

## RESEARCH ON THE USE OF EXTRA-EARLY CULTIVARS FOR INCREASING ECONOMIC EFFICIENCY IN WATERMELON GROWING IN THE SOUTHERN ROMANIA

**Agatha POPESCU**

University of Agricultural Sciences and Veterinary Medicine, Bucharest, 59 Marasti, District 1, Zip code 011464, Bucharest, Romania, Phone: +40 21 318 25 64/232, Fax: + 40 21 318 28 88, E-mail: agatha\_popescu@yahoo.com

**Corresponding author email:** agatha\_popescu@yahoo.com

### **Abstract**

*The paper aimed to study the influence of two cultivars: Crisby and Karistan, with a different maturation length, upon economic efficiency in watermelon growing in an experiment running on sandy soils at SC Casa Pepenilor Verzi SRL Dabuleni, Dolj County, Romania in the year 2011. The experience was organized on 1.25 ha divided into 2 plots: V1-cultivated with Crisby F1 cultivar, an extra-early type and V2-cultivated with Karistan cultivar, a tardy type. The main economic indicators followed in the experiment have been the following ones: watermelon yield, production cost, income, profit, profit rate and gross margin. Crisby cultivar produced 30 t fruit per ha, starting from the 1<sup>st</sup> part of June when the selling price was Lei 1.2/kg and assured Lei 22,611 profit/ha. Karistan cultivar generated 70 t fruit per surface unit beginning from the 2<sup>nd</sup> part of July when the selling price was Lei 0.3/kg and produced Lei 6,051 profit per ha. As a conclusion, the use of an extra-early cultivar could assure a more efficient watermelon growing because fruit could be delivered earlier in the market covering in a better way consumer's demand and increasing producers' income and profit.*

**Keywords:** extra-early cultivar, economic efficiency, Romania, watermelon growing

### **INTRODUCTION**

Watermelons are sweet, tasty, juicy, nutritive and healthy fruits consumed as such divided into slices, salad or juice, especially in summer season [16].

It is a healthy fruit with a good impact on people's diet because of its nutrients and energetic value [7,13]. It also has a good effect on metabolism and blood pressure [2].

Watermelon juice is also a promising feedstock supplement, diluent and nitrogen supplement for ethanol biofuel production [3].

Watermelon growing is suitable mainly in the hot areas where the conditions for fruit development and maturation are fulfilled. Watermelon can be successfully cultivated on sandy soils [1,5,6,8,10, 11].

Watermelon production depend on cultivar, fertilization and irrigation [4, 9,12,13].

In Romania, the traditional region for watermelon growing is the Southern part, especially the Oltenia region where more than 10,000 households are growing watermelons on

sandy soils in the communities of Danesti, Bechet, Calarasi and Dabuleni.

Dabuleni is “ the country” of watermelons”, because 70 % of the 3,600 existing households, that is 2,500 households are cultivating in average one hectare with watermelons [17].

The yield varies between 50 and 100 t/ha depending on watermelon cultivar, its productive potential and the moment of maturation.

Traditionally, watermelons are harvested at the beginning of August in Romania, but the use of the early and extra early cultivars and varieties has determined as harvesting to start even in the first part of the month of June.

In Romania, both Romanian and imported cultivars, tested and adapted to the local conditions of soil and climate are cultivated (Dulce de Dabuleni, De Dabuleni, Crimson Sweet, Sugar Baby, Lady F1, Farao F1, Granit F1, Crisby F1, Red Star F1, Top Gun F1 [6].

The main characteristics of watermelon cultivars are: maturation moment, shape and

weight of the fruit, vigour and stress resistance of the crop.

Fruits earlier harvested have a smaller weight, 4-5 kg and are more sensitive to diseases and pest. On the contrary, fruits later harvested are heavier, weighing 8-10 kg and even more and are more resistant to stress conditions.

Some research results have proved that watermelon plants treated with foliar fertilizers based on Boron (Complex Boron, Cupribor and Folibor) registered a yield by 43-47 % higher compared to the untreated and unfertilized ones [8,14].

Watermelon growing is achieved in various technological systems such as: in the field, in greenhouses and in the tunnels. The applied technology has also an important influence both on fruit production and maturation period [6].

