Scientific Papers. Series A. Agronomy, Vol. LXV, No. 2, 2022
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

# PRELIMINARY RESULTS REGARDING THE INFLUENCE OF SOME NUTRIENT SUBSTRATES ON THE FRUITS QUALITY IN BLACKBERRY

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***Abstract***

*Blackberries are an important commercial fruit crop, widely grown in all temperate regions of the world. The blackberries contain significant amounts of polyphenol antioxidants such as anthocyanin pigments linked to potential health protection against several human diseases. In Romania, it is not cultivated on a large scale. The studied plantation was established in the spring of 2020, and the results presented refer to the fruits harvested in 2021. The crop combines different nutritive substrates, that were applied to the soil, as: manure, forest compost, semi-fermented compost and spent mushroom substrate (SMS). The experiences were set up in the field within SCDP Băneasa the experimental farm Moara Domneasca, Afumati. This paper considers a classic blackberry culture (variety: Triple Crown). The research was based on both the monitoring of the physico-chemical characteristics of the soil and the monitoring of the biometric indicators of the fruits. This paper presents preliminary results of research conducted in order to study the possible influence of nutrient substrates on the quality of blackberries fruits.*

***Key words****: blackberry cultivation, biometric indicators, preliminary results, physico-chemical characteristics.*

## INTRODUCTION

Blackberry is one of the 740 species of the genus Rubus in the Rosaceae family and it grows spontaneously in Europe, the Middle East, North Africa and North America, being introduced into culture in America at the beginning of the XIX century and in Western Europe in the second half of the century XIX (Balan et al., 2013).

Throughout history, the blackberry has had significance in medicine and has been used in many ways. Today, the demand for blackberries is increasing, this fruit being defined as functional foods in the medical terminology and the public awareness of this issue is also growing (Eskimez et al., 2019).

Blackberries can be consumed, either fresh or processed in the form of juice, syrup, jam, sherbet, liqueur and these fruits present a rich biochemical content. Numerous studies draw attention to the properties and benefits of these biochemical constituents and provide further encouragement that selection in breeding can be utilised to increase the levels of beneficial compounds in these fruit (Cho et al., 2004; Clark and Finn, 2008; Mladin et al., 2008). Anthocyanins, ellagitannins, phenolic acids, flavonoids, vitamins, minerals as well as other compounds contribute to blackberries high antioxidant capacity (Diaconeasa et al., 2014; Kaume et al., 2012; Vlad et al., 2019) and also have anticarcinogens, anti-neurodegenerative and anti-inflammatory effect (Milosevic et al., 2012).

Considering the demand for these fruit is increasing and the fact that they can be processed and consumed in different ways, they can be valorised on a high price (Eskimez et al., 2019). The potential production of blackberries could be 15-30 tons/ha, depending on the variety and the duration of profitable exploitation is 12-15 years, with a rate of net annual profit of 62% (Sumedrea et al., 2014). This crop also has other advantages, among which a low ecological selectivity and regularly yields products (Clark and Finn, 2011; Eyduran et al., 2008; Eskimez et al., 2019; Milosevic et al., 2012).

The purpose of this work is to carry out studies on the potential of using the compost used by mushrooms in fruit growing, respectively in blackberry culture.

The specific objectives are:

- Comparative study of the influence of the 5 culture substrates on the soil in which the Triple Crown blackberry variety is planted;
- The study on the influence of the physico-

chemical characteristics of the soil determined by the 5 types of substrates on the quality of the fruits of the Triple Crown blackberry variety in the pedo-climatic conditions of the Experimental Base Moara Domneasca in Ilfov county.

The reason for choosing this topic was the knowledge, recovery and valorisation in Romanian agriculture of a secondary product from mushroom production, the compost used by mushrooms, allowing mushroom producers to meet environmental requirements and protect people's health.

All these organic materials from agriculture, forestry, animal husbandry are rich sources of different plant nutrients (Khan et al., 2012). Moreover, there is a continuous interest in using different organic wastes as a growth medium and nutrient source for plants due to the growing awareness of environmental issues (Grigatti et al., 2008).

