Advances Using Indole–3–butyric Acid (IBA) Dissolved in Water for—Rooting Cuttings, Transplanting, and Grafting

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INTRODUCTION

Since the 1930s the plant growth regulator indole-3-butyric acid (IBA) has been used in the rooting of cuttings and other growth processes. Other uses for IBA include promoting root regeneration when transplanting plants and to possibly improve grafting success. Concentrations used for rooting range from 10 to 20,000 ppm IBA. The method of use and concentration of IBA is determined by many variables including plant type, time of year, propagation conditions, etc.

Liquid sources of IBA include premixed concentrated liquids containing up to 1.03% IBA dissolved in organic solvents such as ethanol (up to 99.5%) (EPA registrations as of 1992), and water soluble tablets containing 20% IBA which are made into a solution by the grower (U.S. registered Rhizopon-AA Water Soluble Tablets) (Blazich, 1988; Hartmann et al., 1990; Macdonald, 1986). IBA dissolved in water has proved to be more effective for rooting than IBA dissolved in alcohol, or the other auxins, indoleacetic acid (IAA) or naphthaleneacetic acid (NAA) (Blazich, 1988; Hitchcock and Zimmerman, 1939). IBA dissolved in water may be more effective because high concentrations of alcohol can dehydrate, injure, and be toxic to basal stems, scions, and other plant tissues (Blazich, 1988). When IBA is dissolved in a high concentration of alcohol another serious problem can occur. When the alcohol evaporates the concentration of the IBA increases. An IBA concentration beyond the threshold of auxin tolerance will inhibit plant growth (Blazich, 1988).

IBA USED FOR ROOTING CUTTINGS

IBA is applied to cuttings for rooting in powder or liquid formulations. Different concentrations are used because of different plant types, season, and other variables. Methods using IBA in solution are basal immersion, total immersion, quick dip, and spray drip down. It is difficult to relate concentration to root promotion when comparing IBA blended in powders and liquids (Blazich, 1988; Heung and McGuire, 1973; Bonaminoto, 1983; Bonaminoto and Blazich, 1983; Hitchcock and Zimmerman, 1936, 1939). Variation is due to the method of application, retention, and use of the IBA by the plant tissue.

IBA Used for Rooting of Cuttings by Basal Immersion. The IBA immersion method is suitable for hard-to-root plants. It is used to root *Prunus* rootstocks, evergreen and deciduous shrubs, conifers, and *Platanus* × *acerifolia* (London plane) (Macdonald, 1986, ill., pp 345-346). Treatment involves immersion of the basal ends of the cuttings approximately one inch into the solution for 4 to 12 hours. For cuttings propagated under mist the treatment is a maximum of 4 hours. The

cuttings are planted immediately after treatment. For woody and herbaceous cuttings use 50 to 150 ppm IBA dissolved in water.

IBA Used for Rooting of Cuttings by Total Immersion. Total immersion of the cutting produces high quality roots. Treat by immersing the whole cutting in solution for a few seconds and stick the cutting immediately after treatment. For herbaceous cuttings of plumbago, ivy, clematis, delphinium, lavender, and ficus use 50 to 250 ppm IBA dissolved in water.

With stem cuttings of *Berberis*, *Cotoneaster*, *Lavandula*, *Prunus*, *Pyracantha*, and *Viburnum*, total immersion in an IBA solution has shown better rooting than dipping the basal ends of the cuttings in IBA by the dry dip method. Cuttings were immersed two minutes in 1,000 ppm IBA dissolved in water. The totally immersed cuttings had an increase in fresh weight of the roots when compared to dry dipped (Van Bragh et al. 1976).

IBA Used for Rooting of Cuttings by Quick Dip. Many growers prefer the quick dip method. In this method, the basal ends of cuttings are immersed approximately one inch into a solution for a few seconds. The cuttings are stuck immediately after treating. The quick dip method may produce variable rooting because cuttings are immersed for only a brief time at a high IBA concentration there may be inadequate absorption of the IBA. The following concentrations are recommended:

- Herbaceous, tropical plants, house plants, and roses use 150 to 500 ppm IBA dissolved in water.
- Chrysanthemums use 400 to 500 ppm IBA dissolved in water.
- Softwood cuttings use 1,000 ppm IBA.
- Hardwood cuttings use 2,000 ppm IBA.
- Difficult-to-root hardwood cuttings use 5,000 to 20,000 ppm IBA. A 20,000 ppm treatment with a very fast dip time is used in rare cases for extremely difficult-to-root plants.

