

## **EVOLUTION OF STARCH INDICATOR IN RIPENESS APPLE FRUITS IN VOINESTI**

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### **Abstract**

*Precision agriculture is a method that assesses the spatial variability of soil, crop, yield and quality creating management zones within field and optimizing the application of inputs. A relatively new agricultural management practice is precision agriculture, which is going to be applied and evaluated in apple plantations within this research. The aim of the research is to assess the spatial (within field) and temporal (over time) variability in soil, vegetation, yield, and quality in apple plantations and the effects to the environment.*

*The aim of this study, the evolution of starch in apple is to establish the optimum time to start harvest. Regarding starch test, the researches highlights a direct and strong correlation between starch hydrolysis from fruit and physiological maturity to harvest apples.*

Keywords: starch test, apple, ripeness, precision agriculture.

### **1. INTRODUCTION**

The apples in Romania are usually used for eating or for drinking as natural juice. It is important to mention that a huge part of the total apple production is exported to other countries and the prices are high (0,64 euro/kg).

The European Union encourages farmers to produce high quality products. Additionally, it is trying to combine consumers' satisfaction with the environmental protection.

The application of new and alternative agricultural methods such as the production of certified fruits by integrated crop management is one of the most important issues of the European Union in order to produce safe and more competitive products at the international markets.

At the market the fruits are judged by the commercial value: appearance, shape, size, colouring and after taste quality as texture flesh, juicy, flavor components that form the sensory ensemble.

Regarding fresh apples, the quality potential is influenced by pedo-climatic specific conditions, by technology in certain areas, as well as the optimum time for harvesting and consumption.

The most important stage during the development of fruit is the maturation or ripening stage. It evolves into a climacterix state (the ripening commercial stage of the fruit) when the fruit has the best quality for consumption. In terms of physiologie, during climacterix stage the fruit has the color, taste and smell specifically to the cultivar and a maximum intensity of the respiration. The maximum intensity of respiration during climacterix is correlated with the biggest oxidative phosphorylation, a process that provides energy, necessary to biochemical reactions during ripening. During fruit ripening, there is a gradually disintegrating of mitochondria by oxidative processes, releasing energy.

Budin et al. (1979) found a decrease in ATP content, ie from 0.95 to 0.62 mg/100 to fresh peach fruit. Therefore they proposed using ATP content as biochemical index for the maturation degree of fruit.

During fruit ripening, there is a number of physiological and biochemical transformations that change the characteristics and structure of fruits.

During ripening, into the fruit occurs the synthesis of aromatic, volatile substances, that gives the characteristic flavor and aroma. In apple fruit is synthesized n-butyl acetate, acetic aldehyde, ethyl acetate, ethyl alcohol and ethyl-2-metilbutanat. The biochemical and physiological processes during ripening can also be controlled during fruits storage, by the action of external factors, such as temperature, atmospheric composition, etc.

To establish the optimum time for harvesting, it is used the specific indicators such as: starch test, the change of skin and seeds colouring, flesh texture or firmness, number of days from blooming to ripening, the colouring code.

Regarding starch test, the researches shows that there is a direct and strong correlation between starch hydrolysis from fruit and physiological maturity to harvest apples.

### **2. MATERIALS AND METHODS**

The researches were conducted at SRDP Voinesti, Dambovita. The area is part of the Tree Region I, Southern and South-East Hills (Constantinescu N. and Teaci D., 1967), characterized by a continental climate, attenuated by orographic, hydrographic and biosphere factors.

Voinesti fruit growing basin, located on the Dambovita river is specialized in apple culture.

The orchard was planted in 2004, with Florina cultivar, grafted on MM 106 and Generos cultivar as the pollinator.

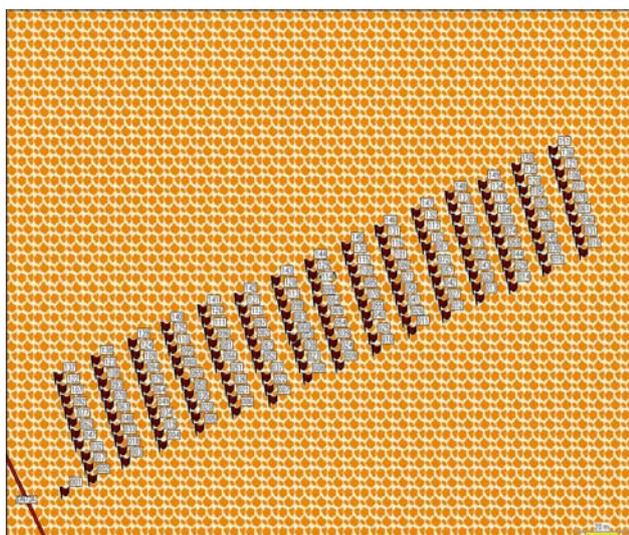
The Florina cultivar, created at INRA Angers, is a middle vigorous tree; the blossom is comparatively late; the variety is a good pollinator. The fruits are medium to large, round-conical to round-flattish, often with unsymmetrical halves. The basic color of fruit is yellow-green, and the cover - smudged and striped red to dark

red, almost all around the whole fruit, they have moderate wax cover. The flesh is cream-colored, crackling, juicy, sweet, slightly tart, aromatic, with very good quality. The harvest ripening is about the end of September the beginning of October. Keeping season and consumption: November to March. The tree is resistant to apple scab, very slightly sensitive to powdery mildew and fire blight.



