

# COMPARAREA A DOUĂ SISTEME DE CONTROL A BURUIENILOR ÎNTR-O LIVADĂ DE MĂR DE MARE DENSITATE

## COMPARISON OF TWO WEEDS MANAGEMENT SYSTEMS IN A HIGH DENSITY APPLE ORCHARD

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### Abstract

This paper presents preliminary results from a trial performed in a 12 years high density apple orchard focused on the study of two most common weeds management systems and their effects on apple tree growth and yield. Conventional weed management has a long tradition based on the use of herbicides for weed control. The public's negative perception related to the excessive use of chemical products in orchards, the negative effects on the health and biodiversity of the soil, herbicide resistance, put farmers in a situation of needing an effective strategy of weed control. Mowing the vegetation has proven to be both a practical and successful solution that can be adopted not only in conventional crop systems, but also for organic crops.

**Cuvinte cheie:** măr, controlul buruienilor, cosire, erbicidare, livadă.

**Key words:** apple, weeds management, mowing, herbicide, orchard.

### 1. Introduction

With a low density root system per unit area (Merwin et al, 2003), trees are easily out-competed for food and water by weeds. Traditionally, in the apple plantations of RIFG Pitesti, and probably in most apple plantations in Romania, weed management involves mowing between the tree rows and eradicate weeds, through herbicide use, in the rows. Herbicide along the tree rows is easy to apply, not expensive compared to other methods (e.g. Mia et al, 2020), showed that the average costs per hectare could be 66.5% - 72% lower compared to integrated tillage and integrated mowing), and effectively stimulates growth and fruit yield (Harrington et al. 2005). Normally, chemical control of weeds requires 2 applications, pre-emergent and post-emergent, immediately after the grass started its growth. But the practical observations in the orchard imposed another application in mid-late summer for perennials control.

### 2. Material and methods

The study was carried out in 2023 in a 'Golden Delicious clone B' apple plot established in 2009, within the Research Institute for Fruit Growing Pitești, provided with a drip irrigation system. The tree planting distance is 3.5 x 1 m, with a density of 2,857 trees/ha, the rootstock used is 'M9', the shape of the crown is a thin spindle, characteristic for fruit trees grafted on rootstocks of medium-low vigor. Cultural practices adopted for this experimental plot were mowing between the rows and herbicide on the row of trees. Treatments with plant protection products were applied to combat some diseases and pests with high frequency in apple trees plantations.

**'M9' rootstock** - is the most used rootstock (including its clones) in fruit growing in the major growing countries, characterized by the low vigor, early fruiting (2<sup>nd</sup> year after planting, if the trees obtained in the nursery show early shoots and fruit buds), quality and constant production. It requires a support system, deep, well-drained fertile soils. It is sensitive to frost, drought, root cancer, woolly apple aphid.

**'Golden Delicious cl. B'** – The 'Golden Delicious' variety (of which group 'Golden Delicious cl. B' is also a part), originates from the USA, it has been in production since 1916, but even today it is still very popular, including its new clones. It is recommended to be harvested while the skin is still green, but even then it is good to eat. It is widely present throughout the world. In France, in 1970, it accounted for 65% of apple production. The tree is of medium vigour, bears abundantly from the second year, with a tendency to overload, that requires thinning. The fruit is attractive, medium-sized, yellowish pulp, sweet, slightly acidic, aromatic. It keeps well under classic storage conditions and controlled atmosphere.

The experience was monofactorial and the factor under test was the method of managing the vegetation on the row of trees. A Randomized Complete Block Design (RCBD) was set up with three blocks and two treatments:

V1 = Herbicide applied along the trees row;

V2 = Row mowing.

In order to achieve the proposed objectives, observations were made in the field, as well as observations and determinations in the laboratory.

Biometric data were obtained by measuring 30 fruits/variant harvested in the morning at full maturity and analyzed within a maximum interval of 2 hours after harvesting, as follows:

- Fruit weight was measured using a high precision electronic scale;
- The diameter and length of the fruit tail were determined by measuring with an electronic calliper
- Fruit firmness was measured using a non-destructive penetrometer, Bareiss Qualitest HPE, equipped with a 0.25 cm<sup>2</sup> plate and a round tip with Ø 5.0 mm;
- Skin color was assessed using the Konica Minolta CR 400 chromameter;
- The soluble solids content was determined by the refractometric method using the Hanna HI 96801 portable refractometer;
- The pH of the juice was determined using the Mini Lab pH meter;
- The determination of water and total dry matter was carried out by the gravimetric method;
- The Fuleki method was used for the determination of total anthocyanin pigments, and the Folin-Ciocaltau method for total polyphenols;
- Vitamin C content, sugar content using the Fehling-Soxhlet protocol was determined by the iodometric method;
- An electronic calliper was used to measure trunk diameters at the start and at the end of the vegetation season and their difference was determined to calculate the increase in trunks cross-sectional area (TCSA).

**The collected data** were of a numerical type, aiming at the objective of plant growth and fruiting evaluation, as well as some quality characteristics of the fruits. One Way- **ANOVA** was used to determine whether or not the means of groups were equal.

