

THE INFLUENCE OF CLIMATIC CONDITIONS ON THE PECULIARITIES OF GROWTH AND FRUITFULNESS, AND THE FRUIT QUALITY OF APPLE VARIETIES

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Abstract

In recent years, production increases are achieved not by expanding the area occupied by trees, but through crop intensification. The main focus is to replace traditional crops (with large trees) and super intensive orchards. Is expanding propagation, in vitro "by meristem culture to obtain seedlings "free" viruses. Will increase in the future and concentrating cultures of different species pools and religious centers, edaphic and climatic conditions that provide the required association sort-rootstock in order to maximize the potential of the biologic. Fruit growing enroll more fully by way of technical progress. It is becoming more dynamic following a swift adaptation to the requirements of the global market.

Keywords: variety, influence, climatic conditions, quality, apple.

1. INTRODUCTION

The quality of a product should not be regarded only as its external appearance and after some physical attributes, but also by the content of active biochemical principles, which give the energy value of the product.

The concept of quality includes four types of features, namely:

- biological value principles that content high biological value ;
- organoleptic qualities: taste, smell, colour, consistency;
- quality traits related to industrial processing technology
- hygienic quality .

Shape is one of the first features to be taken into account in assessing the quality of a product.

Size depends very much on the fruit developed. The high demand is for fresh consumption, medium and large fruits. The fruit too large, besides being easy to be knocked down by winds have difficulty in packaging and recovery. On apple fruit, flesh is loose, comparable to the size of the typical variety and difficult to store.

With a shortage of fruit on tree growth it develops excessively vigorous shoots. Therefore, determining the optimal load of fruit per tree leads not only to make production quality but also to balance all plant functions. Fruit colour is a feature for assessing their quality and at the same time an indicator for assessing the degree of maturity to harvest. There are three colours: background colour, colour of skin coverings and colour overlay. The background colour of skin present in all varieties forms whether or not the fruit is exposed to sunlight. It can be green, yellow, white or intermediate shade between these colours. The green colour is due to chlorophyll, the yellow to carotenoid pigment. Cover colour occurs in some varieties.

It is set relatively evenly over colour background, as pink, red or purple on the sunny side of the fruit, or the entire surface in the case the background colour is fully marked.

The intensity of colour coatings is influenced by the nature of the soil but also to the decrease of the repeated under the optimum temperature overnight, the various mechanical damage, etc. of the trees. Colour overlay is in the form of stripes or striate arranged over colour cover. It is common in apple varieties. To achieve a more intense colour of the skin of fruit, red fruit varieties should be placed in favourable exhibitions and trees with crown that is sufficiently rare for the light to penetrate easily into all its parts.

Consistency, juiciness, flavour and aroma of fruit pulp, although hereditary, and therefore specific for each variety are significantly influenced by environmental conditions and agricultural technology.

It is known that the apple pulp consistency best yield in orchards with fallow soil. Sugar content and acidity are influenced by climatic conditions of each year and agrotechnics.

High temperatures and too strong sun exposure promotes internal browning of yellow fruit or superficial scald of apple varieties.

The presence of excess water leads to large fruit size but diluted, made up of large cells with a low content of dry material.

The absence or scarcity of water increases the physiological fall reduces fruit growth rates that remain small and the harvest is reduced.

A high temperature in the first half of the fruit promotes the growth of their size. Apple fruit quality depends heavily on temperature during flowering and fruit growth during the first weeks. It was found that the same kind gives flatter fruit in warmer regions and rather elongated in cool regions.

Regarding the influence of light on fruit quality has been shown that under proper lighting, fruits are larger and richer in solids. This is a corollary of light effects on photosynthesis. Insufficient light decreases the formation of anthocyanin pigments, the content of ascorbic acid and sugars.

Palatability and storage of fruits depend on the conditions of their food during the phenophases of growth and maturation.

Obtaining high yields of fruit quality can be obtained where the circumstances of pedo-climatic factors are included in the corresponding optimal varieties requirement.

2. MATERIALS AND METHODS

This paper is based on the recorded knowledge of interest in trees for improving their behaviour to the action of various growth factors.

Resistant varieties and hybrids are the most reliable and effective disease prevention.

Research undertaken at the Research Station of Horticulture Development of Voinești, Dambovită County in the period 2007 - 2012 have revealed several biological features on specific disease-resistant apple varieties: Ciprian, Florina, Generous, Pioneer, Prima, Voinea, grafted on rootstock MM 106, with trees planted at a distance of 4.0 x 2.0m (1250 trees/ha) with a form of the crown free flattened and in row direction.

