Effects of Gibberellin Synthesis Inhibition on Feeding Injury by Potato Leafhopper on Apple

Kathleen Leahy, Duane Greene, and Wesley Autio
Department of Plant & Soil Sciences, University of Massachusetts

Overview

Although the gibberellin synthesis inhibitor Apogee (prohexadione-calcium) was introduced in apple primarily as a horticultural tool to reduce shoot length and thereby decrease the amount of necessary pruning and associated costs, the inhibition of gibberellin synthesis has also shown beneficial effects in controlling some important pests of apple. The most dramatic effect has been seen on the shoot-blight phase of the bacterial disease fire blight, but some effects have also been seen on flush-growth-feeding insects such as green apple aphid and obliquebanded leafroller. To date, however, no studies have been published on the effects of Apogee on potato leafhoppers *Empoasca fabae* (Harris) (Byers et al., 1997; Paulson and Hull, 1999; Yoder et al., 1999).

Potato leafhoppers are occasional orchard pests in the mid-Atlantic and Northeast. These insects are not able to winter in the north. They overwinter in the southern United States and migrate northward on storm systems over the course of the spring and early summer. In apple, they feed in vascular tissue in rapidly-developing shoot tissue. In mature trees, this injury is not generally considered serious, although in young trees it may be necessary to apply control measures for a moderate to severe infestation. There is, however, some evidence that potato leafhoppers may play a role in facilitating the shoot-blight phase of fire blight, by introducing feeding wounds in susceptible tissue on which *Erwinia amylovora*, the bacterium which causes fire blight, is growing epiphytically (on leaf surfaces), allowing the bacteria to invade the leaf and cause infection (Koehler, 2000; Pfeiffer et al., 1999).

Since potato leafhoppers feed directly on tissue likely to be affected by gibberellin synthesis inhibition, we thought that the possibility of suppressing or even completely controlling these leafhoppers with Apogee or a similar gibberellin synthesis inhibitor was strong enough to warrant further study. This work was done as part of a larger study looking at the interactions of gibberellin synthesis and potato leafhoppers with fire blight.

Materials & Methods

A 200-tree section of a block of 15-year-old McIntosh/M.7 at Scott Farm in Dummerston, Vermont was used for the study. A randomized-complete-block design was used, with ten replications and two trees per treatment within each replication. Buffer trees were employed within the row, and a buffer row was employed between treated rows. Apogee was applied at the rate and timings recommended for commercial growers in this area, 12 oz per 100 gallons dilute at early petal fall (May 12) and a second application at the same rate when growth would have been expected to resume, June 1.

There were two levels of two treatments used in this experiment: Apogee treated and non-treated, and potato leafhoppers excluded or permitted. The insecticide Provado (imidacloprid) was used for exclusion, at the highly reduced rate of 0.5 oz per 100 gallons dilute recommended by researchers at the Cornell Hudson Valley Laboratory (Scaffolds newsletter, June 2001). Provado was applied when potato leafhoppers began to appear in the orchard, June 22, and was re-applied when numbers appeared to be resurging, July 20.

Shoot length was measured using a measuring tape

on five shoots per tree (10 shoots per tree for the first two sample sessions) at 10-day intervals beginning at petal fall to assess the effectiveness of the Apogee treatment. Potato leafhopper injury was evaluated with a spectrophotometer early in the season, but this method became cumbersome and was eventually supplemented with a visual rating scale of injury, with 0 being no visible injury and 5 being severe injury. Because of the high mobility of potato leafhopper adults, which were the predominant life stage, we did not succeed in getting a reliable count of leafhopper numbers per shoot. In future studies a field-adapted vacuum cleaner device may be used for this purpose.

Results & Discussion

Shoot length measurements showed that Apogee had a highly significant effect on shoot growth (Figure 1), both in the presence and absence of potato leafhoppers. Potato leafhoppers arrived later than usual in New England and did not reach high numbers in any location, leading to a fairly low damage level in the control. Using the visual rating scale assessment of leafhopper injury, Apogee and Provado, individually, had a highly significant effect on reducing leafhopper injury (Figure 2). Where both materials were used together, leafhopper injury was singificantly lower than where either material was used alone. On the last assessment date, August 15, 2001, the average level of feeding injury where Apogee was used alone was 0.83, where Provado was used alone was 0.78, and where both were used together was 0.31. Untreated control trees showed an injury level of 2.13 for this date. Thus, there appears to be a substantial benefit to potato leafhopper control using Apogee either alone or in combination with insecticide.

The mechanism by which gibberellin inhibition affects leafhopper feeding is not known and will be investigated further. The enhanced effect of Apogee plus insecticide may be due to the reduction in new,

