SUMMARY

of the doctoral thesis entitled:

RESEARCH ON THE INFLUENCE OF CROP SUBSTRATES ON THEIR PRODUCTION AND QUALITY IN RASPBERRY AND BLACKBERRY SPECIES UNDER THE CONDITIONS OF THE BANEASA SCDP

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Organic matter plays an essential role in maintaining and improving soil fertility, which is fundamental to the productive capacity of plants. In the current context, with the challenges of climate change and the intensive use of agricultural resources, we believe that a correct management of organic matter can contribute to the protection and regeneration of soils.

The improper use of mineral fertilizers, without taking into account the physical and chemical characteristics of the soil, has led to significant changes in its chemical composition.

One of the most crucial factors in agriculture is the environment in which the plant grows and develops. Substrates need to be capable of supplying plants with sufficient water, nutrients, and oxygen, as well as providing support throughout the plant.

The purpose of this Doctoral Thesis, entitled "***Research on the influence of culture substrates on the production and its quality of raspberry and blackberry species under the conditions of SCDP Băneasa"*** is to carry out studies on the potential use of mullein, spent mushroom compost, compost of forest and semi-fermented compost in the culture of fruit bushes.

Spent Mushroom Substrate is often considered waste, but this review explores its potential to contribute to a circular economy. SMS can be reused in various ways, including as compost or substrate for growing other species of mushrooms. Biodegradable packaging, building materials, biofuels, and enzymes can be produced using it as a feed, as well as improving their health. These multiple uses not only reduce waste, but can make agricultural production more sustainable and efficient. Furthermore, by using CO2 emissions and the heat generated during mushroom cultivation to heat greenhouses, plant growth can be stimulated and additional benefits can be gained.

The fact that one kg of fresh mushrooms produces 5 kg of worn substrate implies that SMS is available in a large quantity. In Romania, this type of substrate has been studied relatively little, which is why the topic addressed has significant practical importance. Research on the use of SMS in agriculture is constantly evolving, targeting various aspects related to the content rich in macro and micronutrients. Particular attention is paid to the development of technologies and methodologies that can improve SMS, increasing its value as an agricultural resource.

The doctoral thesis' objective was to investigate the potential of using mushroom compost in fruit growing, particularly in the culture of fruit shrubs. In this sense, observations and determinations were made in the experimental field and confirmed by the chemical analyzes carried out in the agrochemical laboratory of SCDP Baneasa Bucharest.

The specific objectives of the doctoral thesis were:

●A comparison of the impact of 5 culture substrates on the soil used for planting different varieties of raspberries and blackberry.

●The focus of the study is on the impact of three different substrates on the physico-chemical characteristics of the soil on the development of various varieties of raspberries and blackberry.

●The study is devoted to investigating how soil physico-chemical

Cultivation of blackberries and raspberries in the field on compost substrate used by mushrooms aims at the possibility of expanding the cultivation area for these fruit bushes and on other nutritious substrates (a mixture of manur, semi-fermented compost, forest compost, and a mixture of each substance in equal amounts).

The selection of this subject matter was based on the understanding, retrieval, and capitalization of a by-product of mushroom production in Romania, namely spent mushroom compost, which allows mushroom producers to meet environmental requirements and protect human health.

For this purpose, the determinations carried out in the experiment were carried out in the pedoclimatic conditions specific to the Bărăganu Plain, the experiments were carried out in the period 2020 - 2022, for 2 species of plants, fruit-bearing shrubs (blackberry and raspberry), each species consisting of 3 varieties.

The doctoral thesis is structured in six chapters. The first two chapters provide background information that supports the theme of the scientific study, presenting and arguing the ideas identified in the agricultural literature. The following three chapters are dedicated to the research itself, carried out in the period 2019-2022.

The first chapter of the thesis, entitled "***Study on the current level of knowledge in raspberry and blackberry culture"***, presents the analyzed species, including details about their origin, the area of cultivation and the importance of these crops. The particularities of growth and fruiting of each species are also discussed, as well as their requirements for environmental conditions and culture technology.

In the second chapter, entitled ***"The current stage of research on raspberry and blackberry crops on different crop substrates at the world and national level"***, data are presented regarding the crop substrates used in the research and their influence on agricultural crops.

Manur represents a very well decomposed manure, being richer in nutrients than this. The decomposition of manure is very advanced, it lasts for 2-3 years, and the weight becomes 25% of the initial weight. Buckthorn is also used to improve heavy soils, being applied in crops of many plant species, in combination with celery soil and leaf soil. The specific weight of a cubic meter of sea buckthorn varies between 800 and 850 kg. This is not used in its pure state, as it can cause burning of the plants. After a maturation period of 6-8 years, blackthorn can be considered a natural fertilizer of the "fat soil" type. Manure fertilization helps to supply adequate amounts of nitrates to the soil, meeting the nutritional requirements of vegetables and enriching the soil with high-qual

The leaf compost is a compost obtained from the leaves of the trees, especially those of beech, linden, maple, anine, hazelnut, which fall in autumn, through aerobic fermentation, in advanced decomposition phase (1-3 years). The application of mineral fertilizers, especially nitrogen, or watering with manure must, hastens composting, and ensures its high quality, obtaining a good soil.

