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PROPAGATION AND VEGETATIVE GROWTH OF SOME *COLEUS BLUMEI* Benth. CULTIVARS

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ABSTRACT

The objective of this study was to investigate the effect of different rooting substrates on the rhizogenesis process of the cuttings of some Coleus blumei cultivars from the Wizard series ('Jade', 'Coral Sunrise', 'Scarlet' and 'Velvet Red'), and to evaluate the subsequent vegetative growth of plants grown in pots. The best results regarding the rooting percentage and number of roots per cutting were obtained in the perlite substrate for all coleus cultivars. The cuttings rooted in peat and perlite had a higher root length compared to the other rooting substrates. "Wizard Scarlet" and "Wizard Velvet Red" cultivars recorded the highest values of the plant height, leaf size, number and length of shoots at the end of the experiment, while the plants of "Wizard Jade" cultivar had the lowest growth rate in height.

INTRODUCTION

Coleus blumei Benth. (fam. Lamiaceae) is an herbaceous perennial species, native from south-east Asia, Africa and Australia, with the stem more or less branched of 0.5-1 m high. The leaves are simple, ovate, opposite, with serrated, crenate or wavy edge. There are numerous coleus cultivars and varieties on the market, with a great diversity of shapes and sizes of leaves, variegated and brightly coloured in shades of red, dark-pink, cream, yellow, purple, green, with attractive patterns (spots, strips, flecks, mosaics and concentric shapes). Nguyen et al. (2008) have successfully developed several new coleus selections, with trailing growth habit and orange foliage colour. The flowers are small, white, blue or purple, arranged in erect spikes at the top of the plant and have no decorative importance. Flower spikes are removed as they appear and develop.

Leaf variegation is an important characteristic of ornamental plants, and it is caused by differences in the levels and distribution of chlorophyll pigments and/or anthocyanins. Based on the results obtained in their studies about photosynthetic activity of variegated leaves of different cultivars of coleus by chlorophyll fluorescence techniques, Borek et al. (2016), Lin et al. (2019) reported significant differences in chlorophyll and carotenoid contents, among differentially pigmented sectors of the leaf and among the cultivars. Light quality, light intensity, temperature and other conditions can influence anthocyanins synthesis and accumulation, chlorophyll concentrations, plant growth and foliage colour intensity (Nguyen & Dal Cin, 2009). Garland et al. (2010) reported that 'Kong Red' and 'Wizard Coral Sunrise' coleus, grown at DLIs < 5.8 $mol \cdot m^{-2} \cdot d^{-1}$ for 8 weeks exhibited more green coloration

and less burgundy and coral variegations, thus the plants were considered to be of low quality, therefore they recommend growing the two coleus cultivars under a minimum DLI of 10.0 $mol \cdot m^{-2} \cdot d^{-1}$. Anthocyanin accumulation, chlorophyll content and leaf pigmentation of 'Fairway Mosaic' coleus increased when plants were grown under a 18-h photoperiod with SL from LEDs delivering a photosynthetic photon flux of 170 $\mu mol \cdot m^{-2} \cdot s^{-1}$ at a light ratio of 75:25 red:blue, compared with plants grown under HPS lamps (Tarakanov et al., 2012). Growth of coleus plant increased simultaneously with increasing LED light intensities (Hussain et al., 2018). The control of the plant growth is one of the most important aspects in the production of ornamental plants to obtain marketable plants, by manual pinching, and/or application of different plant growth regulators (Boldt & Barrett, 2006). Barrett et al. (2003) reported that increased concentrations of uniconazole applied as a spray to the surface of container media, prior to planting bedding plant seedlings, decreased plant height. To produce and keep the plants more compact and stimulate lateral or basal branching, the tip of the plant shoots will be regular pinched.

For optimal growth, it requires partial shaded places, fertile, high in organic matter, moist, well-drained soils, without excess humidity, which can cause leaf fall and the occurrence of diseases. In colder areas, coleus is often cultivated as an annual plant, being sensitive to low temperatures. Light tolerance varies among coleus cultivars, many cultivars are best grown in shade, while others tolerate heat and grow optimally in full sun (Rogers & Hartlage, 2008).

