ROOTING ABILITY OF STEM MICROPROPAGULES OF *FICUS BENJAMINA* L. AND THE POSSIBILITY OF THEIR FURTHER USE IN INTERIOR LANDSCAPING

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Ficus is one of the most widespread flowers and ornamental plants, characterized by a huge number of cultivars that were introduced to Europe from America, Africa and Australia [3, 7, 11]. Numerous *Ficus* taxa are unpretentious and relatively shade-tolerant plants that require appropriate soil and air moisture.

Representatives of this genus are beautiful evergreens that can decorate any living space or office [9]. In addition, before the revolution, the attendance of plants of this genus in the house characterized the aristocracy and financial solvency of the owner. Today, there are approximately 800 species of *Ficus* known and each has its own unique beauty [6. 11].

Among the variety of plants grown at home, *Ficus benjamina* is the most famous. These flowers are widely used in office landscaping. and residential premises is thanks to it is the attractive color of its leaves and its ability to create various life forms [13].

Due to intensive growth processes, *Ficus* trees grow to a tree over a meter high in a few years [7, 11]. Large-sized specimens in containers are grown as floor plants, they perfectly green and decorate the interior of large rooms, halls, and offices [4]. New ornamental forms and species of *Ficus* are constantly appearing in the retail network, which increases interest in these plants.

Ficus benjamina is an incredibly popular plant both among indoor plant lovers and among professionals involved in interior landscaping and phytodesign.

Relevance. To date, it is necessary to specify the peculiarities of cuttings in compliance with the biological and genetic characteristics of individual plant cultivars and their decorative forms in different climatic zones, but also find measures that promote regeneration and stimulate the growth in cuttings root system.

The purpose and objectives of the research. The target of the study was to identify the peculiarities of physiological processes in conditions of regenerative capacity in stem cuttings of *F. benjamina* and to perfection some agrotechnical measures for the propagation of the flower and ornamental species in the forest-steppe of Ukraine.

To achieve the purpose, the next tasks were achieved:

- to study the science books about the vegetative method of propagation of *F. benjamina*;
- to identify the optimal timing of cuttings which is based on the biological features of the taxon and its decorative forms;
- to consider the peculiarities of using *F. benjamina* plants in interior landscaping.

Object of study - vegetative method of propagation of *F. benjamina* varieties Anastasia and Golden King.

The topic of the research is *F. benjamina* Anastasia and Golden King.

Methods of research. The study was carried out at Gardening department and Forestry of Sumy NAU.

Stem cuttings 14-15 cm long were used as planting material for asexual propagation of *F. benjamina*, which was harvested with a part of two-year-old wood (Fig. 1). Micropropagules were placed in water during 2 hours.

Fig. 1. *Cuttings of F. benjamina Anastasia*

The temperature regime during rooting was in the variety of +20 - +25°C, air humidity 65 - 70 %. The mother plants of *F. benjamina* (Anastasia and Golden King) up to 6 years old were used for cuttings.

Search work was performed in two directions:

1. Definition of the impact of the time of cuttings on callus and carogenesis in stem micropropagules of *F. benjamina*.

2. Consideration of the shape effect features on the rhizogenic ability of cuttings.

The scheme of the one research to determine the effect of the term of harvesting of cuttings on the rhizogenesis process in micropropagules included the following options: 1) control (15.03); 2) 15.05; 3) 15.06; 4) 15.08. Micropropagules were harvested from the decorative forms Anastasia and Golden King.

Fig. 2. *Micropod of F. benjamina Anastasia in water*

The harvested cuttings were tied in bunches of 10 pieces and immersed with their lower ends in clean water at 2-4 cm of their length (Fig. 2).

The scheme of the second experiment to determine the effect of varietal characteristics of *F. benjamina* plants on the root process system recovery included the following variants: 1) control (Anastasia); 2) Golden King.

The research work was performed in compliance with the procedure for the propagation of flowering and ornamental plants of the Botanical Garden of NUBiP of Ukraine [8].

Results of the research. Plant reproduction is the main biological features of the organism, conclusive in the making of a new generation. Their essence is that the role of one individual to form such generation [1, 12].