Combining different practices to protect the soil and feed it with organic matter is proving to be the most effective method.

## MATERIALS AND METHODS

The study was conducted at Experimental Base Moara Domnească, located N-E of Bucharest (in the Vlasia Plain, a subunit of the Romanian Plain), in Ilfov county, right about 17 km from Bucharest. The farm belongs to the Research and Development Station for Fruit Growing Băneasa. The experimental plot was established in the early spring of the 2020 by planting the Triple Crown blackberry variety on nutrient substrates (spent mushroom substrat, garden soil compost, semi-fermented compost, forest compost, and a mixture of the 4 substrates in equal quantities), spaced 3.0 m apart between rows and 1.0 m apart in the row.

A description of Triple Crown blackberry variety we have used in our study is:

- It is a blackberry variety approved by the Agricultural Research Service in Beltsville, Maryland - USA
- Average frost resistance
- The fruits are large (8-10 g), with a superb sweet taste; firm, with good resistance to handling and transport.
- The harvest period is from mid-July to mid-August. High fruit production is obtained (over 15 t fruit/ha).

The plantation was provided with a training system, a drip irrigation and standard cultural practices were applied.

One of the most important factors in agriculture is the environment in which the plant grows and develops. Substrates must be able to provide the necessary water, nutrients and oxygen for plants, as well as support for the whole plant (Kang and colab, 2004; Miller and Jones, 1995).

The methods used were:

- Determination of pH in aqueous suspension 1:2.5; SR 7184-13:2001; PTL 04.
- Determination of humus by wet oxidation, using the Walkley - Black - Donut method, and titrimetric dosing; STAS 7184/21-82; PTL 12.
- Determination of nitrogen (Nt) using Kjeldahl methode STAS 7184/2-85; PTL 09.
- Determination of soluble potassium was carried out in ammonium lactate acetate, according to the Egner-Riehm method, STAS 7184/18-80; PTL 22.
- Determination of soluble phosphates was done in ammonium lactate acetate extract by the Egner-Riehm method; STAS 7184/19-82 PTL 19.
- Determination of accessible Mg was done in $CaCl_2$ 0.025n (Mg).
- Determination of exchangeable calcium ($Ca^{2+}$) was done in (ammonium acetate 1n, pH=7.0); STAS 7184/12-88, cap 2, PTL 26.

For the correction of the soil reaction, the degree of saturation with bases, $V_{Ah}$, which represents the ratio between the sum of the basic cations, SB, and the total cation exchange capacity, SB + Ah, was determined, and for estimating the amount of soil mineralized organic matter and that of N mineralized from this, the nitrogen index was determined, IN = H *VAh/100.

In order to establish the substrate in which the Thorn Free variety adapted best, for the southern part of Romania a sample of 20 harvested fruit were collected at 3 different moments from each substrate and analysed under biometric and bio-chemical aspects. Fruit length and width were measured with a digital calliper and the size index was calculated using the formula: (height + 2 × diameter)/3 (Ancu et al., 2014). Fruits weight was measured with an electronic scale (Precisa Balance XT 620M). Soluble solid content was determined using a digital refractometer (Hanna Instruments - HI 96800) and the fruit pH with a digital pH meter.

## RESULTS AND DISCUSSIONS

The soil type at Experimental Base Moara Domneasca is a reddish preluvosoil. Several analyses were performed to the level of the soil profile, within the internal laboratory for agrochemical and biochemical analyses, to determine its physical and chemical properties.

The following soil characteristics were determined (by granulometric analysis for determination the soil content in clay, dust and sand): a high percentage of clay ranging from 40.55% in the upper horizon 0-40 cm, to 41.63% at a depth of 41-53 cm and 47.39% at depths greater than 54 cm (Table 1).