Coleus blumei is easily propagated vegetatively from shoot tips cuttings, which can be rooted in light, porous, permeable substrates, consisting of peat, sand, perlite, vermiculite, as single components or a combination of them in different proportions. The harvesting methods, stock plant health and age, the season of the year when cuttings are harvested, environmental conditions for rooting, treatments applied for cuttings influence the production of the rooted cuttings (Crawford et al., 2016). Peterson et al. (2018) have compared the rooting of coleus stem cuttings performance in different propagation systems, namely in a submist, subirrigation and subfog aeroponic system, as alternatives to traditional overhead mist. The results obtained showed that the cuttings in the submist aeroponic system had longer, thinner, more uniformly roots around the stem, and established and grew more rapidly after transplanting in containers with peat-based substrate, than cuttings rooted in the other systems. Hamilton et al. (2002) studied the influence of leaf area, thickness of cutting and shipping conditions on rooting, and reported that, the amount of foliage retained on cuttings influenced strongly the rooting quality, the cuttings with thick stems had better root systems, and high quality coleus cuttings can be shipped for short periods of time. It is also possible the propagation by seeds and micropropagation through apical meristem culture (Mariani et al., 2019), and from different explants such as nodal and internodal segments, petiole, shoot tips, leaf segments, etc. (Zagrajski et al., 1997; Rani et al., 2006; Jing et al., 2008; Bauer et al., 2008; Sahu & Dewanjee, 2012).

Rosmarinic acid is one of the main active compound of *Coleus blumei,* a polyphenol with pharmacological importance and many health benefits, such as antioxidant, anti-inflammatory, antiviral, antibacterial activities (Bauer et al., 2015; Bulgakov et al., 2012). Numerous researches have been conducted on its production through *in vitro* culture, and different plant tissues have been studied for their potential to synthesize and accumulate rosmarinic acid (Petersen et al., 1995; Park et al., 2008; Nagpal et al., 2008; Qian et al., 2009; Medina & Cardenas, 2017).

Coleus is usually used as an outdoor ornamental plant, in flowerbeds, simple and mixed borders, bedding carpets, in groups or mass planting, as well as in window boxes, hanging baskets and vertical gardens, for decorating balconies and terraces. It combines well with annual species and other decorative plants through flowers or leaves, to create more texture and add visual interest and colour in parks and gardens.It is also suitable for growing indoors, in pots as a houseplant (Safeena & Thangam, 2017).

The study aimed to determine the influence of different substrates on rooting of cuttings and to evaluate the vegetative growth of plants at some cultivars of ornamental coleus, grown in pots in greenhouse.

MATERIAL AND METHODS

The research was conducted within the Floriculture Department, Faculty of Horticulture from Craiova, in greenhouse conditions, during the 2018-2019 period, on four cultivars of *Coleus blumei*: "Wizard Jade" (compact, bushy plants, with an upright growth habit and medium-size leaves, with cream-white center and green edge), "Wizard Coral Sunrise" (serrated, velvety leaves, with salmon-pink center and light green edge with olive-green spots), "Wizard Scarlet" (bright scarlet-red leaves with pale green edge) și "Wizard Velvet Red" (dark red, velvety leaves).

The biological material was formed of shoots tips taken in early September from healthy, vigorous stock plants grown in the field, in order to obtain cuttings. The cuttings of 8-10 cm length, with two pairs of terminal leaves (all the other leaves were removed) were treated at the base with a rooting biostimulator for herbaceous plants, in powder form (Radistim 1), and were planted in three rooting substrates consisting of peat and perlite (1:1), sand, perlite. Observations were made on the percentage of rooting, number of roots per cutting and root length, in order to determine the influence of the substrate on the rooting process of the cuttings, in October. Then the rooted cuttings were planted in 12 cm diameter pots, in a substrate composed by mixture of peat, manure and perlite (2:2:1), under greenhouse conditions.

The evolution of the plants obtained from cuttings was observed for a period of seven months, after the planting in pots. Observations and biometric measurements on vegetative growth rates, the height of the plants, the number of shoots per plant, the length of the shoots, the length and the width of leaves were made on the studied coleus varieties every two months.

