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THE INFLUENCE OF SUBSTRATE TYPE ON THE MORPHOLOGICAL AND ORNAMENTAL CHARACTERS OF SOME VARIETIES OF *IPOMOEA BATATAS* GROWN IN CONTAINERS

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Abstract

In this study, three ornamental varieties of Ipomoea batatas (`Heart Bronze`, `Black`, `Heart Lime`) were studied to evaluate the influence of substrate type on some morpho-decorative characters. The plants were grown in 70 L containers in which four types of substrate were used: garden soil + peat, garden soil + peat + hydrogel, garden soil + peat + coconut fiber, garden soil + peat + coconut fiber + hydrogel. `Heart Bronze` was characterized by a richer vegetative mass (2-6 times more leaves than the other two varietys) and `Heart Lime` by longer branching. In all varieties, the substrate consisting of garden soil + peat favored stem branching, and in the varieties 'Heart Lime' and 'Heart Bronze' it favored the stem length growth. To increase the number of leaves/plant, the substrate of garden soil + peat + hydrogel can be recommended for all varieties, although good results were also obtained with the substrate containing coconut fiber. The results show that the presence of hydrogel, which helps in solubilization of nutrients and their uptake, ensured the formation of more leaves.

***Key words**: sweet potato, ornamental varieties, morphological characters.*

INTRODUCTION

The *Ipomoea* L. genus, family *Convolvulaceae*, comprises numerous species, including sweetpotato (*Ipomoea batatas* (L.) Lam), a plant cultivated mainly in tropical regions of Latin America, Africa and Asia as a food crop (Zhang et al., 2009; Nimmakayala et al., 2011; Roullier et al., 2013; He and Qin, 2020; Wood et al., 2020; Jiang et al., 2022; Xiong and Kaluwasha, 2022). Central America is considered to be the main center of sweetpotato origin, without excluding the existence of secondary centers in China, Southeast Asia and East Africa (Aguoru et al., 2015; Loebenstein, 2009).

Among the 14 species placed in the Batatas section of the *Ipomoea* genus, sweetpotato is the only one used in food crops for its tuberous roots and edible leaves (Wood et al., 2020; Jiang et al., 2022; Xiong and Kaluwasha, 2022).

Recent studies indicate the worldwide presence of more than 35000 taxa of *I. batatas* in *ex situ* collections (Roca et al., 2007; Kim et al., 2018, Jackson et al., 2020). An impressive collection is held by the International Potato Center in Peru (Nimmakayala et al., 2011; Xiong and Kaluwasha, 2022).

I. batatas is a perennial plant, but usually cultivated as an annual in about 117 countries (Gruneberg et al., 2015; Widaryanto and Saitama, 2017; Behera et al., 2022; Nimmakayala et al., 2011). Due to the rich content of starch, protein, fiber, sugars, β-carotene, vitamins, fatty acids, essential minerals, etc. in the tuberous roots, young shoots, leaves and petioles, it is a global staple food with high nutritional value (Bovel-Benjamin, 2007; Nimmakayala et al., 2011; He and Qin, 2020; Wood et al., 2020; Jiang et al., 2022). It also has numerous medicinal or industrial uses (stationery, textiles, etc.), depending on the needs of the production area (Gruneberg et al., 2015).

It has tuberous roots and stems up to 7 m long, green or purple, with high branching power. Leaves, alternate, long petiolate, have large, variously shaped blades (Huaman, 1991; Behera et al., 2022; Jiang et al., 2022). The color palette of leaves, stems, and tuberous roots includes shades of white, yellow, orange or brown, pink, reddish-purple, or deep purple (Jiang et al., 2022). *I. batatas* is usually propagated vegetatively, by stem cuttings or tuberous roots, but recent studies have also admitted shoots by *in vitro* propagation (Cioloca et al., 2020; Jiang et al., 2022; Behera et al., 2022; Tadda et al., 2022). It prefers sunny sites, well-drained soils with a pH of 5.5-6.5 and temperatures of about 21-26°C. It is highly adaptable to different soil and climatic conditions (Behera et al., 2022; Nimmakayala et al., 2011). Studies on the influence of the type of substrate (perlite, peat, coconut fiber, etc.), including hydroponic culture, both on vegetative mass or tuberous root production and for rooting cuttings, have shown that the use of a light substrate that allows good aeration and retains soil moisture, such as coconut fiber or perlite, leads to better results (Cruz de Souza et al, 2022; Stoian et al., 2022; Mohd et al., 2022; Perez - Pazos et al., 2023). In terms of nutrients, potassium, has been shown to have a beneficial effect on the taste, shape, size, color or texture of sweet potatoes (Darko et al., 2020).

