Sociedade Cultural e Educacional de Garça
Faculdade de Ensino Superior e Formação Integral – FAEF

Revista Científica Eletrônica de Agronomia da FAEF

ISSN 1677-0293

XXII – Volume 39 – Número 1 – Junho 2021

ALTERNATIVE SUBSTRATES FOR IXORA PRODUCTION (*IXORA CHINENSIS* LAM)

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RESUMO – A Ixora (*Ixora chinensis* Lam) é uma planta comum usada no paisagismo tropical. A propagação desta espécie é feita por estaquia. Neste trabalho, avaliou-se diferentes substratos de baixo custo para a melhor produção de ixora por este método de propagação. Estacas foram cultivadas em casa de vegetação com oito diferentes substratos. Analisou-se o número e comprimento dos brotos, peso dos brotos e raízes. Observou-se que as melhores plantas produzidas foram nos substratos S1, S3, S6 e S7. Já as piores nos substratos S2, S4 e S5.

Palavras-chave: Paisagismo, plantas ornamentais, propagação vegetativa.

ALTERNATIVE SUBSTRATES FOR IXORA PRODUCTION (*IXORA CHINENSIS)* LAM

ABSTRACT – Ixora (Ixora chinensis Lam) is a common plant used in tropical landscaping. The propagation of this species is done by cuttings. In this work, different low cost substrates were evaluated for the best production of ixora by this propagation method. Cuttings were grown in a greenhouse with eight different substrates. The number and length of shoots, weight of shoots and roots were analyzed. It was observed that the best plants produced were in the substrates S1, S3, S6 and S7. The worst in the substrates S2, S4 and S5.

Keywords: Landscaping, ornamental plants, vegetative propagation.

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ISSN 1677-0293
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1. INTRODUÇÃO

The cultivation of flowers and ornamental plants in Brazil is a recent activity that generates employment and income in different States of the country. The cultivation of flowers and ornamentals has become an important economic activity in Brazilian agribusiness, and has showed relevant development, improving in quality, competitiveness and is spreading for all regions of the country (SILVA et al., 2015). This type of agricultural activity occurs primarily on small farms and most of them with family workforce (MITSUEDA et al., 2011). The production of ornamentals is one of the most important sources of income in Ribeira Valley, State of São Paulo, Brazil. In this region, the production of ixora (*Ixora chinensis* Lam) is important as alternative to increase income for several local small producers. However, there is only few information about the use of substrates for the cultivation and propagation of these plants.

Ixora is an ornamental bush widely used in landscape projects. This plant can grow alone along walls, on lawns and grass and railings, under full sun. This plant is indicated for tropical and subtropical regions and its propagation is done by stem cutting (LORENZI, 2013). This species is chosen by landscapers because of the color of its flowers (RORIZ, 2000). According to UY and GARCIA (2020), the colors are various (yellow, pink, and orange), showing different sizes.

The quality and quantity of roots, as well as the potential of rooting, may change depending on the species, cultivars, and external and internal factors. The development of new propagation materials may contribute for a rapid production of ornamental plants. PEIXOTO (2017) mentions that the propagation of ornamental plants is simple, cheap, fast, and does not require special techniques. It is a method of propagation widely used, and its viability depends on the formation capacity of adventitious roots of each species, the quality of the formed root system and the further development of the plant in its final location (MILANI et al. 2015). In this context, vegetative propagation by stem cutting can be an

option, because its simplicity, speed, and low cost of execution. Because of these technical features, stem cutting is intensively used for propagation of ornamental plants (COSTA JUNIOR, et al. 2018).

It is estimated that Ribeira Valley destines around 800 trucks every month full of ornamental plants and tropical flowers to the main cities of the country, such as Sao Paulo, Campinas, Curitiba, Rio de Janeiro, among others. On the other hand, such amount of plants carries with them a lot of soil attached to the roots, which can turn the soil poor in the ornamental producing areas. Improve the soil quality of these areas with a good substrate can partially solve the problem of soil removal from the producing regions. Adequate porosity, humidity retention, density, and availability of nutrients to plants are desirable characteristics of the soil for any plant that can be propagated (MEEROW, 1995). It is necessary to use mixtures of components, which must present appropriate physical and chemical properties, for the establishment and development of the ornamental plants (SANTOS; CASTILHO, 2018). These characteristics may provide better establishment of roots, better root distribution and formation.