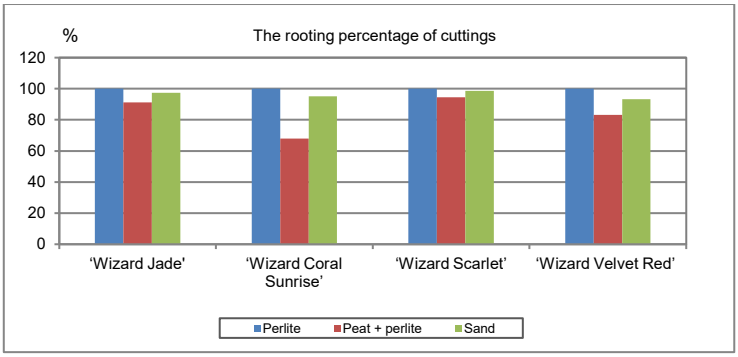
RESULTS AND DISCUSSIONS

The rooting rate of cuttings is influenced by multiple factors such as cultivar, mineral nutrition and physiological condition of stock plant, type of cuttings and the period of the year when they are made, treatment of cuttings with different growth regulators before planting, the environmental conditions (temperature, light, water and used rooting media), the presence of leaves on cuttings, etc.

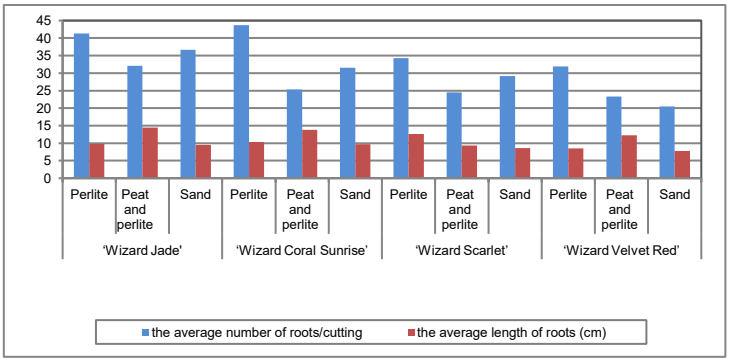
Regarding the influence of the substrate on rooting, perlite was found to be superior to the others, in this substrate being obtained the highest percentage of rooted cuttings (100%) for all coleus cultivars. There was significant difference between cultivars in terms of the rooting percentage of cuttings in the mixture of peat and perlite in which, the lowest percentage of rooted cuttings was observed at "Wizard Coral Sunrise" (67.9%), followed by "Wizard Velvet Red" (83.2%). In the sand, the percentage of rooted cuttings ranged between 93.3% for the "Wizard Velvet Red" cultivar and 98.7% for the "Wizard Scarlet" (graph 1).

In the vegetative propagation by cuttings, the rooting substrate quality is an important factor that affect the root system growth. The ideal rooting substrate must have a good water-holding capacity and permeability for air and water, such that to provide adequate moisture to the cuttings and oxygen supply for roots respiration, requirements necessary for rapid root growth and the subsequent development of plants, and must be also free from pathogens.

The root system of the rooted cuttings was evaluated before planting in pots. The best results regarding the average number of roots were obtained at the cuttings rooted in perlite, compared to the other rooting substrates, in all studied coleus cultivars. The highest number of roots per cutting (43.7) were recorded at “Wizard Coral Sunrise”. The longest roots were observed at the “Wizard Jade” (14.5 cm) and “Wizard Coral Sunrise” (13.8 cm) cultivars, in the substrate formed of peat and perlite mixture, and at “Wizard Scarlet” (12.6 cm), in perlite. The lowest average values of these morphological parameters were recorded in “Wizard Velvet Red” (20.5 roots/cutting and 7.8 cm root length), in sand (graph 2).



