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STUDY REGARDING THE INFLUENCE OF SOME TECHNOLOGICAL FACTORS ON THE QUALITY OF SWEET POTATO PLANTING MATERIAL

Elena Maria DRĂGHICI, Elena DOBRIN, Adrian CHIRA, Lenuța CHIRA, Daniela BĂLAN, Gabriela LUȚĂ

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd, District 1, Bucharest, Romania

Corresponding author email: draghiciem@yahoo.com

Abstract

The preliminary study was conducted at the University of Agronomic Sciences and Veterinary Medicine of Bucharest, Faculty of Horticulture, on various sweet potato varieties obtained at the SCDL Dăbuleni, Romania. The sweet potato tubers were rooted in different types of substrates, in various combinations (100% peat, 100% perlite; 25% peat+75%perlite; 50% peat + 50% perlite; 75% peat + 25% perlite), with the aim of obtaining shoots necessary for establishing the crop. Observations were made regarding the growth of the obtained seedlings and the rooting time.
The root volume and root mass were determined, and correlations were made regarding the influence of the type of substrate and the fertilizers used.

Key words: *Ipomea batatas, substrate.*

INTRODUCTION

The sweet potato (*Ipomoea batatas* (L.) Lam) belongs to the *Convolvulaceae* family and is native to South America. It is currently cultivated on all continents, but China is the world leader in terms of production.
Sweet potatoes are rich in carotene, fiber, minerals, and vitamins, making them recommended for diabetics, heart patients, and those with digestive disorders, as they have beneficial effects on immunity.
Recent analyses regarding the areas cultivated with sweet potatoes in Spain indicate a significant decrease of approximately 60% over the past two years. This reduction has been caused by several factors, including rising production costs, such as high prices for agricultural inputs (energy, fertilizers, labor), as well as increasing competition from Egypt in European markets.
The production of sweet potatoes in Egypt has grown due to lower production costs, favorable climate, and access to European markets through large-scale exports. As a result, the competitive prices of Egyptian sweet potatoes have negatively impacted the competitiveness of Spanish producers, leading to a reduction in the cultivated areas in Spain.
This trend highlights the challenges faced by European farmers in the face of globalization and international competition, underscoring the need for new strategies to maintain their competitiveness in the European market (https://www.freshplaza.com/europe/).
Sauti et al. (1994) demonstrated that sweet potato is a crop that can bring substantial benefits when intercropped with maize or sorghum.
Tadda et al. (2022) showed in their studies that sweet potato shoots can also be obtained through in vitro multiplication.
Lyu et al. (2020) mention that light is a very important factor both for obtaining high-quality seedlings and for the growth of sweet potato plants.
The experiments conducted on the Pumpkin and Chestnut varieties at the Banu Mărăcine station in Craiova showed that sweet potato yields can reach 53.3 tons/ha and 35.6 tons/ha, respectively (Dinu and Soare, 2015).
In Romania, sweet potatoes are cultivated on limited areas, and experiments conducted at the Research Institute in Dăbuleni on sandy soils in southern Oltenia have yielded remarkable

results, with good quantitative and qualitative production (Croitoru et al., 2019).

In Romania, there have been efforts to create sweet potato varieties with very good results under production conditions. Thus, at USAMV of Bucharest in 1991, the variety Victoria IANB was created, followed by the variety Crux in 1997. Given that the climatic conditions in our country are favorable for sweet potato cultivation, and market trends have been positive, the research team at the Research Development Station for Plant Culture on Sands (SCDCPN) Dăbuleni identified, selected, created, and registered two additional varieties, “DABU 23” and “KORETTA,” in 2023.

In Romania, the Official Catalog of Crop Plant Varieties for 2024 lists four varieties, including KSC1 and KSH1, which have been registered since 2015, and Dabu 23 and Koretta, which were registered in 2023.