Plant reproduction has two methods: sexual and vegetative. The foundation of vegetative reproduction is the regenerative ability of plants to restore lost organs. During root propagation, a new generation is reproduced from somatic cells or tissues. Nowadays, the hereditary features are fully preserved [12].

The main methods of root propagation of plant organisms of the *Ficus* genus in artificial conditions are rooting of micropropagules, cuttings and grafting. The most promising is reproduction by stem micropropagules, which is based on root reproduction and is appropriate for commercial production of rooty plants. It has been established to take root ability of a plant organism is conditioned by genetic features, but largely depends on a lot of different factors (cuttings and age of parent plants, the time of cuttings, the using of exogenous auxin stimulants, environmental factors. Cuttings harvested from plants of various ages and parts of the stem from the same part of the plant organism are characterized by physiological heterogeneity [1, 12].

A film is formed on the surface of the cut, under which cells divide vigorously and later form a callus.

The pocedure of callusogenesis began on day 18 (Table 1 and Fig. 3) under the conditions of root propagation of Anastasia variety on the control variant.

Table 1. Impact of the scion period on the processes of callus and correlation of *F. benjamina* Anastasia

No	Variant	Term of occurrence, days	
		Callusogenesis	Root formation
1.	Control (15.03)	18	30
2.	15.05	17	32
3.	15.06	20	38
4.	15.08	-	-

Fig. 3. *Rooted cuttings of F. benjamina Anastasia*

In some experimental variants, the starting of this process almost did not differ from the control, but at 15.08 the procedure of callusogenesis was not noticed. The next process after callusogenesis is the procedure of the root system formation.

We have noticed the procedure of root system formation in the experimental variants (15.05 and 15.06) began 2-8 days later than in the control.

The review of the experimental results strongly revealed that the researched_period of micropropagation influences the processes of root system recovery in Anastasia cuttings. Early harvesting of cuttings creates prerequisites for a significant increase in their reproductive capacity than the implementation of this measure lately.

The research work results of the learning regeneration ability of Golden King planting material you can see in Table 2 and Fig. 4.

Table 2. Impact of the scion period on the procedure of callus and carogenesis of Golden King variety

No	Variant	Term of occurrence, days	
		Callusogenesis	Root formation
1.	Control (15.03)	26	41
2.	15.05	24	40
3.	15.06	29	46
4.	15.08	-	-

Fig. 4. *Rooted cuttings of Golden King variety*

It was found in the results of scientific work that cuttings are an allowable measures for planting production material for the investigated taxon. It was researched that the callusogenesis processes begin to occur on day 24-29 (at early harvesting of cuttings). The procedure of callusogenesis are followed by root formation. In the researched variant the root system formation started on day 41, and in the experimental option - on days 40-46.

During the research, it was discovered that the *F. benjamina* variety with variegated leaves rooted worse. It is likely that the low chlorophyll content affects the rate of some physiological processes (callus and correction).

The effectiveness of the reproductive cuttings capacity is judged by the intensity of root system growth and the extent its branching. For this purpose, we measured the length of roots on micropropagules of *F. benjamina* of some varieties. The results of scientific researches you can see in Table 3.

Table 3. Influence of varietal characteristics of *F. benjamina* plants on root growth of framework of micropods

No.	Variation	60 day	80 day	100 day
		Extent of the root framework, cm		
1.	Control (Anastasia)	4,7	6,4	7,7
2.	Golden King	3,1	4,3	5,5
NSR_{05}		0,28	0,31	0,26

During the research, scientists discovered various characteristics of *F. benjamina* affect on the root system formation of planting material. After 60 days 60 the the root system length in the control variant was 4.7 cm, and in the experimental version - 3.1 cm, which is 1.5 times less. There was a considerable distinction among the options (NSR_{05} was 0.28).

They noticed on the 80th and 100th day after the cuttings were made, the above trend was monitored. In the research, a considerable difference was noted by variants (NSR_{05} was 0.31 and 0.26).

Analyzing the data obtained, it can be assumed that that varietal characteristics of *F. benjamina* are an important factor that directly affects of the root system length.

Cuttings of the Anastasia variety formed a root system of bigger length than the planting material of the variegated Golden King variety.

