METHODS OF PRECISION AGRICULTURE IN RESEARCH OF APPLE QUALITY, WEIGHT AND FRUITS SIZE

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Abstract

Precision agriculture is applied by carrying out field experiments in apple plantations to assess the extent of spatial variability within apple plantations and to apply variable rate inputs at the right amount, on the right place, in the right time within each field. The expected outcome of this research will be the investigation of the potential benefits of applying precision agriculture in apple plantations and the further adoption of precision agriculture, which is still in its infancy.
The main benefits of assessing crop and yield variability is to create management zones to variably apply inputs according to their actual demands (right place, right time, right amount).

Keywords: precision agriculture, apple, size, weight, quality.

1. INTRODUCTION

According to the definition given by the International Organization for Standardization, quality is a set of properties and characteristics of a product that gives it the ability to meet customer requirements expressed or implied.

The concept of quality fruit is a complex notion that can be analyzed in the following areas: agronomic, commercial, organoleptic, nutritional and health.

Productive potential of the apple is a complex quality which is genetic determined by the basis of hereditary cultivar, but is much influenced by the interaction between genotype or cultivar and climatic conditions of the culture's area.

Other factors that contribute to shaping this cultivar traits are linked to earliness of fructification, fruition type, trained and leadership, resistance to diseases and pests, compatibility on grafting and pollination, density and rootstock used.

Introducing in the culture the apple cultivars with genetic resistance to disease brings a decrease of envorinmental pollution, along with 50-55% cost savings compared to orchards with traditional cultivars.

In Romania there is a particular concern in the new plantation for resistant apple cultivars, due to the high costs of pesticides and fuel to respect culture technology. The regulation (CE) nb. 1221/2008 regulates the cultivars apple grown from Malus domestica Borkh., for delivery fresh to the consumer, but the apples for industrial processing are excluded (14).

In all classes, subject to the special provisions for each class and the tolerances allowed, apples must be: intact; sound, produce affected by rotting or deterioration such as to make it unfit for consumption is excluded; clean, practically free of any visible foreign matter; practically free from pests; practically free from damage caused by pests; free of abnormal external moisture; free of any foreign smell and/or taste. In addition, they must have been carefully picked.

Apples are classified in three classes:

-*"Extra" class* - apples in this class must be of superior quality. In shape, size and colouring, they must be characteristic of the variety and with the stalk which must be intact. The flesh must be perfectly sound. They must be free from defects with the exception of very slight superficial defects provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package.

- *Class I* - apples in this class must be of good quality. In shape, size and colouring, they must be characteristic of the variety. The flesh must be perfectly sound. The following slight defects, however, may be allowed provided these do not affect the general appearance of the produce, the quality, the keeping quality and presentation in the package: a slight defect in shape; a slight defect in development; a slight defect in colouring; slight skin defects which must not extend over more than: 2 cm in length for defects of elongated shape, 1 cm^2 of total surface area for other defects, with the exception of scab (*Venturia inaequalis*), which must not extend over more than 0,25 cm^2 of total surface area; slight bruising not exceeding 1 cm^2 of total surface area and not discoloured. The stalk may be missing, provided the break is clean and the adjacent skin is not damaged.

- *Class II* - this class includes apples which do not qualify for inclusion in the higher classes but satisfy the minimum requirements specified above. The flesh must be free from major defects. The following defects are allowed provided the fruit retains its essential characteristics as regards the quality, the keeping quality and presentation: defects in shape; defects in development; defects in colouring; skin defects which must not extend over more than: 4 cm in length for defects of elongated shape and 2,5 cm^2 of total surface area for other defects, with the exception of scab (*Venturia inaequalis*), which must not extend over more than 1 cm^2 of total surface area; slight bruising not exceeding 1,5 cm^2 of total surface area which may be slightly discoloured.

According to Regulation (CE) nb. 1221/2008**,** size is determined either by the maximum diameter of the equatorial section or by weight. For all varieties and for all classes the minimum size is 60 mm, if measured by diameter or 90 g, if measured by weight. Fruit of smaller sizes may be accepted, if the Brix level of the produce is greater than or equal to $10,5^{o}$ Brix and the size is not smaller than 50 mm or 70 g (14).

2. MATERIALS AND METHODS

The researches have been conducted at SRDP Voinesti, Dambovita.

The experiment was carried out on a commercial apple orchard located at Voinesti, in Dambovita county (25^{0} $14^{'}$ $268^{''}$ E şi 45^{0} $05^{'}$ $211^{''}$ N, altitude 423 m).

The orchard was planted with Florina cultivar and the pollinatory was Generos cultivar.

Tree rows were spaced 4 m apart and trees in the row were 3 m apart, on the 0,9 ha surface. Trees were trained as pyramidal-shape.

