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Research Reports

NAA Reduces Vegetative Shoot Growth on Rootstocks of Ornamental Peach[1]

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Abstract

Vegetative bud growth was controlled on dormant peach rootstock of budded *Prunus persica* (L.) Batsch. 'Bon Fire' with naphthaleneacetic acid (NAA) applied as a trunk paint. Vegetative bud growth was suppressed with all test concentrations (2,875 to 11,500 ppm) through 210 days after treatment (DAT), although scion bud mortality of 'Bon Fire' was greater with concentrations above 8,625 ppm. Naphthaleneacetic acid applied at 5,750 ppm provided excellent vegetative bud control, vigorous scion bud growth, and minimal scion bud mortality.

Index words: auxin, growth regulator, NAA, nursery production.

Growth regulators used in this study: K-Salt™ FruitFix™ (NAA), 1-naphthaleneacetic acid, potassium salt; Tre-hold® RTU (NAA), 1-naphthaleneacetic acid.

Species used in this study: *Prunus persica* (L.) Batsch. 'Bon Fire'.

Significance to the Nursery Industry

Removal of vegetative shoots produced on rootstocks is a repetitive, laborious task that is required for successful production of budded 'Bon Fire' peach. Scion bud vigor is often reduced to the point of death if rootstock vegetative buds are allowed to develop. Naphthaleneacetic acid (NAA) solutions, painted onto the trunks of dormant plants, controlled rootstock vegetative bud growth during the growing season and eliminated the need for hand pruning. Although all concentrations of NAA tested controlled vegetative bud growth, a solution of 5,750 ppm provided excellent vegetative bud control, vigorous scion bud growth, and minimal scion bud mortality. Although commercially available solutions of NAA are labeled for use on several ornamental tree species, however, none are labeled for ornamental peach trees.

Introduction

Ornamental peach, *Prunus persica* (L.) Batsch. 'Bon Fire', is a popular plant that is grown as a short budded standard tree, and noted for the burgundy leaf color and emanation of

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peach fragrance during the summer. Typically, rootstock seeds are retrieved from peach processing plants and sown in field nursery beds in the fall. During late summer of the first growing season, mature summer dormant buds of 'Bon Fire' are 'T' budded onto the seedlings about 46 cm (18 in) above the soil line, creating a short standard. In the following growing season, the seedling rootstock produces copious amounts of shoot growth from vegetative buds, necessitating costly hand removal of shoots four to five times (David Greene, Pro-Gro Nursery, McMinnville, TN, personal communication). Removal of the shoots is required to prevent loss of vigor, overgrowing the scion, and death of the scion bud. Excessive vegetative growth on the rootstock is triggered by the removal of its terminal bud, which manufactures auxin that inhibits vegetative bud growth (14).

Spray applications of NAA solutions have reportedly controlled root suckers, basal shoots, water sprouts, and vegetative buds on fruit trees (3, 4, 5, 8, 9, 11, 12, 14), nut crops (5) and grapevines (10, 13). Successful control of trunk vegetative buds was achieved with various concentrations of NAA solutions on *Pyrus calleryana* Decne. 'Bradford' (7), *Betula nigra* L. (1), *Pyracantha coccinea* Roem.(2), and *Lagerstroemia indica* L. (6) at production nurseries and in landscape settings (1, 2, 6, 7). A commercial NAA product, currently labeled as Tre-Hold® (Amvac Chemical Corp., Newport Beach, CA), is marketed as a vegetative bud inhibitor for several fruit crops and 16 ornamental trees.

These experiments investigated the effects of timing and concentrations of NAA applications for rootstock vegetative bud control and phytotoxicity on scion buds of ornamental peach trees.

Materials and Methods

Experiment 1. Buds of *Prunus persica* 'Bon Fire' were budded at 46 cm (18 in) above the soil line onto one-year old field grown *P. persica* seedlings on July 27, 1996, in a field nursery in McMinnville, TN. During late August, while the scion bud was still dormant, the rootstock was pruned 1.3 cm (0.5 in) above the bud union. Prior to spring bud break, uniform plants were selected for this experiment. On March 4, 1997, NAA (ethyl ester formulation, Tre-Hold® RTU, 1.15% a.i., Amvac Chemical Corp., Los Angeles, CA) was applied with a small paint brush to the entire rootstock trunk, carefully avoiding the scion bud. Treatments were solutions of NAA at 0, 2,875, 5,750, 8,625, and 11,500 ppm; these were equivalent to Tre-Hold® RTU at 0x (water control), 0.25×, 0.50×, 0.75×, and 1×, respectively. Ten single plant replications were completely randomized in the plot. There was no rainfall within 48 hours of treatment application. Plants were not irrigated during the growing season, but maintained with traditional fertility and soil management practices by the nursery producer. Scion bud length and rootstock vegetative shoot number were recorded at 30, 60, 90, 120, 180, and 240 days after treatment (DAT). Vegetative shoots were removed from the rootstock at each observation date.

