CCNB Project No. 5500-182

CALIFORNIA CITRUS NURSERY BOARD

Final Report for 2010

Project Title: Optimization of imidacloprid application rates for the management of ACP on containerized citrus

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Objectives:

1. Assess the uptake of imidacloprid soil treatments at different application rates for the systemic protection of containerized citrus trees from feeding by the Asian Citrus Psyllid (Year 1)
2. Determine the impact of potting media on the uptake of imidacloprid drench treatments (Year 1)
3. Determine the impact of container size on the uptake of imidacloprid drench treatments (Year 2)
4. Determine the persistence of imidacloprid treatments applied at wholesale nurseries (Year 2)

Accomplishments/Findings During the Reported Period:

This project was jointly funded by the California Citrus Nursery Society and the California Citrus Research Board. We report here the results of research conducted up to Dec 31, 2010, which includes data from an ongoing trial that will be completed in April 2011. The full results from this trial, and 2 others planned for the Spring and Summer of 2011, will be reported in the final report due to the CRB in Oct, 2011.

In California, regulated citrus nursery stock must be treated under regulatory supervision with both a systemic and foliar pesticide in order to move within the area quarantined for Asian citrus psyllid (ACP). Imidacloprid is one of the systemic options available to growers and is the focus of our research at UCR. The CDFA typically interprets quarantine guidelines as requiring that the maximum label rate of the systemic product be used. Application at the maximum label rate listed for psyllids then allows movement of regulated nursery stock within the area quarantined for ACP for a 3-month period. At the time we submitted our proposal in 2009, efforts were underway by Bayer CropScience to raise the maximum label rate of Admire Pro for ACP control

from 0.33 ml/cu ft to 5 ml/cu ft potting media, a 15-fold increase. Although that label was approved, the CDFA is not enforcing the use of the maximum label rate until data are available supporting the need for such a comprehensive increase, based largely on our research. Our trials are designed to evaluate different application rates, as well as several factors that might impact the uptake of imidacloprid into potted citrus, and the data generated will then be used in the decision-making process concerning suitable rates of application.

Trial 1 – Assess the Uptake of Imidacloprid at 2 Application Rates into Minneola Tangelos Budded on Carrizo and Macrophylla

In this trial, we compared the uptake of imidacloprid into 2-year old Minneola Tangelos growing in 5 gallon pots. The trees were budded onto 2 rootstocks (Carrizo and Macrophylla), allowing us to determine whether there was an impact of rootstock on uptake. Imidacloprid was applied as Admire Pro at 2 treatment rates – 0.33 ml/cu ft and 5 ml/cu ft potting media – to 8 trees from the 4 possible treatment rate/rootstock combinations. To assess the efficacy of the treatments, we used 200 ppb imidacloprid as the target concentration. This concentration was determined by Dr Mamoudou Setamou of Texas A & M to be effective at controlling ACP nymphs.

There was a clear effect of rate on the uptake of imidacloprid, with higher concentrations present in trees treated with the 5 ml/cu ft rate. In Figure 1, data are plotted on a log scale to demonstrate the substantial differences in residues at the 2 rates. In trees treated with 0.33 ml/cu ft, 3 – 4 weeks elapsed before the 200 ppb imidacloprid threshold was reached. However, once the threshold concentration was reached, there was excellent persistence of imidacloprid within the trees. In trees treated with the 5 ml/min rate, thresholds were reached within 1 week of applications, and there was excellent persistence of imidacloprid within the trees. However, there was a vast excess of imidacloprid in trees treated at the higher rate, indicating that lower application rates might be just as effective at protecting the trees within the required certification period.

Although the 200 ppb threshold was reached within 1 week in all trees treated at the higher rate, the rate of imidacloprid uptake was faster and peak concentrations were higher in trees that were budded on Macrophylla rootstock (Figure 1). However, after week 12, the concentrations of imidacloprid were consistently higher in trees budded on Carrizo rootstock, suggesting a decline in imidacloprid reserves from the trees budded on Macrophylla.