Figure 1. The orchard studied
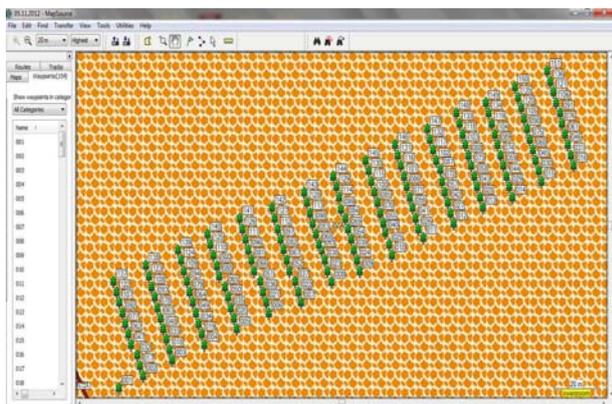**Source: authors**

Figure 2. Graphical representation of experience

In the first decade of October, the harvesting it began, when the apples reached the size and weight specific to the cultivar.

The yield of each tree, recorded with GPS Garmin Etrex EURO, was manually harvested, in plastic bags and weighed separately.

Figure 3. Orchard studied with the harvesting bags
Source: authors

Fruit samples were collected in order to estimate the quality of the fruits: size and weight. The samples were collected from the middle part of the trees. Surfer (v. 8, Golden Software) was used to produce interpolated maps.

3. RESULTS AND DISCUSSIONS

The average weight of fruit was determined using an electronic scale, type Kern, KB model. They ranged between 91,3 şi 238,9 g/fruit. The average value determined is 140.69 g/fruit.

Figure 4. Determining the weight of fruits
Source: authors
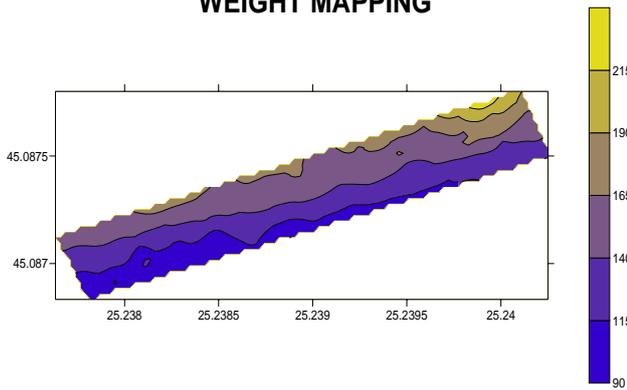
WEIGHT MAPPING

Figure 5. Weight fruits mapping

The fruit size (diameter) was determined by using a calibrator. Fruit diameter values were between 60 and 86 mm, with an average of 68 mm.

Figure 6. Determining the size of fruit
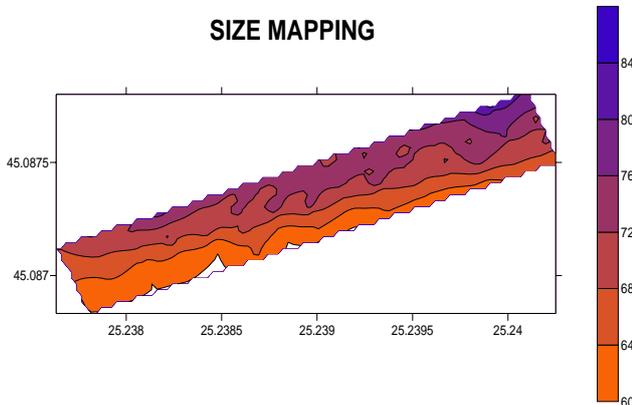**Source: authors**

SIZE MAPPING

Figure 7. Size fruits mapping

The yield of each tree, that was recorded using a GPS device, it was hand harvested and weighed. The recorded values were between 8 - 27 kg/tree, with an average yield of 17,90 kg/tree. The total yield, for all mapped surface, is 14 t.
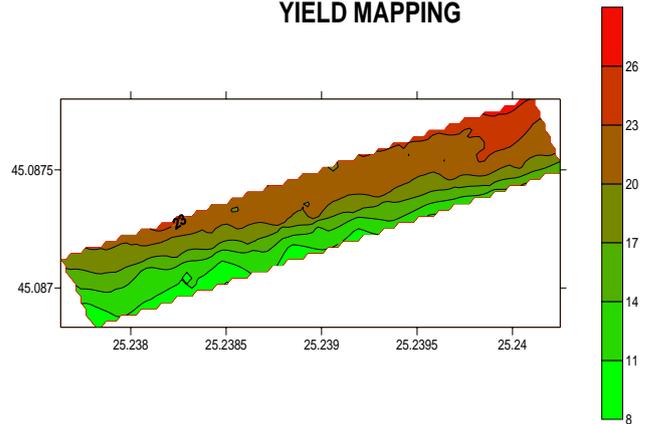
YIELD MAPPING

Figure 8. Yield mapping

4. CONCLUSIONS

According to standards market for fresh apples, the fruit size measured at diameter (average fruit is 68 mm) leads to their classification in "extra" class.

Regarding the average weight of fruit was found that the values are covered by the specific parameters of cultivar, determined on an average of 140.69 g / fruit.

The yield of each tree, as well the total production is in direct correlation with the size and weight of fruit, up to a total production of 14 t/surface mapped.

5. ACKNOWLEDGMENTS

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