

Vegetative Propagation in Piperaceae Species

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ABSTRACT

Piperaceae species of forest remnants of Maringá, Paraná, Brazil present vegetative propagation through root or stem (stolon). This reproduction type was verified in *Piper amalago* L., *P. arboreum* Aublet, *P. xylosteoides* (Kunth) Steud., *Peperomia parnassifolia* Miq. and *Ottonia martiana* Miq. Root and stem branches of these species were analyzed anatomically. Results indicated that the vegetative propagation in *Piperaceae* should be studied in other forests. New and additional studies should be made if the structural variations were induced environmentally or fixed genetically.

Key words: Piperaceae, vegetative reproduction, stolon, stem, root

INTRODUCTION

The Piperaceae, while not so large a family as a number of others are nonetheless is considered a comparatively big one, conservatively estimated to contain at least 2000 or probably more species. Members of the family occur throughout the tropics of both the hemispheres, with major concentrations and centers of dispersal occurring in Latin America and in Malaysia. In the United States, only a few species of *Peperomia* Ruiz and Pavon are found in southern Florida (Yuncker, 1958). Brazilian forests harbour 283 species of *Piper* L., 25 species of *Ottonia* Sprengel, 459 species of *Peperomia*, and two species of *Pothomorphe* Miquel (Yuncker, 1972, 1973, 1974, 1975).

The Piperaceae species are erect or scandent shrubs, small trees, or succulent, terrestrial or

epiphytic herbs, with stems commonly more or less nodose (Yuncker, 1972; Judd *et al.*, 2001).

The most familiar commercial product of the Piperaceae is pepper, a condiment made from the pulverized fruits of *Piper nigrum* L. Other species of *Piper*, such as *P. betle* L., *P. methysticum* G. Forst., and *P. cubeba* L. F., are the source of other well known spices or masticatories. Some species of *Piper* have diverse local medicinal uses. Species of *Peperomia* are often cultivated as house-plants, being favored for neat, fleshy-firm, shining, often patterned leaves and their ability to grow in filtered or indirect light (Cronquist, 1988). Piperaceae species can reproduce sexually and vegetatively. In the literature there is mention of vegetative propagation in *Piper*. Gartner (1989) estimated that more than 40% of the *Piper* plants had been propagated vegetatively in the lowland tropical forest of La Selva, Costa Rica. Greig and

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Mauseth (1991) registered that the subterranean portions of adventitious roots of *Piper auritum* L. grew horizontally and produced new shoots (root suckers). *Piper* species were propagated by several means, including stem sprouting, root sprouting, layering, and fragmentation (Greig, 1993). In forest remnants that occur in the northwest region of Paraná, Brazil, there are also Piperaceae species that spread vegetatively, by aerial or underground organs. This paper presents analysis and discussion on this propagation type in these species.

MATERIAL AND METHODS

The Piperaceae species that is *Piper amalago* L., *P. arboreum* Aublet, *P. xylosteoides* (Kunth) Steud., *Peperomia parnassifolia* Miq. and *Ottonia martiana* Miq. occur in the Horto Florestal de Maringá, Paraná, Brazil, forming a big shrubs. The collected material was selected identifying which plant regions presented vegetative propagation.

The anatomical analysis of the vegetative propagation organs was done using freshly-collected material or material fixed in FAA 50 (Johansen, 1940). This material was cut freehand or in a rotation microtome to make semi-permanent and permanent slides, respectively for the microscopic studies, carried out according to the usual techniques. Sections were stained in astra blue, safranin and hematoxylin (Johansen, 1940; Dnyansagar, 1958). The following stains were used for specific color tests: phloroglucinol and sulfuric acid, Sudan IV and IKI for lignins, lipids and starch, respectively (Johansen, 1940; Souza *et al.*, 2005).

The photographs were obtained with Sony digital camera (model DSC-P51). The photomicrographs were taken using image capture (Image Pro-Plus version 4.0 - Media Cybernetics program, adapted to the Olympus microscope BX50).

Voucher specimens were deposited in the Herbarium of the Universidade Estadual de Maringá and registered as follows:

Piper amalago L. BRAZIL. Paraná, Maringá, Horto Florestal, 9885 (HUEM)

P. arboreum Aublet BRAZIL. Paraná, Maringá, Horto Florestal, 8821 (HUEM)

P. xylosteoides (Kunth) Steud. BRAZIL. Paraná, Maringá, Horto Florestal, 10582 (HUEM)

Peperomia parnassifolia Miq. BRAZIL. Paraná, Maringá, Horto Florestal, 11993 (HUEM)

Ottonia martiana Miq. – BRAZIL. Paraná, Maringá, Horto Florestal, 8974 (HUEM).