IBA Used for Rooting of Cuttings by Spray Drip Down. The spray dip down method is cost effective since it uses minimum labor and low IBA concentration. Cuttings are first stuck in trays. The rooting solution is then sprayed on the leaves and stems until beads of liquid drip down into the medium. For chrysanthemum, begonia, dieffenbachia, heath, and hibiscus use 50 to 250 ppm IBA dissolved in water.

Two Methods to Root Chrysanthemum Cuttings. From 1989 to 1991 the research department at Lyraflor, de Lier, Holland conducted large production tests on the rooting of chrysanthemums. Two methods produced cuttings with high quality and symmetrical root systems:

1) Spray drip down using 5 to 150 ppm IBA dissolved in water

2) Quick dip immersion of the basal end of the cutting for 2 sec in 150 to 400 ppm IBA dissolved in water.

Three Methods to Root Rose Cuttings and Stenting Roses. Research at the Rhizopon Research Center, Hazerswoude, Holland, concluded that rose cuttings produced quality roots by either of three methods (Eigenraam, 1990):

1) Dry dip at 0.25% to 0.6% IBA.

2) Quick dip immerse at 250 to 500 ppm IBA dissolved in water.
3) Spray drip down at 50 to 100 ppm IBA dissolved in water for potted roses.

IBA USED FOR ROOT REGENERATION WHEN TRANSPLANTING ROOTED PLANTS

IBA solutions can promote increased numbers of regenerated roots on woody plants. Optimal concentrations (tested on black walnut, tulip tree, and scarlet oak) for bare root immersion absorption for 5 min were 1,000 to 3,000 ppm IBA. Immersion longer than 5 min or 3,000 ppm IBA inhibited root regeneration and shoot development (Struve and Moser, 1984).

IBA Used for Root Regeneration When Transplanting Roses. Rose crops start with transplanting dormant bushes. Survival of transplants requires rapid root regeneration. Treatment with IBA solutions speeds new root initiation and increases root elongation rate. Survival is improved and there is earlier and higher flower yield. Best results with *Rosa multiflora* 'Kanagawa' were achieved when the roots were immersed for 5 min in 1,000 ppm IBA dissolved in water. The most effective concentration for 'Montrea' on the rootstock *R. canina* 'Inermis' was 500 ppm IBA dissolved in water. Application of NAA or IAA was not found to be as effective (Fuchs and Van Pol, 1986; Fuchs, 1986).

For over 50 years Dutch rose growers have transplanted half-year-old rose bushes using an IBA treatment. The bare roots are immersed for 10 min in 150 ppm IBA dissolved in water or for 5 min in 250 ppm IBA dissolved in water. Water is used as the solvent to eliminate toxic effects from organic solvents. After treatment the rose bushes are planted immediately. At planting time the soil temperature is kept above 50°F and air temperature above 65°F with relative humidity at 80%. Warm soil temperature is a co-factor in utilization of IBA (Fuchs and Van Pol, 1986; Fuchs, 1986).

The Hortus USA Research Center used IBA immersion-absorption when transplanting Simplicity™ shrub roses (Jackson and Perkins, Medford, OR). The treated plants had consistently higher flower yield—up to 60%—over the control plants. Before planting the bare roots were immersed for 10 min in 150 ppm IBA dissolved in water. After treatment the plants were planted in the field. Leaf and stem growth and start of flowering was similar on both treated and control plants. Results suggested that the first stage growth of leaf flush came from stored carbohydrates; the second stage growth of the flowers was influenced by the IBA (Rhizopon Researcher, 1992).

IBA USED FOR GRAFTING

Propagation by grafting of ornamental conifers can be unpredictable and variable. IBA has been used to stimulate cell division at the graft union. Grafts of *Picea pungens* 'Hoopsii' on *P. abies* rootstock were improved by immersing the scion bases for 3 min in 200 ppm IBA prior to joining. Treated grafts were consistently improved by 13% over the controls (Beeson and Proebsting, 1990). Scion wood of *Carya illinoinensis* 'Desirable' (pecan) was successfully grafted onto the lateral roots of 'Van Deman' pecan seedling rootstock by dry dipping the scion in 1% and 2% IBA in talc. Shoot survival for IBA treated grafts was 20% higher than the controls (Yates and Sparks, 1992). Research is necessary to determine if liquid

immersion of the scion will have similar success.

DISCUSSION

IBA dissolved in water is a useful plant growth regulator for the grower and propagator. It is used for rooting of cuttings by dry dip, total immerse, basal immersion, spray drip down, and quick dip methods. Root regeneration is promoted when transplanting rooted plants using IBA by immersion-absorption. It promotes plant growth and higher flower yield. IBA has been shown to improve graft takes of difficult-to-graft plants; studies must be made to determine if IBA dissolved in water is useful. Future developments will come from testing IBA dissolved in water on a wide range of plants, and new application methods and carriers.

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