginning of October, and the consumption period from September to March.
15. Depending on the ripening and storage period of the fruits, apple varieties with genetic resistance to diseases are grouped as follows:
- summer varieties, with fruit ripening in the period 01-31.08, with fruit storage for 15-30 days: Romus 3, Real;
- summer-autumn varieties, with fruit ripening in the period 01-10.09, with fruit storage for 40-50 days: Remar;
- autumn varieties, with fruit ripening in the period 15-25.09, with fruit storage for 70-105 days: Iris, Dacian;
- winter varieties, with fruit ripening in the period 25-30.09, with fruit storage for 145-150 days: Inedit, Florina.
16. The promotion of apple varieties with genetic resistance to diseases, to private fruit growers in established fruit basins, has the advantage of obtaining quality fruit production, beneficial to consumers.

17. In apple varieties with genetic resistance to diseases, cultivated in an intensive system, grafted on the MM 106 rootstock, the first harvest in modest quantities was recorded in the 4th year after planting, the largest being in the Iris and Inedit varieties, of 5.4 – 6.2 t/ha.
18. Analyzing the average production recorded in the 4 years of study, it is found that the apple varieties Real, Remar, Inedit and Florina stand out from the other apple varieties studied, being recorded, average productions of 12.6 - 14.5 t/ha, reaching a production potential of over 20 t/ha starting with the 7th year from planting, at a density of 1250 trees/ha, with trees grafted on the MM 106 rootstock.
19. The classification of apple varieties with genetic resistance to diseases, studied, depending on the biomass of the fruits, results from the average weight, respectively: with the largest fruits, the Real, Remar, Dacian varieties stand out, with fruits of 168 - 212g. The smallest fruits are recorded in the varieties: Romus3, Inedit and Iris with fruit sizes of 146 - 158g.
20. Analyzing the average values of pulp firmness, it is found that the Remar, Real, Inedit, Dacian and Florina varieties register values of 10.3 – 11.1 kgf/cm^2, compared to the Romus 3 and Iris varieties with values of 8.9 – 9.4 kgf/cm^2.
21. The dry matter content of apple varieties with genetic resistance to diseases, in the period 2019 - 2022, was maintained within limits between 11.3 and 15.5%.
22. The apple varieties with genetic resistance to diseases studied show good resistance to the attack of the apple scab (Venturia inaequalis) and increased resistance to the attack of powdery mildew (Podosphaera leucotricha), with an insignificant degree of attack.
23. Compared to the disease-sensitive apple variety, to which a number of 14 phytosanitary treatments were applied, only 8 treatments were required for the resistant apple variety, usually with insect-acaricides, however, fungicides were also applied for a preventive treatment for bacterial burn and 1-2 treatments before harvest to combat sooty mold and storage diseases.
24. The economic effects of apple varieties with genetic resistance to diseases are materialized by the reduced cost of phytosanitary treatments, which is 2 times lower than in orchards with classic, sensitive varieties, and the consumption of diesel fuel, which is reduced by 53%.
25. By promoting disease-resistant apple varieties in cultivation, beneficial economic results are obtained for producers, environmental protection and apple lots with reduced pesticide residues, increasingly demanded by consumers.

Recommendations

- Apple varieties with genetic resistance to diseases are recommended for expansion in established fruit-growing areas in our country, due to the high economic efficiency of the method of replacing the assortment with varieties that lead to obtaining apple lots with reduced pesticide residues, increasingly requested by consumers;
- Of the apple variety with genetic resistance to diseases, taken into study, the most precocious and productive varieties that are suitable for promotion in an intensive system are: Real, Inedit, Remar, Florina, which achieved average productions, over the four years of study, of 12.6 - 14.5 t/ha, with quality fruits, corresponding to market requirements;
- The apple variety with genetic resistance to diseases is suitable for intensive cultivation, with trees grafted on medium-vigorous rootstocks (MM 106), at distances of 4 x 2 m, with a planting density of 1,250 trees/ha.

5. REFERENCES

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