### 3. Results and discussions

#### Average fruit weight

Although data found in the literature confirm that the vegetation around the tree (as in the case of V2, where the grass was only mowed and left as mulch around the tree) is in direct competition with the trees for water and nutrients, and we expected in a in the same way that they also influence the size of the fruit, we observed that the average fruit weight of the mowed version was higher (136.11 g compared to the herbicide variant, respectively 133.50 g) (Table 1).

#### Fruit firmness

Most studies find that fruits with high firmness are generally preferred by consumers. Moreover, farmers and traders know that fruits with high firmness are more resistant to transport and storage. In herbicide variant, the fruits had a higher firmness compared to the mowed one (75.44 units in V1 versus 72.65 in V2), which was also accompanied by a higher level of the **pH** of the fruit juice, that can be translated perhaps through a lower degree of ripening of the fruits in this variant at the time of harvest, especially if correlated this aspect with a better **sugar content** in V2 variant, respectively 13.36% compared to 11.98% in V1 variant (Table 2).

#### Skin color

Most of the time, the color is also taken into account in evaluating the degree of ripeness of the fruit. In the CIELAB system, color can be represented by using coordinates in a uniform color space consisting of the brightness variable L \* and the chromaticity indices a \* and b \*. Thus, if the L \* coordinate provides information regarding the brightness, the positive values of a \* are located on the red axis and the negative ones on the green axis, and the positive values of b \* are located on the yellow axis and the negative ones on the blue axis. Analyzing in the present case the 3 coordinates, we observed that for the L \* coordinate the values were almost identical, and the a \* and b \* coordinates differed quite a bit between the 2 variants, we can conclude that at the time of harvesting, the difference in terms of skin color was not different between the 2 samples collected for determinations for this purpose (Table 1).

As we noticed and when we discussed the higher fruit weight for the mowed variant there is a positive influence of this variant (probably due to the mulching effect obtained by mowing the vegetation and the supply of nutrients that they bring to the soil through subsequent decomposition), and on the **vegetative growth**, which is observed both by the increase in trunk cross sectional area (TCSA) and by the growth of annual branches (Table 1).

From Table 3, in which the chemical composition of the fruits in the two variants is detailed, it can be seen that the fruits of the V2 variant have a higher sugar content (13.98% compared to 11.77% in V1) and a higher total acidity, but lower vitamin C and polyphenol content.

#### **4. Conclusions**

The proper management of weed along the tree row is a current challenge in all commercial plantations, and is a much more acute problem when the use of herbicides is not desirable. Mowing the vegetation has proven to be the most effective method at the moment, and the machines built for this purpose have to deal with complex situations generated by a number of factors mentioned above. In addition, the positive effect on the quality of the production and the vegetative development of the trees was also demonstrated.

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#### **References**

1. Harrington K.C., Hartley M.J., Rahman A., James T.K., 2005. Long Term Ground Cover Options for Apple Orchards. *New Zeal. Plant Prot.* 58: 164–168.
2. Merwin I.W., 2003. Orchard floor management systems. In *Apples: Botany, Production and Uses*; Ferree D.C., Warrington I.J., Eds.; CABI Publish: Cambridge, UK, pp. 303–318.
3. Mia M.J., Massetani F., Murri G., Facchi J., Monaci E., Amadio L., & Neri D., 2020. Integrated weed management in high density fruit orchards. *Agronomy*, 10(10): 1492.

## Tables

**Table 1. Fruit quality**

Variant	Fruit weight (g)	Firmness (HPE)	pH	TSS (°Brix)	Color		
					L*	a*	b*
V1 - Herbicide	133.50 <sup>a</sup>	75.44 <sup>a</sup>	3.96 <sup>a</sup>	11.98 <sup>a</sup>	68.59 <sup>a</sup>	-13.32 <sup>a</sup>	32.14 <sup>a</sup>
V2 - Mowing	136.11 <sup>a</sup>	72.65 <sup>a</sup>	3.81 <sup>b</sup>	13.36 <sup>a</sup>	68.31 <sup>a</sup>	-10.18 <sup>a</sup>	30.96 <sup>a</sup>

\*Values followed by the same letter are not statistically different (P<0.05).

**Table 2. Development of the vegetative part**

Variant	Increase in TCSA (cm <sup>2</sup> )	Shoot length (cm)
V1 - Herbicide	5.61 <sup>b</sup>	32.80 <sup>b</sup>
V2 - Mowing	<b>6.69<sup>a</sup></b>	<b>40.28<sup>a</sup></b>

\*Values followed by the same letter are not statistically different (P<0.05).

**Table 3. Chemical analysis**

Variant	Water %	Total dry matter (%)	Total titratable acidity expressed as malic acid (%)	Vitamin C(mg/100g fresh fruit)	Total polyphenols (mg gallic acid /kg fresh fruit)
V1 Herbicide	<b>88.23<sup>a</sup></b>	11.77 <sup>b</sup>	0.31 <sup>b</sup>	<b>8.57<sup>a</sup></b>	<b>2928.98<sup>a</sup></b>
V2 Mowing	86.02 <sup>b</sup>	<b>13.98<sup>a</sup></b>	<b>0.44<sup>a</sup></b>	7.42 <sup>b</sup>	2543.51 <sup>b</sup>

\*Values followed by the same letter are not statistically different (P<0.05).