RESULTS AND DISCUSSION

The Piperaceae that occurred in Maringá forest remnant formed fruits and seeds and was seemingly viable and capable of germinating. Seeds, for instance of *P. amalago* (Souza and Rosa, unpublished data), *P. crassinervium* H. B. and K. and *P. hispidum* Sw. (Albiero, 2005) germinated and formed phanerocotylar seedlings.

In spite of the possible sexual reproduction it was observed that Piperaceae species occurred as big shrubs and could spread vegetatively. The responsible organs for the propagation were aerial or underground.

In *P. amalago*, there was vegetative propagation by adventitious and plagiotropic roots that originated from the base of the plant. These roots presented secondary growth, with periderm; persistent collenchymatous and parenchymatous cortex with endodermis provided Casparian strips, and secondary xylem and phloem whose parenchymatous rays are rich in amylose content cellular (Rosa and Souza, 2004).

On the other hand, in *P. xylosteoides* (Figure 1) the aerial branched shoot, which were initially erect, bent and grew along the substrate surface (Figure 2) of the forest, showed adventitious roots (Figure 3) and could become independent of the original plant. Therefore, this branched shoot behaved as stolons and spread vegetatively the plant. In *Ottonia martiana* (Oliveira *et al.*, 2005) and *Piper arboreum* were also formed stolons, starting from aerial branched shoot, although in the second species, the stolon could also be underground.

The organs involved in the vegetative propagation of *P. xylosteoides*, *Ottonia martiana* (Oliveira *et al.*, 2005) and *P. arboreum* have stem structure. They presented uniseriate epidermis or periderm and collenchymatous and parenchymatous cortex (Figure 4). The inner collenchymatous cells of the cortex differentiated in the groups of fibers. In *P. xylosteoides*, the fibers formed a sclerenchymatous continuous ring in the cortex (Figure 4). The cortex was limited internally by endodermis with Casparian strips, except in *P. xylosteoides*. In the three species, the stele was constituted by two rings of collateral vascular bundles and parenchymatous pith (Figure 4). The peripheral ring of bundles was bounded internally and

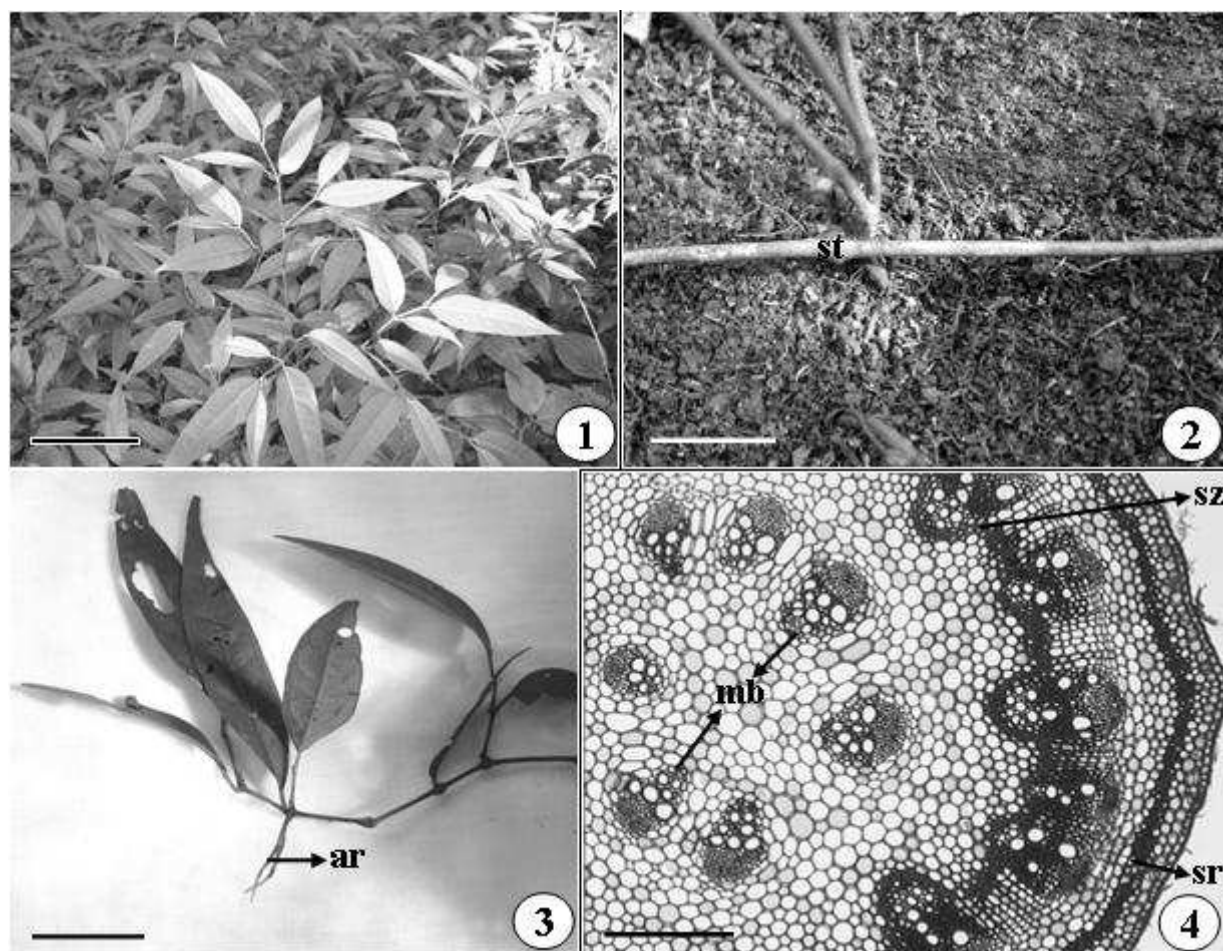
separated from the pith by a sinuous sclerenchymatous zone and had fascicular and interfascicular cambium (Figure 4). In the bundles of the inner ring, there was just fascicular cambium. In the pith bundles of the *Ottonia martiana* (Oliveira *et al.*, 2005) and *P. arboreum* fibers could occur in the xylem outer margin and fiber primordia in the phloem face, not observed in *P. xylosteoides*.

