

## The influence of the type of substrate on the production of sweet potatoes

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**Abstract** Some results concerning the obtaining of sweet potato on hydroponic mattresses are in this research. Sweet potato (*Ipomoea batatas*) is a less common vegetable in Romania. The climate change and degraded land surfaces have led to finding alternatives to avoid them. It is recommended the sweet potato growing in unconventional systems, on different substrates (peat, perlite) in the absence of an optimal soil. The research of this paper has aimed at obtaining of 'Beuregard' sweet potato on unconventional crop substrate (perlite, peat, 50% 2 or 4 mm perlite and 50% peat) in a glass greenhouse. The paper has been carried out in a greenhouse of the Hortinvest Research Center from the University of Agronomic Sciences and Veterinary Medicine of Bucharest, in 2016 and 2017 years. 'Carolina Ruby' is a sweet potato variety with orange pulp, from Egypt. The fertilization has been done with ammonium nitrate and Organic Grow. The statistical analysis of results has been by the Duncan test (0.05 significance level). The higher average values have been recorded to the variants with 4 mm perlite substrate compared to the plants cultivated on the 2 mm perlite substrate. 'Carolina Ruby' sweet potato grown on perlite, peat or perlite and peat substrates and fertilized with ammonium nitrate and Organic Grow is recommended for crops from Romania.

### Key words

*Ipomoea batatas*,  
substrates type,  
peat, perlite

The sweet potato plant (*Ipomoea batatas* L.) is widespread throughout the world (O'Brien P.J., 1972; Roullier et al., 2013), but it is a less common vegetable in Romania, introduction into culture did not have very good results (Vinătoru et al., 2019). It is an important staple food worldwide (Sharma and Kaushal, 2016), an important food crop, and a source of energy and nutrition in many countries [23; 24].

The climate change and degraded land surfaces have led to finding alternatives to avoid them [10; 11; 13]. It is recommended the sweet potato growing in unconventional systems, on different substrates (peat, perlite) in the absence of an optimal soil. The sweet potato crop in soilless system has superior yield compared to the conventional crop. Al-Kinani et al., (2021) have experienced the soilless vegetable crop systems. The earliness and production of vegetables have good results in this unconventional systems.

Bradley and Marulanda (2001) mentioned the possibility of cultivating sweet potatoes in a soilless system, an aspect also supported by Sheikh (2006) and Drăghici et al. (2021). This system reduces the soil, water, and nutrients requirements, there are no used herbicides and the pesticides are barriers to vegetables [6].

Carmassi et al., 2005 say that the water salinity must be permanently controlled.

Reuse of the resulting nutrient solution from the drain leads to a saving of water and nutrients Bar-Yosef (2008) aspect also highlighted by Langenhoven (2016). Ayşe Gül et al. (2005) have investigated several substrates (perlite, peat and other) and have obtained significant production increases.

Bourke (1977) recommends sweet potato cultivation the location on light soils, with low and moderate fertility, well-drained and optimal texture. Also, fertilizers should be carried out with moderate amounts of fertilizer, staggered, throughout the growing season. Darko et al. (2020) also confirmed this, arguing that productivity increases through the efficient use of fertilizers.

Parr et al. (1994); Olajire-Ajayi et al. (2015) mention the favourable influence of the activity of microorganisms, which convert nitrogen, phosphorus and potassium from the soil into a form that plants use effectively for growth and development.

Antiaobong, 2007 emphasizes that the correct choice of assortment, depending on the crop area, climatic conditions and the technology applied is an essential aspect of obtaining good threshing yields. Also, Ravi and Indira, (1999); Ravi and Saravanan, (2012) claim that, in addition to the mentioned aspects regarding the environment and soil factors, the origin and quality of the planting material also play an important role.

An important aspect is the quality of rooted cuttings used for planting. Thus, some researchers mention that for soil-free cultivation, cuttings EC the nutrient solution applied during rooting but also in culture is very important. The application of a low concentration of  $0.8 \text{ dS m}^{-1}$  led to the prolongation of the vegetation period and to a high concentration of  $2.4 \text{ dS m}^{-1}$  to a formation of higher vegetative mass to the detriment of the formation of tubers (Sakamoto and Suzuki (2020).

Dolphin et al. (2015) in the experiment performed on the potato crop established in a soilless system, used sand as a culture substrate and applied nutrient solutions in three different concentrations of nitrogen, phosphorus and potassium ( $\text{mg L}^{-1}$ ) in relation to 125-20-200; 175-40-250; and 225-60-300.

The present experiment of this research has aimed the identify technology for obtaining the 'Carolina Ruby' sweet potato on perlite, peat, perlite and peat substrate (100% peat; 100% 2 mm perlite; 100% 4 mm perlite; 50% 2 mm perlite + 50% peat; 50% 4 mm perlite + 50% peat) in the greenhouse condition from Horticulture Faculty, Bucharest, Romania.

## Material and Method

The study has been carried out in a greenhouse of the Hortinvest Research Center at the University of Agronomic Sciences and Veterinary Medicine of Bucharest, in 2016 and 2017 years.

### Biological material

The research has been conducted on 'Carolina Ruby' sweet potato (*Ipomoea batatas*). The biological material was provided by Egypt.

'Carolina Ruby' is a sweet potato variety, with elongated and conical tuberous roots, orange pulp and dark orange epidermis (figure 1) and with a vegetation period of 90 days.



Figure 1. 'Carolina Ruby' sweet potato variety

### Crop substrate

We used an unconventional crop substrate. Mattresses for growing have been filled with perlite of 2 or 4 mm and peat.

