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# THE BEHAVIOR OF GALA, JONAGOLD, GOLDEN DELICIOUS AND GRANNY SMITH APPLE VARIETIES IN ORGANIC FARMING SYSTEM

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***Abstract***

*In the present study, the behaviour of the 'Gala', 'Jonagold', 'Golden delicious' and 'Granny Smith' apple varieties, grown in an organic orchard in Arad County, Romania is presented. The intensive orchard was planted in 2010, on 3.275 ha with apple trees, grafted on M9 rootstock, using 2.6 m x 0.8 m planting distances and 3.5 m high concrete poles with 5 lines of wires, as trellis system. The total yield and productivity of the apple varieties are presented and compared with the initial data estimated in the business plan of the structural funds' project. 2017 was the first year in which the total harvested production surpassed the estimation from the business plan, seven years after planting, but the overall real total production was still 68.1 tones, lower than previsioned. Fruit quality was reduced due to scab attack symptoms, sunburns, cracking and low calibre. Even so, by using intelligent marketing strategies as "buy locally" and "pick it yourself" besides the organic distribution chains, the economic losses were diminished. Considering our results, we do not recommend the cultivation of high disease sensitive apple varieties in organic orchards in areas with high infection pressure and without an efficient phytosanitary protection. The cultivation of scab resistant varieties and a proper orchard management could be the solution for the development of the organic apple production.*

***Key words***: *apple production, high density, productivity, fruit quality.*

## INTRODUCTION

As eating healthy and life quality becomes more and more important, the market shifts its focus and the business owners reorient themselves towards the organic products and services that satisfy the clients needs. EU makes serious efforts to fulfill their citizen expectations and promote and support the organic farming developpment. The organic farming in Romania is still at its beginning, the dynamic of organic production indicators showing different fluctuations, except the organic fruit and vineyard areas, where the trend was constantly ascending (MADR, 2018). This ascending situation was also sustained by the EU structural funds given for agriculture and rural development. Although the total organic area cultivated in Romania decreased with 21.5% in the period 2012-2016 (EUROSTAT, 2017), the organic orchard and vineyard area tripled in the same period (Burghelea et al., 2016). Romania makes serious efforts to support and promote organic farming, including advantages offered by different EU structural funds measures for agriculture for those activating in the organic sector. For the period 2007-2013 the procentage of the European Union subsidy received by Romania was 52.02% in average (Marinas et Prioteasa, 2016), altghough some afirm. For the Measure 1.2.1 (Agriculture), in October 2016, in Romania, out of 8738 projects proposals, 3849 were aproved and 2789 finalised, with a total of 662,274,906 euro payments.

Apple is the most important fruit species in Romania, our country having the second highest area cultivated with the apple in Europe (after Poland), representing a share of 10.2% of the total EU-28 production area and only a share of 3.6% of the total EU-28 harvested production (EUROSTAT, 2016).

Organic fruit growing has increasingly gain interest both from Romanian and European farmers or investors, althgough uncertified organic food (as farmers' market, self-production etc.) is considered by consumers to

be more “organic” than certified organic food (Petrescu et al., 2016).
The company Fruit4you, Belgian investors, which owns the 3,275 ha of organic apples in Horia village, Vladimirescu commune, Arad county, received more than 350,000 euro for the implementation of their organic apple orchard.
In this paper, we present the economic results of the organic apple orchard in Arad County, in terms of production, productivity, income in the 2011-2017 period and we compare these results with the previsions made in the structural funds business plan.

## MATERIALS AND METHODS

The data used for this study were gathered from the apple orchard belonging to company Fruit4you, lat: 46.1986, long: 21.4285 (Figure 1). As the investors were from Belgium, the same technology as in Belgium was used for the apples plantation. The soil was prepared in the spring and the planting was done with a planting machine.


Figure 1. The Fruit4you orchard

The trees were imported from a Belgian nursery, transported in a temperature-controlled cargo and kept at 25-28°C (the normal temperature environment), after arrival, with the roots in water for 24 hours to get hydrated. The planting was done in June-July 2011, because of the delays in trees delivery. The late planting period caused a premature period of dormancy, which made the young trees apparently looking as they were died in the autumn. The delay in plants delivery also forced the investor to build a buffer for the irrigation system that collects the water from the well and reduce the water temperature difference before the irrigation. The planting machine, with an potential efficiency of 4,800 trees/day manage to plant the orchard (3,275 ha) in four days. On the 90 m x 360 m plot 3 years old plants of ‘Gala’, ‘Jonagold’ (‘Red Prince’) ‘Golden delicious’ and ‘Granny Smith’ varieties, grafted on M9 rootstock, were planted.
The investors preferred to plant at 2.6 m x 0.8 m, for a „fruit wall shape” high density orchard, with 4,000 trees/ha, having 3.5 m high concrete poles and 5 lines of wires. The poles were distributed every 10 m, for 360 m, with a space in the middle of the orchard, where the tractor can make the “U” turn. The varieties were planted by groups of four rows, starting and the scheme repeated for 27 lines. The inter rows were mowed mechanically and the row was cleaned by hand.
Fertirrigation was insured by drip irrigation lines placed directly at the ground level, working on 4 sectors, every day, with 2 hours of watering per sector.
The hail and pest protection was insured by a hail protection net that covers the top and the four laterals of the orchard (Figure 2).