According to KÄMPF (2000), the most common substrate found to produce seedlings are sand, rice husk, vermiculite, soil, and a mix of these elements. For FACHINELLO et al. (1994), using sand as a substrate is beneficial, since its low cost, easy accessibility, and presents positive characteristics regarding drain system, being an adequate method to use for the root establishment for herbaceous and semi-wood cutting.

The objective of this research was to evaluate the efficacy of stem cutting production of ixora using different substrates, since there are few studies on the topic.

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2. MATERIAL AND METHODS

Ixora plants (*Ixora chinensis* Lam.) that provided the material to the experiment were, approximately, one year old, and they came from Ribera Valley commercial areas. Branches on vegetative stage were collected and transferred to a plant shed for the confection of stem cuttings. The basal and median parts of the branches were used, removing the ends. In all branches, a basal cut was made to increase the root surface. Stem cuttings of 15 cm length were made, keeping two pairs of leaves in each one.

The experiments were carried out at São Paulo State University (UNESP) nursery (CERe-UNESP) located in Registro, SP (latitude 24º29'22" S, longitude 47º50'10" W, altitude 11.99 m). This location is representative of a humid tropical climate (Af) with transition to Cfa, with no defined dry season, according Köppen's climate classification (ALVAREZ et al., 2013).

Eight different substrates and/or proportions were evaluated to compare their efficacy in ixora stem cutting production. The treatments were: S1: 100% rice husk substrate; S2: 100% organic substrate; S3: Mix of organic substrate and soil in proportion of 1:1; S4: Mix of organic substrate and soil in proportion of 2:1; S5: Mix of organic substrate and soil in proportion of 3:1; S6: Mix of coarse sand, soil and rice husk substrate in proportion of 1:1:1; S7: Mix of coarse sand, soil and rice husk substrate in proportion of 2:1:1; and S8: Mix of coarse sand, soil and rice husk substrate in proportion of 3:1:1.

Soil from the superficial layer of a yellow latosol and sand were collected, air dried and sieved to prepare the substrates. The experimental design used was completely randomized design, with eight treatments and four repetitions with 15 stems cutting each one. Plastic trays with 15 cavities were used and filled with the evaluated substrates.

Destructive and non-destructive evaluations were performed during the experiment. Destructive evaluations were weight of roots, and shoots. Shoots and roots of each plant were separated, washed, transferred to paper bags, and dried at 60ºC, until obtaining the dry weigh, thus, determined the total weight dry. The non-destructives evaluations were number and length of shoots. To evaluate the shoot length, a graduated rule was used, and a visual count was performed to calculate the number of shoots per plant. All the evaluations were performed 83 days after planting.

Data were statistically analyzed by ANOVA followed by the Tukey`s test ($p < 0.05$). Statistical analysis was performed using AgroEstat (BARBOSA; JÚNIOR, 2015).

3. RESULTS AND DISCUSSION

There was statistical difference for the number of shoots among the treatments. Most treatments showed a high number of shoots, on average, which ranged from 30.25 (S1) to 21.00 (S8). The highest difference in ixora mean number of

shoots was observed when compared S1 (30.25) and S3 (30.00) with S2 (20.00) and S5 (16.50) treatments (Table 1).

Table 1. Number of shoots for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments).

Treatment*	Number of shoots**
S1	30.25 a***
S3	30.00 ab
S6	25.25 abc
S7	25.00 abc
S8	21.00 abc
S4	20.00 bc
S2	20.00 c
S5	16.50 c

*S1 (100% rice husk substrate), S2 (100% organic substrate), S3 (Mix of organic substrate and soil in proportion of 1:1), S4 (Mix of organic substrate and soil in proportion of 2:1), S5 (Mix of organic substrate and soil in proportion of 3:1), S6 (Mix of sand, soil and rice husk substrate in proportion of 1:1:1), S7 (Mix of sand, soil and rice husk substrate in proportion of 2:1:1), and S8 (Mix of sand, soil and rice husk substrate in proportion of 3:1:1).

