THE INFLUENCE OF SUBSTRATE TYPE ON THE MORPHOLOGICAL AND ORNAMENTAL CHARACTERISTICS OF SOME CULTIVARS OF *IPOMOEA BATATAS* GROWN IN POTS

INFLUENȚA TIPULUI DE SUBSTRAT ASUPRA CARACTERELOR MORFOLOGICE ȘI ORNAMENTALE ALE UNOR SOIURI DE *IPOMOEA BATATAS* CULTIVATE LA GHIVECE

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Abstract. *The aim of this work was to evaluate the influence of the type of substrate on the morpho-decorative characters of three ornamental cultivars of Ipomoea batatas ('Heart Bronze', 'Black', 'Heart Lime') grown in pots. Four types of substrates were used, resulting from the mixing of various components (garden soil + peat; garden soil + peat + hydrogel; garden soil + peat + coconut fiber; garden soil + peat + coconut fiber + hydrogel). The results showed that the substrate composed of garden soil and peat favored, in all three cultivars studied, the increase in stem length and the number of leaves/plant, while in the cultivars 'Black' and 'Heart Lime', it also determined the increase in the degree of stem branching. The degree of stem branching was less influenced by the substrate, but it was dependent on the cultivar. The worst results were obtained in plants grown in a mixture composed of garden soil + peat + coconut fiber + hydrogel. Regarding the cultivars, 'Heart Bronze' stood out with a larger number of branches and leaves, and 'Heart Lime' with longer branches.*
Key words: *Ipomoea batatas*, morfo-decorative characters, substrates

Rezumat. *Lucrarea de față a avut ca scop determinarea influenței tipului de substrat asupra caracterelor morfo - decorative de la trei soiuri ornamentale de Ipomoea batatas ('Heart Bronze', 'Black', 'Heart Lime') cultivate la ghivece. S-au utilizat patru tipuri de substraturi rezultate din amestecarea diferitelor componente (pământ de grădină + turbă; pământ de grădină + turbă + hidrogel; pământ de grădină + turbă + fibră de nucă de cocos; pământ de grădină + turbă + fibră de nucă de cocos + hydrogel). Rezultatele au scos în evidență faptul că substratul alcătuit din pământ de grădină și turbă a favorizat, la toate cele trei soiuri studiate, creșterea în lungime a tulpinilor și numărul de frunze/plantă, în timp ce, la soiurile 'Black' și 'Heart Lime' a determinat și creșterea gradului de ramificare a tulpinilor. Gradul de ramificare a tulpinilor a fost mai puțin influențat de substrat, dar a fost dependent de soi. Cele mai slabe rezultate s-au obținut la plantele cultivate în amestec alcătuit din pământ de grădină + turbă + fibră de nucă de cocos + hidrogel. În ceea ce privește soiurile, 'Heart Bronze' s-a remarcat printr-un număr mai mare de ramificații și frunze, iar 'Heart Lime' prin ramificații mai lungi.*
Cuvinte cheie: *Ipomoea batatas*, caractere morfo-decorative, substraturi

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INTRODUCTION

The sweet potato (*Ipomoea batatas* (L.) Lam) is part of the *Convolvulaceae* family, which includes approximately 60 genera, among which the *Ipomoea* genus with approximately 600-800 species.

The origin of the sweet potato is considered to be in Central and South America and represents one of the most important food crops, mainly in areas of Asia and Africa (Loebenstein, 2009, Zhang, *et. al*. 2009, Jiang *et. al*, 2022, Xiong and Kaluwasha, 2022). It has a high nutritional value and also has uses in the medicinal industry (Islam, 2014, Krochmal-Marczak *et. al*, 2018, Alam, 2021).

I. batatas is a perennial plant, but usually cultivated as an annual. It presents tuberized roots of different shapes and sizes, long stems of up to 7m, and numerous leaves arranged alternately, with long petioles, and a large blade, glabrous or slightly pubescent of various shapes (oval, circular, triangular, cordate or hastate, entire or palmate-sectate). The flowers are axillary, infundibuliform, small in size, white or lilac (Sîrbu and Paraschiv, 2005, Prabawardani, 2007).

Ornamental varieties are in a wide range of shapes, sizes, colors and can have a great decorative potential in arranging gardens, terraces, especially in hanging pots, containers and planters, or as a ground cover plant and color spots (Gupta *et. al*, 2019, Cruz de Souza, 2022).

