Comparison of Auxin-Talc Treatments in Apple Graft Union Formation©

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Auxin (IAA) is a plant produced chemical that is commercially available in synthetic form (IBA and NAA) for rooting cuttings. Liquid auxin formulations have been shown to increase grafting success, but to date auxin in a powdered talc formulation has not been researched. In this experiment the wounded region of the scion was treated with select concentrations of auxin-talc formulations. The graft union was periodically analyzed indirectly using a hydraulic conductivity meter to determine rates of healing among treatments. Auxin applications did not shorten the time to budbreak and in some cases actually slowed budbreak. Results indicated that Hormodin 3 (8,000 ppm IBA) suppressed rootstock suckering and initially produced larger shoots on the scion when compared to other treatments and the control. However, by the time the study was terminated, there did not appear to be any visual differences between treatments in regard to shoot lengths.

INTRODUCTION

Auxin (indole-3-acetic acid or IAA) is a plant-produced chemical that controls cell elongation in roots and is commercially available in a synthetic forms (indole-3-butyric acid or IBA and 1-naphthaleneacetic acid or NAA) for aiding adventitious root formation in cuttings. Auxin also stimulates callus cell formation as well as differentiation of vascular bundles. In previous studies, auxin has been applied to the wounded region of scion material (top portion of a grafted plant) to aid in graft union formation. Liquid auxin applications used in grafting have been proven to stimulate cell division at the graft union (Kroin, 1992). To date, only liquid formulations of the auxin have been examined for their ability to improve graft union formation. Auxin-talc suspensions are readily available as pre-made commercial rooting compounds (Hormodin® and Rootone®) and are easy to use with little-to-no preparation as compared to liquid auxin formulations. Additionally, auxin-talc preparations are less likely to spread disease-causing organisms from plant-to-plant during the grafting process.

OBJECTIVES

- Effectively model commercial apple grafting conditions.
- Quantify the rate and extent of graft union formation.
- Compare treatment-effectiveness in graft union formation.
- Determine effects of auxin-talc formulations in graft union formation and subsequent plant growth.

MATERIALS AND METHODS

- In December 2006, 75 bare-root rootstocks were obtained and immediately potted into Fafard® 3B potting medium in Classic 200 plastic nursery containers. The apple rootstock is a commercially used, nondwarfing seedling rootstock, *Malus* 'Antanovka' (1/4 inch in diameter).
- Potted rootstock was placed in a walk-in cooler (36 °F–40 °F) to establish roots while providing necessary chilling-hours for dormancy.
- In January 2007, *Malus* 'Antanovka' rootstock was moved to a cool greenhouse to initiate sap flow and break dormancy (Fig. 1).
- In February 2007, scionwood was collected and brought to campus and stored in a refrigerator. The scion material is *M. domestica* 'Liberty' (1/4 inch in diameter), collected from the University of Vermont Horticulture Research Center (South Burlington, Vermont) (Fig. 2).
- Rootstocks/scions were grafted on 12 Feb., using a mechanical bench grafting device to reduce technical errors during grafting and to follow commercial grafting methods. (Fig. 3).
- Grafting blades were swabbed with rubbing alcohol after every five grafts to reduce the risk of disease contamination.
- Grafts were treated with one of three IBA talc concentrations (Hormodin® 1 (1,000 ppm), Hormodin® 2 (3,000 ppm), or Hormodin® 3 (8,000 ppm IBA), or an IBA/NAA formulation (Rootone®) also containing thiram fungicide.
- The graft union was then wrapped in Parafilm® (flexible waxed paper) and the plants were returned to the cool greenhouse (Fig. 4).
- The graft union was placed against an electrically heated callusing pipe to localize warmth at the union and aid in healing. (Fig. 5).
- Due to relative uniformity in temperature and light conditions in the greenhouse, plants were placed on the callusing pipe in a Completely Randomized Design (CRD).
- The study was carried out in the University of Vermont greenhouse on 84 ft^2 of bench space in a cool greenhouse compartment maintained at 68 °F (day)/60 °F (night) (Fig. 6).
- Date of budbreak and number of suckers on the rootstock which developed during the 10 weeks following grafting was recorded. Suckers were counted and removed daily.
- Plants were randomly selected at each harvest time.
- Plants were visually examined at 5 weeks following grafting (Fig. 7).