**Mean number of shoots for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments). For each treatment: four repetitions with 15 stem cuttings per repetition.

***Numbers followed by the same letter in the column are not significantly different according to Tukey test ($p<0.05$); data transformed to $y=((0.5(x+\sqrt{x^2+34^2}))^{1.7719}-1)/1.7719$ (Box-Cox transformation).

The rice husk, when charred, offers high drainage capacity, easy handling, reduced weight, alkaline pH, absence of plant pathogens and nematodes, adequate amount of macronutrients that are essential to plant development (SAIDELLES et al., 2009). According to KLEIN et al. (2002), commercial substrates when mixed with rise husk in different proportions can improve the physical-hydric properties of the substrate, providing better porosity, expressing in a better development of shoots for ixora plants. TERRA et. al. (2011), studying the production of potted chrysanthemum, recommend that rice husk might be used as a substrate to this plant development, using it full or in combination with other components of a commercial substrate.

The highest mean length of shoots was observed for plants in the S3 treatment (8.32 cm) S7 (6.75 cm), and S1 (6.72 cm). On the other hand, the lowest mean length of shoots was observed for plants in S5 (2.92 cm) and S2 (2.97 cm) treatments, with significant difference from the best treatments (Table 2).

Organic substrate has characteristics that improves physical, chemical, and biological soil conditions, and when organic compounds are decomposed, nutrients turn available to the plants (MOREIRA et al., 2011). The satisfactory development of ixora shoots can be related to a better utilization of the available nutrients in the substrate by the plants, as well as many other factors that

may contribute to improve the substrate quality and, consequently, the plant production. According to FERRAZ et al. (2005), the substrate density, porosity, water and air availability, chemical proprieties, and pH are important factors to consider for a good substrate to develop plants.

Table 2. Length of shoots (cm) for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments).

Treatments*	Length of shoots (cm)**
S3	8.32 a***
S7	6.75 a
S1	6.72 a
S6	6.35 ab
S8	5.62 ab
S4	5.17 ab
S2	2.97 b
S5	2.92 b

*S1 (100% rice husk substrate), S2 (100% organic substrate), S3 (Mix of organic substrate and soil in proportion of 1:1), S4 (Mix of organic substrate and soil in proportion of 2:1), S5 (Mix of organic substrate and soil in proportion of 3:1), S6 (Mix of sand, soil and rice husk substrate in proportion of 1:1:1), S7 (Mix of sand, soil and rice husk substrate in proportion of 2:1:1), and S8 (Mix of sand, soil and rice husk substrate in proportion of 3:1:1).

**Mean length of shoots (cm) for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments). For each treatment: four repetitions with 15 stem cuttings per repetition.

*** Numbers followed by the same letter in the column are not significantly different according to Tukey test ($p < 0.05$).

Ixora planted in S6 and S7 substrates showed the highest mean weight of roots, respectively, 3.15 and 3.09g (Table 3). These substrates favored the roots development probably because both substrates have high porosity. Thus, a substrate with good porosity may cause good development of roots, since it consists of larger solid particles that increase the quantity of the pores, consequently containing more air and water, which are fundamental elements to develop plant roots.

Mini-ixora (*Ixora coccinea* "Compacta") plants developed in different substrates showed high efficiency for stem production (high percentage of rooting and quality of the roots) when sand was used as substrate a (ALMEIDA et al., 2008). In this study, plants showed the lowest mean weight of roots when they grew up in S5 treatment (0.68g), probably because this substrate shows many organic compounds in its constitution. In addition, Emerald grass substrates based on organic compost showed the best results for the evaluated parameters, being recommended its use in the cultivation (SANTOS et al., 2020). An organic compost has low porosity and aeration when are pure (WENDILING et al., 2006).

Table 3. Weight of roots (g) for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments). O peso tem que está relacionado com o número e quantidade de raízes.