The most important factor influencing the performance per surface unit is watermelon cultivar and variety, considering that soil and climate conditions are similar.

In this context, the paper aimed to present a comparative experiment in watermelon growing on sandy soils under a dripping irrigation system at SC Casa Pepenilor Verzi SRL, Dabuleni, Dolj County, Southern Romania, in 2011 in order to identify the effects on fruit yield, production cost, income, financial results, and economic efficiency. In this purpose, two cultivars with different maturation length were used as follows: Crisby, an extra-early cultivar and Karistan, a tardy watermelon cultivar.

## MATERIAL AND METHOD

In order to study the effect of watermelon variety on the economic performance, the experiment was carried out in the year 2011 at SC Casa Pepenilor Verzi SRL, Dabueni, Dolj County, Southern Romania on the surface of 1.25 ha, divided into 2 plots: V1-0.625 ha cultivated with Crisby cultivar, an extra early variety, and V2- 0.625 ha cultivated with Karistan cultivar, a tardy variety.

The watermelon crop was grown on a sandy soil in the field under a dripping irrigation system. The crop technology consisted of tillage, cultivar selection, transplants preparation, fertilization, transplanting of the

small plants into the field, integrated weed and pest control, irrigation, crop maintenance and harvesting.

In order to analyze the economic efficiency in watermelon growing, the following economic indicators have been taken into account: watermelon yield and production, production cost by cost item (cost of producing transplants and transplanting in the field, tillage and crop maintenance, weed and pest control, irrigation cost etc), income coming from marketed fruits, selling price, profit, profit/ha and profit per kg, cost/ha and cost/kg, income/ha and per kg, and profit rate.

All the calculations have been made both per surface unit (ha) and total cultivated area with the 2 watermelon cultivars.

The data were collected from farm evidence [15] and were processed according to the modern methodology for 1 ha, for 0.625 ha cultivated with each variety and 1.25 ha cultivated with the both cultivars in the experiment.

## RESULTS AND DISCUSSIONS

**The choice of cultivars.** The two varieties chosen to be used in this experiment are different concerning the period of maturation and production potential: V1-Crisby is an extra-early variety and V2-Karistan is a tardy cultivar.

Table 1. The main characteristics of watermelon cultivars

| Characteristic           | V1-Crisby  | V2-Karistan                                |
|--------------------------|--|--|
| Maturation               | Extra-early  | Tardy                                      |
| The moment of maturation | June 10, 2011  | July 15, 2011                              |
| Fruit shape              | Oval   | Oval                                       |
| Shell thickness          | Fine   | Fine                                       |
| Fruit weight (kg)        | 7-10   | 8-10                                       |
| Pulp (flesh)             | Crispy, very sweet, fine, dark red and small black seeds | Crispy and sweet, carmine red, black seeds |
| Yield (t/ha)             | 30   | 70   |
| Crop technology          | In the field   | In the field                               |

Similar features are mentioned in other research results [6, 18,19,20].

**Tillage.** The sandy soil was worked with the tractor and plough and then with the disk harrow.

**Fertilization** was achieved at the same time with tillage paying attention to the amount of fertilizer per surface unit and the moment of application, taking into account that for 50 t production per ha, watermelons extract from soil 85 kg Nitrogen, 65 kg Phosphorus and 135 kg Potassium [6].

The fertilizers were incorporated into the ground at ploughing using the disk harrow. The dose of complex fertilizer was 550 kg/ha for assuring a balanced NPK ratio so that P and K to be in a higher amount as the fruit flesh to remain crispy.

During the vegetation period, the Elite foliar fertilizer was supplementary applied (N<sub>20</sub>P<sub>60</sub>K<sub>15</sub>) as a powder dissolved in 300 litres water. The dose was 4-5 kg Elite powder per ha.

**Transplanting** of the small plants into the field was carried out in the 2<sup>nd</sup> part of the month of April. A number of 5,000 transplants were used for planting 1 ha. The distance between rows was 1.8-2 m and between plants 0.5-1 m.

**Integrated weed control** was achieved after harvesting, in summer season, using Glicos, a universal herbicide (also it could be used Roundup, Clinic 360 SL with similar effect) in the corresponding dose of 4-5 litres/ha, diluted with 300-350 litres water. Also, the Toxin fungicide (Adonis fungicide could be also used) has been also applied in a dose of 30-40 g for 10-15 litres water in order to assure a good watermelon production without causing damages by diseases and pest.