In recent years, sweetpotato has become a popular crop in the ornamental sector due to the variety of foliage colors and shapes, stem length and habit diversity in the approximately 6000 identified varietys, mostly in the USA and South Korea (Lee et al., 2021; Gruneberg et al., 2015). The plant offers various potential uses in hanging pots, pots, containers and window boxes, ground coverings, color patches and wall cladding, pergolas, gazebos, green wall landscaping, etc. (Lee et al., 2021; Cruz de Souza et al., 2022; Ozarchevici et al., 2024).

The majority of studies in *I. batatas* focus predominantly on factors influencing nutrient storage and accumulation in the tuberous roots, but there is a considerable lack of knowledge on aboveground morphology (Somda and Kays, 1990).

The aim of this work was to evaluate the influence of different substrate types on the morpho-decorative characters of some ornamental varieties of *I. batatas* grown in containers.

MATERIALS AND METHODS

The study was carried out in the period 2023-2024, under the experimental field conditions of the Floriculture Discipline, Iasi University of Life Sciences (IULS), Romania. Three ornamental varietys of *I. batatas* (first factor) and four types of container substrate (second factor) were used, with the experiments being organized in randomized blocks with three replications. The plant containers were kept in unprotected conditions, the experimental crops were annuals with a similar growing season as field plants (May-October).

Plant material

The sweetpotato varietys used as experimental material were 'Heart Lime' (HL), 'Heart Bronze' (HB) and 'Black' (B), used in the text with the abbreviated names in brackets.

Variety characterization was adapted from Huaman's (1991) method, based on the use of plant descriptors of *I. batatas*. The method has been adapted and used by other authors in studies on the morphology of sweet potato varieties (Cruz de Souza et al., 2022; Jackson et al., 2020). From the total descriptors, only those that helped in the general description of the studied varieties with reference to stem and leaf characters were selected. The parameters used for stem description were: plant twining capacity, plant growing habit (spreading - >75 cm; semi-compact – 50-75 cm; compact - <50 cm), plant covering capacity (high - 75-90%; medium - 50-70%), vine predominant color.

Table 1. Characterization of the sweet potato varietys vines

Cv.	Descriptors			
	PTC	PGH	PCC	VPC
HL	Non-twining	Spreading	High	Green
HB	Slightly Twinning	Semi-compact	High	Mostly purple
B	Non-twining	Compact	Medium	Dark purple

PTC – plant twining capacity, PGH – plant grow habit, PCC – plant covering capacity, VPC – vine predominant colour

The characters that most differentiated the varieties from each other were those related to growth habit (PGH) and the predominant color of the stems and their branches (VPC). Also, the plant covering capacity ranged from high (HB and HL) to medium in the case of variety B (Table 1).

Characterization of leaves was done according to the following criteria: leaf shape, leaf lobes type, leaf lobes number, mature leaf color. Leaf shape ranged from triangular to almost divided, number of lobes from 1 to 5 and the color from green to dark purple (Table 2, Figure 1).

Table 2. Characterization of the sweet potato varietys leaves

Cv.	Descriptors			
	LS	LLT	LLN	MLC
HL	Triangular	Very slight	1-3	Green
HB	Hastate	Slight	3	Mostly purple
B	Almost divided	Deep	5	Full purple

LS – leaf shape, LLT – leaf lobes type, LLN – leaf lobes number, MLC – mature leaf colour

'Heart Lime' 'Heart Bronze' 'Black'

