Tuesday afternoon, December 6, 1988

The Tuesday Afternoon session convened at 1:45 p.m. with Anna Knuttel serving as Moderator.

THE USE OF GLYCOLS AS SOLVENTS FOR *ROOTING HORMONES*

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Abstract: Cuttings of *Malus* 'Snowdrift', *Prunus subhirtella* 'Pendula Plena Rosea', and *P. serrulata* 'Kwanzan' were subjected to various concentrations of indole-3-butyric acid (IBA) and 1-naphthleneacetic acid (NAA) dissolved in propylene and ethylene glycols; IBA/NAA combinations obtained from Woods Rooting Compound and from Chloromone (indole-naphthylacetamide). Cuttings were rooted in a mist supplied greenhouse with bottom heat during the summer of 1988. Rooting percentage and rooting time indicated no significant differences between glycol preparations and Wood's Rooting Compound. In all cases, auxin-glycol solutions and Wood's Rooting Compound proved to be superior to Chloromone. It is clear that auxin preparations using glycols as solvents are acceptable as liquid quick-dips.

INTRODUCTION

There is a need for a liquid quick-dip auxin preparation that can be readily prepared by the average nurseryman from easily obtained materials. Commercial liquid rooting hormone formulations utilize very toxic solvents and auxin combinations which have led to hormone overdose, excessive callus, and extensive basal burning of some cuttings (1,2,6,8,9). Solvents such as ethyl alcohol, dimethyl sulfoxide (DMSO), and acetone have been shown to be toxic to plant tissue (1,7,9,11,12). The wounding of cuttings is a common practice and this further exposes unprotected plant tissues to harsh solvents (8).

Glycols are polyhydric alcohols that are closely related to glycerol and behave in many ways like water (5). These two characteristics make them ideal candidates as solvents for auxins. There have been reports of polyethylene glycol being used as a solvent for auxins (6), but the author could find no references in the *Proceedings International Plant Propagators' Society* on the use of ethylene glycol or propylene glycol for this purpose.

MATERIALS AND METHODS

Three to four node cuttings of *Malus* 'Snowdrift', *P. subhirtella* 'Pendula Plena Rosea' and *P. serrulata* 'Kwanzan' were collected between June and August of 1988 (Figure 1, Tables 1,2). Cuttings were wounded basally, treated with the respective hormone and

stuck in 2¼ in. Nu-Pots with a peat:sand:perlite medium (1:3:1,v/v/v). Cuttings were placed in a greenhouse under mist (10 sec/10 min) with supplemental bottom heat set at 25°C.