- Plants from each treatment were harvested and evaluated 10 weeks after grafting (April, 2007). Hydraulic conductivity of the unions was indirectly examined using a pressure chamber (Fig. 8).
- All plants were fully hydrated the day before leaf harvest for use in the pressure chamber by watering the container/media to saturation.
- The night before harvest, leaves designated for "pre-dawn" harvest (the uppermost fully expanded leaf) were covered with aluminum foil to retain maximum moisture content in the leaves. The aluminum foil was labeled for each leaf.
- Between 7–8 AM, pre-dawn hydraulic conductivity was measured by removing the leaf covered in aluminum foil and its entire petiole from the stem using a razorblade and immediately placed in a plastic baggie and sealed. Five plants were harvested per auxin treatment. One leaf was removed from the baggie at a time, removed from the aluminum foil, and a fresh cut was made to the petiole. The petiole was inserted in a rubber gasket and the gasket was closed to securely fasten the petiole in place. The leaf blade was then inserted into the chamber and air pressure was gradually applied. As soon as water was seen bubbling out of the petiole, the pressure was recorded. This was repeated for each leaf harvested. Each leaf was then processed through a leaf area meter and pressures were adjusted for leaf area
- The same plants from which the pre-dawn leaves were harvested were placed in a greenhouse maintained at 86 °F (30 °C) with HID lights and fan circulation. The leaf directly below the leaf harvested for pre-dawn was used to determine the pressure needed to exude water from the leaf during full transpiration. Leaves were considered at full-transpiration at 3 PM that same day.

RESULTS AND DISCUSSION

- Initially, plants treated with higher concentrations of auxin-talc had more vigorous scion growth than other treatments based on visual observations (Fig. 7). This was not apparent by the final harvest 10 weeks after grafting. Scion growth of all treatments appeared similar.
- The highest concentration of auxin-talc suppressed rootstock suckering. A function of auxin in plants is to maintain dormancy of lateral buds, and it is thought that this is why the higher concentrations of auxin-talc prevented rootstock suckering.
- Treatments did not appear to have an effect on date of bud break.

It is hypothesized that there was initially more xylem formation in the graft union treated with higher concentrations of auxins due to the larger shoots that formed by Week 5 (Fig. 7), however, this was not evident by Week 10.

Greater differences between pre-dawn and full-transpiration pressures indirectly indicate a less conductive graft (due to physical and/or anatomical impedance). Hormodin 1 and 2, and Rootone treatments had significantly improved conductivity across the graft union when compared to the untreated control however, the highest rate of auxin application (Hormodin 3) did not increase vascular conductivity.

CONCLUSIONS

- Hormodin 3 (8,000 ppm IBA) suppressed rootstock suckering and initially produced larger shoots on the scion when compared to other auxin treatments and the control.
- Graft unions were analyzed using a leaf pressure chamber in order to compare water content in leaves amongst treatments as an indirect indicator of union conductivity and xylem formation. Plants with lower auxin concentrations had a greater leaf water content at full transpiration then the control or Hormodin 3. This indicates an increase in vascular conduction of water between rootstock and scion at lower auxin levels. Further study is required to examine the effects of powdered auxin formulations over time.

LITERATURE CITED

Kroin, J. 1992. Advances using Indole-3-butyric acid (ISA) dissolved in water for rooting cuttings, transplanting, and grafting. Comb. Prac. Intl. Plant Prop. Soc. 42:489–492.

Figure 1. *Malus* 'Antanovka' rootstock moved to greenhouse to initiate sap flow.

Figure 2. Scion material 'Liberty' being collected.

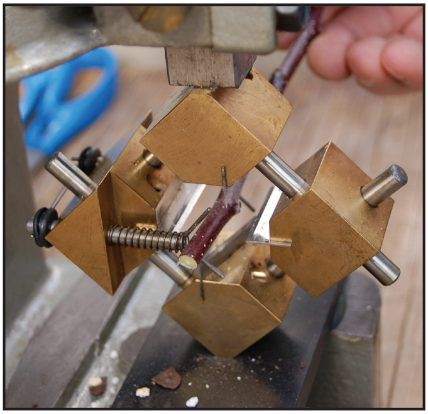

Figure 3. Mechanical beach-gravity device.

Figure 4. Grafting operation.

Figure 5. Plants in cool greenhouse and placed against an electrically healed callusing pipe.

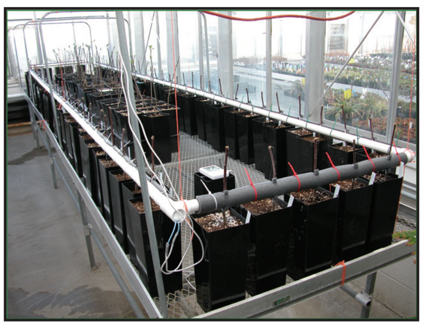

Figure 6. University of Vermont greenhouse where research was conducted.

Figure 7. Five weeks after grafting.

Figure 8. Pressure chamber to measure hydraulic conductivity.