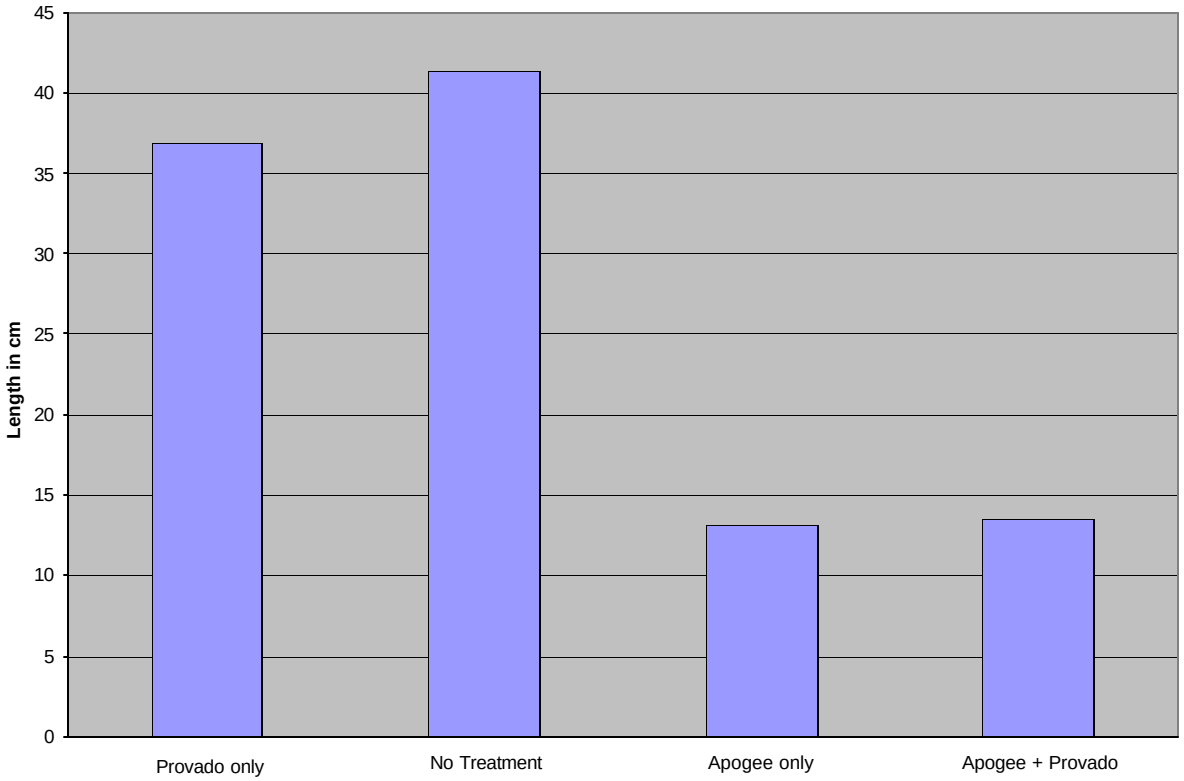

Figure 1. The effects of Apogee and Provado on shoot growth of 15-year-old McIntosh/M.7 trees.

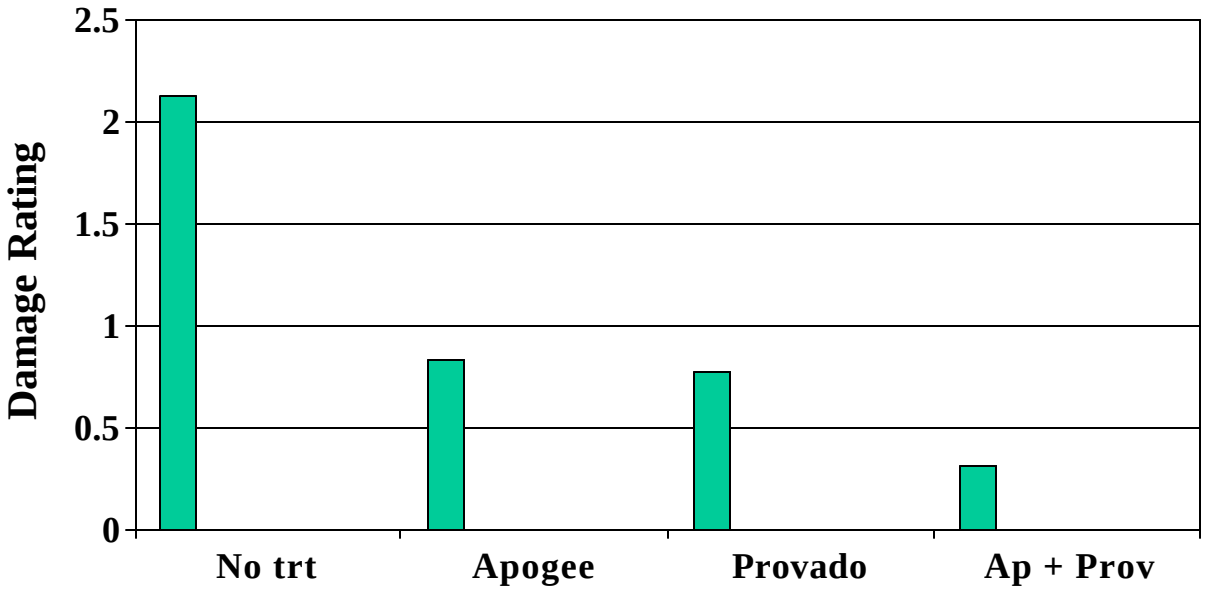

Figure 2. Potato leafhopper damage (0-5 scale, with 0 being no injury and 5 being severe injury) on 15-year-old McIntosh/M.7 trees as affected by Apogee and Provado.

untreated leaf area where shoot growth is inhibited. For Apogee alone, it is possible that visual or chemical cues used by the insects are muted by the treatment, or it could be that the leafhoppers begin feeding but find the treated plant unpalatable. Behavioral studies of potato leafhoppers exposed to Apogee-treated and nontreated foliage separately and in choice situations will be conducted to try to elucidate the nature of the response.

Regardless of the reason, however, the fact that injury appears to be reduced by the inhibition of gibberellin synthesis is of significance for growers needing to control this insect. Specifically, where Apogee has been used and leafhopper numbers are not exceptionally high, there may be no need for an insecticide directed at the leafhoppers. In cases where a severe fire blight outbreak is in progress and leafhopper numbers are high, an insecticide may still be warranted, and should hopefully have greater efficacy in combination with the Apogee.

More work needs to be done to understand the nature of the effects of gibberellin synthesis inhibition on leafhoppers and on to understand the relationship between potato leafhoppers and fire blight. In addition, it would be enlightening to repeat the experiment under higher populations of potato leafhopper and see whether or not the effects continues to hold true, or are muted or enhanced under such conditions.

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