Micropropagation of *Spathiphyllum* and *Syngonium* is Facilitated by Use of Interfacial Membrane Rafts

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Abstract. Explant growth and shoot multiplication of *Spathiphyllum* and *Syngonium* were compared on agar-solidified medium and interfacial membrane rafts floating on liquid medium. After 25 d of culture, greater shoot multiplication and fresh mass gain were achieved by plant material grown on rafts. Shoot multiplication of *Spathiphyllum* and *Syngonium* on membrane rafts reached a maximum at 25 d, whereas the fresh mass increased throughout the culture period (40 d). The number of shoots of *Spathiphyllum* and *Syngonium* material grown on membrane rafts remained constant between 25 and 40 d of culture. The plants grown on membrane rafts also developed more roots.

The rate at which cultures grow and multiply during micropropagation is influenced by the physical nature of the growth medium. The most common support used for plant tissue culture is agar-solidified medium. However, there are some disadvantages to the use of agar (Debergh, 1983; George, 1993; Powell and Uhrig, 1987). These problems can be overcome by using liquid culture, which results in faster rates of shoot growth and multiplication (Simmonds and Werry, 1987) than are possible on solidified medium. However, the use of liquid medium in place of agar has its limitations such as hyperhydricity (vitrification) in case of certain species, and often requires optimization of medium components (George, 1993; Hussey, 1986). Rafts made from microporous membranes floating on liquid medium can serve as an alternative to either solidified or liquid medium (Adelberg et al., 1992; Hamilton et al., 1985; Kong and Chin, 1988; Young et al., 1991).

In this study, we analyzed the growth and multiplication of *Spathiphyllum* and *Syngonium* shoots using agar-solidified medium and interfacial floating membrane rafts (IFMR) on liquid medium. The IFMR is a new type of raft equipped with a buoyant element to maintain the membrane position at the air–liquid interface. Cultures on IFMR combine the advantages of growth on solid and liquid media (Watad et al., 1995, 1996).

Materials and Methods

Explants of *Spathiphyllum* ‘Petite’ or *Syngonium* ‘White Butterfly’ were obtained from propagules established and grown for at least 10 monthly subcultures on MS medium

(Murashige and Skoog, 1962) containing 3% sucrose, 0.8% agar (Difco Bacto agar), and 9.3 μ M kinetin. The pH of the media was adjusted to 5.8 with KOH before autoclaving. Five uniform propagules of *Spathiphyllum* and *Syngonium* were cultured in 50 mL of agar-solidified medium (ASM) or on rafts (Liferaft, Sigma, St. Louis) floating on liquid medium in GA7 Magenta vessels (Sigma). Twenty-five propagules were used for each treatment (five propagules per vessel, five vessels per treatment) and experiments were repeated. Each propagule of *Spathiphyllum* and *Syngonium* contained one single shoot (6–8 mm) with an initial average fresh mass of 125 and 185 mg per propagule, respectively. The medium used for shoot growth and multiplication was the same as the MS medium described above, except agar was omitted for floating raft cultures. All cultures were maintained in a growth room at 24 ± 2 °C, under a 16-h photoperiod with a photon flux density of 60 μ mol·m⁻²·s⁻¹ provided by cool-white fluorescent lamps. Plant material was destructively harvested 25 and 40 days after the start of the experiment and the following variables were recorded: length of main shoot (height from base of shoot to base of longest leaf’s lamina of this shoot), mean number of shoots and roots, and fresh mass (FM) gain (final FM – initial FM). Data were tested by analysis of variance and means were separated by Duncan’s new multiple range test.

Results and Discussion

Shoot multiplication and growth were significantly better for both plant species grown on membrane rafts (Table 1). On ASM, only six shoots of *Spathiphyllum* developed after 25 d as compared to 14 shoots on the IFMR. However, the number of shoots remained constant between 25 and 40 d on rafts (Table 1). During the same period the number of shoots developed on ASM increased from 6 to 10. These results indicate that shoot multiplication was faster on liquid medium using IFMR than on ASM. Similar results were also obtained for *Syngonium*, even though fewer shoots were produced (Table 1).

Both species had gained more FM at 25 d of growth on the rafts than on ASM. After 25 d of culture the FM gain by *Spathiphyllum* and

Table 1. Comparison of effect of growth conditions (ASM—agar-solidified media; IFMR—interfacial membrane raft floating on liquid medium) on growth and shoot multiplication of *Spathiphyllum* and *Syngonium* shoot explants. Responses were measured 25 and 40 d after initiation of micropropagation. Data represents the growth characteristics of the initial shoot explant.

Medium	Period of growth (d)	Length of main shoot (mm)	Shoots per explant (no.)	Fresh mass gain (mg)	Roots per explant (no.)
<i>Spathiphyllum</i>					
ASM	25	29.4 a ²	6.0 b	252 c	3.3 b
IFMR		30.7 a	14.2 a	539 ab	3.9 b
ASM	40	31.3 a	10.1 ab	380 bc	8.2 a
IFMR		31.5 a	14.4 a	625 a	11.1 a
<i>Syngonium</i>					
ASM	25	29.4 b	2.3 c	473 c	6.1 c
IFMR		32.2 ab	4.5 a	820 b	8.4 bc
ASM	40	30.1 b	3.2 b	1465 a	9.7 b
IFMR		37.1 a	4.9 a	1798 a	13.9 a

²Mean separation in columns by Duncan’s multiple range test at $P \leq 0.05$.

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Syngonium grown on agar medium was 47% and 58% of that obtained on rafts, respectively. After 40 days in culture, the FM gained by *Spathiphyllum* and *Syngonium* grown on ASM was 61% and 81%, respectively, of that gained by plants grown on rafts.

Height of *Spathiphyllum* was similar for those grown on ASM and IFMR. However, *Syngonium* grown on rafts were taller after 40 days of culture. The developed shoots from both treatments were morphologically similar and showed no signs of hyperhydricity. In general, plants grown on rafts developed more roots than those grown on ASM. Increase in root count on plants grown on rafts, between day 25 and day 40, could be a reflection of faster utilization of cytokinin (which in principle inhibits root development). Enhanced aeration at the base of the explants on rafts may also have influenced root initiation and growth. The developed plant clusters from both tested species derived either from agar-solidified medium and rafts on liquid medium were successfully acclimatized to ex vitro conditions (data not shown).

The rates of explant growth and shoot multiplication on rafts were superior to those

on ASM supplemented with identical nutrients and growth regulator concentrations. Similar results using membrane rafts were reported for other species (Adelberg et al., 1992; Watad et al., 1995, 1996; Young et al., 1991).

The above results demonstrate that the IFMR system can result in a more rapid shoot multiplication and FM gain within a shorter period than growth on ASM. This possible significant decrease in duration of time for subculture of *Spathiphyllum* and *Syngonium* could be of important value for commercial micropropagation of these plant species.

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