On April 17, a second group of budded 'Bon Fire' plants in the plot were subjected to the same NAA treatments. At this time scion buds had broken dormancy (average length 2.9 cm [1.1 in] and vegetative shoots on the rootstock had developed. Prior to NAA treatment, vegetative shoots on the rootstock were removed. Data were recorded as previously described.

A square root transformation was used to stabilize the variance of the vegetative shoot number data. Vegetative shoot number for the March 4 and April 17 applications were modeled separately using Proc Mixed in SAS (SAS Institute, Cary, NC), with the least square means option. A chi-square test was used to evaluate scion mortality. Data on growth rates of surviving scions (calculated as growth between two measurement dates divided by the number of days between them) were analyzed using the Proc Mixed procedure in SAS (Version 8.2).

Experiment 2. Treatments and methods were similar to Experiment 1 with the following exceptions: plants were budded on July 31, 1997, rootstocks were pruned above the scion bud on Sept. 9, 1997, another NAA source (potassium salt formulation, K-Salt™ Fruit Fix™, 6.25% a.i., Amvac Chemical Corp.) was included, and all treatments were applied March 13, 1998. Naphthaleneacetic acid concentrations for FruitFix™ were equal to those from Tre-Hold®. An emulsifier control (carrier in the Tre-Hold® product) was included.

Results and Discussion

Experiment 1. Vegetative shoot control. Time of application, NAA concentration and number of days after treatment at which data were taken significantly influenced vegetative shoot number on 'Bon Fire' peach. Plants treated on March 4 with NAA at 5,750, 8,625 and 11,500 ppm were statistically indistinguishable and had fewer vegetative buds on average than plants treated with either 2,875 ppm or no NAA (Fig. 1A). For specific measurement days, 11,500 ppm NAA produced fewer rootstock vegetative shoots 30 DAT than 5,750 and 8,625 ppm and fewer vegetative shoots 60 DAT than 5,750 ppm.

Differences among treatments (other than the control) were smaller with the April 17 NAA application. Since vegetative shoots were removed prior to NAA treatment, there were fewer buds on all rootstocks. Over time, only control plants differed from treated plants (Fig. 1B). At 90 DAT, plants treated with 2,875 ppm resulted in more vegetative shoots than plants treated with 5,750 and 11,500 ppm. On 120 and 210 DAT, plants treated with 2,875 and 11,500 ppm differed significantly.

Scion mortality. There were no significant differences ($p = 0.1869$) among treatments on scion mortality for plants treated on March 4, although the control and plants treated with 2,875 ppm had six and seven scion bud deaths, respectively (the other treatments had 3). We attributed the high rate of scion deaths in the first 60 days after treatment to the vigorous growth and competition from the rootstock vegetative shoots.

In contrast, plants treated on April 17 had significant mortality differences by the end of the growing season ($p < 0.0001$). All scion buds died in the 11,500 ppm NAA treatment, six out of ten died with 8,625 ppm, one died with 5,750 ppm and none died with 2,875 ppm and the control. This observation concurs with previous studies (3, 11) where scion bud death occurred in avocado and valencia orange from high concentrations of NAA. We observed a discolored and a blistered appearance on the rootstock bark on plants treated with 8,625 and 11,500 ppm NAA within 60 DAT and attributed this to the higher concentration of NAA and perhaps the waxy type emulsifier used as a carrier with Tre-Hold®. Keever et