**Irrigation** was compulsory in order to support production because Dabuleni area is “the pole” of hot summers in Romania. In 2011, only 5 wettings were applied in the period of high temperatures over 30 degrees. Even though watermelons are resistant to drought, due to the strong root system, in the stage of intense fruit growth, irrigation is compulsory. The modern dripping irrigation method used in the experiment has had a lot of advantages as follows: water was centrally and automatically distributed at the same pressure at the root of each plant as much as it needed, water consumption was kept at an optimum level, soil aeration was a corresponding one, a diminished weeding degree was recorded and pest attack was successfully prevented. The Elite foliar

fertilizer was applied at the same time with irrigation. The irrigation water was assured by the well drilled at 35 m depth into the ground, from where water was directly pumped into the water pipes transporting it to the plant roots. The amount of water used per one wetting was 250 cubic meters/ha but due to the high temperature in the stage of the fruit growth, 4 wettings were required, meaning 1,000 cubic meters water consumption for V1-Crisby cultivar and 6 wettings, that is 1,500 cubic meters for V2-Karistan cultivar.

**Harvesting** was manually done depending on the moment of each cultivar maturation: June 10-15, 2011 for Crisby variety and later than July 15 2011 for Karistan cultivar. The fruits were collected from the field in the moment of maturation, recognized based on the following criteria: thin short tail, tendril dried at the end, shiny shell, leaving white traces when it is scratched and turning yellow at the contact with the soil, the appearance of a specific cracking sound when we press the fruit or touch it by finger.

**Watermelon Yield** was 30 t/ha for V1-Crisby cultivar and 70 t/ha for V2-Karistan cultivar, determined by each variety production potential.

Table 2. Production, Sale Price and Gross Product per ha by cultivar in 2011

|                    | MU     | V1-Crisby | V2-Karistan | Difference V2-V1 |
|--------------------|--------|-----------|-------------|------------------|
| Yield              | Kg/ha  | 30,000    | 70,000      | +40,000          |
| Average sale price | Lei/kg | 1.2       | 0.3         | -0.9             |
| Gross Product      | Lei/ha | 36,000    | 21,000      | -15,000          |

**Watermelon Production** counted for 18.75 t for V1-Crisby cultivar and 37.5 t for V2-Karistan variety, taking into account that each cultivar was cultivated on 0.625 ha. The total watermelon production corresponding to 1.25 ha was 56.25 t.

**Marketed Fruit Production** was represented by 56.25 t of which: 18.75 t Crisby watermelons, sold at Lei 1.2/kg average price in the 1<sup>st</sup> part of June 2011 and 37.50 t of Karistan watermelons sold in the 2<sup>nd</sup> part of July 2011 at Lei 0.25/kg, average price.

**Gross Product**, resulted from watermelon commercialisation to various retailers, counted

for Lei 36,000 in case of V1-Crisby cultivar and Lei 15,000 in case of V2-Karistan variety.

**Planting Cost.** The expense of transplanting of the small plants into the field counted for Lei 6,000 taking into consideration that 5,000 plants were planted per surface unit both for Crisby and Karistan cultivar and the production cost per transplant was Lei 1.2 in 2011.

For the surface planted with each cultivar, 0.625 ha, the planting cost was Lei 3,750 and for the whole surface planted with the both varieties, 1.25 ha, the expense counted for Lei 7,500.

**Cost of own mechanical works** needed for tillage made with the tractor, plough and disk harrow (fuel, lubricant, machine parts, repairs etc) counted for Lei 855/ha and the cost of the related labour Lei 95/ha, totalizing Lei 950/ha, similar for the both watermelon varieties, Crisby and Karistan.

**Fertilization Cost** was determined by the type of fertilizer, the dose per surface unit, the number of sacs purchased from the market and purchasing price per sac. The dose of complex NPK fertilizer was 550 kg/ha. The farmer bought 11 sacs of 50 kg each at Lei 130/sac, meaning Lei 1,430 per ha.

For the cultivated area with each cultivar, 0.625 ha, this meant Lei 893.75 both for Crisby and Karistan cultivar.