*Research variants:* 100% peat (V1); 100% 2 mm perlite (V2); 100% 4 mm perlite (V3); 50% perlite (2 mm) + 50% peat (V4); 50% perlite (4 mm) + 50% peat (V5).

### Planting

On June 26, 2016, rooted cuttings were planted directly on the mattress. So, on a support wide of 50 cm, the mattresses were placed two at a time, side by side. The distance between supports was 1.2 m. On each mattress were planted 3 plants at 30 cm. (Figure 2).



Figure 2. Planting of sweet potato on mattresses

### Nutrition conditions

Before planting, the substrate was previously moistened with a nutrient solution. After planting, the nutrient solution was administered, it had an EC of 2.20 micro-Siemens and a pH of 6. On each plant, 150 ml of solution was administered 3 times/day, for 4 weeks and then 250 ml of solution, 3 times / day until the end of the culture. Harvest It was performed on October 16, 2016 (figure 3).

At the end of the culture, the number of tuberous roots formed per plant was determined for each year of cultivation. The total production obtained on each plant, on variants, was also evaluated.

### Statistical analysis

The statistical analysis of results have been by the Duncan test (0.05 significance level).

## Results and Discussions

The number of tuberous roots formed in the experimental substrate variants are presented in table 1. In 2016 a larger number of tuberous roots were formed compared to 2017. Most were formed at V3 - perlite 4 mm in 2016. On average in 2016-2017 the highest number was recorded at V3 - perlite 4 mm and V5 - perlite 4 mm 50% + peat 50%.

The lowest number of tuberous roots was recorded in V4 - perlite 2 mm 50% + peat 50% where probably, due to the small granulation of the substrate, the roots did not have enough oxygen for a normal development.

It was found that, on average, during the two years of cultivation compared to V1 in which peat was used as a substrate in all variants where we used perlite with a grain size of 2 mm, a smaller number of tuberous roots was obtained.

Table 1. The root number per sweet potato plant cultivated on perlite mattresses (2 and 4 mm) and signification (Duncan test)

Variants	2016	2017	In average 2016-2017
V1 - peat 100%	8.67	7.33	8.00 c
V2 - perlite 2 mm	8.33	7.33	7.83 b
V3 - perlite 4 mm	9.67	8.33	9.00 d
V4 - perlite 2 mm 50% + peat 50%;	7.33	7.00	7.17 a
V5 - perlite 4 mm 50% + peat 50%;	9.33	8.67	9.00 d

The highest total number of tuberous roots obtained per plant was recorded in the 2016 year at V3 (9.67 tuberized root) of which 5.34 weighing over 200 g/root and the lowest at V4 (7.33 tuberized root) of which 3.33 weighs more than 200 g/root. In V1, where we used peat as a substrate, the total number of tuberous roots was 8.67 pieces of which 4.67 roots had average masses over 200 g.

It was also found that in the variant where 2 mm perlite was used, 4.33 roots of about 200 g and only 4 roots per plant under 200 g were obtained. In the V5 in which 4 mm perlite was used mixed with peat, the highest number of roots per plant was obtained, of which four roots are 200 g and 5.33 roots over 200 g (table 2).

Table 2. Tuberous root number per plant in 2016 year

Variant	Tuberized root number (no)		
	total	under 200 g	over 200 g
V1 - 100% peat	8.67	4.00	4.67
V2 - 100% 2 mm perlite	8.33	4.00	4.33
V3 - 100% 4 mm perlite	9.67	4.33	5.34
V4 - 50% (2 mm) perlite + 50% peat	7.33	4.00	3.33
V5 - 50% (4 mm) perlite + 50% peat	9.33	4.00	5.33

The total number of tuberous roots obtained per plant in 2017 was 8.67 at V5 - 50% (4 mm) perlite + 50% peat. At this variant we had observed that the total number of roots over 200 g was 4.42 tuberized root. The number of tuberized roots was lower than in 2016.

It was found that the fewest tuberous roots to be formed were formed at V4 where 2 mm perlite and peat were used. Of the total roots formed, a number of 2.67 roots weighed over 200 g and 4.33 roots over 200 g. (Table 3).

Table 3. Tuberized root number per plant in 2017 year

Variant	Tuberized root number (no)		
	Total	under 200 g	over 200 g
V1 - 100% peat	7.33	4.25	3.08
V2 - 2 mm perlite	7.33	3.75	3.58
V3 - 4 mm perlite	8.33	4.33	4.00
V4 - 50% (2 mm) perlite + 50% peat	7.00	4.33	2.67
V5 - 50% (4 mm) perlite + 50% peat	8.67	4.25	4.42

Figure 3 shows aspects of the potato crop as well as the tuberous roots obtained on the 4 mm perlite and 2 mm perlite substrate.



(a.)



(b.)



(c.)

Figure 3 (a, b, c). Aspects of sweet potatoes at harvest

## Acknowledgements

The data presented in this paper have been obtained in for the doctoral thesis '*Study on the modernization of some technological links of some horticultural species growing in soilless system*' from the Doctoral School of Engineering and Management of Vegetal and Animal Resources from the Faculty of Veterinary Medicine. University of Agronomic Sciences and Veterinary Medicine of Bucharest.

## Conclusions

This experience identified a technology for obtaining sweet potatoes "Carolina Ruby" grown on different types of substrate.

Experimental variants have shown that the yield of the sweet potato crop depends on the type of substrate. The lowest number of tubers was obtained for the variants in which we used 2 mm granular perlite. This is due to a lack of proper oxygenation at the roots. So, the higher average values have been recorded to variants with 4 mm perlite substrate compared to the plants cultivated on the 2 mm perlite substrate.

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