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THE INFLUENCE OF DIFFERENT ROOTING SUBSTRATES ON THE ROOT SYSTEM OF *ABUTILON HYBRIDUM* HORT. NEW PLANTS OBTAINED BY CUTTINGS

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Abstract

The purpose of the research was to identify to what extent rooting substrates used for vegetative propagation on commercial plant Abutilon hybridum, influence the defining parameters for the future decorative potential of the plants. It has been tested a number of substrates defined as classical for two different rooting cuttings shoot (the segment and peak), aiming the evolution of the roots. For statistical interpretation of data it was developed an indicator that reflects the two types of measurements: percentage of rooting (%) and the average length of root cuttings (avg) for each type of substrate, called ITPS (I = Rooting T = Segment, P = Peak, S= Shoot).

Key words: *Abutilon, Alpha Cronbach, cuttings, substrate.*

INTRODUCTION

Abutilon hybridum is a species originating in tropical and subtropical areas of southern America. This species is a vigorous shrub that can reach up to 1.5 meters high. Flowering occurs in summer, with fine flowers, red colored appear to be suspended like bells (Fanghua Niu et al., 2013).
Abutilon plants are eminently decorative indoor plant, grown in container system, but it can be seen also in the outdoor spaces in summer. Here are some of the reasons why the species is becoming more popular: it well recover the sunny places present in front of windows, supports very well logging, maintenance work are relatively simple for this plant. Because shoots are long, lean and suspended, plants can be used in hanging baskets or any other medium that allows it to manifest its pendent character.
The propagation by cuttings, regardless of their type, the organogenesis reproduces normal polarity plant due to natural auxines movement to basal pole, where the roots are formed. Regeneration of new individuals of plant fragments is governed by the complex interplay of hormones and other endogenous factors. The rooting process is stimulated by the presence of buds and leaves (H.T. Hartmann et al., 1983, quoted by Burzo et al., 2004). Also from cuttings are true regenerate’s decorative features of the mother plant (Șelaru, 2005).
Whether rooting substrates are formed from natural materials (peat, sand) or artificial materials (perlite, vermiculite etc.) used alone or in mixtures, they must be sterile, breathable, have good ventilation and a good retention of water capacity and shape stability (Davidescu et al., 2001; Şelaru, 1995, 2005).
Worldwide a series of works are dealing with items on rooting plant *Abutilon hybridum*, in terms of the influence of certain factors on cuttings rooting. Either it been determined the irrigation norm for certain types of substrates (60% peat, 40% perlite) during cuttings rooting on *Abutilon* and *Lantana* (Kim and van Iersel, 2009) either is determinate the influence on daily lighting scheme on cuttings rooting placed on a substrate consisting of 80% peat and 20% perlite (Currey et al., 2012).
Usually the literature contains references to the local substrates used because of the specific location of the conducted research. Thus in a research that studies the substrate effect on the percentage of survival and growth of plants Jojoba (*Simmondsia chinensis*) obtained from cuttings at Jojoba Naturals Company greenhouse and shade house, Sana'a Yemen it been used in the first experiment a addition of

peat and sand substrates that can be easily obtained at the place where research is conducted (Ahmed M. EeD, 2016).
For this reason this research has focused on the influence of different substrates used mainly in Romania, for the rooting of cuttings shoot of *Abutilon hybridum*, with two variants: segment respectively peak shoot cuttings.
Also in the present research we try to identify an applicable statistic indicator which can quantify the experimental results. The intention is to use this type of indicator in other studies too, to check it viability as a rule as too in other ornamental species.

MATERIALS AND METHODS

The research was conducted in greenhouses of the Hortinvest Center of U.A.S.V.M. Bucharest. Long shoots were harvested from the mother plant in didactic collection. It had been made two types of cuttings of shoot: the peak section and - a number of 2-3 nodes each. Cuttings have different lengths due to the fact that the distance between the nodes on the shoot is different, the larger the smaller the base and the top, this being the average of 6.08 cm and 9.17 cm cutting the section for cutting the edge. After the taking the cuttings were then differently conditioned, the leaves from lower node were removed to root, and the other leaves from the upper nodes have been shortened by nearly half, to have a smaller leaf area with a less intense process of leaves transpiration.
It had been used 10 cuttings in each category for each substrate individually. Substrates for rooting cuttings were peat, perlite, river sand, and a mix of 1: 1 ratio between peat and sand.
Once fashioned, the cuttings were distributed properly in prepared substrates rooting, in alveolar plates.
Distribution and organization of these are shown in Table 1.

