Fire blight and Vegetative Growth Control Response of Several *Malus* Rootstock and Cultivars Treated with Prohexadione Calcium



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Introduction

Fire blight (FB), a serious bacterial disease of apple pear, leads to loss of bearing surface and often tree death. Research on the GA-synthesis inhibitor, prohexadione calcium (PC), indicates it is an effective compound for minimizing FB infections as well as for regulating tree growth. The commercial interest in PC is its ability to reduce secondary FB infections as well as reduce the need for dormant and/or summer pruning (Figure 1).

Previous studies on PC, however, are not reflective of the growing conditions experienced and apple cultivars used in northern growing regions of North America.

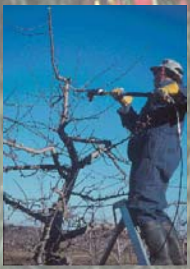

Figure 1: Dormant pruning of apples is a labour intensive practice

Research Objectives

- Evaluate new and innovative strategies for the control of fire blight (*Erwinia amylovora*) in pear and apple with minimal use of the antibiotic Streptomycin
- Determine the influence of prohexadione calcium (Apogee) on fire blight and vegetative growth control
- Determine the efficacy of PC for regulating the shoot growth of six commercial apple cultivars

Materials and Methods

Experiment One

- 1-yr old rootstock liners of B.9, M.26, M.7, M.9 EMLA, V.1, V.3, Quince A, and Bartlett were potted in 3.6 L containers using a mix of 70% (v/v) peat, 20% (v/v) paper mill sludge (organic amendment), 5% (v/v) perlite, fritted micronutrients (250 g/m3), 18-6-8 Type 360 Nutricote (7.5 kg/m3) and agricultural lime (2.12 kg/m3) and grown in the greenhouse (25ºC/15ºC day/night).
- Shortly after bud break, one primary shoot was selected to grow on each plant.
- Individual rootstock liners were treated with one of the following PC sprays using a CO_2 compressed air sprayer:

  1. water control
  2. 1 x 250 mg.L-1 PC(30-April)
  3. 2 x 125 mg.L-1 PC (30-April, 7-May)
  4. 3 x 83.3 mg.L-1 PC (30-April, 7-May, 14-May)
  5. 4 x 62.5 mg.L-1 PC (30-April, 7-May, 14-May, 21-May).

- Treatments were arranged in a two factor factorial RCB design (PC and rootstock treatments) with five replications.
- On 22-May, actively growing shoots (40-50 cm long; 20-30 nodes) were inoculated with fire blight using a 'dirty scissors' technique - the youngest fully expanded leaf and adjacent younger proximal leaf, were each excised with scissors across the midportion of the leaf blade perpendicular to the midrib containing a virulent strain of *Erwinia amylovora* (E2017P) at a concentration of ~10^8 cfu·ml^{-1}
- Five weeks post inoculation (after the progression of the lesion had ceased) the basipetal movement of fire blight from the point of inoculation was recorded (Quamme and Bonn, 1981). The length of each inoculated shoot as well as the spread of the infection into subtending 2-yr wood in some instances was recorded.
- Following arc-sine transformation, percent data were analyzed by PROC GLM using SAS (Cary, NC) and treatment means were separated Fishers' protected LSD (P=0.05).

Experiment Two

- Ten individual trees of 7-yr old 'Vista Bella', 'Thome Empire', 'Redspur Delicious', 'Mutsu', 'Reinders Golden Delicious' and 'Northern Spy' apple trees on M.9 rootstock, spaced at 2.5 m x 4.5 m and grown to a slender spindle, were treated with one of the following PC sprays using a commercial airblast sprayer.

Experiment Two

- Treatments: a) water only; b) 2 x 125 mg·L^{-1} PC (16-May, 31-May), and; c) 4 x 125 mg·L^{-1} (16-May, 31-May, 18-June, and 28-Jun). All PC treatments contained 125 mg·L^{-1} ammonium sulphate, 0.125 % (v/v) Regulaid surfactant, and 0.1 % (v/v) of a defoamer.
- A split-plot design with Apogee as the main plot and cultivar as the split plot was used. Treatments were replicated three times.
- The trees were defruited first with 2000 125 mg·L^{-1} of carbaryl followed by hand thinning to maximize vegetative shoot growth in the absence of fruit.

Results and Discussion

Experiment One

- *Number of Leaves.* Apogee treatments significantly reduced the number of leaves by 5% irrespective of rate and timing; M.7 and M26 had the greatest while M.9 and Bartlett had the fewest number of leaves respectively
- *Shoot Length*. Apogee treatments significantly reduced the length of shoots by 22% irrespective of rate and timing; B.9, M.7, Quince A, and M.26 had the longest shoot length while Bartlett had the shortest shoots
- *Internode length.* Apogee treatments significantly reduced shoot internode length by 15% irrespective of rate and timing; B.9 and Quince A had the greatest internode length while V.1 and V.3 had shortest internode length
- *Fire blight*. Plants treated with Apogee had significantly shorter lesions caused by *E. amylovoa* than the untreated trees, irrespective of rate and timing. However, when expressed on a percentage of total stem infected, the Apogee effect was not significant (Fig. 3)
- Rootstocks differed in their resistance to fire blight: V.1 and M.7 were most tolerant while V.3, M.26 and M.9 least tolerant (Fig. 3).

Figure 2: Apple rootstock displaying E. *amylovora infection*

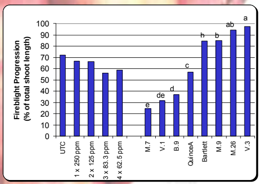

Figure 3: Apogee and rootstock effects on progression of fire blight

Experiment Two

- Shoot Growth. Apogee significantly reduced shoot extension growth by 33% irrespective of the number of sprays or cultivar (data not shown).
- With the exception of Red Delicious, the seasonal pattern of shoot growth was curvilinear over time with 83% of growth occurring within the first six weeks of bloom, averaged over all cultivars. Red Delicious shoot growth followed a linear pattern for approx. ten weeks after bloom.

Summary

- The influence of Apogee in reducing infections caused by E. *amylovora* appears to be related to its direct effect on retarding growth rather than some other intrinsic change within the plant
- Strong rootstock differences in susceptibily/tolerance to E. *amylovora* exist which appear unrelated to vigour and extension shoot growth
- To maximize the effect of the Apogee, sequential sprays should commence at bloom or petal fall when less than 5 cm growth has occurred
- The growth response to Apogee was similar for all of the five cultivars examined in this study
- Two applications of 125 mg·L^{-1} beginning at petal fall and spaced at two week intervals was as equally effective as four sprays beginning at petal fall and spaced at two week interavls

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