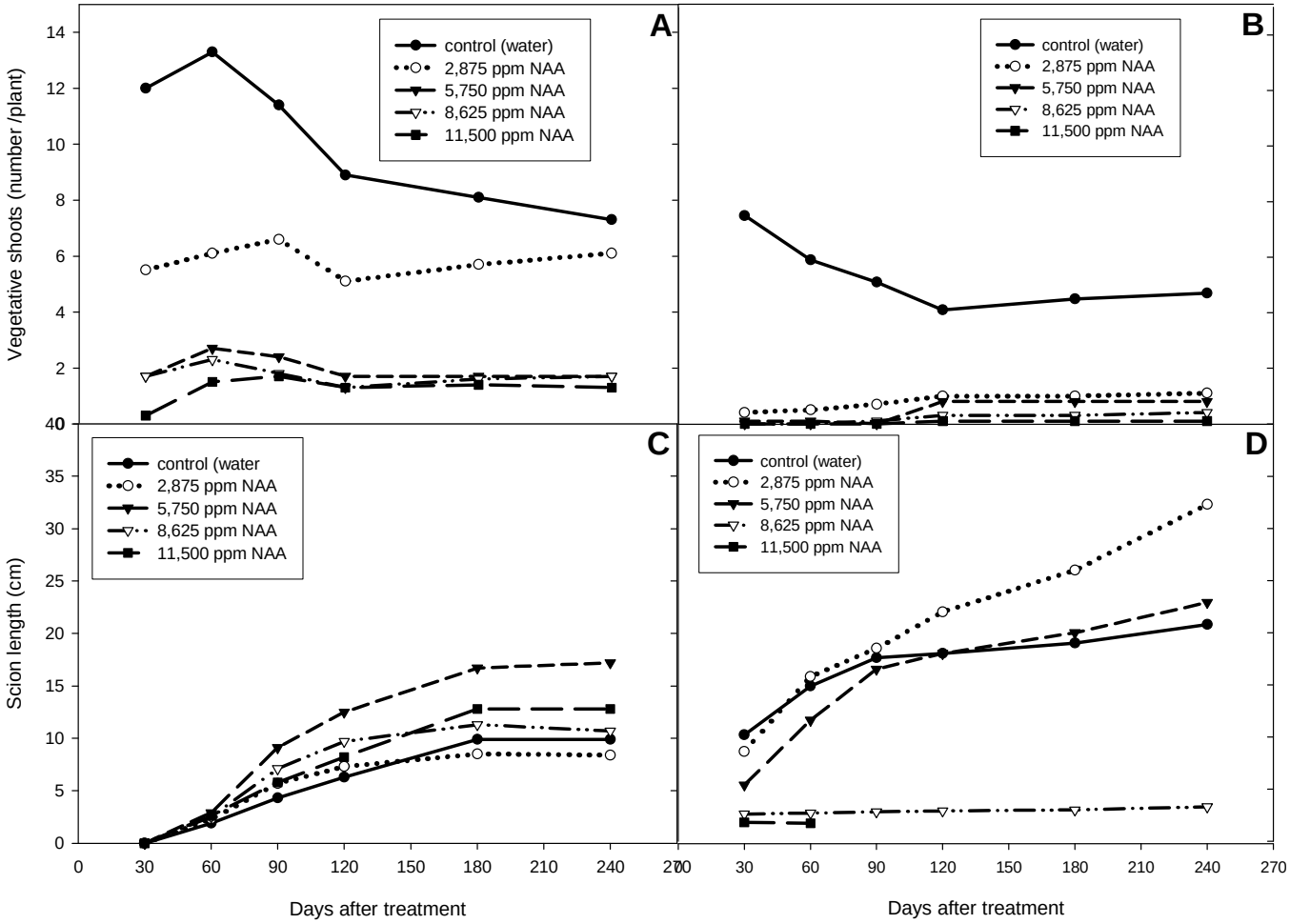

Fig. 1. Vegetative shoot emergence on the rootstock of budded *Prunus persica* 'Bon Fire' after NAA, as Tre-Hold®, was applied on March 4, 1997 (A), or April 17, 1997 (B), and subsequent scion bud growth after March 4, 1997 (C), or April 17, 1997 (D), application, Experiment 1.

al (6) described an oil-soaked dark appearance following NAA treatment on *Pyrus calleryana* Decne. 'Bradford' pear that diminished with time. Based on our data, 8,625 and 11,500 ppm NAA were detrimental treatments when applied to actively growing plants.

Scion growth. Scion growth rate was affected by date but not NAA concentrations (Fig. 1C). Scion growth averaged 12.8 cm (5.0 in) among treatments and generally decreased with increasing concentrations of NAA.

Plants treated on April 17, in addition to the day effect, had both treatment effects and treatment by day interaction effects (Fig. 1D). Since all the plants that were treated with 11,500 ppm NAA died by 60 DAT, they were removed from the analysis. Plants treated with NAA at 8,625 ppm showed the lowest average growth rate and were significantly shorter than plants treated with 0 (control), 2,875 and 5,750 ppm. The significant interaction term ($p < 0.0001$) indicated that the growth rates differed among treatments and that the magnitude of the differences was influenced by the time after treatment (DAT). Control plants (0×) grew more in the first 30 DAT than plants treated with 8,625 ppm, but grew less than plants treated with 5,750 ppm during the first 30 to 60 DAT.

This data confirms that time of application is an important variable, considering 8,625 and 11,500 ppm NAA killed scion buds when plants were actively growing (April), but were not lethal when applied to dormant plants (March). The recommended concentration of Tre-Hold® is 11,500 ppm NAA for sprout and vegetative shoot control on established ornamental trees. This concentration is phytotoxic to 'Bon Fire' resulting in mortality of the plant. Naphthaleneacetic acid, from Tre-Hold®, at 5,750 ppm provided acceptable vegetative shoot control, scion mortality was low, and scion growth was vigorous in both the March and April applications.