In Romania, the existence of climatic and soil conditions highly variable and different compared to other countries, created the main reason for the existence of improvement as many cultivated varieties.

Temperature (of winter and the vegetation), soil moisture and light are limiting factors for growth, profits and even the existence of plants. In all breeding programs, selection of new genotypes is based on the mode of action of these factors on plants and their response. It is estimated currently as having importance, the following three objectives, which are treated in this paper:

- production potential;
- high quality fruit;
- genetic resistance to disease.

To these permanent objectives there are associated with more positive traits that make a valuable variety:

- natural resistance to stress factors;
- temperature (extreme limits);
- water (excess or deficit);
- pollutants.

In this way they could value the ecological potential of the country and the specific consumption of the native population.

As main objective it has been the interest in the relationship between natural factors and quality of fruit produced, how influencing factor deficiency or excess on resistance of apple varieties can be.

Since the introduction of disease-resistant varieties in culture, the question of which factors and how they act on growth, yield and quality of these varieties we have decided that the main aim of the paper is researching how climate change affects the strength and quality.

Following the response of trees, both in terms of production and fruit quality appearance, climate change, one of the objectives of the research is to adapt these species and varieties to climatic variations.

3. RESULTS AND DISCUSSION

Peculiarities of growth

The vigour of the tree is expressed in terms of quantity of accumulated annual volume of vegetative growth, the size of the trunk, the branches of the frame length and demiskeleton length increases yearly due to the interaction of the stock variety and, as well as other factors such as the degree of fertility soil, planting distances etc. The vigour of the tree on a few disease-resistant varieties of apple at the age of 13 and 24 expressed by the circumference of the stem, the total length of the scaffold and demiskeleton, the angle of branching, the amount of crown, point out the following:

- trunk circumference ranged from 35.3 (Pioneer) and 49.0 cm (Voinea) in trees aged 13 and 63.8 cm (Ciprian) - 74.8 cm (Voinea) in the 24 years old trees, higher values being assigned to the varieties Prima, Generous, Voinea, Florina and lower values on Ciprian and Pioneer varieties, all varieties are grafted on rootstock MM 106;
- tree height at the age of 13 was maintained at values of 280 cm (Pioneer) - 320 cm (Generous, Florina, Prima), and the thickness of garden fence of 150 cm (Ciprian, Pioneer) - 170 cm (Generous, Florina, Prima, Voinea), recording on smaller force varieties (Pioneer and Ciprian) a crown volume of 8.625-10.125 m³/ha and on the vigorous ones 11.475-11.900 m³/ha. At the age of 24 the resistant apple varieties height were between 300 cm (Generous, Pioneer) and 340 cm (Voinea) thickness of fruit bearing fence of 150 cm on (Pioneer) - 180 cm (Generous) with a crown volume between 9,375 m³/ha (Pioneer) and 12,325 m³/ha (Voinea).

- branching angle at both ages (13 and 24), the natural conditions of growth was 46-72 degrees on the first floor, second floor 45-68 degrees and 41-72 degrees in the third floor. With greater branching angles stands the varieties Pioneer, Ciprian, Voinea, on Pioneer variety growth vigor I attenuated by the very largest branching angles;

- total scaffold length was 749 cm (Pioneer) - 1.134 cm (Voinea) in trees aged 13 years and 708 - 1.010 cm in those 24 years, and the demiskeleton the 2.357cm (Pioneer) - 3.529 cm (Generous), in both ages, with similar values as a result of the stabilization of volume of the crown. Due to uniform distances in planting by fruiting cutting, the fence fruit was maintained within the limits required by mechanical means of access intervals between rows.

Based on existing data and observations from the orchard, it is necessary that the distance among the varieties of apple trees Prima, Generous, Voinea, Florina should be at least 3.5 m, and the Ciprian and Pioneer of 3.0 m. 4.0 m distance between rows is sufficient for growth under normal conditions of trees and shifting technological equipment to carry out the works, under the form of free crown flattened in the direction of the rows of trees.

The degree of differentiation with fruit buds

Productive potential of varieties and the production, made for the current year is closely related to the extent of fruit bud differentiation.

From the data obtained it can be said that the 6 apple varieties showed a high potential fruitfulness, marked by a percentage of fruit buds from 26.5 to 33.7 % (average over the two years). The varieties with bigger load of flowering shoots (in both years) were Ciprian, Generous and Prima.

If with young trees, fruit buds percentage may be higher, with older trees, bear in mind that this figure does not exceed 30-35 %, especially in susceptible apple varieties alternation of fruition, such as Pioneer and Generous.

On apple varieties resistant to diseases that distinguishes long annual branches (Pioneer, Voinea, Prima) percentage of fruit buds is more than 40-50%.