**Figure 1. Florina cultivar**  
Source: authors

The mapped surface has 0.9 ha, with 10 rows. The between-row spacing is 4 m and the intra-row tree spacing is 3 m. Trees were trained as pyramidal-shape. The soil texture is brown eumezobasic; the maintaining soil system is lying between row and intra-row tree. Due to the genetic resistance to disease at the cultivar, the number of treatments applied to trees is low (4-6 treatments), applied especially against pests (*Cydia pomonella* and *Quadraspidiotus perniciosus*). For graphical representation of experience, was used the GeoMap source software and for the altitude mapping was used Surfer software (v. 8, Golden Software).



**Figure 2. Graphical representation of experience**



**Figure 3. Graphical representation of experience (google map).**

During harvesting, fruit samples are carried out manually, from the middle part of the trees. During the collection of the fruit samples the coordinates of the location were identified by using GPS devices, so we can make the mapping of yield, firmness, pH and S.S.C.

An important stage of the harvesting period is the determination of harvest maturity. The difference between immature and over-mature fruits is usually a few days, depending on cultivar, area, season, agro-technical measures etc.

The starch - iodine test maturity is a safe method for determining the maturity of most of the apple cultivars and it is the simplest indicator of apple maturity. This test measures the transformation of starch into glucose, which is correlated with ethylene evolution.

The iodine test is based on dry matter accumulation (soluble sugars), that hydrolyze from starch conversion, once the fruit reaches the characteristic size and physiological maturity.

Thus, by applying potassium iodide on fruit sectioned, after a minute, it can observed a coloration in blue on flesh, more or less pronounced.

Discoloration of 0.5 cm around the seminal box indicate the optimum time for beginning of harvest. Iodine was freshly prepared and kept in dark container. Fruits were collected from the middle part of the trees and were sectioned horizontally, around the "equator" of the fruits. On sectioned surface, it sprayed potassium iodide solution and observations regarding the colouring obtained were made.

### **3. RESULTS AND DISCUSSIONS**

The studied area is located in the middle of fruit growing basin Dambovita ( $25^{\circ} 14' 268''$  E and  $45^{\circ} 05' 211''$  N, altitude 423 m).

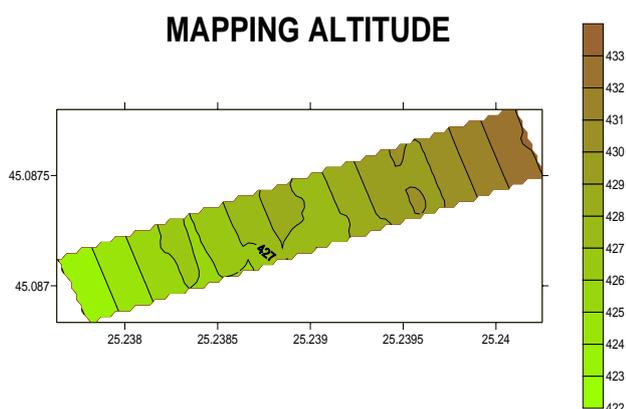
By using GPS data, from GPS Garmin Etrex EURO and Surfer 8 software, the altitude mapping was created.



**Figure 4. Determining geographical coordinates using a GPS**

Source: authors

Analysing figure 5 it can observe that, in the studied area, the altitude varies from 422 m in S-V to the 433 m altitude in N-E.



**Figure 5. Mapping altitude**

With starch - iodine maturity test (AI) was realised the diagram of starch indicator. The dark areas indicate the presence of starch and the light areas indicate glucose.



**Figure 6. Apples in the maturity stage, indicating the beginning of harvest**

Source: authors



**Figure 7. Apples in the over-maturity stage**

Source: authors



**Figure 8. Starch diagram**

Source: authors

#### **4. CONCLUSIONS**

Analysing the apple surface, in term of specific colouring, is found that harvesting can begin.

Discoloration of 0.5 cm around the seminal box indicate the optimum time for beginning of harvest.

Thus, the first decade of October is the optimum moment to harvest, in the climatic conditions of 2012.

#### **5. ACKNOWLEDGMENTS**

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