Table 1. The granulometric composition of the soil (Experimental Base Moara Domneasca, 2019)

| Horizon | Depth (cm) | Clay (%) | Coarse sand (%) | Fine sand (%) | Dust (%) | Texture |
|---|---|---|---|---|---|---|
| Ao | 0-40 | 40.6 | 0.36 | 34.3 | 24.8 | Clay loam |
| Ao/Bt | 41-53 | 41.6 | 0.52 | 21.5 | 56.3 | Clay loam |
| Bt | 54-200 | 47.4 | 0.37 | 27.6 | 30.3 | Clay loam |
| C | Over 200 | 36.2 | 0.42 | 32.0 | 32.0 | Clay loam |

The clay texture determines a low mobility of nutrients and a poor permeability of the water in the soil. The soil content in humus is good in the first 40 cm of profile, where most of the roots of young trees are located, reaching the value of 3.26%, then suddenly decreases up to 1% in the Bt horizon profile (Table 2). The pH is slightly acidic at the soil surface (6.4), reaching alkaline in the C horizon (8.3).

Table 2. Physical and chemical properties of the profile soil (Experimental Base Moara Domneasca, 2019)

| Horizont / Properties | Ao | Ao/Bt | Bt | C |
|---|---|---|---|---|
| Humus (%) | 3.26 | 1.87 | 1.0 | 1.0 |
| Soluble Ca (mg/100 g soil) | 55 | 32 | 32 | 30 |
| Hydrolitic acidity (meq) | 2.8 | 2.04 | 1.72 | 0.18 |
| Exchangeable Bases (meq) | 22.6 | 23.62 | 26.28 | - |
| Total cation exchange capacity (meq) | 28.65 | 28.04 | 30.01 | - |
| Base saturation degree (%) | 78.94 | 84.28 | 87.53 | - |
| pH | 6.4 | 6.6 | 6.8 | 8.3 |
| Total N (%) | 0.144 | 0.102 | 0.075 | 0.07 |
| Soluble P(mg/100g soil) | 50 | 40 | 40 | 30 |

Other indicators like the nitrogen index (NI), hydrolytic acidity, humus, organic carbon and so on were determined during before planting (2020) (Table 3) and after planting (2020) (Table 4).

The climate of the Moara Domneasca is temperate continental.

The annual mean temperature is 12°C and the total annual amount of precipitation is ranging between 550 and 600 mm.

Table 3. Soil's characteristics determined before planting (Experimental Base Moara Domneasca, 2020)

| | |
|---|---|
| Date | 2020 |
| Plot | Shrubs (*Rubus* ssp.) – CP1E5 |
| Depth (cm) | 0 – 20 |
| pH | 6.33 |
| Exchangeable Bases (meq) $Ca^{2+}+Mg^{2+}+K^{+}+Na^{+}$ | 13.30 |
| Hydrolitic acidity (meq) | 5.60 |
| Humus (%) | 5.27 |
| Organic Carbon | 3.03 |
| Total cation exchange capacity (meq) | 18.9 |
| Base saturation degree (%) | 68.83 |
| Nitrogen Index | 3.63 |
| P (ppm) | 51.96 |

Table 4. Soil's characteristics determined after planting (Experimental Base Moara Domneasca, 2020)

| | |
|---|---|
| Date | 2020 |
| Plot | Shrubs (*Rubus* ssp.) |
| pH | 7.3 |
| Exchangeable Bases (meq) | 12.29 |
| Hydrolitic acidity (meq) | 2.77 |
| Humus (%) | 4.46 |
| Organic Carbon | 2.59 |
| Total cation exchange (meq) | 23.57 |
| Base saturation degree (%) | 98.35 |
| Nitrogen Index | 4.39 |
| P (ppm) | 60.1 |

For this study we took into account the average values of temperature, precipitation and relative humidity for the blackberry harvesting period (July - August of 2021) (Table 5, Figures 1-3).