The planting material for establishing the sweet potato crop consists of shoots emitted from the sweet potato roots, which are rooted using various methods, such as water, soil, or other types of substrate. Once the shoots have grown to about 10-15 cm in length, they are detached from the sweet potato root and placed for rooting in water or other substrates. After roots have developed, the cuttings are ready for planting.

The process of producing cuttings takes place about two months before field planting. Rooting cuttings requires temperatures of 20-25°C. They are planted in a substrate (such as compost or garden soil) or in water. The cuttings are then acclimatized before being planted in the field.

The quality of sweet potato seedlings can be affected by the fertilization regime (Solano, 2018), photoperiod, and light intensity.

Yong (2008) states that sweet potato shoots exhibited very good growth at a photoperiod of 16/8 hours, with an intensity of 200 $\mu mol \cdot m^{-2} \cdot s^{-1}$, and at a temperature of 23°C during the day and 20°C at night. Yarmento and Meamea (2019) mention that applying treatments to limit apical shoots resulted in increased vegetative growth as well as larger root yields.

Sasaki (1991) and Velumani and Raju (2012) note that planting sweet potatoes at high densities influences growth as well as the formation of branching in the plant.

Velumani and Raju (2012), Crop Physiology of Sweetpotato, Fruit, Vegetable and Cereal Science and Biotechnology, Global Science Books, http://www.globalsciencebooks.info/Online/GSBOnline/images/2012/FVCSB_6(SI1)/FVCSB_6(SI1)17-29o.pdf.

The level of fertilization influences sweet potato production (Esan et al., 2021).

Research conducted by Hlerema in 2021 on sweet potatoes focused on optimizing cultivation practices by analyzing the horizontal placement of cuttings during planting.

To maximize the production of sweet potato cuttings (Ipomoea batatas), it is essential to pay attention to the size and quality of the tuberous roots, as these directly influence both the number and vigor of the cuttings. Obtaining high-quality planting material requires a rigorous evaluation of the shoots developed from tubers, considering criteria such as uniformity, vigor, and regeneration capacity.

Thus, a fundamental objective of this study was to identify the number of vigorous shoots produced by each plant and to determine the optimal timing for their emergence. Additionally, the evaluation of the cultivation substrate and fertilization regime aimed to identify the most effective conditions for obtaining a high number of quality shoots suitable for planting.

The selection of planting material was based on the vigor of the shoots, ensuring a biologically homogeneous and agronomically optimal material adapted to the cultivation conditions.

MATERIALS AND METHODS

The experiment was conducted in the greenhouse of the Research Center for Quality Control of Horticultural Produce, Faculty of Horticulture, UASMV of Bucharest, from 25 October to 10 November 2023.

The biological material used in the experiment consisted of four sweet potato varieties: V1 - Dabuleni 23; V2 - Hayanmi; V3 - Koretta; and V4 - Ro-CH-M.

“Hayanmi” is a Korean variety with white flesh, included in the SCDCPN Dăbuleni collection since 2015. The sweet potato line “DCh19/3” was obtained at SCDCPN Dăbuleni through selection and has purple flesh.

The substrates used for rooting the sweet potato tubers were: 100% peat; 100% perlite; 25% peat + 75% perlite; 50% peat + 50% perlite; and 75% peat + 25% perlite.

The statistical program for analysis was STATISTICA, StatSoft software (version 10) to perform ANOVA analysis at $p \leq 0.05$, 0.01, or 0.001 levels, and Tukey HSD was used to compare the significant difference of each dependent variable at $p \leq 0.05$.

RESULTS AND DISCUSSIONS

In the case of most varieties, substrates with a combination of peat and perlite (especially those with equal or higher percentages of perlite) led to a higher number of shoots compared to using either 100% peat or 100% perlite. For V1 - Dăbuleni 23, the highest number of shoots (20.3) was obtained from the substrate composed of 50% peat and 50% perlite, while the lowest number (14.7) was recorded with 100% perlite (Figure 1).
For V2, the Hayammi variety, the highest number of shoots (20.7) was achieved with the 100% perlite substrate and the combination of 25% peat and 75% perlite, suggesting that this variety responds better to substrates with a higher perlite content. The lowest number of shoots was identified in the substrate made of 75% peat and 25% perlite (17.3 shoots per tuber) (Figure 1).