Figure 1. Leaf appearance of *I. batatas* varieties

Growing substrates

The substrates were composed of three basic components (garden soil, peat, coconut fiber) and hydrogel. As in the case of the sweet potato varietys, abbreviated names have been used, in brackets. The garden soil (GS) was a cambic chernozem with a sand-loamy texture and a weakly alkaline pH (7.8). The peat (P) was SuliFlor (SF2) with pH = 5.5-6.5 and medium structure (0-20 mm), improved with complex fertilizers (1.5 kg/m^3 NPK 14-16-18) and additives based on limestone and dolomite powder. Dehydrated coconut fiber (C) had a pH = 5.5-6.5 and a water absorbtion capacity of 650-850%. Granular hydrogel (H), an environmentally friendly potassium-based hydroabsorbate, had a neutral pH and a filtration surface density of 30-60 mesh. In the execution of the substrate variants, the mixtures consisted of equal volumetric parts of the presented components, except for the hydrogel, added 2 g/L. The following substrate variants were obtained, for which the abbreviations corresponding to the components were used: garden soil + peat (GSP), garden soil + peat + hydrogel (GSPH), garden soil + peat + coconut fiber (GSPC), garden soil + peat + coconut fiber + hydrogel (GSPCH). The determination of the main physico-chemical indices of the substrates (Table 3 and Table 4) was carried out at the Research Institute for Agriculture and Environment (ICAM) of the Iasi University of Life Sciences.

The substrate chemical composition were analyzed following the standard provided by the National Institute for Research and Development for Pedology, Agrochemistry and Environmental Protection (ICPA, Bucharest). Soil pH was measured in 1:2.5 soil to water suspension using a pH meter (Mettler-Toledo, Greifensee, Switzerland). Available phosphorus (P) and potassium (P) were extracted in aqueous solution using the colorimetric molybdenum blue method and measured spectrophotometrically with a Specord Plus UV–Vis device (Analytikjena, Jena Germany). The potassium and microelements (Zn, Cu, Fe, Mn) quantification was performed using Atomic Absorption Spectrometry (AAS ContrAA 700, Analytikjena, Jena, Germany).

Table 3 presents the granulometric composition of substrates where we noted that there is a redistribution of fractions within the added substrate which facilitate the plant growth. The incorporation of peat, coconut fiber and hydrogel improved the water retention capacity of sand-loamy soils texture and increase their nutrient holding ability.

Table 3. Granulometric composition of substrates

Substr.	CS 2.0-0.2%	FS 0.2-0.002%	D 0.02-0.002%	CC <0.002%	*PC <0.01%*
GSP	-	34.8	45.8	19.4	*54.2*
GSPH	-	35.3	38.5	26.2	*52.3*
GSPC	-	37.0	35.8	27.2	*53.7*
GSPCH	-	39.4	28.7	31.9	*46.2*

CS – Coarse sand, FS – Fine sand, D – Dust, CC – Colloidal clay, PC – Physical clay.

The influence of substrate granulometric composition was also identified by Stoian M. (2022), who obtained different results in terms of yield and vegetative mass using peat and 2 type of perlite and recorded the best results in the mixture with better porosity wich allowed a proper oxygenation.

Table 4. Chemical characteristics of substrates

Substr.	pH	P ppm	K ppm	Zn ppm	Cu ppm	Mn ppm	Fe ppm
GSP	6.04	231	262	5.20	13.20	42.26	72.79
GSPH	5.84	190	401	5.21	13.28	45.10	81.91
GSPC	5.97	190	255	6.51	11.53	45.96	57.86
GSPCH	6.09	212	469	6.08	13.07	48.99	66.47

Table 4 presents the substrate chemical composition and reflect the differences between the components added, highlighting the changes observed in terms of fertility management and maintenance of physico-chemical balance. The GSP, GSPH, GSPC and GSPCH substrate

maintained stable soil pH showing slight acidification. A medium content in phosphorus and potassium was displayed demonstrated the mobilization and element availability mediated by different substrate compositions.
The experimental crops were established annually by planting cuttings in 70 L containers (3 plants/container). The determinations and observations were carried out during the vegetative period of the plants and aimed to monitor some biometric indices that define the morpho-decorative particularities of the plants (number of branches and leaves per plant, stem length).
Interpretation of the results was carried out using statistical analysis in order to obtain a series of indices on the direction, strength and relationship between the analyzed morphological characters. The Kolmogorov-Smirnov test was used to check the normality condition and the Mann-Whitney test was chosen to compare the means of two selections from independent populations, since the data were found to be non-normalized. The scatter plot and mathematical modeling by linear regression were also used. Statistical testing was performed at 0.05 level of significance using MS EXCEL professional application from MS OFFICE 2020 package.

RESULTS AND DISCUSSIONS

The observations and determinations carried out aimed both to evaluate the decorative effect of the three sweet potato varieties grown in containers and the influence of substrate type on some morphological characters of the plants.

