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Micropropagation of self-heading *Philodendron via* direct shoot regeneration

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Abstract

The present study describes a direct shoot regeneration-based micropropagation procedure for the self-heading cultivars of *Philodendron*. Three types of explant (*i.e.* leaf lamina, petiole, stem nodal segment) were screened for their shoot induction potential following a three months treatment with 0.5 mgl^{-1} of either 2,4-dichlorophenoxyacetic acid (2,4-D), thidiazuron (TDZ) or both. Results indicated that the leaf laminas were poor candidates for shoot induction whereas the petioles showed potential for adventitious shoot production at frequencies of 2.8–11.1% in two of the cultivars tested. Stem nodal segments were the most responsive among the three as shoots formed directly following the TDZ treatment at frequencies of 16.7–41.7% depending on the cultivar. When comparing the effectiveness of different cytokinins to induce shoot proliferation on stem nodal segments, it was found that the 0.5 and 1 mgl^{-1} of kinetin (Kn) and 6-benzyladenine (BA) treatments resulted in higher shoot formation percentages compared to the 0.5 and 1 mgl^{-1} of TDZ treatments in two of the three cultivars. Furthermore, more shoots were produced on BA than on Kn-supplemented media in all the three cultivars. Shoots derived from the 0.5 mgl^{-1} of BA treatment can be induced to root following one month incubation with 0.1–1 mgl^{-1} of indole-3-butyric-acid (IBA). The rooted shoots showed 100% survival after acclimatization in

the greenhouse. The procedure reported in the present study can assist in the large-scale multiplication of elite self-heading cultivars of *Philodendron* in the future.

Highlights

► First report on the micropropagation of self-heading *Philodendron* cultivars. ► Stem nodal segments were the explants of choice for the micropropagation of *Philodendron*. ► Shoots were directly induced with 0.5–1 mgl^{-1} of BA at 55.6–80.6% frequencies and mean shoot number of 40.8–50.4. ► Shoots induced with 0.5 mgl^{-1} of BA rooted successfully on IBA-supplemented media and produced normal-looking plants. ► All the rooted shoots survived acclimatization in the greenhouse.

Introduction

The genus *Philodendron* is the second largest member of the Araceae family and is composed of more than 500 species native to tropical and subtropical America and the West Indies (Mayo et al., 1997). *Philodendrons* are highly appreciated for their attractive foliage and tolerance of interior environments and have been produced for use extensively in interiorscaping. Two distinct growth types can be found in *Philodendron*: the vining type which dominated foliage plant sales from the 1950s to the early 1970s, and the self-heading type which has become popular in the last 40 years due to an increasing number of new hybrids with red, yellow or orange foliage that were released to the market (Chen et al., 2002). In Taiwan, *Philodendron* constitutes an important share in the foliage plant market and the raising popularities of self-heading cultivars have made them to rank among the top ten most popular plants in the floricultural trade.

To fulfill grower's demands for potted plants of *Philodendron*, procedures for rapid propagation of elite cultivars are essential. Conventional propagation of *Philodendron* by stem cuttings is slow due to the low number of cuttings that can be made from each plant. It is also technically inconvenient as the sap of the plant can cause contact dermatitis (Reffstrup and Boll, 1985). Micropropagation is a comparatively more attractive means for *Philodendron* propagation as a higher number of plants can be generated in a shorter time period compared to the conventional procedure. In addition, tissue culture of tropical foliage plants has been proposed as a means to eliminate various systemic viral, fungal and bacterial diseases that are often prevalent in stock plants (Hartman, 1974, Henny, 1988). Tissue culture has also led to improved plant forms compared to those propagated by traditional methods. It was found that tissue culture-derived *Dieffenbachia*, *Spathiphyllum*

and *Syngonium*, also belonging to the Araceae family, produced a fuller and more compact plant when compared to those propagated by traditional cuttings (Conover, 1985).

