The Rooting of *Daphne odora* Thunb. Cuttings in a Hydroponic Propagation System

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INTRODUCTION

Rooting hormones (auxins) promote root initiation on cuttings Dip applications of the auxin indolebutyric acid (IBA) at concentrations up to 6000 ppm are commonly used. In aeroponic systems (systems which use regular misting of the root zone with nutrient solution) it has been shown that cuttings will root equally well when continuously exposed to low auxin concentrations in the solution misting the cutting bases (Nir, 1980).

Oxygen is essential for root formation to take place (Zimmerman, 1930). The propagation medium used for cuttings must therefore have the correct balance between available water and oxygen. Failure to achieve this balance can result in stress either in the form of dehydration or anaerobic conditions. Such stress in the rooting zone can result in collapse and death of the cutting. The aerial part of the cutting is protected from dehydration, usually by misting or fogging.

The Ein Gedi Aero-hydroponic System developed by Soffer (1989) has been adapted successfully for propagation. It uses a combination of aeroponics and water culture (root zone immersed in a flowing nutrient solution). Good strike rates have been achieved without the use of aerial fog or mist. The nutrient solution becomes the vehicle by which auxins and other substances are delivered.

This paper describes a hydroponic propagation system based on the Nutrient Film Technique (NFT) (Cooper, 1979). Our studies were conducted to determine strike rates and root growth after different exposure times to a low concentration of IBA and the effect of solution temperatures on rooting performance. The test plant, *Daphne odora* Thunb., is an evergreen shrub with strongly-perfumed flowers and it is normally propagated from semi-hardwood cuttings during summer to mid-autumn in a sand:peat mixture (Poynton, 1977). Rooting usually occurs after 6 weeks.

MATERIALS AND METHODS

The hydroponic propagation modules were assembled using plastic-lined galvanised channels 2.4 m long, 7.5 cm high and 10 cm wide The channels were filled to a depth of 5.5 cm with black polypropylene beads, 4 mm long by 3 mm in diameter. The channels had a slope of 1:20 and at the lowest point the beads were retained by a wad of shadecloth

A submersible pump was used to pump the solutions from a 50 liter plastic drum through 13 mm tubes into the top end of the channels. Plastic jets delivered the solution at 1.2 l/min. The solution was recycled into the tank with considerable splash to aid aeration. All modules were set up in a 50% shade house and each was individually covered with 50% shade cloth, supported on wire hoops, to reduce

light and increase humidity. Because the shade house had an automatic sprinkler system which operated for 10 min twice daily, the channel outfalls and drums were covered with black plastic to prevent excessive dilution from the overhead irrigation and to exclude light. Two studies were conducted with cuttings of *D. odora*.

Study 1

To determine if exposure time to IBA influenced rooting and subsequent performance of the plant. Three modules were used:

1) Control— tap water only.
2) Tap water containing 10 ppm KIBA (potassium salt)—renewed weekly.
3) Tap water only—this module was used to receive cuttings at regular intervals from module 2.

Cuttings were harvested on 10/2/90 from 7-year-old stock plants, grown hydroponically in bags of scoria, and were stored in a refrigerator at 1 to 3°C for 3 days. Tip cuttings approximately 8 cm long with 5 to 6 leaves were inserted into the beads in the channels to a depth of 4.5 cm. Fifty cuttings were placed in module 1 and 130 in module 2. After 1, 3, 10, 16 and 31 days, 19 cuttings were removed from module 2, washed, labelled and transferred to module 3. On day 21, all cuttings were assessed for signs of rooting and then returned to their respective module. Eight rooted cuttings were selected at random for a final assessment on day 37; numbers of roots, maximum root lengths, and dry weights were determined. The roots were dried for 4 days at 80° C in a forced draught oven.