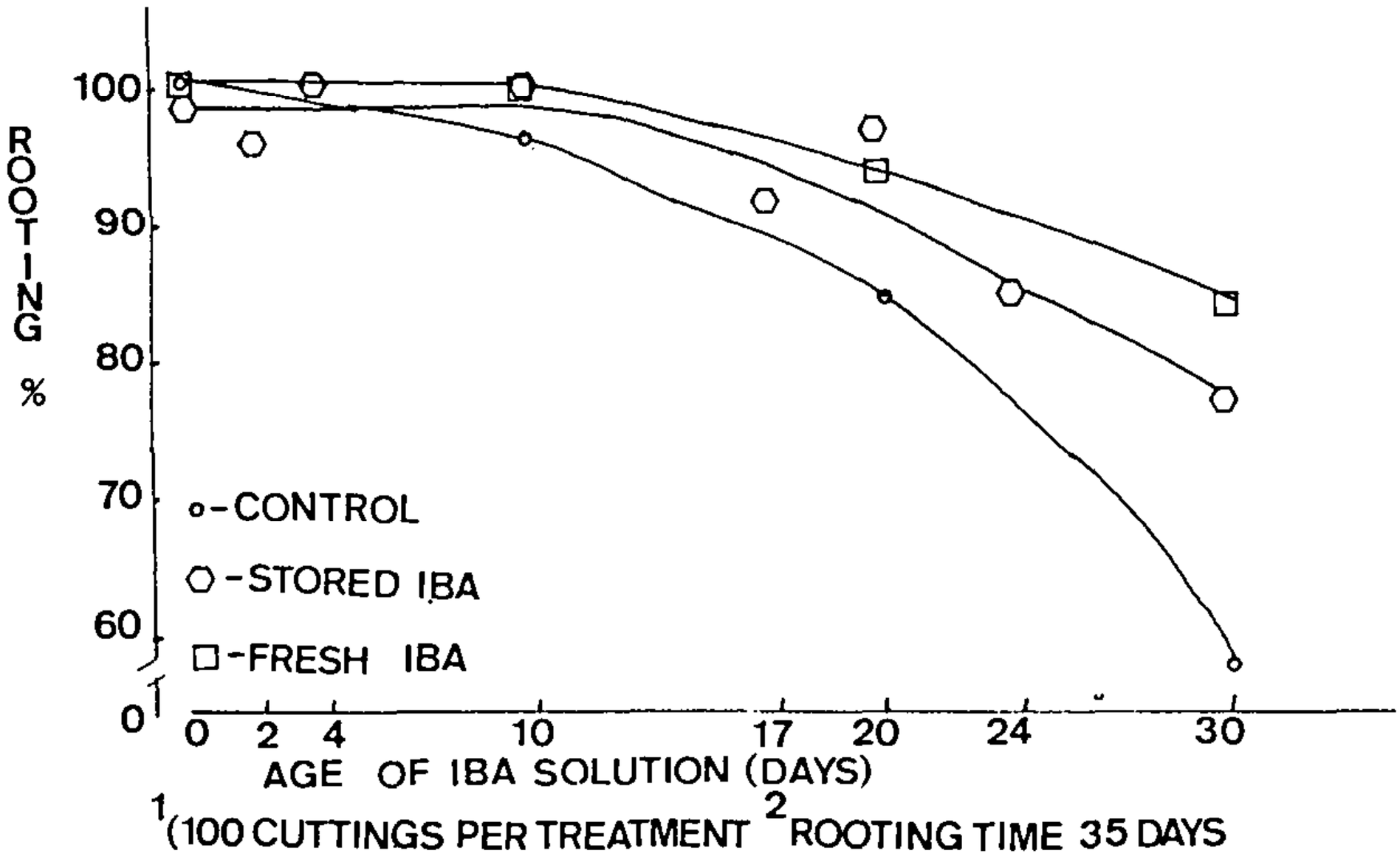

Figure 1. Response of *Prunus serrulata* 'Kwanzan' to an 800 ppm IBA-glycol solution[1,2]

Auxin-glycol preparations were made by combining 1 part auxin-talc (Hormo Root series), 8 parts water at 60°C., and 1 part glycol in a kitchen blender, and mixing thoroughly for 45 to 60 sec. The auxin-talc concentration was selected to provide specific ppm of auxin in the final solution. Benomyl, boron, and rutin (quercetin −3,5 rhamnoglucoside) were also added in some cases to the auxin glycol solution. Benomyl was added in excess of desired ppm to insure saturation. Although the solubility of benomyl is around 4 ppm in the preparation, 14 g of Benlate was added to 250 ml of solution (Figure 1, Table 1,2 give specific amounts of auxins and additives used).

Table 1. Response of *Malus* 'Snowdrift' cuttings to various auxin solutions.[1,2]

Auxin solution	Rooting Percentage[3]
1000 ppm IBA ethylene glycol	98[a]
1000 ppm IBA propylene glycol	98[a]
1000 ppm IBA/NAA Woods	100[a]
1000 ppm indole-naphthyl acetamide	76[b]

[1]100 cuttings per treatment
[2]Rooting time, 36 days
[3]Significant difference, 5% level; Yates Chi Square.