In such cases the cuts are applied annually to fruition during the rest of the trees in order to achieve a proper normalization of the fruit, and when the fruit bud differentiation is ensured on long annual branch (twig, branches) they get thinned with age and vigour of the variety and rootstock.

In terms of 2011, fruit production in some apple varieties, including those resistant to substantially decreased due to unfavourable weather conditions during flowering.

In these conditions there were recorded impairments of floral buds in percentage of over 90% (browning of the androceus and of the gineceus) in most varieties and a lower percentage, 35-40% respectively that during the frost on the varieties that that flower buds were in a less advanced phenophases (Generous) situation encountered also on varieties with the ability to differentiate fruit buds on the long annual branches (Pioneer, Voinea, Prima).

In 2011, production on the variety Generous was not affected by frost due to a phenophase less advanced of the floral buds and the production of other varieties has been saved as a result of fruitfulness on annual tree branches (branches and cane), where floral buds were bloomed later than on fruit skewers.

The data analysis shows that on spikes production was done at the rate of 14-24% on rods 8-35%, 13-46% on branches and 20-54% on fruit hearths.

Garnishing with fruit formations

Regarding the distribution of fruit on the trees crown formations at the age of 10-12 years have seen a slight shift of the fruit to the top of the crown, with a higher intensity to vigorous varieties (Prima, Generous, Voinea).

From observations it appears that the bottom is on average 20-30% fruit formation to the middle and upper formations where the percentage of fruit is divided almost equally. Therefore, starting at the age of 10-12 years on disease-resistant varieties will have to intervene to reduce the demiskeleton cuts particularly on the top of the crown, in such a way that the bearing formations

are evenly distributed throughout the Garden fence height (crown).

Degarnishing skeleton and demiskeleton branches.

Degarnished areas occur inside vigorous varieties trees with crowns that are not cut during the youth to enter the fruit.

Apple varieties Florina, Generous, Voinea and Prima have during the first years of vegetative growth an exceeding average of 70-80 cm. In this case if nothing is done with arching branches of the intensification of fruit bud differentiation and skeletal branches of demiskeleton must be cut at least 1/3 of the length to cause new growth of shoots and garnish with fruit formations.

On varieties that bear fruit on branches, typical of the variety Pioneer, degarnished areas are almost non-existent due to long arching branches that differentiate fruit buds and bent under the weight of the fruit.

Because of this camber it is diminished the degarnishing of the skeleton and demiskeleton as it is know that much of buds situated on the arched branches start vegetation and ensure a rational and productive use of skeleton and demiskeleton.

A similar situation is encountered on Ciprian variety that has the ability to bear from years 2-3 after planting, causing a slowing of vegetative growth and hence a decrease of the degarnished areas.

Phenological phases of fruiting bodies

Registration flowering phenophases was performed in the 2011 - 2012 from the vegetation of trees by the end of flowering, initiation and completion of which is influenced more by the climatic conditions of the area.

In 2011, the vegetation of trees occurred later than normal years.

Fruit bud swelling started after the first decade of April. The first variety that this phenophase was recorded on was variety Ciprian respectively on 11.04.2011. The day after it has been seen the swelling buds on Voinea variety and on Prima two days apart. Later joined the vegetation debut the apple varieties with disease resistance such as Generous and Florina.

Compared with standard apple varieties (Jonathan, Golden Delicious and Starkimson) differences are not significant.

Since the second decade of April there were only positive daily average temperatures, most over 9 degrees C, which resulted in a faster evolution on deployment of the phenophases on fruit bud.

The leafy and deleafy were held under 10 days from the phenophase of fruit bud swelling. By the end of April were developed and phenophases of developing of flower buds and the pink button.

Feathering fingers inflorescences and open flowers were first registered after May 1, 2011, when temperatures were higher than normal.

In the first decade of May average daily temperatures ranged between 17.5 and 22.2°C, with daily maximum

of 26.0 C to 32.0°C, the absolute maximum temperature of 32 degrees C of May.

In conditions of very high temperatures, lack of precipitation, flowering phenophases were held faster on flowering varieties with significant differences between the varieties of apple.

Thus the first flowers opened on 03.05.2007 on varieties Cyprian and Prima, Generous, Florina, Voinea. Mass flowering was recorded in only two days, and at another 2-4 days petals start shaking were registered.

In this regard in 2012, the vegetation of trees took place at the end of March, beginning of April, according to normal years.

First registered varieties which fruit buds were swelling were on Ciprian and Prima respectively on 28.03.2012. Two days after they joined the swelling buds Voinea variety and the varieties Florina 5-7 days, Pioneer and Generous, the latter started the latest in the growing among the apple varieties with genetic resistance to disease.

