THE INFLUENCE OF TECHNOLOGY ON THE ECONOMIC INDICATORS IN A CLASSIC AND INTENSIVE APPLE PLANTATION

Aurora VENIG[1], Adelina VENIG[1], Ciprian ŞCHIOP[1], Mihai UIVAROŞI[1], Andreea MOISI[1]

[1] University of Oradea, Faculty of Environmental Protection, Oradea

RESEARCH ARTICLE

Abstract

A grafted apple orchard is an excellent long-term and very long-term investment. Apple culture is so widespread, on the one hand, because of the food and therapeutic value of the fruit, and on the other hand, for its high economic value. Apples have special biological characteristics, being among the few fruits that retain their freshness for a long time, being able to be transported over long distances and consumed at any time of the year. On the territory of our country, apple trees have favorable conditions for growth and fruiting in all areas. Apple plantations, if they are well cared, can reach economic exploitation ages of up to 15-30 years with important ecological and economic values. The establishment of a professional orchard involves the performance of works, costs which are presented in this paper.

Keywords: apple trees; economic efficiency; harvest; expenses
#Corresponding author: venig_aurora@yahoo.com

INTRODUCTION

The importance of apple culture is due to the food and taste value, the fruit having a major role in the rational nutrition, then in the prevention of some diseases, in increasing the national income, as well as in improving the microclimate conditions (Berar, 2012). Apples can be consumed fresh, dried, prepared in cooked form, pickled apples, as non-alcoholic drinks such as juices, nectars, alcoholic beverages, cider. It can be processed in the form of jams, compote, marmalade. Malus domestica is a rustic species, well adapted to the temperate climate, the extremes of which it withstands better than all other fruit species, giving the highest yields. (Adams, 2019)

The modernization of fruit production and its intensification aims at the concentration of fruit growing in established basins and centers, the organization of new fruit farms, with a specialized assortment of varieties to ensure the production of commodity fruit in large quantities, of superior quality and at low costs.

The development of apple culture, the realization of large and quality productions, represent objectives whose solution is possible by finding and adopting measures aimed at increasing the efficiency of production on the lands occupied by this culture. (Grădinariu & Istrate, 2010)

A priority of contemporary fruit growing is the organization of the production of fruit planting material from the most valuable varieties, establishing the assortment of productive varieties for industrialization. (Ghena et al., 2010)

Researchers from all over the world, as well as those from Romania, are concerned with the creation of varieties resistant to turnip and powdery mildew. Another trend manifested worldwide is the creation of new rootstocks and valuable varieties, adapted to the new conditions of apple cultivation, establishing the assortment with productive varieties and special commercial qualities for fresh consumption and for industrialization.

Through the modernization works, the grouping of the varieties in the existing plots was improved, depending on the degree of fertility, thus ensuring a better pollination of them.

The apple can be grown in very different pedoclimatic conditions and lends itself to all existing cultivation systems, from the classic to the super-intensive, even in palisade artistic cultures. Its fruit withstand transport very well, compared to other fruits, and constitute a raw material of great importance in the food industry (Fassman, 2017). The apple tree is a species characteristic of temperate zones, with the characteristics of growth and development in long annual cycles, being a long-lived species. The tree culture represented by the orchard

constitutes a complex agroecosystem, which in order to achieve superior production performance and high economic efficiency, includes a series of actions aimed at ensuring the trees growth and fruiting conditions corresponding to the specific requirements, from the establishment of the plantations and continuing throughout the life span of the trees. The fruit tree species are demanding in terms of light, but the requirements of the apple are lower than those of the pear, cherry, etc.

In conditions of insufficient light, the trees grow and bear poorly and the fruits do not colour sufficiently and the taste remains deficient (Mihuț, 2005).