In *Peperomia parnassifolia* there was also stolon. The vascular system of stolon consisted of scattered bundles embedded in the parenchymatous ground-tissue and each bundle was surrounded by endodermis with Casparian strips, characterizing a monostele.

An endodermis in the stem has also been recorded for other species of *Piper* (Bond, 1931), *Peperomia* (Takemori, 2002; Souza *et al.*, 2004)

and *Ottonia* (Souza *et al.*, 2004). Bond (1931) tentatively concluded that the endodermis was a vestigial structure of no primary importance in the internal economy of the stem. Lersten (1997) reviewed the occurrence of the endodermis with a Casparian strip in the stem and leaf of vascular plants and considered that this strip in aerial organs had no known functional role.

Undoubtedly, the Piperaceae species of Maringá forest remnants, Brazil, adopted reproductive strategy by formation of new plants from budding of vegetative organs. In the analyzed species, only *P. amalago* presented root with budding ability. All the other species, besides the terrestrial species *Peperomia parnassifolia*, showed propagation by stem that behaved as stolon. However, root sprouting was registered in other species of *Piper* (Greig and Mauseth, 1991; Greig, 1993).



Figures 1 to 4 - Vegetative propagation in *Piper xylosteoides*. Fig. 1. General aspect of the plant. Fig. 2. Stolon with vegetative branch. Fig. 3. Vegetative branch with adventitious roots. Fig. 4. Detail of stolon in cross-section. (ar – adventitious roots; mb – medullary vascular bundles; sr – sclerenchymatous ring; st – stolon; sz – sclerenchymatous zone). Bars = 3cm (figs. 1, 2 and 3); 200 μ m (fig. 4).

Clonal populations of arboreal species that are established by the process of bud formation on root systems have been registered (Apezzato-da-Glória, 2003). According to Apezzato-da-Glória (2003) and Daubenmire (1974), the phenomenon of bud formation on roots was frequently observed in environments that were disturbed mainly by the action of fire. Rodrigues *et al.* (2004) registered species which sprouted from the root buds of forest fragment, affected by several fires.

In the case of the Maringá Piperaceae, the fire factor did not exist interfering in the propagation process. However, the environment of occurrence of these plants suffered significant anthropic action, when the original forest of this region was explored in no discerning and predatory condition. It should be emphasized that the vegetative propagation in Piperaceae should be studied in other forests. New and additional studies should be made if the structural variations were induced environmentally or fixed genetically.

RESUMO

Espécies de Piperaceae de remanescentes florestais de Maringá, Paraná, Brasil apresentam propagação vegetativa por meio de raiz ou caule (estolão). Este tipo de reprodução foi verificado em *Piper amalago* L., *Piper arboreum* Aublet, *Piper xylosteoides* (Kunth) Steud., *Peperomia parnassifolia* Miq. and *Ottonia martiana* Miq. Raiz e ramos caulinares destas espécies foram analisados anatomicamente segundo técnicas usuais. É necessário enfatizar que esse tipo de propagação em Piperaceae deve ser investigado em espécies que ocorrem em outras matas. Novos e adicionais estudos devem ser feitos para se saber se essas variações estruturais são induzidas pelo ambiente ou fixadas geneticamente.

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