Comparing with standard apple varieties, when the vegetation on variety Jonathan, was recorded on 30 March, and the Golden Delicious and Starkinson on 06/04/2012.

After the first four days of April, when they recorded minimum temperature of -0.1 - 3.0 degrees C, but with temperatures above 10°C during the day, followed only positive temperatures, with daily averages of 7,4 to 13.6°C maximum and 14 to 24.3°C, resulting in a normal development of the shoots phenological phases in all varieties of apple fruit studied.

Opening of buds and flowering took place within 7-9 days after the phenophase of fruit bud swelling.

Flower buds occurred after the second decade of April and after April 24, 2012 were recorded the first flowers to open on Prima and Ciprian varieties. With the other apple varieties with disease resistance, the first flowers opened 2-5 days later precisely on 26 and 29 April.

Climatic conditions during flowering were adequate, with the exception of 17 to 20 April when there were maximum 15 – 14°C. Higher average daily temperatures were recorded from 30 April to 5 May, when Pioneer varieties, Voinea and Generous were in full bloom.

In terms of 2012, time during flowering apple varieties with genetic resistance to disease was between 8 and 10 days.

Age of ripening and consumption of fruits

The Prima variety is harvested in the last decade of August and can be stored and consumed the whole month of September, Voinea variety is harvested in the first decade of September and stored until December.

Other varieties are harvested after 15 September, starting with the variety Generous then Ciprian and Florina, all with good storage over the winter.

Of the 2011 production, fruit variety Ciprian were kept under natural cooling until the first decade of March, over 136 days, with a percentage loss on drying of 6.5% and 8.5 % by blackening.

On Generous variety thanks to a wax layer that forms the skin of the fruit, dehydration losses were only 4 % and 8.0 % by rotting. Storage capacity deposits with natural cooling is up in mid-February. With greater losses, retention period may be extended until March.

Florina has the highest retention period, the fruit can be eaten up in April with the loss of up to 4.5 % by rotting plus 3.5% loss on drying.

Physicochemical characteristics that define the quality of apple consumption maturity phase *Physical properties*

Physical properties investigated have targeted aspects of shape, colour, fruit size and specific weight of apple from the fruit production of 2012.

It was studied a number of 6 varieties: Generous, Pioneer, Voinea, Ciprian, Florina and Prima. The form of the most common varieties were analyzed : spherical - oblate (Ciprian), conical - truncated (Pioneer and Voinea), spherical - truncated (Generous) tapered (Florina) and spherical (Prima).

Colour. Studied at the 6 varieties I met a colour palette of predominantly red and yellow and gold colours, rusty, covered with shades of stripes or points.

Specific weight - the average value in the 6 varieties studied was 0.42 g/cm³ in the variety Generous fruit and 0.79 g/cm³ in the variety Ciprian fruits, other varieties falling between.

Chemical composition

Apple varieties with genetic resistance to disease existing in culture are mainly consumed fresh.

Therefore the pleasing appearance of the fruit must be associated with good taste, which is given by the major biochemical constituents.

Research conducted on the chemical composition of apple fruit varieties studied (six varieties) yielded the following data:

The water content. Environmental water content of 83.62% was recorded in the varieties analyzed, with a minimum of 83.26% Voinea variety fruits and a maximum of 84.12% at fruit variety Generous.

Total solids. Environment total solids content in fruit varieties analyzed was 16.22%. Within varieties, a minimum was recorded Generous fruit variety: 15.88% and a maximum variety Voinea: 16.64%.

Soluble solids. Medium SUS content was 13.33%, with a minimum of 12.8 % at Pioneer variety and a maximum of 14% Ciprian variety.

Acidity. Environment total acidity content was 0.46%, and the limits were between 0.4 % and Ciprian, Voinea and Florina varieties and 0.6% for the variety Generous.

Ascorbic acid - present in apple fruit average volume of 4.93 mg/100g. The maximum content of vitamin C was 6 mg/100g on variety Ciprian, and the minimum of 3.08 mg/100g on Pioneer variety.

Minerals. The maximum in the SM, 0.29% was recorded for variety Generous, and the minimum of 0.24% at Pioneer variety with an average of 0.26% in all varieties.

4. CONCLUSIONS

The present study aimed to analyze the influence of climate change (changes in temperature, light, moisture, air and soil) on the strength and quality of fruit varieties with genetic resistance to diseases and pests.