Graph 1. The influence of substrate on the rooting of coleus cuttings

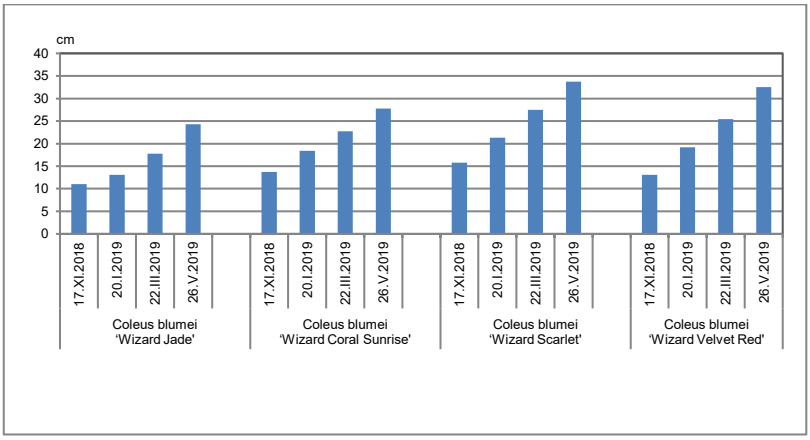


Graph 2. The average number of roots per cutting and the roots length

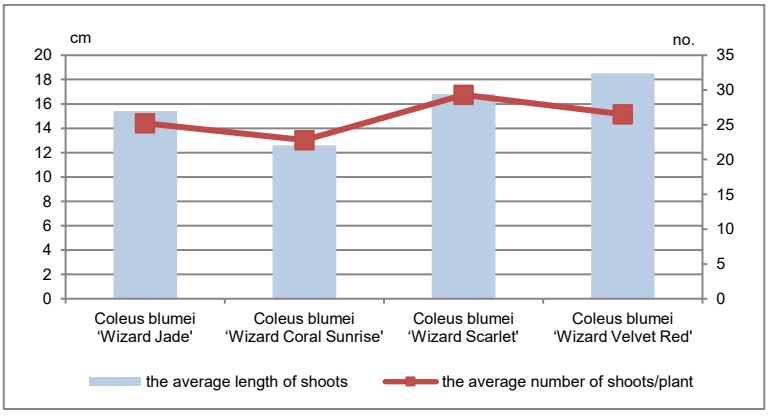
Regarding the average height of the plants, the highest value was recorded in the “Wizard Scarlet” cultivar (33.7 cm), while the “Wizard Jade” had the lowest value of this parameter (24.3 cm). The height growth rate of the plants was between 13.2 cm in the “Wizard Jade” cultivar and 19.4 cm in “Wizard Velvet Red”, at seven months after the planting of the rooted cuttings in pots (graph 3).

At the end of the evaluation period of the plants vegetative growth, observations and measurements on the number of shoots/plant and the length of the shoots were carried out. The results obtained showed that “Wizard Scarlet” cultivar had an average number of shoots (29.3) and “Wizard Velvet Red” recorded an average length of the shoots (18.5 cm) higher than those of the other cultivars. The lowest number of shoots/plant (22.8) and the average length of the shoots (12.6 cm), were recorded at “Wizard Coral Sunrise” cultivar (graph 4).

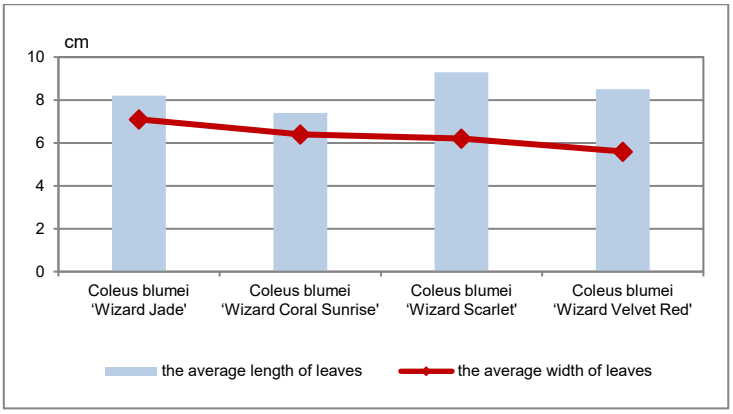
In terms of the average length of the leaves, the highest value was recorded at the “Wizard Scarlet” cultivar (9.3 cm), and the lowest value at “Wizard Coral Sunrise” (7.4 cm). The average width of the leaves ranged between 5.6 cm in “Wizard Velvet Red” and 7.1 cm in “Wizard Jade” cultivar (graph 5).



Graph 3. The average height of plants at *Coleus blumei* cultivars



Graph 4. The number of shoots/plant and the shoots length



Graph 5. The average size of leaves

CONCLUSIONS

Coleus blumei can be grown as an indoor perennial plant, in pots or mixed containers, being highly appreciated for its decorative, elegant leaves, which vary in shape, size and colour combinations, depending on cultivar. The most relevant results showed that the best substrate for the rooting of cuttings and regarding the average number of roots produced per plant was perlite, for all coleus cultivars. The highest values of the studied morphological parameters, were recorded at the "Wizard Scarlet" and "Wizard Velvet Red" cultivars, after seven months from planting the rooted cuttings in pots.

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