In conditions of too strong light, the flesh of the fruit becomes glassy in some varieties. The apple grows and bears fruit well in areas where the average annual temperature is 8 - 11°C. The biological threshold from which flower buds start is 8°C, and for the opening of the first flowers it is 11°C. (Maurer, 2016)

The apple is the most frost-resistant species among those cultivated in our country. They can withstand temperature drops down to -34°C. Apple blossoms freeze at -1.6°C to - 2.2°C, and newly formed fruits at -1.1°C.

The apple has high demands on water, needing 650-700 mm of precipitation annually. The optimal soil water content is 70-75% of the field capacity. An atmospheric humidity higher than 70% favours the attack of the turnip, the most damaging apple disease.

The requirements of the apple in relation to the soil are quite high. The apple grows well on fertile, deep, medium-textured, loamy-clay soils (clay up to 49% in dry areas), with a pH of 6.5-7.5. The level of fertility must be quite good, otherwise productions are small and unreliable. Heavy, compact, stony, salty, marshy soils are not suitable. The exposure is recommended to the south, southeast. (Stănică & Braniște, 2013)

The technology of establishing and maintaining tree plantations takes into account the system of tree cultivation and the volume and destination of the harvest, for each species and variety.

The classic system is characterized by a low degree of intensification, being dominated in world fruit growing until the middle of the 20th century. It is characterized by high-vigour trees with tall trunks, globular or pyramidal crowns, which respect natural development trends. Planting distances are used large, 6-8 meters, such as in the case of the apple. The combination of these distances between rows and per row results in a reduced number of trees per hectare, between 150-300, which makes the investment value low. As a result of the large planting distances, the land occupied by the orchard is incompletely used. To establish a plantation in the classic system requires combinations of rootstock varieties with high and very high vigour, this leads to the delay in fruiting of the trees, which is achieved after 7-8 years after planting, sometimes even more. To this is added the strong intervention through training cuts, which aim to create vigorous crowns with a strong skeleton to occupy the nutrition space and support the harvest (Venig, 2006).

Agro-phytotechnical works such as cutting, phytosanitary treatments, harvesting, are carried out with some difficulties and higher costs that also influence the quality of the fruits. Thanks to the tall trees and voluminous crowns in this orchard system, the degree of mechanization of the works is reduced, compensating with manual labour, which raises the cost price of the fruits. The life span of the trees and the exploitation period of the orchards is 40-50 years, sometimes even more, the classic system of tree cultivation being applicable to all fruit tree species (Venig, 2014). The classic system shows a narrowing tendency in favour of more modern, intensive and super-intensive systems, which are superior including in terms of labour productivity. (Himmelhuber, 2013)

The intensive system currently holds the share of orchards in our country and worldwide. It is suitable for all fruit tree species, including apple, cherry varieties. This system has the following characteristics:

- Trees of medium and small vigour are used for planting, where the height can reach 3-3.5 meters;
-Planting distances are 4-5 meters between rows and 2-5 meters between trees per row, which allows to achieve densities from 400 to 1250 trees per hectare.

The technology of maintenance of fruit plantations includes a series of technological rods that are applied in stages and differentiated starting from the period of youth, fruiting and decline of the orchard (Mihăiescu, 2007).

During the fruiting period that is desired to extended over as long a period as possible, the emphasis is on carrying out fruiting cuts and maintenance of the crowns so that it remains within the limits of the space established at planting, respecting the optimal height and thickness (Cepoiu et al., 2005). During this period, more emphasis is placed on the health of the trees by applying the integrated complex to

combat diseases and pests. At the same time, in order to stimulate the obtaining of quality fruits, the trees will be additionally fertilized, and the related fruits and flowers can be affected by thinning.

The soil will require work that ensures a good supply of nutrients and water to the trees, through the application of fertilizers, irrigation plus weed control to prevent the absorption of water and nutrients by them (Schmid, 2019).