Treatment*	Weight of roots (g)**
S6	3.15 a***
S7	3.09 a
S1	2.95 ab
S8	2.69 ab
S3	2.49 ab
S4	1.14 ab
S2	0.87 ab
S5	0.68 b

* S1 (100% rice husk substrate), S2 (100% organic substrate), S3 (Mix of organic substrate and soil in proportion of 1:1), S4 (Mix of organic substrate and soil in proportion of 2:1), S5 (Mix of organic substrate and soil in proportion of 3:1), S6 (Mix of sand, soil and rice husk substrate in proportion of 1:1:1), S7 (Mix of sand, soil and rice husk substrate in proportion of 2:1:1), and S8 (Mix of sand, soil and rice husk substrate in proportion of 3:1:1).

** Mean weight of roots (g) for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments). For each treatment: four repetitions with 15 stem cuttings per repetition.

*** Numbers followed by the same letter in the column are not significantly different according to Tukey test ($p < 0.05$).

Some components frequently used to produce seedlings of ornamental species, for example, substrates coming from composting of different organic wastes, sugarcane bagasse, carbonized rice husk, pinus husk and coconut fiber, as well as the mixing of these materials with soil or sand (PEGO, ANTUNES; SILVA, 2019).

Table 4. Weight of shoots (g) for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments).

Treatment*	Weight of shoots (g)**
S3	7.41 a***
S7	5.90 ab
S6	5.82 ab
S1	5.37 ab
S8	5.04 abc
S4	4.59 bc
S5	2.41 c
S2	2.38 c

*S1 (100% rice husk substrate), S2 (100% organic substrate), S3 (Mix of organic substrate and soil in proportion of 1:1), S4 (Mix of organic substrate and soil in proportion of 2:1), S5 (Mix of organic substrate and soil in proportion of 3:1), S6 (Mix of sand, soil and rice husk substrate in proportion of 1:1:1), S7 (Mix of sand, soil and rice husk substrate in proportion of 2:1:1), and S8 (Mix of sand, soil and rice husk substrate in proportion of 3:1:1).

**Mean weight of shoots (g) for ixora (*Ixora chinensis* Lam) plants in different substrates (treatments). For each treatment: four repetitions with 15 stem cuttings per repetition.

***Numbers followed by the same letter in the column are not significantly different according to Tukey test ($p < 0.05$).

Ixora plants growing in S3 treatment showed the highest mean weight of shoots (7.41 g) (Table 4). There was no significant difference in the mean weight of shoots in plants from S3 treatment and those from S7 (5.90 g), S6 (5.82 g), S1

(5.37 g), and S8 (5.04 g). The lowest mean weight of shoots was observed in plants at S2 (2.38 g) and S5 (2.41g) treatments. The mean weight of shoots from these plants were not statistical different from plants of S4 (4.59 g), and S8 (5.08g) treatments. High weight of shoots can indicate that plants had better root establishment, as we see in Table 3, where the lowest mean weigh of roots was observed in plants from S5 treatment.

In the experiment, the type of substrate chosen directly interfered in the weight of the roots and shoots. It was noticed that the substrates that had in their composition the largest amount of organic compound, as S5, S2 and S4 treatments, obtained the less mean weight of shoots. These data are in agreement with PÊGO et al. (2019), who claim that the stem cutting of ornamental plants can be affected by physical properties of the substrate, such as porosity, density and water holding capacity. These characteristics can limit factors in vegetative propagation, causing physical restrictions on emissions and root growth.

4. CONCLUSION

Rice husk substrate (S1) or a mixture of organic substrate and soil in the proportion of 1:1 (S3) can be used to produce shoots from ixora stem cutting. A mix of organic substrate and soil in the proportion of 1:1 (S3) can be also recommended to improve shoot length and weight in ixora stem cutting. Mixture of sand, soil, and rice husk substrate in proportion of 1:1:1 (S6) can be apllied to improve the development of ixora roots. For weight root and lenght of shoots, it is also recommended mixture of sand, soil and rice hush in the proportional of 2:1:1 (S7).

It is not indicated to use organic compost in mixture with a low soil concentration, such as 2:1 (S4) and 3:1 (S5), for ixora production, as well as 100% organic substrate (S2).

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