The total fertilization cost for 1.25 ha in experiment was Lei 1,787.50.

For foliar fertilization, an amount of 5 kg Elite fertilizer was bought, representing the dose per surface unit. Taking into consideration that this fertilizer is commercialized in sacs of 25 kg, the fertilization cost counted for Lei 100/ha, for Lei 62.50 for 0.625 ha cultivated with each watermelon variety and for Lei 125 for 1.25 ha cultivated with the both cultivars.

Therefore, the fertilization cost totalized Lei 1,520/ha, Lei 956.25 per 0.625 ha and Lei 1,912.50 for 1.25 ha cultivated with watermelons in the experiment.

**Cost of Weed Control** counted for Lei 175/ha, taking into account that 5 litres of Glicos herbicide were purchased at Lei 35/litre. For 0.625 ha, the related cost of weed control was Lei 109.37 and for 1.25 ha cultivated with the two cultivars, it counted for Lei 218.75.

**Cost of Fungicide** represented Lei 24/ha, taking into consideration that 2 litres of Toxin fungicide was bought at Lei 12/litre. This meant Lei 15 fungicide cost per 0.625 ha cultivated with each watermelon variety and Lei 30 for the total experimental surface, 1.25 ha cultivated with the both cultivars.

Table 3. Production Cost per ha by cost item and watermelon cultivar in 2011 ( Lei/ha)

| Cost item        | V1-Crisby | V2-Karistan | Difference V2-V1 |
|------------------|-----------|-------------|------------------|
| Planting         | 6,000     | 6,000       | -                |
| Fertilization    | 1,530     | 1,530       | -                |
| Plant protection | 199       | 199         | -                |
| Irrigation       | 800       | 1,200       | +400             |
| Tillage          | 950       | 950         | -                |
| Part-time labour | 3,000     | 4,080       | +1,080           |
| Electricity      | 120       | 200         | +80              |
| Supplying cost   | 80        | 80          | -                |
| VARIABLE COST    | 12,679    | 14,239      | +1,480           |
| Depreciation     | 300       | 300         | -                |
| Rent             | 360       | 360         | -                |
| General cost     | 50        | 50          | -                |
| FIXED COST       | 710       | 710         | -                |
| PRODUCTION COST  | 13,389    | 14,949      | +1,560           |
| GROSS MARGIN     | 23,321    | 6,761       | -16,560          |

**Cost of Irrigation Water** was higher in case of Karistan cultivar due to its longer period of vegetation in comparison with Crisby variety. So, taking into account that Crisby cultivar needed 4 wettings of 250 cubic meters water each, this meant 1,000 cubic meters water consumption/ha. The price per one wetting was Lei 200, meaning Lei 800/ha, Lei 500 for 0.625 ha. In case of Karistan cultivar, the irrigation water counted for Lei 1,200/ha, because it needed 6 wettings. For 0.6,25 ha, the cost of the consumed water was Lei 750.

Therefore, for the whole surface cultivated with the two cultivars, 1.25 ha, the cost of irrigation water was Lei 1,250.

**Part-time labour Cost** was determined by the labour required both for transplanting the small plants and harvesting of fruits. In case of V1-Crisby cultivar, a number of 10 part-time workers were used for planting 5,000 stalks/ha. They were paid Lei 50/working day and in addition they received lunch (Lei 10/person/day) for a period of two working days. Therefore, the cost of labour required for



planting 1 ha with Crisby cultivar was Lei 1,200, meaning Lei 750 for 0.625 ha.

For harvesting of Crisby watermelon fruits, a number of 6 part-time workers were used for a period of 5 days in order to collect 30 t fruits from 1 ha. They also received Lei 50/day and a lunch costing Lei 10/person/day. Taking into account all these calculations, the harvesting cost for Crisby watermelons was Lei 1,800 /ha and Lei 1,125 for 0.625 ha.

The total cost of part-time labour used for Crisby cultivar counted for Lei 3,000/ha and Lei 1,875 for 0.625 ha.