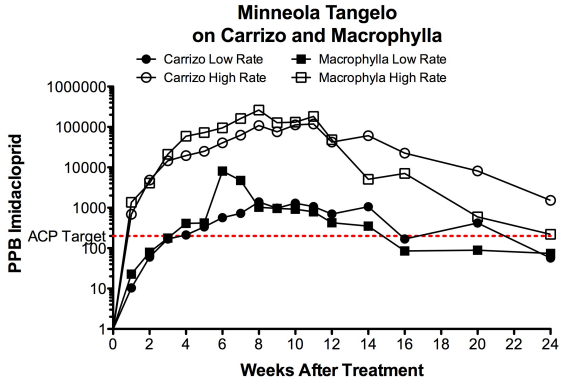


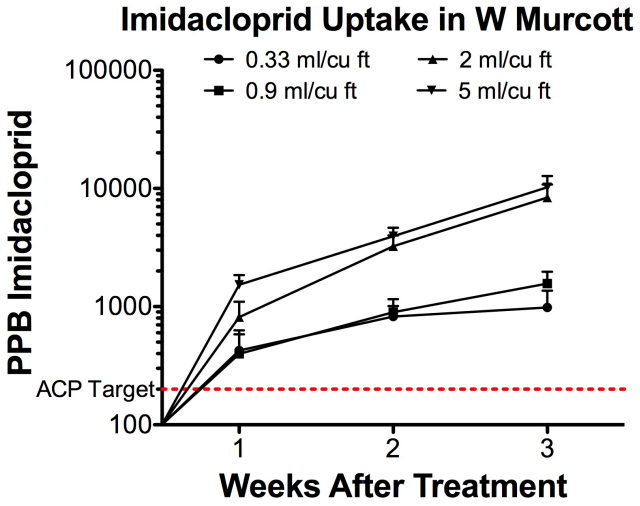
Figure 1. Uptake of imidacloprid into 2-year old Minneola Tangelos budded on Carrizo and Macrophylla rootstocks. Trees were treated with Admire Pro at 0.33 ml and 5 mls/cu ft potting media. Each point represents the mean concentration of imidacloprid for 8 trees. The red dashed line indicates the target threshold of imidacloprid required for ACP control.

Trial 2 – Assess the Uptake Imidacloprid at 4 Application Rates into W Murcott Mandarin Oranges Budded on Trifoliate

In this trial, we compared the uptake of imidacloprid into 2-year old W Murcott mandarin oranges growing in 5 gallon pots. The trees were budded onto Trifoliate rootstock. Imidacloprid was applied as Admire Pro at 4 treatment rates – 0.33 ml/cu ft, 0.9 ml/cu ft, 2 ml/cu ft and 5 ml/cu ft potting media – with 8 trees per treatment and 8 untreated trees for controls. In this report, we present the first 3 weeks of monitoring data.

Imidacloprid concentrations were above the 200 ppb threshold in all trees at 1 week after treatment, even in trees treated with the lowest rate. This is in contrast to the data from Trial 1, where at least 3 weeks elapsed before threshold concentrations were reached at the 0.33 ml rate. Concentrations were highest in trees treated with the 5 ml/cu ft rate, and were comparable with those measured in Trial 1 in trees treated at the 5 ml/cu ft rate. For all treatments, concentrations were still increasing at 3 weeks. We will continue to monitor the imidacloprid levels in these trees for a total of 24 weeks.

Figure 2. Uptake of imidacloprid into 2-year old W Murcott mandarin oranges budded on Trifoliate. Trees were treated with Admire Pro at 0.33 ml, 0.9 ml, 2 mls and 5 mls/cu ft potting media. Each point represents the mean concentration of imidacloprid for 8 trees. No imidacloprid was detected in the control trees. The red dashed line indicates the target threshold of imidacloprid required for ACP control.



Assessing the efficacy of imidacloprid treatments in commercial nurseries

The reason for evaluating imidacloprid levels in nursery trees was to get some idea about the efficacy of imidacloprid treatments under nursery conditions. At a commercial nursery in Fallbrook, CA, we evaluated the uptake of imidacloprid in trees treated with Admire Pro. This nursery was located outside the quarantine zone during our sampling period and treatments were applied to control citrus leafminer. Trees at this nursery were treated through their drip system. When we visited the nursery, all trees used for sampling had received 2 Admire Pro applications, both at the 0.33 ml/cu ft rate. The first treatment was on May 18, the second on Aug 18. We sampled leaf tissue on Sept 8 and Oct 21 from a variety of rootstock/scion combinations and container sizes. Table 1 provides details of the trees used in the sampling program.

Table 1. Trees used for imidacloprid monitoring at commercial Fallbrook nursery

Scion	Rootstock	Container Size
Bearrs Lime	Trifoliate	5 gal
Eureka Lemon	Trifoliate	5 gal
Valencia	Trifoliate	5 gal
Valencia	Trifoliate	15 gal
Valencia	C35	15 gal

In all trees, imidacloprid concentrations collected 3 weeks (Sept 8) after the most recent Admire Pro application were above the 200 ppb target level. Most notably, the highest concentrations were in the Valencia trees budded on C35, levels that were 6.5-fold higher than in the Valencia/Trifoliate combination growing in similar sized pots (Figure 2). This result provides further confirmation that the rootstock may impact the rate of uptake of systemic insecticides. In consultation with industry experts, they were not surprised by this data, explaining that the Trifoliate rootstock would be more challenging, particularly during the cooler months when the rootstock has a tendency to go dormant.

There was a dramatic decline in imidacloprid concentrations in all trees at 9 weeks after treatments, although the Valencia/C35 trees still retained the highest concentrations. The trees were flushing regularly, and it is likely that the imidacloprid titers in the trees had been diluted by the emergence of new foliage since the first samples had been taken 6 weeks earlier.