Figure 2. The trellis and the hailnet system

No tree pruning was done in the first year. In the second year the trellis system was put in place, the first three wires, followed by the next fourth and fiftth wires in the third year.
The canopy forming prunings were performed after the Belgian method, during the flowering time, which also implies slow shoot growths of around 30 cm/year.
As the orchard is included in the organic farming system, the insects were controled with pheromone disruptors and the hail nets, that were kept closed from May 1$^{st}$ to September

30.800 units/ha of Isomate CLR mating disruptors (active substance codlemone), were used each year, being placed at height of the 3rd wire (~ at 1.8 m), one every 3 trees, one the edges and one every 5 or 8 trees in the centre of the orchard. Every year the dispensers were put in place at the beginning of May (Bujdei et al., 2016). The insects attack was estimated under 1%, in the flowering period only, when the net is still closed, for a better pollination.
After the net was closed, no insect issues were observed in all 6 years of cultivation. Mineral oil was sprayed in spring 2012 and treatments with cooper (Bouille Bordelaise WDG) were applied during the seasons.
The fruits were picked at maturity and kept in cold storage, at 4°C.

## RESULTS AND DISCUSSIONS

Our paper presents the real experience of one applicant to 1.2.1 Rural Development Measure, focusing on the real challenges that one investor met within an organic apple orchard.

**Yield, productivity and economic efficiency**

The average fruit production/ha was estimated at 18.58 t/ha in the business plan and the realized production was of 15.91 t/ha, with 14.35% less (Table 1). The differences were much higher in the first five years, only 50% of what was estimated was realised until 2016. The year 2017 was a very good year for apple growing in the region with an average annual production of 48.55 t/ha, which represented a record.

Table 1. The estimated and the realized apple production in the 2011-2017 period

| Year | Estimated yield (t) | Real yield (t) | Difference (t) | Difference % |
|---|---|---|---|---|
| 2011 | | 3.03 | | |
| 2012 | 30.00 | | -14,10 | -47.00 |
| 2013 | 55.00 | 23.40 | -31.60 | -57.45 |
| 2014 | 70.00 | 27.30 | -42.70 | -61.00 |
| 2015 | 70.00 | 42.60 | -27.40 | -39.14 |
| 2016 | 70.00 | 41.40 | -28.60 | -40.86 |
| 2017 | 70.00 | 159.00 | 89.00 | 127.14 |
| Total yield | 365.00 | 312.63 | -52.37 | -14.35 |
| Total annual yield | 60.83 | 52.11 | -8.73 | -14.35 |
| Annual yield/ha | 18.58 | 15.91 | -2.67 | -14.35 |

A similar high yield was reported by Sumedrea et al. in 2016, a production of 44.40 t/ha for 'Golden delicious' Clone B. As in the period 2012-2015, the productions were lower than expected, the producer tried in one year, on one row, a production without thinning.
The result was promising, with 35% higher production on that row, but in the following year no production was obtained, as no flowering buds were differentiate.

Table 2. The estimated and realized productions of each apple variety in the 2011-2017 period

| Year | Golden (t) | Gala (t) | Jonagold (t) | Granny Smith (t) | Total yield (t) |
|---|---|---|---|---|---|
| 2011 | 1.00 | 1.00 | 1.00 | 0.30 | 3.30 |
| 2012 | 4.50 | 5.40 | 5.10 | 0.90 | 15.90 |
| 2013 | 3.00 | 9.00 | 11.40 | - | 23.40 |
| 2014 | 8.40 | 8.40 | 10.50 | - | 27.30 |
| 2015 | 13.50 | 16.50 | 12.60 | - | 42.60 |
| 2016 | 15.00 | 17.40 | 9.00 | - | 41.40 |
| 2017 | 48.60 | 53.00 | 57.40 | - | 159.00 |
| Total yield/ variety | 94.00 | 110.70 | 107.00 | | 312.90 |
| Average yield /ha | 14.35 | 16.90 | 16.34 | | |

'Gala' variety was the most productive one, with a productivity of 16.90 t/ha, calculated for the 2011-2017 period (Table 2).
The 'Granny Smith' variety was replaced after the first 2 years, due to its scab sensitivity and low production. Because of scab attack, the general aspect of the trees and apples was unsatisfactory, which forced the producer to sell the 'Granny Smith' apple at a reduced price (50% lower than expected). Although this variety should produce big apples, no fruit was bigger than $65^{+}$ mm (Figure 3).