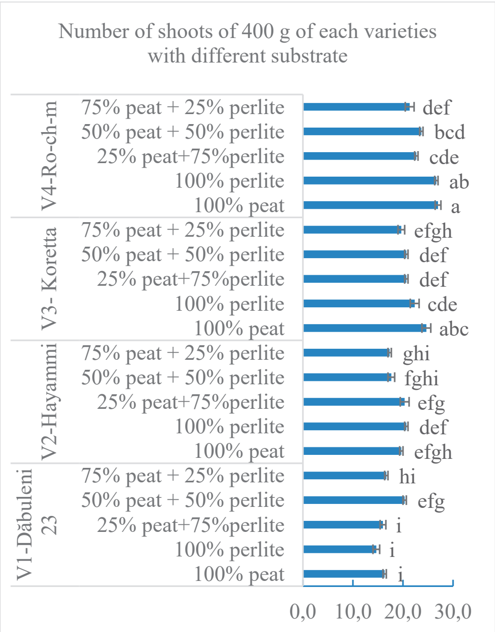

Figure 1. Influence of substrate type on the number of shoots formed on sweet potato tubers

For V3, the Koretta variety, the highest number of shoots (24.7) was identified in the 100% peat substrate, suggesting that this variety develops better in predominantly peat substrates. The lowest number of shoots was observed in the substrate combination of 75% peat and 25% perlite (19.7 shoots per tuber) (Figure 1).
In V4, the Ro-ch-m variety, a high tolerance for shoot emergence was noted, with the highest number of shoots (27.0) obtained in the 100% peat substrate and 26.7 shoots in 100% perlite. It was also observed that the number of shoots slightly decreases as the percentage of peat increases in the mixtures with perlite (Figure 1).
The varieties V4 - Ro-ch-m and V2 - Hayammi responded better in terms of producing a high number of shoots in perlite substrate, while V3 - Koretta thrived in peat substrate. V1 - Dăbuleni 23 exhibited balanced growth across all substrate combinations, with a slight preference for the 50% peat and 50% perlite mix.
It can be appreciated that the substrate played a crucial role in shoot emergence, and the optimal mix varies between varieties. Additionally, each variety shows different responses to substrates, suggesting that the optimal substrate mix for shoot production depends on the specific characteristics of each variety.
Analyzing the number of cuttings based on the variety, a gradual increase in the number of shoots on the tubers can be observed. Thus, the Ro-CH-M variety (V4) showed the highest average number of shoots across all substrate variations, suggesting that it may have a superior potential for shoot emergence compared to the other varieties.
A consistent increase in the number of shoots was noted from V1 to V4, which could reflect genetic or environmental factors influencing shoot formation in the studied varieties (Figure 2).

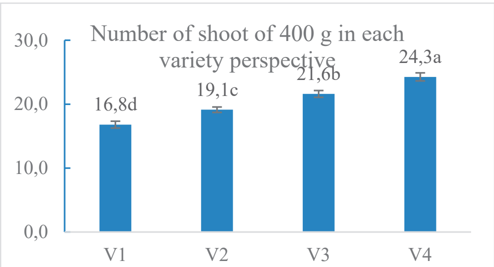

Figure 2. Average number of shoots formed per plant for 400 g tubers

The best results regarding the number of shoots emerging from 400 g sweet potato roots were observed in substrates containing 100% peat (21.9 shoots/tuber) or 100% perlite (21.1 shoots/tuber). As the proportion of perlite increased in the mixtures (from 25% to 75%), there was a noticeable decrease in the average number of shoots per tuber. The mixture of 75% peat and 25% perlite yielded the poorest results (18.8 shoots/tuber), suggesting that a balance between these two components can significantly influence root development.