Apples are harvested at the optimal time, which is established according to phenological indicators (fruit colour, sum of temperature degrees, number of days from flowering to harvesting), physical indicators (pulp firmness, dry matter content, soluble dry matter) and biochemical. If the fruits are harvested too early, they do not ripen fully and there is a sensitivity to storage. (Venig, 2012). The delay in harvesting causes the appearance of risks in storage (storage diseases) and handling. Harvesting is done manually, with the peduncle, without pulling, by a slight twisting of the fruit, protecting it from blows and injuries. They will be carefully transferred from the harvesting packaging to the transport packaging. As much as possible avoid harvesting in the middle of clear, hot days when the fruit temperature rises. It is also necessary to avoid picking wet fruits, either from rain or dew (Chira et al., 2005).

For the present research, there were used three apple varieties: Florina, Liberty, Romus 3. They were planted at a distance of 5 x 4 meters, for the classic plantation and 4 x 2 meters for the intensive plantation.

MATERIAL AND METHOD

The key research methods employed were analysis and synthesis, analogy, and graphics to resemble the results.

RESULTS AND DISCUSSIONS

To the advantages offered by the apple culture is added the financial support offered by international and domestic programs for the development of this fruit crop in different areas of the country. Fruit growers who want to set up apple plantations must know precisely and in detail the costs for all the technological links specific to the crop, the productions and the incomes obtained on the devaluation directions. The value of the investment and its recovery term, the volume of physical production and the life cycle of the plantation, as well as the period in which the production costs are realized, the net income and the work volume are also criteria that must be taken into account. Investment expenses can be partially offset in the first five years after fruiting, or after the eighth year after planting. The profits that are made are different depending on the variety, as well as the skill, perseverance with which the cultivation technique is applied and especially the capitalization of the realized production. It is recommended to choose several varieties, so as to achieve a continuous technological flow for a longer period of the year (harvesting should be done during at least 3-4 weeks), so as to avoid the peaks of work and to make a maximum profit. For the superior capitalization of the fruits, processing capacities can also be developed (fruit dryers, vacuum packing line of apples), temporary storage warehouse.

Table 1

Economic aspects regarding an apple plantation (one hectare)

	Unit	Classic plantation	Intensive plantation
Entire trees number/ha	Pieces	500	1250
Planting distance	meters	5 x 4	4 x 2
Operating time	years	25	20
Exploitation time	years	20	18
Investment value	Ron	97040	127921
Setting up expenses	Ron	52524	71274
a) Surrounding the plantation	Ron	21124	21124
b) Handmade works	Ron	8763	12419
c) Mechanical works	Ron	11594	14123
d) Materials	Ron	11043	23608
Maintenance costs	Ron	44516	48147
a) Handmade works	Ron	12860	16202
b) Mechanical works	Ron	14826	14826
c) Materials	Ron	16830	17119
Annual amortization rate	Ron	4852	7107
Annual operating costs	Ron	33619	53195
a) Handmade works	Ron	11294	28385
b) Mechanical worls	Ron	4627	4627
c) Materials	Ron	17698	20183
Annual direct costs	Ron	38471	60302
Annual indirect costs	Ron	3847	6030

Annual entire costs	Ron	42318	66332
Production	Kg	20000	45000
Cost of production	Ron/kg	2,12	1,23
Selling price	Ron/kg	2,5	2,5
Value of annual production	Ron	50000	112500
Gross annual profit	Ron	7682	46168
Tax	Ron	796	4617
Net annual profit	Ron	6914	41551
Economy size class	-	I	I
Annual profit rate	%	16,3	62,6
Term of investment recovery	Years	14	3
Total profit during the exploitation period	Ron	346	2308
Economic return	%	40	180
Soil analyses, technical assistance	Ron	5100	5100
Land preparation	Ron	6000	6000
Clearing plantation	Ron	2800	2800
Surrounding	Ron	21124	21124
Fertilization	Ron	5000	5000
Planting material	Ron	10000	25000
Planting trees entire work	Ron	2500	6250
Entire setting up expenses	Ron	52524	71274