In recent years, this plant has begun to be studied more and more, especially as ornamental plants (Ozarchevici *et al*., 2022).

The purpose of this paper was to evaluate how the composition of the growing substrate influences the morpho-decorative characters of some varieties of sweet potato grown in pots.

MATERIAL AND METHOD

The experiments were conducted within the Floriculture discipline, at the University of Life Sciences in Iași, Romania.

The plant material was represented by rooted cuttings from three varieties of *I. batatas*: `Heart Bronze`, `Black` and `Heart Lime`, produced by the Syngenta company and purchased from a company specialized in the sale of floricultural planting material.

a) b) c)

Fig. 1. *I. batatas*: a) `Heart Bronze`, b) `Black`, c) `Heart Lime`
(https://www.syngentaflowers-us.com/search?keyword=sidekick&sort_by=search_api_relevance)

`Heart Bronze` (**HB**) is a variety with a very high branching power, hastate leaves, moderately lobed, with khaki green and ruby red or burgundy shades (fig. 1a).

`Black` (**B**) is characterized by the ability to bloom throughout the vegetation season and by the leaves, of violet color, deeply lobed (fig. 1b).

`Heart Lime` (**HL**) is a variety with long branches and cordate or hastate leaves, slightly lobed, lime green in color and ruby-red shades on the edge of the limb (fig. 1c).

For the composition of the substrates, the following components were used: peat, coconut fiber, garden soil, and hydrogel.

The garden soil (**GS**) used was taken from the experimental field; it is a cambic chernozem, with sandy-loamy texture and slightly alkaline pH (7.8).

Peat (**P**) was used with pH = 5.5–6.5 and medium structure (0–20 mm), improved with complex fertilizers (1.5 kg/m3 NPK 14–16–18) and additives based on limestone and dolomite powder.

The dehydrated coconut fiber (**C**) was characterized by pH = 5.5–6.5 and water retention capacity of 650–850%.

The granulated hydrogel (**H**), based on potassium, presented a neutral pH and the filtering surface density of 30–60 mesh.

In each substrate variant, the components represented equal volumetric parts, except for the hydrogel, used in a quantity of 2 g/L.

The experience was bifactorial, namely the variety, with the three graduations (**HB**, **B**, **HL**), and the type of substrate, with four graduations resulting from the following combinations: **GSP** (garden soil + peat), **GSPH** (garden soil + peat + hydrogel), **GSPC** (garden soil + peat + coconut fiber) and **GSPCH** (garden soil + peat + coconut fiber + hydrogel).

The 12 experimental variants were organized in randomized blocks with three repetitions (10 plants/ repetition).

Considering that *I. batatas* decorates through port and leaves, the study focused on determining some characters that influence the ornamental value of the plant: the length and degree of branching of the stems, the number of leaves/ plant. The results were compared with the experience average (control), and the interpretation was made using the analysis of variance, with the “LSD” test (Săulescu & Săulescu, 1967).

RESULTS AND DISCUSSIONS

Table 1 presents the results regarding the cumulative influence of the two experimental factors on the average number of branches/stem and the maximum length of the stems. The number of branches varied between 5 and 11.3. Among the 12 variants, the highest degree of stem branching was recorded in the plants from V_3 (HB/GSPC), which exceeded the control by 39.51%. The fewest branches were had by the ’Black’ variety grown in GSP (V_5) and GSPC (V_7) substrates type. Small differences from the control and not statistically assured were at variants V_2, V_9, V_{11}, V_{12}.

Regarding the maximum length of the stems (Tab. 1), the action of the two factors strongly influenced this character, the differences from the control being very significant, with the exception of variant V_{12}. Very significantly positive differences were recorded in all varieties grown on GSP substrate (V_1, V_5, V_9), to

which were added variants V_{10} and V_{11}, respectively the HL variety grown on GSPH and GSPC.