Table 5. Average weather data of Moara Domnească during the experimental study

| Temperature (°C) | | | Precipitation (mm) | | | Humidity (%) |
|---|---|---|---|---|---|---|
| 2021 (July - August) | 2020-2021 | normal | 2021 (July - August) | 2020-2021 | normal | 2021 (July - August) |
| 25.7 | 14.5 | 12.0 | 6.8 | 623.4 | 600 | 68.3 |

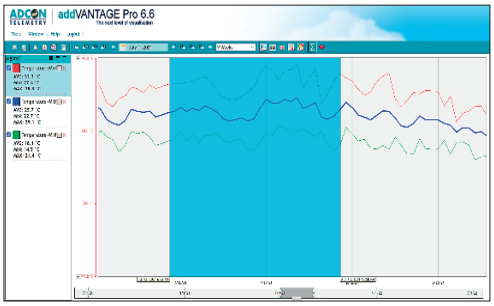


Figure 1. Average temperature dynamics during the harvest period (July - August) 2021

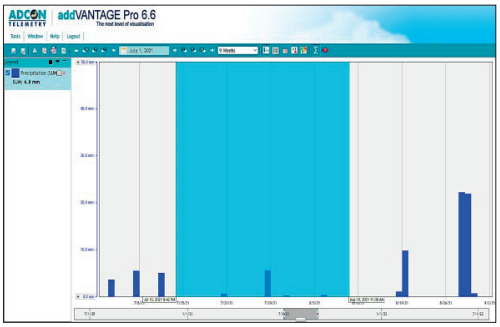


Figure 2. Average precipitation dynamics during the harvest period (July - August) 2021

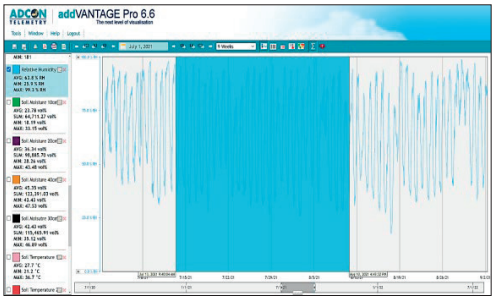


Figure 3. Average humidity dynamics during the harvest period (July - August) 2021

The highest average fruit weight was recorded for the blackberry on the substrate made of spent mushroom substrat (7.33 g), during the first harvest period (T1, 27.07.2021) (Figure 4) followed by the blackberry grown on the mixed substrate (6.55 g) and blackberry grown on semi-fermented compost; the lowest values were registered by the fruits grown on forest compost and garden compost. At harvest 2 (T2, 03.08.2021) (Figure 5) the highest average fruit weight was recorded for the blackberry on the mixed compost substrate 6.47 g, followed by the blackberry grown on the spent mushroom substrate (6.34 g), and the lowest values were recorded for garden compost and forest compost. The same difference was seen in harvest 3 (T3, 09.08.2021) (Figure 6).

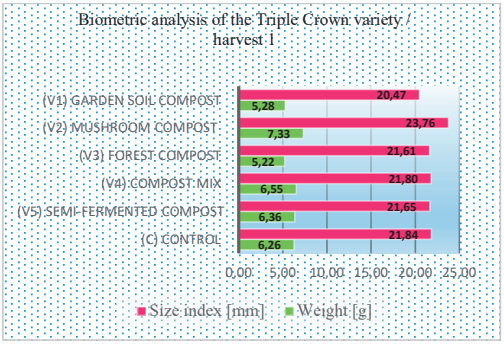


Figure 4. The biometric analysis of the Triple Crown blackberry at first harvest (T1=27.07.2021)

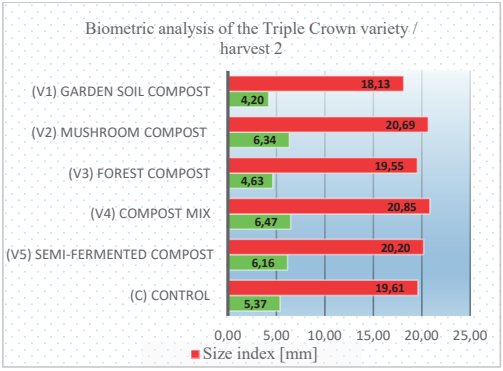


Figure 5. The biometric analysis of the Triple Crown blackberry at second harvest (T2=03.08.2021)

Regarding the size index, the highest values (23.76 mm and 20.69 mm) were recorded by the blackberry on the spent mushroom substrate at the first (T1, 27.07.2021) and the second harvest (T2, 03.08.2021), followed by blackberry grown on mixed substrate. The lowest values were

recorded for garden compost and forest compost.