Although tissue culture has been performed by private firms for the production and supply of *Philodendron* liners, their micropropagation protocols are generally undisclosed to the public. Few procedures have been published to date for the micropropagation of *Philodendron* species and mostly used lateral buds (Jámbor-Benczúr and Márta-Riffer, 1990, Gangopadhyay et al., 2004) and stem nodal segments (Sreekumar et al., 2001) as starting explants. These procedures were however constrained by the low quality of the regenerated shoots (*i.e.* poor elongation and rooting, poor conversion success into plant) as a result of long-term exposure to high concentrations of plant growth regulators (PGRs) used for shoot proliferation (Jámbor-Benczúr and Márta-Riffer, 1990, Vardja and Vardja, 2001, Sreekumar et al., 2001, Gangopadhyay et al., 2004), species and cultivars-dependent requirement of PGR treatments for optimal shoot proliferation (Sreekumar et al., 2001), and the low number of species and cultivars studied (notably the self-heading types). The present study therefore aims at developing an efficient micropropagation procedure for the self-heading cultivars of *Philodendron*. The procedure is expected to achieve a high shoot multiplication rate, obtain healthy plantlets and be readily applicable to different cultivars. To achieve this, the influence of explant type, as well as PGR type and concentration on shoot induction and proliferation was studied. The quality of the induced shoots was evaluated based on their ability to root and to adapt to the *ex vitro* environment.

Section snippets

Plant material and aseptic culture establishment

Three commercial self-heading cultivars of *Philodendron* (*i.e.* ‘Imperial Green’, ‘Imperial Red’ and ‘Imperial Rainbow’) were used in the present study. The plants were purchased from a local nursery and sprayed with fungicides Ridomil MZ and Mancozeb (1000× dilution) each for one week prior to explant excision and establishment *in vitro*. After defoliation, shoot cuttings measuring 5–10 cm long were washed under running tap water for 15 min and divided into single nodal segments each containing a…

Effect of explant and plant growth regulator types on the growth and shoot induction percentages of three *Philodendron* cultivars

Three months following the treatments, none of the explants grown on the PGR-free control medium showed any growth (Table 1). In contrary, explants grown on PGR-containing media presented different growth patterns depending on the type of explants cultured. With the lamina explants, growth was initiated by the enlargement of the explants followed by the production of small and round globules along the cuts across the mid-vein (Fig. 1a). These globular structures, however, were not able to…

Discussion

Contamination is frequently observed during the tissue culture of ornamental aroids such as *Aglaonema* (Chen and Yeh, 2007), *Anthurium* (Kunisaki, 1980), *Dieffenbachia* (Brunner et al., 1995), *Spathyphyllum* and *Syngonium* (Kneifel and Leonhardt, 1992), *Zantesdeschia* (Kritzinger et al., 1998), as well as *Philodendron* (Fisse et al., 1987). Therefore, the present study was initiated by establishing an aseptic shoot stock culture from nodal axillary buds. The regenerated shoots were then divided to…

Conclusion

The present study constitutes the first report on the micropropagation of self-heading cultivars of *Philodendron*. Results in the present study demonstrated that the stem nodal segments showed a higher potential to produce shoot than the leaf lamina and petiole explants under the treatment conditions tested. Shoots can be induced to form following the 0.5 and 1 mgl^{-1} of BA treatments at frequencies of 55.6–80.6% and with an average shoot number of 40.8–50.4 per explant depending on the cultivar.…

Acknowledgement

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> ...Therefore, vegetative propagation through tissue culture technique of Philodendron is an alternative method for obtaining rapid clonal multiplication. There are some reports on in vitro propagation of Philodendron (Gangopadhyay et al., 2004; Kelie et al., 2004; Xiong 2009; Chen et al., 2012; Hassan et al., 2016). However, the difficulty of establishing or maintaining aseptic culture is a definite factor in the tissue culture of aroid plants (Chen and Yeh, 2007)....

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