Table 1. The experimental variants

Experimental Variant	Substrate	Shoot cuttings		Total
		Segment	Peak	
V_1	Peat	10	10	20
V_2	Sand	10	10	20
V_3	Perlite	10	10	20
V_4	Peat+Sand	10	10	20
Total		50	50	100
Shoots medium lenght (cm)		6.08	9.17	

Throughout the period of the cuttings rooting it have intervened by applying a complex of specific care works for directing the micro climate factors.

RESULTS AND DISCUSSIONS

The rootedness process for *Abutilon hybridum* cuttings took place quite quickly, so after approximately 35 days after placing the cuttings in the rooting substrates, the roots were appeared.
The number of new plants (rooted cuttings) obtained greatly varies depending on the substrate used. Also, as occurs rooting process and we appear vegetative growth, so the terminal bud cuttings of new shoots started. Data on the number of rooting cuttings were obtained as summarized in Table 2.

Table 2. The percentage of rooting of the *Abutilon hybridum* cuttings depending on the cuttings type

Cuttings type	Rooting substrates			
	Peat	Sand	Perlite	Peat+Sand
Shoot segment	9	4	8	8
Shoot peak	8	6	10	9
Total	17	10	18	17
Rooting percent (%)	85	50	90	85

As can be seen, the largest percentage of rooting was registered in the cuttings placed on the substrate formed in perlite (90%), followed in descending order of results, on peat and peat + sand mixture (85%). The lowest yield was obtained from the rooting cuttings in sand (50%) (Figure 1).

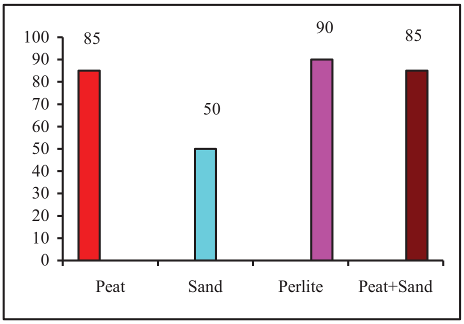

Figure 1. The percentage of rooting the *Abutilon hybridum* cuttings, depending on the substrate

Most favorable substrates for rooting cuttings peak shoot are the species *Abutilon hybridum*, the compose perlite mixture of peat + sand respectively; most unfavorable for this category is sand.

Most favorable substrates for rootedness process on the segment cuttings are peat and peat + shoot sand; most unfavorable for this category is sandy substrate.
Table 3 shows the experimental data presented averages of rootedness process, the ratio of the total number of rooted cuttings and total cuttings.

Table 3. The rooting percentage of *Abutilon hybridum* plants, depending on the cuttings type

Cuttings type	Number of cuttings placed on rooting substate	Rooted cuttings	Rooting percent %
Shoot segment	50	35	35
Shoot peak	50	40	40
Total	100	75	75

Thus, it can be seen that rooting was higher in cuttings from shoot peak (40%) compared with the segment one's (35%), this phenomenon could be explained by the fact that the cuttings in the first category have already top growth format, "energy" so saved can be channeled into a much consistencies of rootedness process.
This difference between the two types of cuttings, although not very significant lead to the idea that shoot tip cuttings have greater vigor and greater seating capacity than those obtained from the rooting sections shoots.
Results on root length obtained in the rootedness process are presented in Table 4.

Table 4. The length of the roots for the new plants obtained from cuttings

Rooting substrates	Roots lenght (cm)	
	Shoot segment cuttings	Shoot peak cuttings
Peat	7	9
Sand	16.45	16.02
Perlite	9.2	8.6
Peat+Sand	5.9	6.7

In the case of segment cuttings root it can be seen that evolution was largely uniform, excelling in the sand (16.45 cm), then descending in perlite (9.2 cm), peat (7 cm) and peat + sand mixture (5.9 cm).
The length of the roots where the plants from cuttings shoot peak was also influenced by characteristics of rooting substrates.
The results were recorded at a maximum of 16.02 cm in length, formed in the roots for the sand to a minimum recorded in the mixture of peat and sand (6.7 cm).
For the other two substrates were intermediate values of 9 cm length of roots (peat) or 8.6 cm (perlite) (figure 2).
For statistical analysis there was defined an indicator that reflects the two types of measurements: rooting percentage (%) and the average length of root cuttings (avg) for each type of substrate.