The mixture of 75% peat and 25% perlite yielded the poorest results (18.8 shoots/tuber), suggesting that a balance between these two components can significantly influence root development (Figure 3).

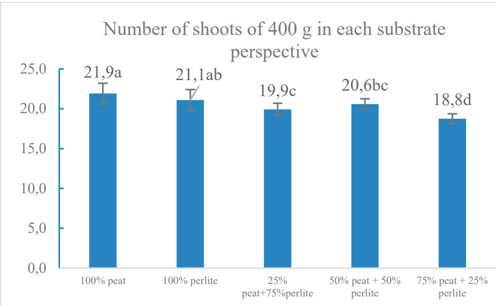

Figure 3 Number of 400 g shoots observed in each substrate type

Figure 4. The appearance of sweet potato plants

In the case of 400 g tubers, for the Dăbuleni 23 variety, the correlation performed to see how the type of substrate influenced the number of shoots indicated that it did not significantly affect it ($R^2 = 0.2239$), as shown in Figure 5.

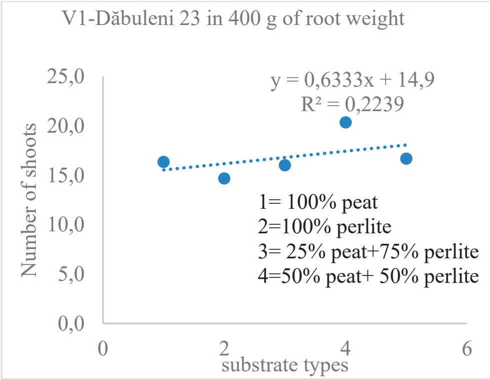

Figure 5. Influence of Substrate Type on the Number of Shoots for Variety V1 - Dăbuleni 23

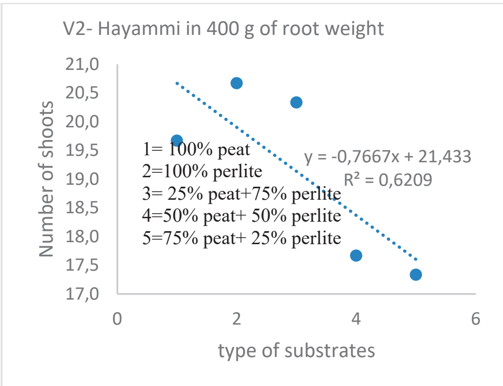

Figure 6. Influence of Substrate Type on the Number of Shoots for Variety Hayammi Using 400 g Roots

In the case of the Hayammi variety, the number of shoots per plant was influenced by the type of substrate ($R^2 = 0.6209$), as shown in Figure 3. This observation was also noted for the Koretta and Ro-ch-m varieties, where the correlation coefficients were highly significant: $R^2 = 0.8826$ for V3 - Koretta and $R^2 = 0.8299$ for V4 - Ro-ch-m, as illustrated in Figures 6-8.

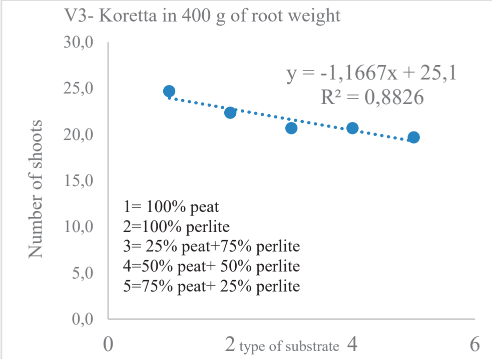

Figure 7. Influence of Substrate Type on the Number of Shoots for Variety V3 - Koretta Using 400 g Roots