Groups of *Prunus serrulata* 'Kwanzan' cuttings were each treated with an 800 ppm IBA-glycol solution over a 30 day period to test for loss of hormone activity with time. The solution for each trial was prepared as outlined but the original solution was made up and stored in a clear glass bottle at room temperature. Samples of the solution were withdrawn at intervals and used to treat cuttings. Control tests were made every 10 days with freshly prepared hormone solution and with 20% propylene glycol without hormones. Wood's Rooting Compound was diluted with tap water to yield the respective ppm strength of IBA/NAA, and Chloromone was used full strength (1000 ppm indole-naphthylacetamide).

Cuttings of *Malus* 'Snowdrift' were collected in June, treated with hormone as described, then examined after 36 days in the bench. Cuttings of *P. serrulata* 'Kwanzan' were collected from July 9th to August 9th and each sample was evaluated 35 days from the time of sticking. *Prunus subhirtella* 'Pendula Plena Rosea' cuttings were examined 56 days from the time of sticking. All cuttings were collected in samples of 100 per specific treatment and were considered to be adequately rooted when 2 to 5 roots emerged from the bottom of the pot. The times selected for evaluation of each species corresponds to this criteria. Statistical evaluations of rooting percentage was based upon Yates modified chi square test, ($p>0.05$).

Table 2. *Effect of additives to IBA-propylene glycol solution on Prunus subhirtella* 'Pendula Plena Rosea'.[1,2]

Auxin solution	Rooting percentage[3]
2000 ppm IBA	25[c]
2000 ppm IBA, 4 ppm Benlate, 50 ppm boron	72[a]
2000 ppm IBA, 4 ppm Benlate, 50 ppm boron, 1000 ppm rutin	62[b]

[1]100 cuttings per treatment
[2]Rooting time 56 days
[3]Significant difference, 5% level; Yates Chi Square

RESULTS

No significant difference between IBA-glycol solutions and IBA/NAA solutions obtained from Wood's Rooting Compound for *Malus* 'Snowdrift' occurred (Table 1). Full strength Chloromone solution was significantly different from the others. In addition, cuttings treated with Chloromone took 24 days longer to achieve adequate rooting.

When samples of *P. serrulata* 'Kwanzan' cuttings were subjected to the same hormone solution (IBA,800ppm) over a period of 30 days, there was a gradual reduction in rooting percentage when the hormone solution was 21 days old (Figure 1), and this was particularly evident with the rooting percentage of the sample taken at 30 days. It was observed that the root quality of control cuttings was lower in comparison to the hormone-treated cuttings. There-

fore in this experiment, control cuttings were considered rooted if only 1 to 2 roots were visible.

The response of *P. subhirtella* 'Pendula Plena Rosea' to additives in the IBA-glycol solution was dramatic (Table 2). Highly significant promotion occurred with the addition of benomyl and boron at 4ppm and 50ppm, respectively. The use of the phenolic compound, rutin, appeared to be inhibitory at 1000ppm.

DISCUSSION

The effectiveness of glycols as solvents in IBA root promoting solutions is clearly demonstrated by the results presented. *Malus* 'Snowdrift' cuttings are very responsive to such solutions and it appears that the solubility of IBA obtained from talc preparation presents no difficulties. Hence, if no other source of IBA were available to the propagator except for talc formulations, they could be used to formulate an effective liquid quick-dip.

When an IBA-glycol solution is prepared as outlined, there is the possibility that some reduction in effectiveness will occur over time if stored for more than 21 days. This may be due to the precipitation of IBA from the solution. This phenomenon is not unusual and it has been encountered in IBA-ethanol solutions as well (4,8,10). Root appearance of *P. serrulata* 'Kwanzan' cuttings did not suggest any toxic effects of the solution nor was there any basal burning at the hormone concentration used (IBA,800 ppm).