Figure 3. Small fruits produced by 'Granny Smith'

'Jonagold' had a lower productivity when compared with 'Gala', but the apples were in majority of 1st category (80+ calibre) (Figure 4). 'Golden delicious' had in average 65% scab free apples, with fruits varying in size between 65 and 80+mm. 'Gala' was more affected by scab, with around 45% scab free apples and the calibre between 60 and 70 mm.

Figure 4. The calibre measurments for 'Jonagold' apples

Regarding the income, in the period 2012-2016 all our estimations were unrealistic, as the real income between 39 and 61% of the estimated one (Table 3).

Table 3. The estimated and actual orchard incomes in the 2011-2017 period

| Year/ to | Estimated income (euro) | Real income (euro) | Difference (euro) | Difference (%) |
|---|---|---|---|---|
| 2011 | | | | |
| 2012 | 17,523 | 4,437 | -13,086 | -74.68 |
| 2013 | 32,126 | 5,986 | -26,140 | -81.37 |
| 2014 | 40,887 | 13,029 | -27,858 | -68.13 |
| 2015 | 40,887 | 17,427 | -23,460 | -57.38 |
| 2016 | 40,887 | 14,113 | -26,774 | -65.48 |
| 2017 | 40,887 | 42,400 | +1,513 | +3.70 |

The average price of apples was 2.5 lei/kg (55 euro cent/kg) and the producer was able to maintain this price only because he has built through the structural funds a cold storage, that allowed him to keep and sell the fruits later than all the other producers in the area and also to deliver in high quantities at once, loading a full truck. Still, the price was not as expected.
Another issue was the lower production obtained in comparison with the estimated one. Beside the stress, this fact leads to the loss of important contracts and direct income losses.

**Crop issues**

The most frequent crop issues that the producer faced were sunburns, cracking and scab (figures 5, 6 and 7) and the most susceptible variety was 'Gala'.

Figure 5. Sun burns and cracking on 'Gala' variety

Figure 6. Scab symptoms on 'Gala' variety leaves

Regarding scab, more than 45% of the 'Gala', more than 35% of 'Golden' and more then 15% of 'Jonagold' fruits had the disease marks, a fact wich led to a loss due to the lower selling price.

**Selling strategies**

The producer mainly used two selling strategies: "buy locally" and "pick it yourself".


Figure 7. The "buy locally" and "pick it yourself" announcements on Fruit4you Facebook page

The main retailer client was Real Hyper Market Arad, but a part of the fruits also were bought by the Belgian fruits and vegetables dealer, Fresh Fruit Service BvB.

## CONCLUSIONS

The estimations in the business plan when the producer applied to structural funds were more optimistic than the results obtained in reality, especially regarding the income and this had a negative impact on the business.

The highly scab sensitive varieties: 'Gala', 'Jonagold' ('Red Prince') 'Golden delicious' and 'Granny Smith' faced serious problems under a high infection pressure and the lack of good protection products. Cooper sulphate couldn't offer an effective protection against scab and the percentage of affected fruits was extremely high, from 15-45%. 'Granny Smith' was eliminated for this reason, after two years of cropping. Insects attack on fruits was kept less than 1% by using winter oil treatment, matting disruption and net closed orchard. The level of fruit production and its poor quality affected seriously the orchard incomes, the results being with 57.38-81.37% lower than the estimated ones. Only in 2017, the income overpassed the estimation, due to an exceptional production.

Taking in consideration our experience, we recommend to other farmers:

- to set up of the irrigation drip line at 60-80 cm height instead of laying directly on the soil - no rats eating the tube and no need to massive replacement due to destruction during weeding;
- to use higher planting distances between rows, to at least 3.2 m;
- to use mechanical equipments for weed control on the fruit tree row;
- to associate in growers groups, in order to fill the eventual gaps that some may have in some years, reduce the cost of cold storage and not at last, to be able to negotiate with the buyer for fair selling prices.

The general conclusion is to avoid the cultivation of scab sensitive varieties in organic apple orchards and to replace them with scab resistant ones. A proper orchard management is needed to control the phytosanitary issues, to ensure a proper fertilization and a rational tree growth and fruit bearing.

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