Table 1

The cumulative influence of the cultivar and substrate on the number of branches and the stem length

Variants	Number of branches (pc)				Stem length (cm)			
	Abs. val.	% from average	Diff. (+-)	Signif.	Abs. val.	% from average	Diff. (+-)	Signif.
V_1 HB/GSP	9.7	119.75	1.6	X	78.0	118.72	12.3	XXX
V_2 HB/GSPH	9.0	111.11	0.9	ns	58.0	88.28	-7.7	000
V_3 HB/GSPC	11.3	139.51	3.2	XXX	58.7	89.35	-7.0	000
V_4 HB/GSPCH	10.3	123.46	1.9	XX	51.7	78.69	-14.0	000
V_5 B/GSP	5.0	61.73	-3.1	000	72.7	110.65	7.0	XXX
V_6 B/GSPH	6.0	74.07	-2.1	00	51.7	78.69	-14.0	000
V_7 B/GSPC	5.3	65.43	-2.8	000	61.3	93.30	-4.4	000
V_8 B/GSPCH	5.7	70.37	-2.4	00	50.0	76.10	-15.7	000
V_9 HL/GSP	8.3	102.47	0.2	ns	86.7	131.96	21.0	XXX
V_{10} HL/GSPH	10.0	123.46	1.9	XX	80.3	122.22	14.6	XXX
V_{11} HL/GSPC	8.3	102.47	0.2	ns	76.0	115.68	10.3	XXX
V_{12} HL/GSPCH	7.7	95.06	-0.4	ns	62.7	95.43	-3.0	0
Average	**8.1**	**100**	**-**	**control**	**65.7**	**100**	**-**	**control**
		$LSD_{5\%}$ = 1.4; $LSD_{11\%}$ = 1.9; $LSD_{0.1\%}$ = 2.5.				$LSD_{5\%}$ = 2.3; $LSD_{1\%}$ = 3.1; $LSD_{0.1\%}$ = 4.1.		

By grouping the variants according to the type of substrate in order to determine the exclusive influence of the substrate on the analyzed characters (Tab. 2), it is observed that the average number of branches/stem is non significantly influenced by this factor, the differences from the control being statistically not assured.

On the other hand, the length of the stems recorded obvious differences, which indicate the favorable effect of the GSP substrate (with 20.55% above the control value), but an unfavorable effect in the case of substrates with hydrogel (GSPH and GSPCH).

Table 2

The influence of the substrate on the number of branches and the stem length

Variants	Number of branches (pc)				Stem length (cm)			
	Abs. val.	% from average	Diff. (+-)	Signif.	Abs. val.	% from average	Diff. (+-)	Signif.
V_I (GSP)	7.7	95.06	-0.4	ns	79.2	120.55	13.5	XXX
V_{II} (GSPH)	8.4	103.7	0.3	ns	63.4	96.5	-2.3	00
V_{III} (GSPC)	8.3	102.47	0.2	ns	65.4	99.54	-0.3	ns
V_{IV} (GSPCH)	7.9	97.53	-0.2	ns	54.8	83.41	-10.9	000
Average	**8.1**	**100**	**-**	**control**	**65.7**	**100**	**-**	**control**

$LSD_{5\%}$ = 1.3; $LSD_{11\%}$ = 2.0; $LSD_{0.1\%}$ = 3.2.

$LSD_{5\%}$ = 1.5; $LSD_{1\%}$ = 2.3; $LSD_{0.1\%}$ = 3.6.

To determine the exclusive influence of the variety, three groups of variants were established, each corresponding to a variety (Tab. 3).

Unlike the substrate, the variety influenced to a greater extent both the degree of branching and the length of the stems, leading to the conclusion that these two characters are primarily determined by the variety.

In terms of the number of branches, the HB variety has a greater branching capacity (approx. 25% above the control value), while the B variety branches much less (values 32% below those of the control). The HL variety, even though it exceeds the control by 6.17%, the differences recorded are non significant. The length of the stems reached maximum values and very significantly positive differences in the HL variety. For the B and HB varieties, the differences were very significantly negative and respectively distinctly significantly negative (Tab. 3).

Table 3

The influence of the cultivar on the number of branches and the stem length

Variant	Number of branches (pc)				Stem length (cm)			
	Abs. val.	% from average	Diff. (+-)	Signif.	Abs. val.	% from average	Diff. (+-)	Signif.
V_I (HB)	10.1	124.69	2	XXX	61.6	93.76	-4.1	00
V_{II} (B)	5.5	67.9	-2.6	000	59.0	89.8	-6.7	000
V_{III} (HL)	8.6	106.17	0.5	ns	76.5	116.44	10.8	XXX
Average	**8.1**	**100**	**-**	**control**	**65.7**	**100**	**-**	**control**

$LSD_{5\%}$ = 0.6; $LSD_{11\%}$ = 1.0; $LSD_{0.1\%}$ = 1.9.

$LSD_{5\%}$ = 1.7; $LSD_{1\%}$ = 2.9; $LSD_{0.1\%}$ = 5.4.