Substrate influence on plant morphology

The *I. batatas* varieties presented above were analyzed in the context of identifying the influence of substrates with different compositions on some morpho-decorative characters: stem length, number of branches, number of leaves/plant. The results of the biometric determinations were analyzed in correlation with the four types of culture substrate: garden soil + peat (GSP), garden soil + peat + hydrogel (GSPH), garden soil + peat + coconut fiber (GSPC), garden soil + peat + coconut fiber + hydrogel (GSPCH).
Interpretation of the results was based on statistical analysis on the variables. It was established both the dependence of plant characters on the growing substrate and the significance of the differences generated by the type of substrate.
The use of graphical representation of the calculated values (mean values) for a small number of plants in the experiment performed, may lead to a slightly distorted conclusion. Therefore, the recommended non-parametric statistical test was the Mann-Whitney test which will indicate in detail the similarities between the compared substrate pairs (medians compared). The dependence between plant character and substrate type was determined, based on the *p-value* resulting from the pairwise comparison of substrates. Values of *p-value* < 0.05 (marked with *) indicate significant differences in relation to the analyzed substrates pair, which means that the respective substrates influence the character differently. Values of *p-value* > 0.05 highlight similarities in the effect of the substrates, in which case it is possible to choose one or the other of them.
The variation trend as well as the minimum and maximum values of the characters according to the type of substrate were analyzed by means with the "stock" type graphs for each variety.

Substrate influence on stem length

Statistical analysis (Table 5) showed both similarities of results (*p-value* > 0.05) and significant differences (*p-value* < 0.05), depending on the variety.

Table 5. Dependence between the length of stem and the type of substrate

Cv.	Substr.	GSPH	GSPC	GSPCH
HL	GSP	0.03074*	0.04363*	0.0268*
	GSPH		0.04746*	0.26435
	GSPC			0.05705
HB	GSP	0.41294	0.09342	0.49202
	GSPH		0.04846*	0.30854
	GSPC			0.03673*
B	GSP	0.025*	0.03074*	0.04746*
	GSPH		0.02872*	0.04846*
	GSPC			0.0548

*Level of significance=0.05

In HL, significant differences were found between all substrate types, except GSPCH–GSPH (*p-value* = 0.26435) and GSPCH–GSPC (*p-value* = 0.05705) between which similarities were found and where substrate choice options may be suggested. These data are partially confirmed also by the mean, maximum and minimum values of the biometric determinations plotted in Figure 2. Very similar values of the stem lengths of the GSPH and GSPCH substrates are observed, suggesting the possibility of choosing the substrate with fewer components (GSPH). Although on the graph the GSPC substrate does not suggest similarity with GSPCH, statistical calculation (Table 5) does not exclude the alternative hypothesis. From the data presented for this variety, the GSP substrate is recommended to obtain plants with longer stems, while the other variants are not excluded.

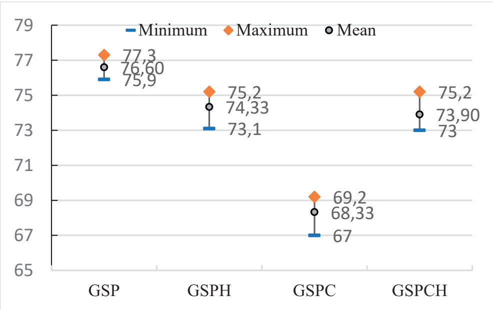

Figure 2. Minimum and maximum values for the length of stem according to the type of substrate (HL)

The HB variety was characterized by a very low dependence of the stem length in the GSP substrate compared to GSPH and GSPCH substrates, the differences recorded being nonsignificant. The highest similarities, with *p-value* = 0.41294–0.49202, were between GSP and GSPH, respectively GSPCH, justifying the choice of the simpler substrate (GSP) (Table 5). Figure 3 also shows similar stem length values in GSP, GSPH and GSPCH substrates, with an average of ca. 69 cm, suggesting that the use of a simple mixture of only peat and garden soil is equally effective. A high level of similarity was also recorded between GSPH and GSPCH (*p-value* = 0.30854), with the recommendation to choose the substrate with fewer components (GSPH). In this variety, for the variants in which the GSPC substrate was compared with the GSPH and GSPCH substrates, the differences were significant (Table 5), also highlighted in Figure 3, where it can be seen that only the GSPH and GSPCH substrates favored stem length growth. The data presented in Figure 3 also suggest the tendency of stem length towards maximum values, regardless of substrate type, as well as the higher variability of this trait in plants grown on GSP.