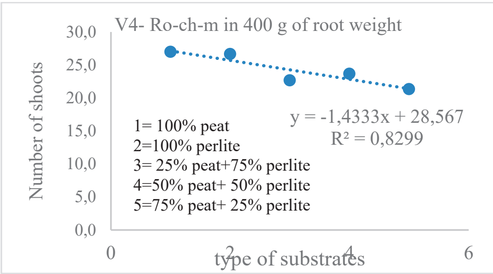

Figure 8. Influence of Substrate Type on the Number of Shoots for Variety V4 - Ro-ch-m Using 400 g Roots

The appearance of sweet potato roots and shoots is shown in Figure 9.

Figure 9. Appearance of sweet potato roots and shoots: a. Dabuleni 23 (V1); b. Hayanmi (V2); c. Koretta (V3); d. Ro-CH-M (V4)

Analyzing the number of shoots formed from sweet potato roots weighing 200g, it was observed that the Dăbuleni 23 variety (V1) had the highest average number of shoots on the 100% peat substrate (11.3 shoots/tuber) , and the smallest on 100% perlite substrate (8.7 shoots/tuber). In the variety Hayammi (V2), the highest number of shoots was obtained on the 100% perlite substrate but also with a mixture of 25% peat and 75% perlite (17.3 shoots). The lowest number of shoots of only 15.7 shoots was obtained on the 100% peat substrate. In the case of the variety Koretta (V3) it was found that it responded best to the 100% perlite substrate, with 21.7 shoots, while on peat it formed only 17.7 shoots. In the variety Ro-ch-m (V4) constant results were noted on all substrates, ranging between 15.7 and 17 shoots, with a slight increase on the mixture of 50% peat and 50% perlite (Figure 10).

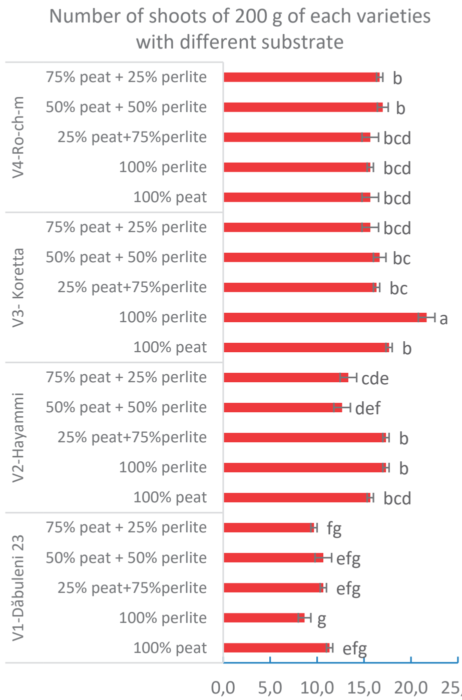

Figure 10. The influence of the substrate type on the number of shoots formed on sweet potato tubers - 200 g tubers

The average number of shoots appearing on the plant in the case of 200 g tubers was on average 17.6 shoots at V3 and the lowest at V1 - the

Dăbuleni 23 variety of 10.2 shoots/plant (Figure 11).

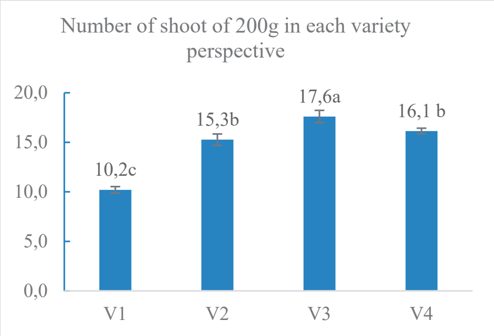

Figure 11. The average number of shoots that appeared depending on the cultivated variety, in the case of 200 g tubers

Analyzing how the type of substrate influenced the number of shoots appearing per tuber, it was found that, on the perlite substrate, in the case of 200 g tubers, an average of 15.8 shoots were obtained and, on the substrate, composed of 75% peat and 25 % perlite, the lowest number of only 13.8 shoots per tuber was recorded (Figure 12).