Figure 2. *Abutilon hybridum* new plants obtained from cuttings rooted in perlite

We normalized the data by minimax method (Myatt Johnson, 2014). Using these notations:
% T - segment cuttings rooting percentage;
% PS - peak cuttings rooting percentage;
avgT - the average length of roots on segment cuttings;
avgPS - the average length of roots on peak cuttings.
It was defined a first formula for the indicator ITPS (I = Rooting, T = Segment, P = Peak, S = Shoot) as follows:

$$ITPS = \frac{\%T + \%PS + avgT + avgPS}{4} \quad \text{(A)}$$

For the data about the rooting percentage for each substrate type we obtained an insignificant correlation ($r = 0.7$; $p = 0.23 > 0.05$) between the segment cuttings and the peak ones, while for the data obtained from the average length of roots for each substrate there were obtained a significant correlation ($r = 0.96$; $p = 0.04 < 0.05$) so it can remove the term avgPS in the formula (A) (because it correlates with avgT) and thus the index can be given by:

$$ITPS = \frac{\%T + \%PS + 2avgT}{4} \quad \text{(B)}$$

Another important aspect in defining this indicator is studying its consistency. For this we used a statistic instrument generally used as a measure of internal consistency, Alpha Cronbach's coefficient (α) (Cronbach, 1951):

$$\alpha = \frac{K}{K-1}\left(1 - \frac{\sum_{i=1}^{K}\sigma_{Y_i}^2}{\sigma_X^2}\right)$$

where K is the number of substrates, σ^2_X is the variance for all data and σ^2_{Yi} is the variance for each substrate. Since we obtain α = 0.79 for formula (A) and α = 0.81 for formula (B) we conclude we have assured the internal consistency of the indicator.

Analyzing the values of the indicator ITPS we observe that the best results were obtained in embodiments where the substrate was represented by perlite (0.63), peat (0.53) and sand (0.50). The lowest values of ITPS have been recorded in the cases in which peat was mixed with the sand (Figure 3).

In conclusion we can say ITPS is a reliable indicator who can help identify the optimal type of substrate for rooting cuttings. We recommend the use of the formula (A). Formula (B) is useful when measuring the roots of the peak shoot cuttings is more difficult. We used this indicator for substrates in which we had the proportion of 1:1 (peat + sand). ITPS indicator can also help us identify the optimal substrate when using substrates in different proportions.

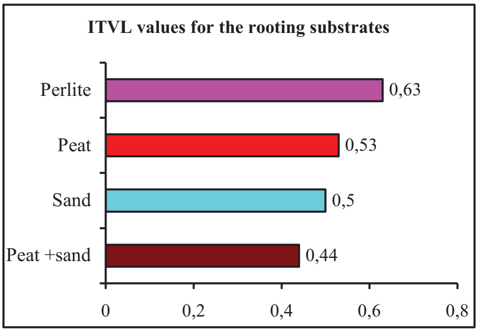

Figure 3. Values of ITPS for diferrent substrates

Vigorous growth of the roots in the variants where the substrate rooting was sand and perlite is explained by the influence of the particle size, texture slight growth stimulating cuttings root, covering both the section and those leading the shoot.

So for perlite it been obtained the best score of the index, while the lowest score was recorded substrate peat + sand. This indicator can be improved by the addition of costs incurred related factors (e.g. price of each substrate).

CONCLUSIONS

Following the experience of made rooting cuttings it been recommended, for peak shoot for Abutilon species, substrates composed of perlite, peat + sand and peat. Cuttings made from shoots segement section had a higher percentage of rooting for the substrate composed of peat and peat + sand. For both types of substrate cuttings rooting worst result was sand.

Root length obtained was highlighted in the case of the substrate consists of sand, for both types of cuttings. The mixture of peat + sand gave the lowest values for the length of root cuttings and the shoot tip cuttings section.

We consider it appropriate to continue the experience with the same components in mixtures with varying proportions and with other local substrates.

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