Table 4. Production Cost by cost item for 0.625 ha cultivated with each watermelon variety in 2011 (Lei)

| Cost item            | V1-Crisby | V2-Karistan | Difference V2-V1 | Total V1+V2 |
|----------------------|-----------|-------------|------------------|-------------|
| Cultivated area (ha) | 0.625     | 0.625       | -                | 1.25        |
| Planting             | 3,750     | 3,750       | -                | 7,500       |
| Fertilization        | 956.25    | 956.25      | -                | 1,912.50    |
| Weed Control         | 109.37    | 109.37      | -                | 218.75      |
| Fungicide            | 15        | 15          | -                | 30          |
| Irrigation           | 500       | 750         | +250             | 1,250       |
| Tillage              | 593.75    | 593.75      | -                | 1,187.50    |
| Electricity          | 75        | 125         | +50              | 200         |
| Part-time labour     | 1,875     | 2,550       | +675             | 4,425       |
| Supplying cost       | 18.75     | 18.75       | -                | 37.50       |
| VARIABLE COST        | 15,786.24 | 8,868.12    | -6,918.12        | 24,654.36   |
| Depreciation         | 62.50     | 62.50       | -                | 125         |
| Rent                 | 225       | 225         | -                | 450         |
| General cost         | 31.25     | 31.25       | -                | 62.50       |
| FIXED COST           | 318.75    | 318.75      | -                | 637.50      |
| PRODUCTION COST      | 16,104.99 | 9,186.87    | -6,918.12        | 25,291.81   |

In case of V2-Karistan cultivar, the cost of part-time labour was similar to the one registered for V1-Crisby cultivar. The only difference is the fact that harvesting required 8 part-time workers for a period of 8 working days for collecting 70 t of watermelons from 1 ha. Under these conditions, the planting cost counted for Lei 2,880/ha and Lei 1,800 for 0.625 ha. The total labour cost related to Karistan cultivar was Lei 4,080/ha by 36 % higher than the one recorded by Crisby variety. For 0.625 ha, part-time labour cost was Lei 2,550.

**Supplying Cost** counted for Lei 30/ha, meaning Lei 18.75 for 0.625 ha and Lei 37.50 for 1.25 ha.

**Depreciation Cost** was Lei 100/ha, Lei 62.50 for 0.625 ha and Lei 125 for 1.25 ha.

**Electricity Cost** counted for Lei 120 in case of Crisby cultivar and Lei 200 in case of Karistan variety.

**Rent Cost** counted for Lei 360/ha, that is Lei 225 for 0.625 ha and Lei 450 for 1.25 ha cultivated with the both cultivars.

**Total Production Cost.** Taking into account all the expenses mentioned above, the total production cost for 1 ha cultivated with V1-Crisby variety counted for Lei 13,389 while in case of V2-Karistan cultivar, it counted for Lei 14,949.

**Gross Margin**, calculated as a difference between gross product and variable cost, was Lei 23,321 in case of V1-Crisby variety, by Lei 16,560 higher than in case of V2-Karistan cultivar, which registered only Lei 6,761. This was due to the higher gross product (Lei 36,000) registered by Crisby cultivar and lower variable cost (Lei 12,679) in comparison with Karistan cultivar whose gross product was by 50 % lower and variable cost by 12.30 % higher in comparison with the levels registered by Crisby variety.

**Economic Efficiency per surface unit.**

**Yield.** In case of V1-Crisby variety, watermelon yield was 30 t/ha, by 40 t lower compared to Karistan cultivar yield.

**Production cost/ha** was Lei 13,389, by Lei 1,560 lower compared to the one recorded by Karistan variety.

**Cost per watermelon kilogram.** As a result, a kilogram of Crisby watermelon needed Lei 0.44 in order to be produced, by 1,76 times more in comparison with Lei 0.25 per kg in case of Karistan variety.

**Income per ha.** Crisby variety assured Lei 36,000, by 71 % more in comparison with Karistan cultivar, which produced only Lei 21,000 income. This was due to the good selling price for the extra-early Crisby variety, Lei 1.2 in comparison with Lei 0.3 /kg for the tardy Karistan variety. The higher price compensated the low production of the extra-early variety and produced more income.

**Profit/ha.** Crisby cultivar produced Lei 22,611 profit per ha, by 3.73 times more than Karistan cultivar, whose profit counted just for Lei 6,051/ha.

**Profit per watermelon kilogram** counted for Lei 0.75 in case of Crisby variety and Lei 0.10 in case of Karistan cultivar.