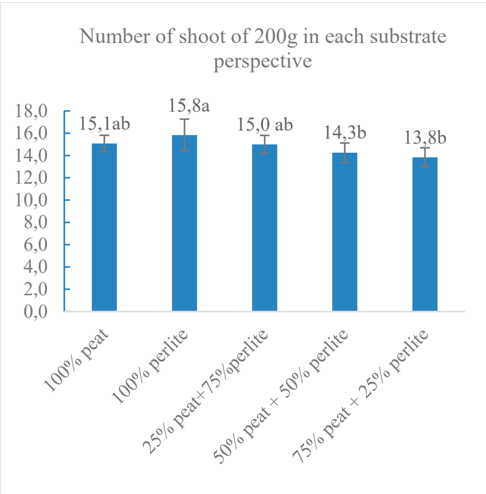

Figure 12. The number of shoots that emerged from the sweet potato tuber weighing 200 g

It was found that in the case of the Dăbuleni 23 variety, no significant relationship was identified (R^2=0.0408), regarding the correlation between the type of substrate and the number of shoots formed from sweet potato roots (Figure 13).

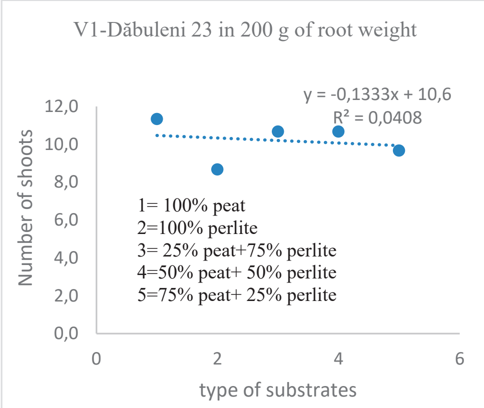

Figure 13. The influence of the type of substrate on the number of shoots in the variety V1 - Dăbuleni 23 in the case of roots of 200 g

The correlation carried out in the case of the Hayammi variety indicates that the substrate had a slight influence on the emergence of shoots (R^2 = 0.4537) (Figure 14).

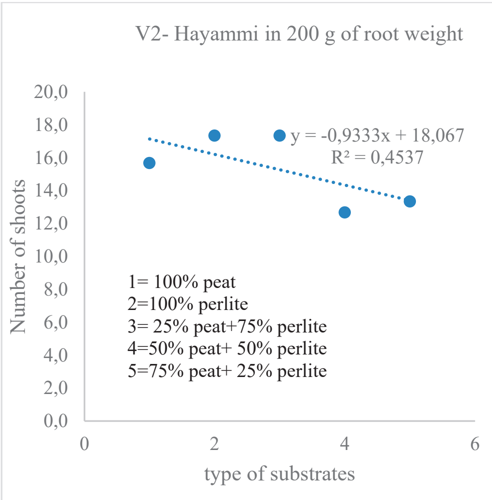

Figure 14. The influence of the type of substrate on the number of shoots in the variety V2- Hayammi in the case of roots of 200 g

In the case of the variety Koretta, it was found that the substrate had a weak influence on the emission of shoots (Figure 15), but in the variety Ro-ch-m, it had a significant influence (R^2 = 0.6579) (Figure 16).

The correlation performed to see how the type of substrate influenced the appearance of shoots showed that the substrate significantly influenced their appearance, the correlation coefficient being $R^2 = 0.6579$ (Figure 16).