Experiment 2. Vegetative shoot control. There were significant effects of time after treatment (DAT), concentration of NAA, and DAT × concentration interaction on the number of vegetative shoots. Plants treated with water (control) and the emulsifier produced the greatest number of vegetative shoots (Fig. 2A). Effects of Tre-Hold® and FruitFix™ treatments on vegetative shoot growth were similar. Significant interactions (other than those involving control treatments) involved 2,875 ppm Tre-Hold® at 30 and 60 DAT when vegetative shoot control was significantly less than other treatments. FruitFix™ is a potassium water-based product, is currently labeled as a chemical fruit thinner for pear (*Pyrus communis* L.), apple (*Malus domestica* Borkh.) and citrus (*Citrus sinensis* L.), and does not contain an emulsifier carrier. We observed no bark discoloration or blistering during the experiment.

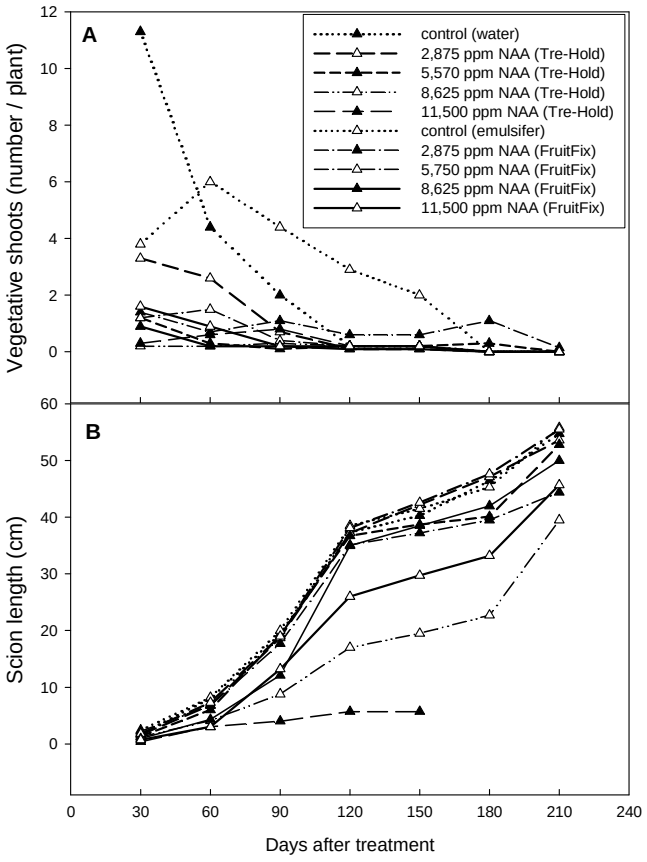

Fig. 2. Vegetative shoot emergence on the rootstock of budded *Prunus persica* 'Bon Fire' after NAA, as Tre-Hold® or FruitFix™, was applied on March 13, 1999 (A), and subsequent scion bud growth after March 13, 1999 (B), application, Experiment 2.

Scion mortality. Naphthaleneacetic acid concentration significantly affected scion mortality. Tre-hold® at 2,875 and 5,750 ppm NAA, FruitFix™ at 5,750 ppm NAA, the control, and emulsifier control caused only a few dead scions (0, 1, 0, 0 and 1, respectively). All scions died with Tre-Hold® at 11,500 ppm NAA (this is consistent with the previous experiment). Tre-Hold® at 8,625 ppm, FruitFix™ at 8,625 and 11,500 ppm NAA caused some scion mortality (6, 7 and 6, respectively).

Scion growth. For those scions that survived, there were significant effects of DAT, NAA treatment, and DAT × NAA treatment interaction on scion growth rate (Tre-Hold® at 11,500 ppm NAA was dropped from the analysis due to scion mortality) (Fig. 2B). The greatest average scion growth rate was similar with 2,875 and 5,750 ppm Tre-hold®, 5,750 ppm FruitFix™, and the water and emulsifier controls compared to Tre-Hold® at 8,625 ppm NAA.

We examined different application techniques of Tre-Hold® and FruitFix™ to alleviate the tedious method of painting the rootstock. In one experiment, 5,750 ppm NAA Tre-Hold® and FruitFix™ were applied as directed sprays to the lower half of the rootstock. Apparently, spray drift reached the scion bud, prevented bud development, and all plants treated had scion mortality. In another experiment, the scion buds were covered with masking tape to protect the bud during a directed spray application of 5650 ppm. Both Tre-Hold® or FruitFix™ products were absorbed through the tape and 100% caused scion death.

To summarize our experiments, 5,750 ppm NAA applied as Tre-Hold® or FruitFix™ trunk paint were superior to other treatments providing effective vegetative bud control, low scion mortality, and vigorous scion growth. A dormant application of NAA, though time consuming, can provide excellent vegetative shoot control and eliminate the necessity of the laborious repetitive task of vegetative shoot removal on 'Bon Fire' peach.

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