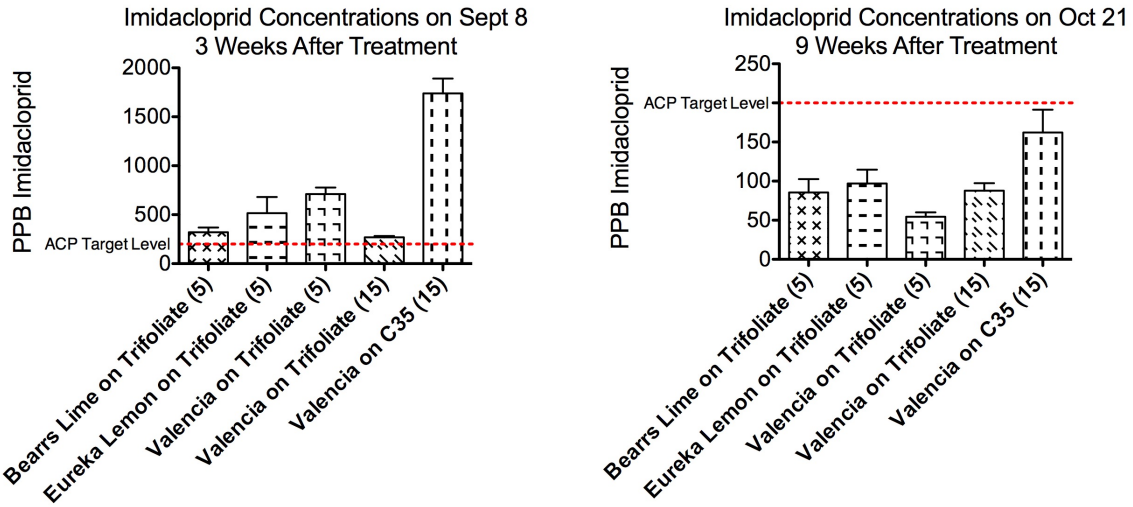


Figure 3. Uptake of imidacloprid at a commercial nursery in Fallbrook, CA (see Table 1 for details on the trees). Trees were sampled at 3 and 9 weeks after the most recent Admire Pro application (0.33 ml/cu ft potting media). The red dashed line indicates the target threshold of imidacloprid required for ACP control.

Practical Applications For the Citrus Nursery Industry

Our data are the first to quantify the residues of imidacloprid in treated nursery citrus. This information will prove invaluable to the industry as it develops control strategies for ACP. It is

important that we understand how effective different application rates of imidacloprid are in terms of the speed of uptake and longevity of protection. Our results are encouraging because they show that imidacloprid will move into trees very rapidly and can provide long-term control of ACP. The techniques we are using in our evaluations will allow us to determine the likely impacts of factors such as soil type, rootstock, container size, formulation, etc, on the uptake of imidacloprid. With this information, we can make recommendations to the industry on how best to deploy imidacloprid in nurseries for ACP control. At this time in our research, we can make several conclusions from our data.

- Higher rates of Admire Pro application will guarantee higher levels of imidacloprid in the leaf tissue. At application rates we tested (0.33 ml and 5 mls/cu ft potting media), we observed no saturation of imidacloprid levels when rates were increased. Thus, increasing the application rate will lead to a higher concentration of imidacloprid in the foliage.
- On 2-year old containerized trees, the maximum allowable rate under the label of 5 mls/cu ft potting media would seem to be excessive. While the use of this rate will ensure the protection of trees, the concentrations of insecticide in the foliage were in vast excess of that which is required for management of ACP. We are currently evaluating additional rates of application intermediate between the 0.33 ml and 5.0 ml rates.
- Additional information is required to determine whether there is a rootstock effect on imidacloprid uptake. The data we have generated thus far suggest that there is an effect; we observed differences in uptake between Minneola Tangelos on Carrizo and Macrophylla, with more rapid uptake in the Macrophylla trees. Monitoring data from a commercial nursery showed higher concentrations of imidacloprid in Valencia trees budded on C35 compared with similarly aged trees on Trifoliate. We will conduct a trial in Spring 2011 that will investigate this issue further.
- Monitoring of imidacloprid levels in nursery stock is an important exercise if we are to optimize imidacloprid use for containerized citrus. The ACP targets the youngest flush on trees for feeding and oviposition, so it is imperative that young flush is protected. Protecting the young flush is probably the biggest challenge for imidacloprid because there may be a lag-time between the emergence of new flush and the establishment of imidacloprid in that tissue. For this reason, the foliar treatments are critical to provide the protection to the flush until the imidacloprid becomes established at toxic concentrations.
- In Trial 1 (Minneola Tangelos), we observed a 3-week delay before the 200 ppb threshold concentration was established in the trees. Therefore, it is important not to assume that once the imidacloprid treatment has been applied that the trees are immediately protected systemically. Again, the importance of the foliar treatments cannot be overstated, particularly when shipments are planned shortly after the imidacloprid treatments.
- In Trial 2 (W Murcott), ACP target thresholds were reached within 1 week. This result is especially encouraging because these trees were budded on Trifoliate. In the commercial nursery, where all trees were located outdoors, imidacloprid uptake was less impressive in the Trifoliate trees treated with the 0.33 ml/cu ft rate. Perhaps conducting the trial in a greenhouse environment has provided conditions (particularly temperature) whereby uptake by the Trifoliate rootstock was improved.