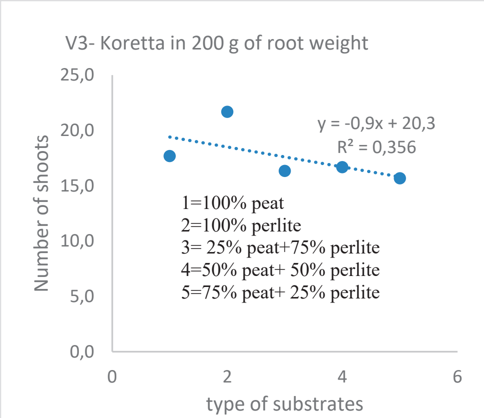

Figure 15. The influence of the type of substrate on the number of shoots in the variety V3 - Koretta in the case of roots of 200 g

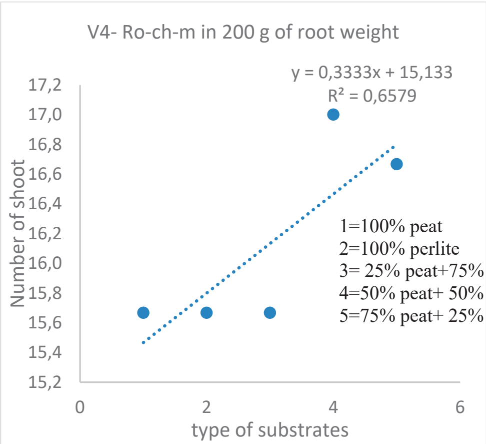

Figure 16. The influence of the type of substrate on the number of shoots in the variety Ro-ch-m (V4) in the case of roots of 200 g

Analyzing how the variety had an influence on the number of shoots, a distinctly very significant relationship was found.

Varieties V3 - Koretta and V4 - Ro-ch-m produced the most shoots, while V1-Dăbuleni 23 had the fewest. The differences between varieties are highly significant ($p < 0.001$), with varieties V3 and V4 not having significant differences between them, but having superior results compared to V2 and V1.

Substrate type has a significant effect on the number of shoots, with 100% peat and 100% perlite roots generating the highest number of shoots (18.5 ± 1.0 shoots) and reducing the percentage of peat resulted in a decrease in them. Root weight also significantly influences shoot production, with plants with 400 g roots having a significantly higher number of shoots compared to 200 g (20.5 ± 0.4 vs. 14.8 ± 0.4). There are significant interactions between varieties, substrate and root weight, suggesting that the effect of each factor depends on the others. The interactions performed provide important insights for optimizing shoot production.

Table 1. The interaction between the analyzed parameters

Varieties (V)	Number of shoots	Significant level %
V1 - Dabuleni 23	13.5 ± 0.7 c	
V2 - Hayammi	17.2 ± 0.5 b	***
V3 - Koretta	19.6 ± 0.5 a	
V4 - Ro-ch-m	20.2 ± 0.8 a	
Substrate(S)		
100% peat	18.5 ± 1.0 a	
100% perlite	18.5 ± 1.1 a	
25% peat+75%perlite	17.5 ± 0.7 b	***
50% peat + 50% perlite	17.4 ± 0.9 b	
75% peat + 25% perlite	16.3 ± 0.7 c	
Root weight (RW)		
200 g	14.8 ± 0.4 b	***
400 g	20.5 ± 0.4 a	
V x S		***
V x RW		***
S x RW		**
V x S x RW		***

CONCLUSIONS

Tubers weighing 400 g or 200 g can be used to produce sweet potato shoots. The study shows that 100% peat and 100% perlite substrates produce the highest shoot emergence in sweet potato tubers with 21.9 and 21.1 shoots/tuber, respectively. Increasing perlite content leads to a reduction in shoots per tuber, with the mixture of 75% peat and 25% perlite resulting in the lowest yield (18.8 shoots/tuber). In the case of 200 g tubers, substrate composition significantly influenced shoot formation in sweet potatoes. A higher content of perlite increased the number of shoots, especially for the variety Koretta.

Dăbuleni 23 prefers peat and Hayammi grows well in mixtures of peat and perlite. Ro-ch-m shows consistent but moderate results on different substrates.

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