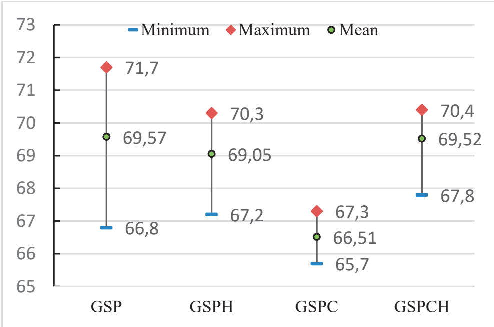

Figure 3. Minimum and maximum values for the length of stem according to the type of substrate (HB)

The influence of substrate on stem length at B variety was relatively different from the others. The only statistically recorded similarity from the comparison of substrate pairs was in the case of GSPC–GSPCH, but the very low *p-value* (0.0548), close to the threshold of significant differences, is less recommending the substitution of one substrate for the other (Table 5).

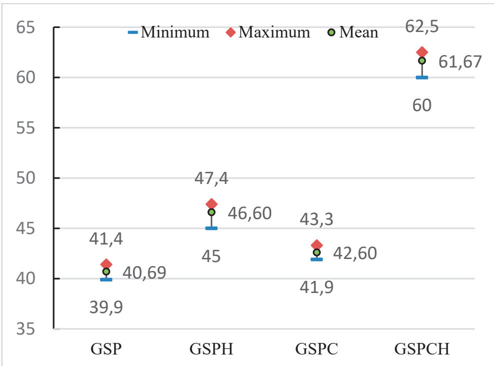

Figure 4. Minimum and maximum values for the length of stem according to the type of substrate (B)

Although the graphical representation (Figure 4) suggests distorted conclusions compared to the statistical calculation (explained by the lower number of plants), the conclusion suggested by the statistical calculation can be maintained. Another peculiarity of the stem length of B variety was the small range of variation between minimum and maximum (1.4-2.5 cm), indicating a greater uniformity of this character within each variant. In all substrate types, the variation trend was towards the maximum values.

Substrate influence on the degree of stem branching

The branching capacity of plants used as ground cover or creeping plants, such as *I. batatas*, is an essential feature of their decorative value. In the present study, the analysis of this character was done similar to stem length in order to determine the degree of influence and the level of similarity of the effect of culture substrates. Table 6 summarizes the results on the dependence of branching degree on the substrate type.

Table 6. Dependence between the number of branches and the type of substrate

Cv.	Substr.	GSPH	GSPC	GSPCH
HL	GSP	0.00001*	0.00001*	0.01831*
	GSPH		0.49202	0.00149*
	GSPC			0.00042*
HB	GSP	0,00326*	0,49202	0,00001*
	GSPH		0,00326*	0,00023*
	GSPC			0,00001*
B	GSP	0,00082*	0,49202	0,11123
	GSPH		0,00082*	0,00027*
	GSPC			0,11123

*Level of significance=0.05

For HL, the statistical analysis showed significant differences in the number of branches/plant between most substrate pairs, especially in the case of GSP compared to GSPH and GSPC, where a very low *p-value* (0.00001) was recorded.

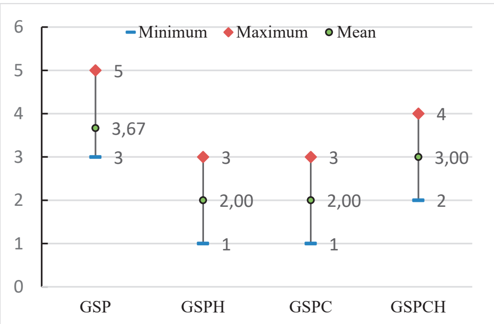

Figure 5. Minimum and maximum values for the number of branches/pl. according to the type of substrate (HL)

Nonsignificant differences (*p-value*=0.49202) of the results obtained for this variety, i.e. similarity of the effect of substrates, were only between GSPH and GSPC. The way in which the effect of each substrate on the number of branches was manifested is also observed in Figure 5. In accordance with the data from Table 6, the median indicates the highest degree of favorability of the substrate GSP, with maximum of 5 branches/plant, the recorded results not being similar to other substrates.