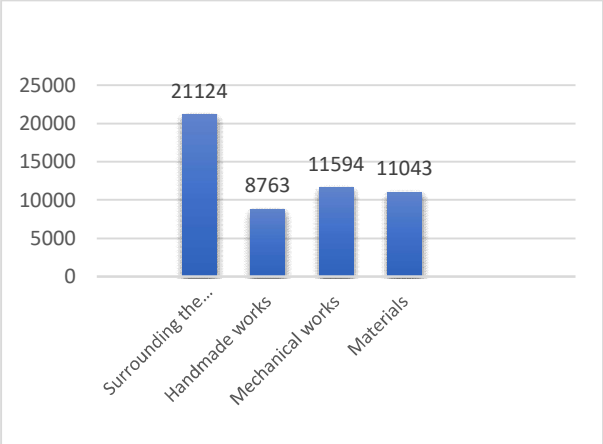

Figure 1. The costs of establishing a hectare of classic apple plantation

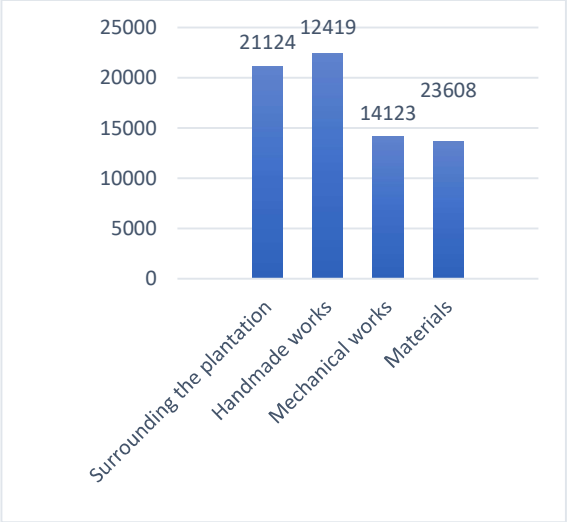

Figure 2. The costs of establishing a hectare of intensive apple plantation

In both cropping systems, the largest share is represented by the expenses with surrounding the plantation and the materials, which is given by the value of the fruit planting material necessary for the establishment of the plantation. The highest level is represented by the material costs incurred with the establishment of the intensive plantation, where a higher number of trees per hectare is needed.