The fallen deciduous leaves, having a carbon/nitrogen (C/N) ratio of 3:1 and containing approximately 1,1% nitrogen and 34% carbon , require a lower nitrogen intake compared to straw, respectively 2-4 kg of nitrogen per tonne of dry matter. In order to promote aerobic decomposition and shorten the composting process, piles of fermented leaves must be decomposed and reconfigured several times. ity organic matter.

Mushroom substrate represents the compost material used to grow a mushroom culture, while mushroom compost (mushroom substrate / spent mushroom compost) describes the material left over after a mushroom culture is finished.

Depending on the species of cultivated mushrooms, the substrates used are obtained from different ingredients, even the preparation method of the respective substrate is different.

The benefits of mushroom compost for soil include improving its texture and structure, enhancing mulching effects, and encouraging the growth of beneficial microorganisms (bacteria and fungi) in the soil, the prevention of soil surface compaction helps to absorb water, improve soil drainage (including clay-rich soil), preserve soil moisture by retaining available water in dry season, and provide the necessary pH changes in the soil.

Chapter III, ***"The purpose and objectives of the research"***, also presents the characterization of the natural environment in which the research was carried out, the morphological, physical and chemical

characteristics of the soil in the researched area, the description of the experimental variants and the methodology for carrying out the analyses.

The experimentation area was situated at the Domnească Mill Experimental Research Base, which is part of the Baneasa-Bucharest Research Development Station.

After the picketing of the land, a randomized experimental scheme was made with 2 species of fruit shrubs (blackberry and raspberry) of 3 varieties each on 5 variants of organic substrate (V1-manur, V1, used mushroom V2-compost, V3-forest compost, V4-mixture 25%V1+25%V2+25%V3 +25%V5, V5-compost semi-fermented and M-martor), in 3 repetitions. Planting distance between rows- 3m. Planting distance between plants (at mur – 1m, with 7 plants/weeds and at raspberries – 0,5m, with14 plants/weeds).

Three blackberry cultivars (S1-Triple Crown, S2-Chester and S3-Dar 24) and three raspberry cultivars (S1-Tulameen, S2-Przehyba and S3-Citria) were used.

Chapter IV entitled ***"The influence of the application of nutrient substrates (in the form of mulch) on the properties of the soil and the blackberry culture"*** includes the description of the blackberry varieties used in the research, the influence of the nutrient substrates on the physico-chemical properties of the soil, the influence of the nutrient substrates on the physical and biochemical characteristics of blackberry fruits as well as statistical analysis and correlations between different soil parameters.

The three blackberry varieties used are Dar-24, Triple Crown and Chester.

The "Dar-24" blackberry variety is a blackberry variety with thorns, originating in Romania (ICDP-Pitesti), with a harvest period between July and August. The variety has medium to high vigor, is resistant to frost and has good productivity. The fruit has a conical-elongate shape and is black in color, glossy, with a sweet taste.

The "Triple Crown" blackberry variety is a new thornless blackberry variety of American origin, obtained in 1998 (Maryland, USA). It has special qualities of the fruit and the plant, high productions and good resistance to diseases. It is a semi-early variety that produces from the first decade of July to mid-August. The fruits are black, sweet, aromatic, firm with good resistance to handling and transport.

The "Chester" blackberry variety is one of the thornless blackberry varieties, among the most resistant to frost and disease. It is a semi-late variety, fruit ripening is staggered from August to late autumn when the frosts come. The fruits are of medium size (6 g), medium firmness but very aromatic, sweet, shiny black, with an oval to spherical shape, large drupes in the fruit with uniform ripening of the drupes.

The data obtained showed that, among the three varieties tested, the "Dar-24" variety has the highest adaptability for growth and accumulation of vitamin C for all 5 culture substrates. The highest vitamin C values were recorded in the fruits of plants grown on semi-fermented compost (V4), where the vitamin C content was 2.5 mg/L, and on the sea buckthorn substrate (V1), where the vitamin C content was of 1.56 mg/L. For the accumulation of anthocyanins, the most favorable substrate for the variety "Dar-24" was the semi-fermented compost (V4) with a content of 230.89 mg/L.

There were significant differences in the concentration of phenolic compounds in the fruit, with 132.13 mgEAG/L being the highest value for the 'Dar-24' variety fruit in the control substrate.

Compared to blank samples, the 'Triple Crown' variety did not display a significant amount of vitamin C in culture substrate variations, with a concentration of 1,073 mg/L; a relatively high value of ascorbic acid close to that recorded in the control sample was obtained in the case of fruits from plants grown on mushroom compost substrate (V2), respectively a concentration of 0.923 mg/L. The forest compost substrate (V3) was the most conducive to the accumulation of significant levels of anthocyanins, the value resulting from the determinations being 241.69 mg/L.

In the "Triple Crown" blackberry variety, apart from the control substrate (345.44 mgEAG/L), the most favorable substrates for the accumulation of a significant content of phenolic compounds in the fruits were: V3 - forest compost with a concentration of 369 .53 mgEAG/L, V4- semi-fermented compost with a concentration of 339.94 mgEAG/L and V2- compost from the mushroom culture where the content of the tops in phenolic compounds was 319.92 mgEAG/L.