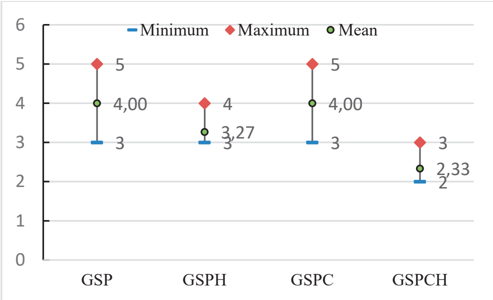

Figure 6. Minimum and maximum values for the number of branches/pl. according to the type of substrate (HB)

Also in HB, the differences resulting from the comparison of substrate pairs were significant, with the exception of GSP and GSPC substrates. The level of significance also suggests the substrates that determine the largest differences in the results, as is the case between GSP and GSPCH, or GSPC and GSPCH, with *p-value* = 0.00001 (Table 6). The data in Figure 6 confirm these aspects, in that the GSP and GSPC substrates gave the best results and similar effect, suggesting the possibility of their mutual substitution. It is also obvious that substrates containing hydrogel (GSPH and GSPCH) are not recommended for increasing the number of branching in HB (Figure 6).

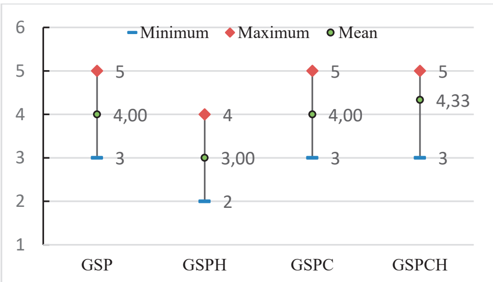

Figure 7. Minimum and maximum values for number of branches/pl. according to the type of substrate (B)

In B variety, several substrate pairs with similar effects on branching number (*p-value* > 0.05) were recorded, such as GSP with GSPC and GSPCH, or GSPC with GSPCH. In all the comparisons involving the GSPH substrate, the differences in the results were significant, indicating the different action of this substrate compared to the others (Table 6).

The Mann-Whitney test data are also supported by the graphical representations (Figure 7). The maximum and minimum values of the number of branches were similar in the GSP, GSPC and GSPCH variants (ranging from 3 to 5), with very small differences of the mean (4-4.33). The fewest branching were formed at the plants grown in the GSPH substrate. The results obtained at this variety indicate that for better branching of the plants it is recommended to choose one of the substrates GSP, GSPC or GSPCH, but from the economic point of view the simpler substrate (GSP) is indicated.

It can be observed that the addition of coconut fiber in the mixture improved the nutrient source and the physico-chemical characters of the substrates which led to an increase in biomass, which was also found in the research done by Perez-Pazos (2023), who also used coconut fiber in the rooting mixture. It is thus understood that each type of mixture influences differently the characters in each variety. A similar situation can be observed to that found by Mohd (2022), who used five types of sweetpotato mixtures including coconut fiber. The best results in terms of vegetative growth was in the substrate where coconut fiber was used in higher proportions to retain moisture.

Substrate influence on number of leaves/plant

Rich leaf mass and high stem branching are two characters that complement each other in obtaining *I. batatas* plants with high decorative value. Therefore, when considering the number of leaves/plant, the choice of culture substrates should be made according to the maximum favorability they can have on this character. In addition, in order to give cultivators the possibility to choose between substrates with different compositions but similar effect on the plants, the significance of the differences between the compared substrate pairs was also calculated for this character (between GSP and GSPCH) and HB (between GSPH and GSPC).

In contrast to the other characters analyzed, the number of leaves/plant showed significant differences between most of the substrate pairs compared for all varieties (Table 7). From the statistical calculation, similarities appeared only for HL. According to the level of significance of the differences (Table 7) and the values indicating the mean, minimum and maximum range of leaf number (Figure 8), it can be seen that the influence of substrates was quite different in HL. The greatest differences (*p-value* = 0.00001) were recorded by comparing the results from the substrate GSPH with those from the substrates GSPC and GSPCH (Table 7), the graph (Figure 8) indicating the direction of influence: GSPH determined the formation of the highest number of leaves (mean 143.6 leaves/plant), while GSPC and GSPCH were less favorable, with mean values of 96.2-106.67 leaves/plant.

Table 7. Dependence between the number of leaves and the type of substrate

Cv.	Substr.	GSPH	GSPC	GSPCH
HL	GSP	0,00008*	0,00453*	0,12302
	GSPH		0,00001*	0,00001*
	GSPC			0,02938*
HB	GSP	0,00001*	0,00001*	0,00001*
	GSPH		0,49202	0,01463*
	GSPC			0,00001*
B	GSP	0,00001*	0,00001*	0,00017*
	GSPH		0,00001*	0,01191*
	GSPC			0,00001*

*Level of significance=0.05

In this variety, the results recommend the use of GSPH substrate. The similarity between GSPC and GSPCH excludes the possibility of choosing between them, both having poorer results.