The use of auxin co-factors is not new (3,13), and their promotive effect on *P. subhirtella* 'Pendula Plena Rosea' suggests that they should be added. There are a number of rooting co-factors and their use in rooting compounds has been limited mainly to talc preparations. However, since many of these compounds are not water soluble, their effectiveness in talc preparations is limited and in some cases, concentrations high enough to be effective, approach toxicity. By including co-factors as outlined here, some of these problems can be overcome. In general, the data presented here indicate that the use of glycols as solvents for root promoting chemicals is effective and should be investigated further.

LITERATURE CITED

1. Banko, T. J. 1983. Effects of IBA, K-IBA, and ethyl alcohol on rooting of *Juniperus chinensis* L. 'Hetzi'. The *Plant Propagator* 29 (2):9.
2. Blazich, F. A. 1980. Auxins other than indolebutyric acid that can be effectively used to stimulate rooting. *Proc. Inter. Plant Prop. Soc.* 30:520–525.
3. Bojarczuk, K. 1983. Propagation of green magnolia cuttings using various root stimulants. *The Plant Propagator* 29 (1):4.
4. Chong, C. and L. Daigneault. 1986 Influence of IBA concentration on rooting of woody perennial nursery stock. *Proc. Inter. Plant Prop. Soc.* 36:108–113.
5. Cram, D. J. and G. S. Hammond. 1964. Organic Chemistry. McGraw-Hill Book Company. New York. p. 57.

6. Dirr, M. A. 1981. Rooting compounds and their use in plant propagation. *Proc. Inter. Plant Prop. Soc.* 31:472–478.
7. Gray, H. 1959. The quick-dip alcoholic solution as an aid to rooting cuttings. *Proc. Inter. Plant. Prop. Soc.* 9:47.
8. Howard, B. H. 1974. Factors which affect the response of cuttings to hormone treatments. *Proc. Inter. Plant. Prop. Soc.* 24:142.
9. Kling, G. S., L. M. Perkins and R. Nobies. 1985. Rooting *Betula platyphylla* [var.] *szechwanica* (REHD) cuttings. *The Plant Propagator* 31:9–10.
10. Macdonald, B. 1986. Practical Woody Plant Propagation for Nursery Growers. Timber Press. Portland, Oregon. 669 pp.
11. Patterson, M. E. and W. C. Nichols. 1988. Metabolic response of Delicious apples to carbon dioxide in anoxic and low oxygen environments. *HortScience.* 23:866–868.
12. Stolz, L. P. 1966. Effect of dimethylsulfoxide (DMSO) and tobacco smoke extract (TSE) on root initiation. *Proc. Inter. Plant Prop. Soc.* 16:281–286.
13. Wells, J. S. 1985. Plant Propagation Practices. American Nurseryman Publishing Co. Chicago, Ill. p. 111.

HYDROGELS AS AUXIN CARRIERS FOR ROOT REGENERATION

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Starch-based polymers, commonly referred to as hydrogels (hydrophilic gels), water-absorbing polymers, transplant gels, or super-absorbents, are being used in a variety of ways in the production of numerous horticultural crops. These products, under such trade names as Terra-Sorb, Agrosoke, Water Grabber, Hydra-Soil, Viterra Gelscape, Aqua Lox, Stasorb, Liqua-Gel, StaWet, Moisture Mizer, and others, are purported to hold up to several hundred times their weight in water, and then to subsequently release water under drying conditions, thereby decreasing the need for irrigation. Gels are also reported to improve field soil and container media aeration, to reduce fertilizer leaching, and to promote ion exchange.

HYDROGEL USES

Hydrogels, not to be confused with wetting agents which are designed to improve water penetration (not retention) into potting media and field soils (16), are advertised by their manufacturers for many uses. These uses range from dipping transplant roots, coating seeds and fluid drilling pregerminated seeds to incorporation into potting media, and landscape planting holes and beds. Other water retaining/extending recommended uses include hydroseeding and sodding, and cut flower holding.