Based on studies and observations to existing apple varieties within the plantation belonging to the Fruit Growing Research Station and Production Voinesti in climate and soil conditions, they behaved differently, giving the following conclusions:

Running the phenophases on the fruiting organs of the studied varieties was fully consistent with the group of varieties (of summer, of autumn, of winter) and the evolution of environmental factors and intervention through technology, pointing out a sliding scale deployment of complex processes to achieve harvest. As for flowering, this phenophase occurred differentiated on each variety, as follows:

- 2011 flowering duration was between 5 and 7 days. The smallest duration of flowering was on varieties Ciprian and Prima, and the most (7 days), on the variety Generous

- 2012 flowering duration ranged from 8-10 days. Early flowering varieties were Ciprian, Prima, Pioneer and late flowering varieties were: Florina, Voinea, Generous.

Physical characteristics of mature fruit were influenced by environmental conditions, technology applied (on soil and tree) and the position that the fruit has in the crown.

Form, regarded as a character of variety in terms of advanced technology not noticed any change.

Size, which is influenced by a number of factors in the study suffered from a failure of a fundamental or complementary element of technology, with the climatic conditions studied.

Colour, together with the shape, is an important feature of the plant and its indication of recognition. Background colour, colour coverage, occurrence of stripes, points of different colours and sizes are essential in identifying those varieties.

The shade of colour is more pronounced on the sunny and less in shady areas covered with leaves, branches or other opaque elements.

Chemical composition varied depending on the variety, the technology used, the amount of fertilizer applied and the relationship between elements and IUA. It should be noted that the averages obtained from the elements studied were within the limits that characterize the variety:

- water content (%) highlights the variety Voinea with the lowest content (83.26 %) and Generous variety with the highest content (84.12 %);

- content in SUT (%) highlights the variety Generous with the lowest content (15.88 %) and variety Voinea with the highest content (16.64 %)

- SUS content (%) highlights the variety Pioneer with the lowest content (12.8 %) and Ciprian variety with the highest content (14.00 %)

- for titratable acid content (%) it highlights varieties Voinea, Ciprian, Florina with the lowest content (0.4%) and Generous variety with the highest content (0.6%)

- ascorbic acid content (mg/100g) we highlight Pioneer variety with the lowest content (3.08) and Ciprian variety with the highest content (6)

- mineral content can highlight the variety of Generous with the highest content (0.29) and Pioneer variety with the lowest content (0.24).

Application of advanced technologies to the terms stipulated by the legislation, prevention of diseases and pests, provision of maximum attention at harvest are fundamental elements of the range of actions for achieving high yields and superior quality.

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6. REFERENCES

- [1] Braniste N. (2004). Cultura mărului, Editura Ceres.
- [2] Braniste N. (2004). Cultura soiurilor de măr cu rezistență genetic la boli în România.
- [3] Brăgău A. (1996). Cercetări privind durata de exploatare a plantațiilor de măr în sistem clasic, intensiv și superintensiv. Teză de doctorat.
- [4] Constantinescu N., Ghena N., Negrilă A., Mihăiescu Gr. (1967). Pomicultură, vol.II. Ed. Agro-Silvică, București.
- [5] Isac Ilarie și colab. (2001). Ghidul micului pomicultor, Ed. Pământul, Pitești.
- [6] Ghena Nicolae, Braniste N. (2003). Cultura specială a pomilor, Ed. Matrix Rom, București.
- [7] Mihăiescu Gr. (1997). Pomicultură specială, Ed. Ceres, București.
- [8] Murvai Monica (1995). Pomologie, Curs LITO, USA București
- [9] Negrilă A. și colab. (1980). Pomicultură și Viticultură, EDP, București.
- [10] Popescu M., Militiu I. Cireasă V., Godeanu I., Cepoiu N., Dobrota Gh., Ropan P., Parnia P. (1992). Pomiculture, Ed. Didactica si Pedagogica - RA, Bucuresti.
- [11] Prodan Gh., Tudor A. T. (1977-1978). Studii privind capacitatea de producție a principalelor soiuri de măr din România, Lucr. șt. IANB, seria B, vol XX-XXI, Horticultura.
- [12] Puiu St., Tescu C, Dragan I., Soroc Gr., Micaș V., (1982). Pedologie, Ed. Didactica si Pedagogica, Bucuresti.
- [13] Tudor A. T. (1995). Valorificarea produselor horticole, Tipografia ArtPrint, București.
- [14] Pomicultura - Lucrări practice. (1992). Institutul Agronomic București.
- [15] Stațiunea de Cercetare și Producție Pomicolă Voinesti la aniversarea a 50 de ani de cercetare științifică și dezvoltare (1950 - 2000). Editura Domino, Târgoviște.