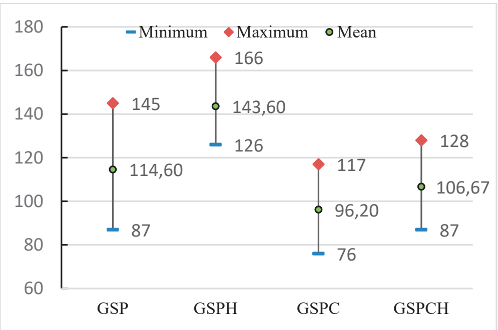

Figure 8. Minimum and maximum values for the no. of leaves/pl. according to the type of substrate (HL)

For HB variety, plants grown in GSP substrate showed the worst results in terms of leaf number, although there was some uniformity of plants, with a relatively narrow range between maximum and minimum values (698–738) compared to other substrates (Figure 9). As a result, the differences obtained from comparing GSPH with all other substrates were significant, within *p-value* = 0.00001 (Table 7). The only similarity was between GSPH and GSPC (Table 7), but of no practical importance in terms of choice (in both cases, the results were less good).

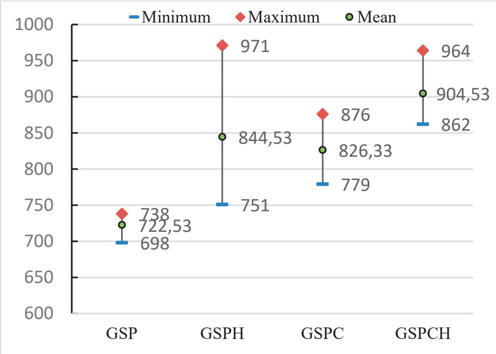

Figure 9. Minimum and maximum values for the no. of leaves/pl. according to the type of substrate (HB)

The data in Figure 9 provide further information on the influence of each substrate on leaf number in HB: higher plant uniformity in GSPC and GSPCH substrates, but with the highest mean values in GSPCH (904.5 leaves/plant); large amplitude between maxima and minima in GSPH, with maxima up to 971 leaves/plant, but with means below GSPCH and trending towards minima (Figure 9).

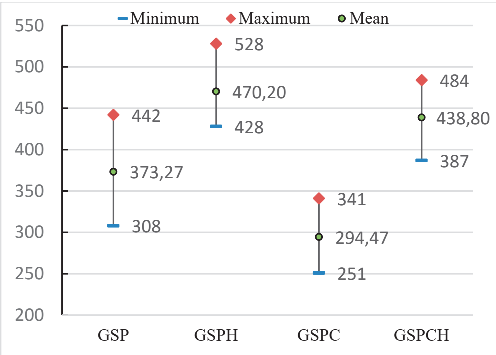

Figure 10. Minimum and maximum values for the no. of leaves/pl. according to the type of substrate (B)

The influence of substrate on the number of leaves/plant in B variety was characterized by significant differences in all combinations of substrate pairs analyzed, so that no similarities were recorded (Table 7). character, GSPH substrate is recommended for B variety. The results presented in Figure 10 indicate a ranking of substrate favorability in terms of number of leaves/plant in B variety, i.e. the highest mean values (470.2) in the GSPH substrate, ranging from a maximum of 528 to a minimum of 428 leaves/plant, with a trend towards minimum values. Relatively good results for this character were also obtained in GSPCH substrate, with an average of 438.8 leaves/plant. Less favorable was the GSPC substrate, with an average of only 294.5 leaves/plant. Due to the maximum results for this character, the substrate GSPH is recommended for B variety.

Analysis of correlations between morphological characters of I. batatas varieties

Detailed assessment of the relationship between the analyzed characters (as variables) was performed by calculating the coefficient of determination (R^2), i.e. the proportion of the total variation of the dependent variable that can be explained by the independent variable. The coefficient of determination was determined in the following combinations: number of branches (BN) and stem length (SL), number of branches (BN) and number of leaves/plant (LN), stem length (SL) and number of leaves/plant (LN).