The highest values of the content of soluble solids (% Brix) were recorded in the blackberry on the garden compost substrate (14.21% and 15.03%) (Figures 6, 7) at the first (T1, 27.07.2021) and the second harvest (T2, 03.08.2021) (Figures 8, 9), followed by mulberry grown on spent mushroom substrate (13.42% and 13.66%).

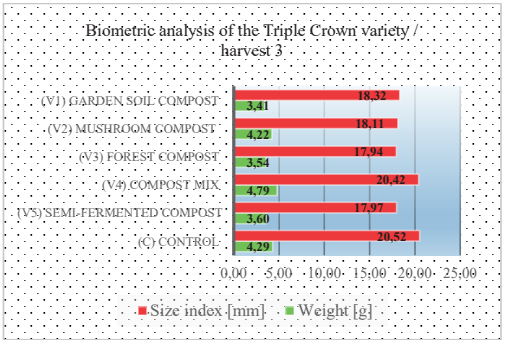


Figure 6. The biometric analysis of the Triple Crown blackberry at third harvest (T3=09.08.2021)

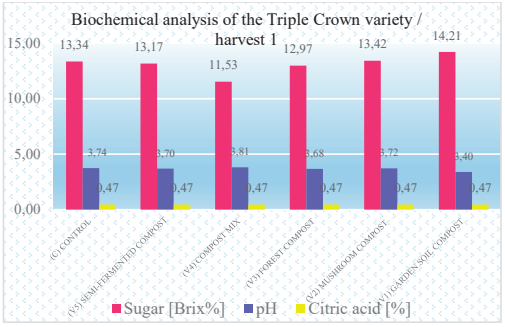


Figure 7. The biochemical analysis of the Triple Crown blackberry at second harvest (T2=03.**08**.2021

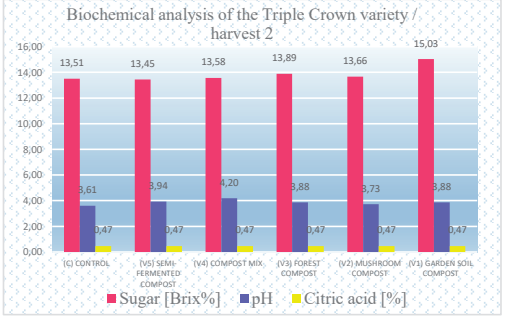


Figure 8. The biochemical analysis of the Triple Crown blackberry at second harvest (T2=03.08.2021)

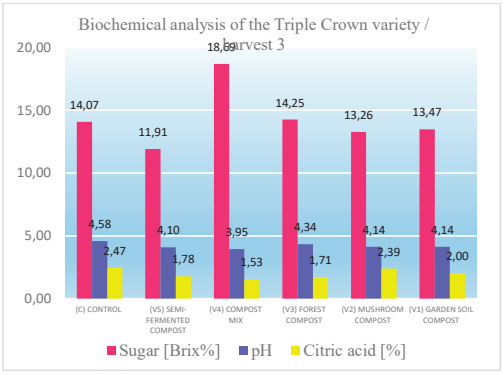


Figure 9. The biochemical analysis of the Triple Crown blackberry at third harvest (T3=09.08.2021)

## CONCLUSIONS

Preliminary results of the study showed that:

- The Thorn Free blackberry variety on the spent mushroom substrate recorded the highest values for average weight and size index, the lowest values were recorded on garden compost and forest compost;
- The highest values for the content of soluble substance were recorded for blackberry grown on garden compost 15.03%, which makes it suitable for processing.

The started study will continue with other pomological, chemical and sensory determinations, doubled by the processing and statistical analysis of the data.

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