Five rooted cuttings from each treatment were transplanted into plastic-wrapped rockwool cubes (75 × 75 × 65 mm high) on 18/4/90. These were maintained in the shade house to become established before being transferred to a dark, cold room at 7°C for 6 weeks. They were then moved to an environmentally controlled greenhouse and grown in hydroponic channels until 3/9/90 when total shoot length was measured. For statistical analysis, the shoot-growth data from treatments 0-1, 3-6, 10-16 and 31-37 days were grouped together.

Study 2

To determine if solution temperature influenced the performance and rooting of cuttings. Two modules were used:

1) Heated 2) Not heated

This experiment was started on 26/9/90 with 21 semi-hard cuttings being placed in each module. These cuttings were obtained from plants grown out of season. Module 1 was heated using a 300 Watt submersible fish tank heater and a minimum temperature of 21° C was maintained. The temperature of module 2 fluctuated with the ambient temperature which varied between 4 and 33°C during the course of the experiment. Both modules has 10 ppm KIBA in the systems for 16 days. A visual assessment was made on 23/10/90 and number of roots and maximum root lengths were measured on the 7/11/90. All data were statistically analysed using Genstat V

RESULTS AND DISCUSSION

Study 1. Exposure of cuttings to KIBA accelerated root formation The 21-day assessment showed that only 2% of the cuttings in the water-control had formed roots, compared with 50 to 74% for cuttings exposed to KIBA (Table 1).

An analysis of variance was carried out on root number, maximum root length and root dry weight In all cases the data showed a peak in the 10 to 20 day region. There was an optimum exposure time to KIBA, after when root initiation was inhibited.

Table 1. The effect of exposure to IBA on rooting performance of *Daphne odora*

Exposure (days)	Rooted 21 days (%)	Rooted 37 days (%)	Root number 37 days	Max root length (mm) 37 days	Root dry weight (mg) 37 days
0	2	74	20 9	9 0	7 4
1	60	63	17 4	32 9	20 6
3	60	68	22 9	36 9	34 1
6	60	79	25 1	35 2	36 1
10	74	79	28 8	44 6	59 6
16	60	68	25.1	33 1	31 3
21	50				
31		63	22 6	27 3	21 0
37		68	20 1	16 6	20 1
LSD 5%			9 6	15 9 2	7 72

The length of time that cuttings were exposed to KIBA influenced the subsequent growth of rooted plants. When plants were grown on for a full growth flush it was found that shoot growth was significantly reduced where the cuttings had been exposed to KIBA for longer than 30 days (Table 2).

The experiment was repeated in 1991 and the results supported the findings from this study, with exception that root number was not significantly affected by exposure time.

Study 2. Root zone warming had a significant effect on the percentage rooted, time taken for roots to appear, maximum root length and root number of *D odora* cuttings (Table 3)

After 27 days a 95% strike rate was achieved in channels heated to a minimum of 21°C, but none of the cuttings in channels at ambient temperature showed visible roots In both studies IBA alone, without heating achieved 63 to 79% rooting, but 100% was achieved by the combination of KIBA and root zone warming.

Table 2. The effect of period of exposure to KIBA on shoot growth in *Daphne odora*

Exposure (days)	Shoot length (mm)
0-1	66 2
3-6	62 8
10-16	53 9
31-37	35 4
LSD 5%	28 5

Table 3. Effect of root zone warming (minimum of 21° C) on the performance of *Daphne odora* cuttings

Treatment	Rooted 27 days (%)	Rooted 42 days (%)	Root number 42 days	Maximum root length (mm) 42 days
Heated	95	100	25 0	88 0
Not heated	0	75	14 3	20 7
LSD 5%		7 6	18 4	

CONCLUSIONS

Exposure to low concentrations of KIBA in a hydroponic propagation system accelerated root production, but did not increase the percentage of cuttings forming roots. Extending the time of exposure to KIBA beyond that giving maximum root numbers, root length and dry weight inhibited root growth. Prolonged exposure to KIBA during propagation retarded later growth. The combination of root zone warming and IBA raised the success rate of rooting to 100%

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