For each combination, the corresponding linear regressions were constructed, illustrated by graphs only for the cases that recorded the maximum values of the coefficient of determination (R^2). Pearson correlation coefficients (r) for pairs of characters indicate predominantly nonsignificant indirect relationships (Table 8).

Table 8. Pearson correlation coefficient results

Variety/ Character	HL		HB		B	
	SL	LN	BL	LN	SL	LN
BN	0.53*	-0.10	-0.19	-0.61*	0.20	-0.21
SL		0.40*		-0.073		0.49*

SL - Stem length, BN - Branches no., LN - Leaves no.

In HL there were positive correlations of medium intensity between BN/SL (r=0.53; R^2=0.2838) and SL/LN (r=0.40; R^2=0.1565). Between BN and LN the correlation was negative nonsignificant (r=0.10; R^2=0.0096).

The graphical representation was given only for the BN/SL pair of characters with the highest R^2 value (Figure 11).

Correlations between characters at HB were negative, but significant only in the BN/LN pair (r=-0.61), indicating that the number of leaves decreased in proportion to the increase in the number of branches and vice versa (Figure 12).

In B variety, BN/SL (r=0.20) and SL/LN (r=0.49) were positively correlated, while BN/LN were negatively correlated (r=0.21). The only correlation with statistically assured results and graphically represented was between SL/LN (Figure 13), with 24% dependence (R^2=0.2366).

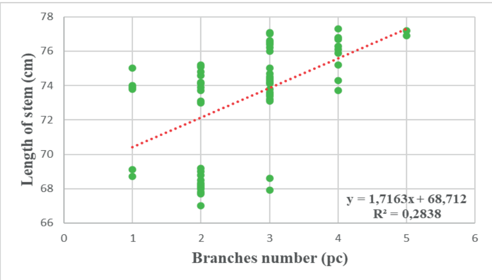

Figure 11. Correlation between number of branches/pl and stem length (HL)

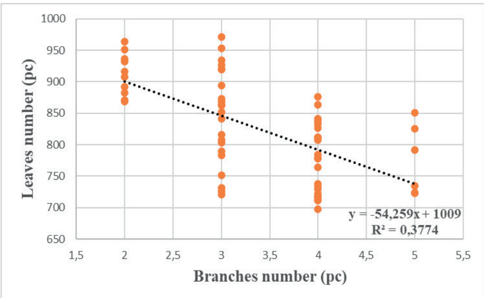

Figure 12. Correlation between number of branches/pl and number of leaves/pl (HB)

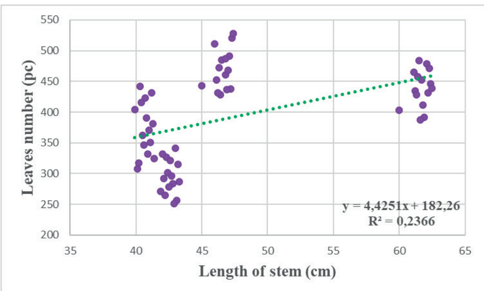

Figure 13. Correlation between number of leaves/pl. and length of stem (B)

CONCLUSIONS

The study carried out on the three varieties of *I. batatas* grown in containers showed that the type of culture substrate used influenced certain morphological characters of the plants, i.e. their decorative appearance.

The reaction of each variety to the composition of the substrates used allowed the formulation of recommendations indicating the variants by which the results for the characters analyzed (stem length and branching degree, number of leaves/plant) could be maximized, in correlation with the way the plants were used. The statistical analysis provided the possibility of establishing the similarity of the effect of certain substrates and choosing those that provide efficiency by a reduced number of components.

In terms of stem branching, the substrate composed of garden soil + peat (GSP) was effective for all varieties, and it also favoured stem length growth in 'Heart Lime' (HL) and 'Heart Bronze' (HB), a characteristic that is well exploited when plants are used for vertical decoration.

To increase the number of leaves/plant, a very important characteristic for cover plants, the substrate of garden soil + peat + hydrogel (GSPH) can be recommended for all varieties, although good results were also obtained with the substrate containing coconut fiber (GSPCH), but considered less efficient due to its complexity and additional costs. The results show that the presence of hydrogel, which helps in solubilization of nutrients and their uptake, ensured the formation of more leaves.

In the analyzed variants the favorable effect of peat (P) was noted, which played a role in increasing the degree of aeration of substrates. In most cases, the efficiency of coconut fiber (C) was ensured in combination with hydrogel (H).

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