Fig. 5. *Variegated forms of Ficus*

Previously, *Ficus* were widely used for landscaping, but then they were forgotten [3-4, 9]. Nowadays, they are gaining popularity again, especially variegated forms, which are a means of interior landscaping (Fig. 5).

The placement of phytocompositions makes the room look more natural. With the help of phytocompositions anyone can create individual decorative elements and partitions. Plants can help to make an unattractive office look more comfortable and pleasant for employees.

The attendance of tall decorative plants in the office changes the atmosphere and purifies the air [13-14].

Fig. 6. *Using large-sized planting material*

Large single specimens are applayed in department interiors. They attract the attention of visitors, change the decor of the space [2, 5, 10]. Large plants look great on the surface of any auditorium or in the lounge of the building. (Fig. 6).

Fig. 7. *Using Ficus in interior landscaping*

Ficus are good plants for interior decoration. Tree-like species (*F. elastika, F. lyrate, F. benghalensis* and others) are well combined in group compositions with other species and decorative plant forms (Fig. 7-9). They are beautiful in the decor of large or medium-sized rooms, sanatoriums, winter gardens, etc. For large rooms, it is recommended to use specimens of plants more than one and half meter high are used [2, 14].

Fig. 8. *The exploit of Ficus in landscaping design*

Fig. 9. *The Ficus using in interior landscaping*

Weaving plants are used for wall decoration. Modern technologies are used to create phyto-pictures that harmoniously combine plants of ornamental plants of various types. Vertical landscaping involves using of ampelous plants that can cling to supports with their leaves or shoots and leaves. This group of plants doesn't need any special conditions and care and is relatively resistant to lack of light [5].

Fig. 10. *Using Ficus in interior landscaping*

F. radicans, *F. montana*, and *F. pumila* are used as ampelous plants to decorate medium-sized or small rooms besides creating phyto-walls in winter gardens (Fig. 10). In addition, they can be used for landscaping industrial premises [9].

Ficus has a favorable affects the quality of room climate in a living space, thanks to its biological characteristics, the house is cleansed of harmful compounds. Indian folk medicine convincingly proves that the plants using of this genus improves the energy of a building and can also cleanse it of negative emotions. The Thai and Chinese nationalities believe that *Ficus* is a guardian of family well-being [7, 11].

In living conditions, *Ficus* needs enough light but it is resistant grows well and develops in conditions of light deficit, but in strong shading, shoots are drawn to the light source and the plant misses its ornamental look [11]. In such way, you are recommended to provide artificial lighting. To preserve the color of variegated forms, they need a sufficient amount of light.

The optimum air temperature for *Ficus* plants is 20-23°C in summer and 18-20°C during winter. It is especially important to protect them from drafts. They react quickly to sharp fluctuations in air temperature and soil hypothermia [7].

When the air in the room is dry, you are recommended to spray the plants with water of moderate room temperature. While watering *Ficus*, it is important to monitor the soil condition, watering it as needed. Excess moisture causes the root system to rot and the plant can die at last.

For planting different species and their decorative forms, a slightly acidic soil mixture is used. It should include peat, sand and leafy soil. Every year, young plants are transplanted, and large specimens, if necessary, increase the container or replace the top layer of the soil mixture with a more fertile one [11].

Conclusions and Suggestions

1. Plants of the family *Ficus* are propagated by seeds, rooting of cuttings, layering and tissue culture. The best is the propagation by lignified micropropagules. You can found micropropagules on the recovery of the root system. Just like you can adapt for the manufacturing of planting material in large quantities.

2. Varietal characteristics, the time of cuttings are stimulating factors of root formation in lignified cuttings of *F. benjamina*. In the researched variants (15.05 and 15.06), root formation processes began 2-

8 days later than in the control. The planting material which we have got of Anastasia variety formed more longer root system than the cuttings of the variegated Golden King variety.

3. The extensive quantity of species and their varieties creates the prerequisites for the widespread use of *Ficus* in landscaping. It has a special look in home interiors and office landscaping. Having created optimal terms for the increase and growth of plants, they will delight people with their appearance and decorative features.

We suggest rooting *F. benjamina* planting material in March-June. Founded on the botanic and biological species features of studing, it is advisable to use it widely in interior landscaping.

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