Table 5. Indicators of Economic Efficiency in Watermelon production per ha by cultivar in 2011

|                  | MU     | V1- Crisby | V2- Karistan | V2-V1   |
|------------------|--------|------------|--------------|---------|
| Cultivated area  | Ha     | 1          | 1            | -       |
| Watermelon yield | t/ha   | 30         | 70           | +40     |
| Cost per ha      | Lei/ha | 13,389     | 14,949       | +1,560  |
| Cost per kg      | Lei/kg | 0.44       | 0.25         | -0.19   |
| Income per ha    | Lei/ha | 36,000     | 21,000       | -15,000 |
| Income per kg    | Lei/kg | 1.2        | 0.3          | 0.9     |
| Profit per ha    | Lei/ha | 22,611     | 6,051        | -16,560 |
| Profit per kg    | Lei/kg | 0.75       | 0.10         | -0.65   |
| Profit rate      | %      | 68.87      | 40.47        | -28.40  |
| Gross margin     | Lei/ha | 23,321     | 6,761        | -16,560 |

**Profit rate** counted for 68.87 % in case of Crisby variety and 40.47 % in case of Karistan cultivar, showing that the both watermelon varieties are profitable but profitability is higher in case of the extra-early cultivar.

**Gross margin** was Lei 23,312/ha in case of Crisby, by 3.44 times higher in comparison with the one registered by Karistan cultivar.

**Economic Efficiency for 1.25 ha experimental surface.**

Table 6. Indicators of Economic Efficiency for 1.25 ha cultivated with Watermelons in 2011

| Specification          | MU     | Value     |
|------------------------|--------|-----------|
| Cultivated area        | ha     | 1.25      |
| Fruit production       | kg     | 100,000   |
| Income                 | Lei    | 47,000    |
| Income per ha          | Lei    | 37,600    |
| Income per kg          | Lei/kg | 0.47      |
| Production cost        | Lei    | 19,198.74 |
| Production cost per ha | Lei/ha | 15,358.99 |
| Production cost per kg | Lei/kg | 0.19      |
| Profit                 | Lei    | 27,801.26 |
| Profit per ha          | Lei/ha | 22,241    |
| Profit per kg          | Lei/kg | 0.28      |
| Profit rate            | %      | 44.80     |

From the whole surface cultivated with watermelons in this experiment, the farmer obtained 100 tons fruits which were sold in the market at Lei 0.47 average price bringing him

Lei 47,000 income. Taking into account that the farmer paid Lei 19,198.74 for producing watermelons from the both cultivars, Crisby and Karistan, on the surface of 1.25 ha, he got Lei 27,801.26 profit, meaning Lei 22,241 per ha and Lei 0.28 per fruit kilogram. The average profit rate was 44.80 % in the year 2011.

## CONCLUSIONS

The use of extra-early watermelon cultivars on a sandy soil at SC Casa Pepenilor Verzi SRL Dabuleni, Dolj County has lead to important results concerning the increase of economic efficiency in watermelon growing.

Local producers could obtain a higher production earlier than the traditional season which normally starts at the beginning of August. Producing watermelons in the 1<sup>st</sup> part of June offers a chance to producers to sell them at the best price in the market.

Crisby cultivar assured 30 t/ha under Lei 13,389 per surface unit production cost and brought Lei 36,000 income to the farmer who finally remained with Lei 22,611 gross profit. Karistan cultivar, which is a tardy variety, assured 70 t fruit/ha under Lei 14,949 production cost and brought only Lei 6,051 profit per surface unit to the farmer.

Therefore, farmers have to pay more attention to the extend of watermelon production along the summer season in order to increase their income and profit.

In this purpose, they have to use a mixture of watermelon cultivars with different maturation length and apply modern technologies.

Crisby cultivar is warmly recommended to be cultivated on larger surfaces in the Southern Romania where soil and climate conditions are suitable to watermelon growing.

In this way, Romanian market requirements could be better covered with watermelons from the domestic production starting from the first half on the month of June.

The use of extra-early cultivars in watermelon growing could lead to a higher profitability in comparison to the one registered by tardy cultivars.

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- [20][www.moreni.ro](http://www.moreni.ro)