In the "Chester" blackberry variety, the substrates that favored a significant accumulation of vitamin C were the semi-fermented compost (V4) respectively 2.71 mg/L and the compost from mushroom culture (V2) respectively 1, 97 mg/L; for anthocyanins, the values recorded in the case of fruits from the

analyzed substrates could not exceed the value obtained in the case of the control sample where the concentration was 521.45 mg/L. Among the 5 types of substrates, significant values of anthocyanins were recorded in the fruits on the mushroom compost substrate (V2) respectively 409.24 mg/L, followed by the semi-fermented compost substrates (V4) with a concentration of 399.21 mg /L and V1 (bramble) with a content of 376.61 mg/L.

In the "Chester" variety, the highest values of the total phenol content, 598.28 mgEAG/L, were noted in the V4 substrate variant (semi-fermented compost).

Chapter V entitled ***"The influence of the application of nutrient substrates (in the form of mulch) on the properties of the soil and the raspberry culture"*** presents the three raspberry varieties used in the research as well as the results of the analyzes performed on the soil and the raspberry fruits after the application of the nutrient substrates.

The three raspberry varieties used in the research are Tulameen, Przehyba and Citria.

The "Tulameen" raspberry variety (origin Canada) is a variety that easily adapts to environmental conditions, being widespread in many areas with a sweet climate, noted for its excellent aroma. For optimal development, it needs a rich, deep soil that retains water quite well but not with excess moisture and sunny exposure. The fruit is very large, weighing between 5-7 g, intense red, shiny, conical, elongated.

Przehyba" (origin Poland) is an early variety, created in recent years and appeared on the market in 2016. It keeps very well, has good firmness and withstands transport in suitable packaging. The Przehyba raspberry belongs to seasonal varieties with an early ripening period. The fruits are elongated, cylindrical, of a bright red, of sizes that come out of any pattern, up to 5 cm in length, very sweet and tasty. It is a dessert variety.

"Citria" raspberry (origin Romania) is a variety with yellow fruits. It forms a bush with a tall stem, with few branches and medium sprouting capacity. The fruits are medium-sized, short-shaped, conical, with small seeds, yellow in color and excellent taste. The planting period is spring and autumn, and the harvesting period in June. The fruits can be consumed fresh or processed. It is an extremely early variety, adaptable to different environmental conditions, resistant to frost and raspberry diseases and is very productive.

The results of the determinations showed that in the "Tulameen" raspberry variety, vitamin C recorded significant levels both in the control variant (1204.29 mg/L) and in the substrate variant V1 (manur), 1027.86 mg/L . The bramble substrate was conducive to the accumulation of vitamin C also in the case of the "Przehyba" variety with a concentration of 1087 mg/L. Among the 3 raspberry varieties analyzed, the highest levels of vitamin C were found in the "Tulameen" and "Przehyba" varieties (the latter without the V2 substrate variant).

Following the results obtained regarding the content of anthocyanins in the fruits of plants grown on different substrates, it was noted that the most favorable substrate for the accumulation of anthocyanins in the fruits was represented, in all three raspberry varieties, by the compost substrate of forest (V3), respectively 99.08 mg/L in the variety Tulameen, 69.7 mg/L in the variety Przehyba and 6.33 mg/L in the variety Citria. Among the 3 raspberry varieties analyzed, the "Tulameen" and "Przehyba" varieties had the highest levels of anthocyanins.

For the "Citria" variety with yellow fruits, the most favorable substrate both for the accumulation of phenolic compounds and for the two antioxidant activity assessment models was the semi-fermented compost substrate (V4); A significant accumulation of phenols, with a high total antioxidant activity, was also recorded in the case of "Citria" raspberry fruits grown on bramble substrate (V1), respectively 88.4 DPPH RSA%.

For the variety "Przehyba" with red fruits, the most favorable substrate for the three analyzed parameters was also semi-fermented compost (V4- 79.93 DPPH RSA%); Significant results were also obtained in the case of fruits from the substrate represented by forest compost, but only for the supply of phenols and for an increased total antioxidant capacity;

For the variety "Tulameen" with red fruits, for the accumulation of phenolic compounds in high quantities, the favorable substrates were forest compost (V3- 220.41 mgEAG/L) and semi-fermented compost (V4- 256.43 mg EAG/ IT). For the accumulation of compounds with DPPH antioxidant activity, the growth substrates V2 (compost originating from mushrooms) with a value of 90.79 DPPH RSA% and V5 (mixed compost) with a value of 88.11 DPPH RSA% were noted. and for the total antioxidant capacity, the

best results were obtained in the case of the samples from the substrates V1 (manur), respectively 201.48 μg/ml and V3 (forest compost), respectively 211.33 μg/ml.

Chapter VI contains ***"General conclusions and recommendations"*** resulting from the research carried out during the doctoral internship.

The thesis comprises 170 pages, a number of 32 tables and 87 figures. The bibliography cites 132 references found in the specialized literature and 6 web sources.