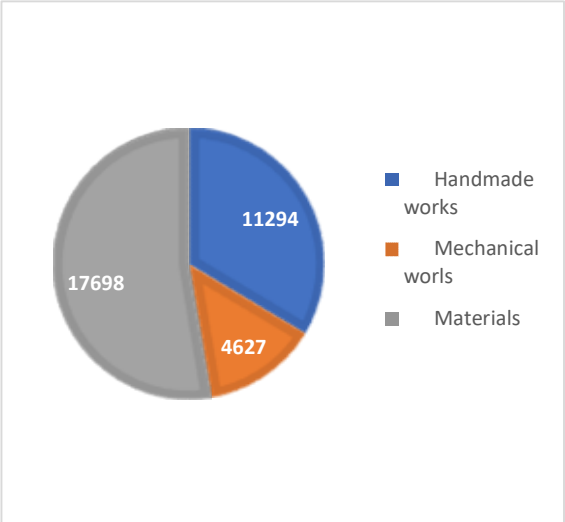

Figure 3. Annual operating costs of a hectare classic apple plantation

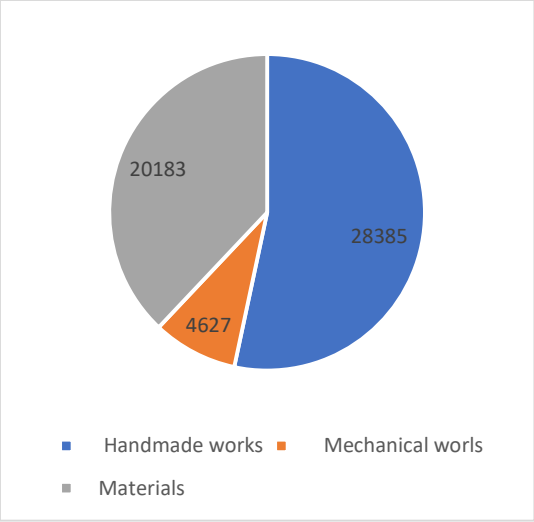

Figure 4. Annual costs of a hectare intensive apple plantation

During the period of exploitation of the plantation, the largest share in the total expenses has the expenses with mechanical works. The value of materials is given by the fuels and pesticides.

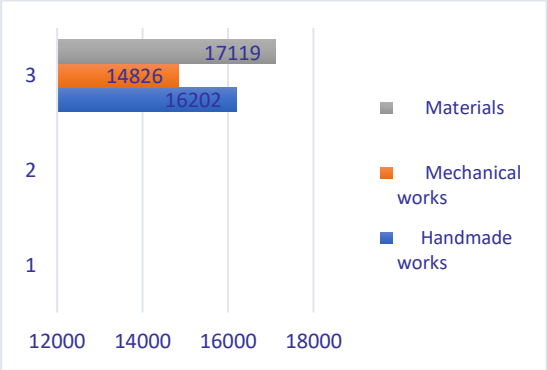

Figure 5. Maintenance costs for a hectare classic apple plantation

CONCLUSIONS

The technology applied to a culture has great influences on the economic indicators of that culture. The technology of establishing and maintaining an intensive apple plantation is very different from that of a classic plantation. This can also be seen from the analysis of the economic indicators of the two types of plantations. For the establishment of a hectare of intensive apple plantation, the expenses are higher by 36% compared to the expenses registered with the establishment of a hectare of classic apple plantation. This is due to the values given by the larger amount of planting material used to establish the plantation as well

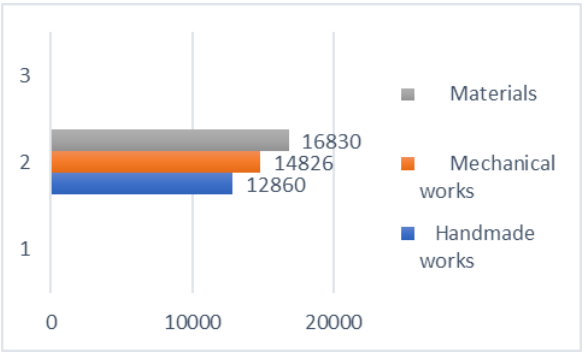

Figure 5. Maintenance costs for a hectare intensive apple plantation

In the structure of the expenses with the maintenance of the plantation until the fruiting, the ones with the materials (diesel, pesticides) and the expenses with the mechanical works have more weight (maintenance works of the orchard, mowing the grass and spraying in the orchard).

as the higher labor values used for planting the trees. The expenses incurred until the entry into the fruit are slightly higher in the intensive plantation compared to those recorded in the classic plantation.

The annual operating expenses are higher in the case of intensive plantation, this being given by the higher values recorded with labor (cutting work and fruit harvesting). The production obtained from one hectare of intensive plantation is significantly higher than that obtained from one hectare of classic plantation. The production cost recorded for a kilogram of apples obtained in an intensive plantation is 31% lower than that recorded for obtaining a kilogram of apples in the classic culture.

The annual net profit obtained from a hectare of intensive apple trees is very significantly higher than the net annual profit obtained from a

hectare of classic apple trees. The annual profit rate is 63.8% in the case of the intensive plantation and 16.3% in the case of the classic plantation.

The investment recovery period is 3 years in the case of the intensive plantation and 14 years in the case of the classic plantation. The total profit during exploitation is 756,324 Ron for the intensive plantation and 138,280 Ron for the classic plantation.

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