Another character analyzed was the number of leaves per plant. As in previous cases, both the cumulative influence of experimental factors and their separate influence were evaluated.

The cumulative influence of the variety and substrate on the number of leaves is presented in Table 4.

Very significantly positive results were recorded for four of the variants, namely V_1 (HB/GSP), V_2 (HB/GSPH), V_3 (HB/GSPC) and V_9 (HL/GSP), which had values that exceeded the control by 13.83–40.56%, while for the variants V_4 (HB/GSPCH), V_{10} (HL/GSPH) and V_{11} (HL/GSPC) the differences were non significant. For the other variants, very significantly negative differences were recorded, the smallest values being at V_8 (B/GSPCH), with 33.18% below the control.

Table 4

The cumulative influence of the cultivar and substrate on the number of leaves/plant

Variant	Number of leaves (pc)	% from average	Difference (+-)	Significances
V_1 HB/GSP	420.7	140.56	121.4	XXX
V_2 HB/GSPH	373.3	124.72	74.0	XXX
V_3 HB/GSPC	340.3	113.83	41.4	XXX
V_4 HB/GSPCH	299.3	100.00	0.0	ns
V_5 B/GSP	264.7	88.44	-34.6	000
V_6 B/GSPH	218.0	72.84	-81.3	000
V_7 B/GSPC	260.0	86.87	-39.3	000
V_8 B/GSPCH	200.0	66.82	-99.3	000
V_9 HL/GSP	371.3	124.06	72.0	XXX
V_{10} HL/GSPH	290.7	97.13	-8.6	ns
V_{11} HL/GSPC	300.7	100.47	1.4	ns
V_{12} HL/GSPCH	252.0	84.20	-47.3	000
Average	**299.3**	**100.00**	**-**	**control**

$LSD_{5\%}$ = 17.2;
$LSD_{1\%}$ = 23.5;
$LSD_{0.1\%}$ = 5.

Regarding the exclusive influence of the substrate on the number of leaves per plant (Tab. 5), a positive influence of the substrate composed of garden soil and peat was observed, with 17.7% above the control value. A less rich

foliage was recorded in plants grown on GSPCH (values 16.34% lower than the control).

Table 5

The influence of the substrate on the number of leaves/plant

Variant	Number of leaves (pc)	% from average	Difference (+-)	Significances
V1 (GSP)	352.3	117.71	53.0	XXX
V2 (GSPH)	294.0	98.23	-5.3	ns
V3 (GSPC)	300.5	100.40	1.2	ns
V4 (GSPCH)	250.4	83.66	-48.9	000
Average	**299.3**	**100.00**	-	**control**

$LSD_{5\%}$ = 11.6;
$LSD_{1\%}$ = 17.5;
$LSD_{0.1\%}$ = 28.1.

From the perspective of the exclusive influence of the variety, the richest foliage was had by the HB variety, while the HL variety recorded the weakest results (Tab. 6).

Table 6

The influence of the cultivar on the number of leaves/plant

Variant	Number of leaves (pc)	% from average	Difference (+-)	Significances
(V1) HB	358.5	119.78	59.2	XXX
(V2) B	303.7	101.47	4.4	ns
(V3) HL	235.7	78.75	-63.6	000
Average	**299.3**	**100.00**	-	**control**

$LSD_{5\%}$ = 15.7;
$LSD_{1\%}$ = 26.1;
$LSD_{0.1\%}$ = 48.7.

CONCLUSIONS

1. Grown in pots, the analyzed cultivars of *I. batatas* can represent a very good option for ornamental use, the results being influenced not only by the characteristics of the cultivar, but also by the type of substrate.

2. The length of the stems was strongly influenced both by the cumulative action of the variety and substrate, as well as by their separate action. The substrate composed of garden soil and peat (GSP) favored the growth of the stems in all analyzed cultivars, while the substrates with hydrogel (GSPH and GSPCH) had a negative influence. Among the cultivars, `Heart Lime` had the longest stems (reported for each type of substrate).

3. The degree of stem branching was less influenced by the substrate, but proved to be dependent on the cultivar (stronger branching at `Heart Lime`, reduced at `Black`).

4. The number of leaves/plant recorded maximum values at the `Heart Bronze` cultivar, each variety being favorable to the substrate made of garden soil and peat.

5. Of all types of substrate used, the GSPCH mix recorded the weakest values for all the characters analyzed.

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