# The Efficacy of Ima-jet (5% Imidacloprid) using Arborjet Micro-Injection Technology to Treat Red Gum Lerp Psyllid *(Glycaspis brimblecombei)* on California Red Gum Eucalyptus Trees (*Eucalyptus camaldulensis).*

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**Abstract**

Sixteen *Eucalyptus camaldulensis.* located in Lemon Hill Citrus, Temecula, California were chosen and flagged for this study, 12 were injected with 5% Ima-jet and 4 were non-injected control trees. The three different rates of 5% Ima-jet were 4mL, 6mL and 8mL. Nine months after treatment, 4 samples from each tree were randomly selected and assessed using the severity of damage/infestation (D/I) rating scale designed for this study. This is a 1-8 scale with 1 being the least D/I and 8 being the most D/I. Twelve leaves from each sample branch were assessed, and the specific leaf location was recorded. Severity of D/I is higher on proximal leaves, and lower on distal leaves. D/I ratings of treatment rates were minor, but there was biological significance of control eucalyptus and treated. Treatment with Ima-jet (5%) indicates an effective reduction in damage/infestation of Red Gum Lerp Psyllid on California Red Gum Eucalyptus Trees.

**Key Words.** Trunk injection; systemic; imidacloprid; Arborjet; red gum lerp psyllid; micro-injection; eucalyptus.

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The red gum lerp psyllid (RGLP) *(Glycaspis brimblecombei)* is foliar pest on red gum eucalyptus trees *(Eucalyptus camaldulensis)*. RGLP is a plant-juice sucking homopteran in the family Psyllidae. This insect was first found in Los Angeles in 1998 and has now spread throughout much of the state of California. It is also found in Florida and Mexico, and has potential to infest the eucalyptus trees growing throughout the southern United States. (Dahlsten et al. 2003) Substantial defoliation of red gum eucalyptus trees has resulted from heavy populations of RGLP. Defoliation caused by these plant-juice sucking homopterans, can result in nutritional stress, disease, and invasion from other insects. (Young 2002)

RGLP nymphs form a protective covering of crystallized honeydew called a lerp. This protective covering over the nymph protects the insects from predators, while it also prevents conventional foliar spraying from making direct contact with the insect. An effective approach to controlling this new pest, along with other foliage pests, may be to execute systemic applications of effective pesticides. (Young 2002) Gill et al. (1999) reported significant results for using systemic insecticides through trunk injection techniques to control sucking insects that feed on ornamental trees. Young (2002) also reported that imidacloprid, because of its long residual in the tree tissue, has a distinct advantage over other pesticides for controlling RGLP infestations.

The objective of this study was to determine the efficacy of 5% Ima-jet delivered by trunk injection with the Arborjet™ air/hydraulic device to minimize RGLP nymph damage in red gum eucalyptus. To provide results on effective dose rates of 5% Ima-jet, we chose three treatments of 4, 6, and 8mL per caliper inch while one set of trees was left untreated.

## Materials and Methods

Sixteen heavily infested *Eucalyptus camaldulensis* in Temecula, California were chosen at random for this study. Twelve trees were randomly chosen and trunk injected in March 2003 with Ima-jet (5% Imidacloprid). Ima-jet was delivered using the Arborjet™ air/hydraulic micro-injection device. Four trees were randomly flagged and left untreated. Mean tree diameter measured 34.5 cm (13.75 in.), and ranged between 20 and 45 cm (8 and 18 in.).

Ima-jet is a newly registered injectable insecticide containing 5% active imidacloprid. Ima-jet is formulated as a soluble liquid with a low viscosity that approximates the viscosity of the xylem sap tissue in *Eucalyptus camaldulensis.* The formulation of this new injectable insecticide (Ima-jet) has shown increased compatibility in tree systems suggesting enhanced tree uptake and distribution throughout the canopy.

Dosage was based on the measurement of tree DBH using a Lufkin D-tape. Of the 12 treatment trees, 4 were injected at a 4mL/cal inch rate, 4 were injected at a 6mL/cal inch rate, and 4 were injected at an 8mL/cal inch rate. Precise dosage delivery was aided by a pressure gauge at the tip of the injection device and an accurate 10-mL dose cartridge (Dose-Sizer™). The mean device pressure setting (primary regulator) was 70psi resulting in a mean tree gauge pressure of 280psi in the sap wood of the injected eucalyptus.

### Arborplugs™

Arborplugs are plastic ports designed by Arborjet, Inc. to be used in conjunction with Arborjet trunk injection systems. The ports, or Arborplugs, taper toward the distal end, and are constructed with a guide cap, anchoring barbs, one-way septum, and infusion legs. (Figure 1) To place the ports, a portable drill is used with a 0.70 cm (9/32 in.) brad point bit to drill 1.6 cm (5/8 in.) into the active sapwood past the bark layer. A specifically designed set tool is used in conjunction with a hammer to insert plugs at a determined depth. Set correctly, the port creates a small reservoir (1.6 cm x 0.70 cm) into which the product is injected and from which it infuses into the transport tissues of the tree. The Arborplug one-way septum is pierced by the probe-like needle of the device, product is delivered to the reservoir and transport tissue, and product remains inside the tree as the needle is removed.

In this study all ports were placed into the eucalyptus trees immediately superior to the trunk flare by using an 18.0v Ryobi drill (model# HP1802M), set tool, and #3 (standard) Arborplugs™. For each tree, the total number of injection sites was

determined using the formula DBH (cm)/5 or DBH (cm)/7.5 [DBH (in)/2 or DBH (in)/3]. DBH = Diameter at Breast Height. A minimum of 4 ports were set at each treated tree.

Non destructive random sampling of all 16 trees was made 9 months following trunk injection. A summary of the 9 month evaluation appears in Table 2. Four sample branches (one from each quadrant) were cut at random from each of the 16 Eucalyptus trees. Each branch was assessed for RGLP nymph damage without prejudice. All samples were assessed using the severity of damage/infestation (D/I) rating scale. (Figure 2)

To create the severity of D/I rating scale, leaf samples were taken from both injected and non-injected eucalyptus trees, and subjectively arranged by the severity of insect damage/infestation over the entire leaf. Insect damage and/or infestation consisted of both live and dead lerps, adult piercing marks, and leaf discoloration and damage. The most severely damaged/infested leaf was marked as 8 and the least severe was marked as 1 on the rating scale of 1-8.

Table 1 associates each number in the severity of D/I scale with a specified percentage of leaf tissue damage, a range of lerps in a $1.5cm^2$ area, a qualitative description to aid in assessment, and the recommended treatment measures. A 1.5cm square section was cut out of cardboard and used as a template to indicate the number of lerps/piercings on template leaves, and assessed leaves. The numbers of lerps, piercing marks, and over all percent of damage were all applied to provide each leaf with a severity rating. The severity of D/I scale was designed to provide a standard and consistent measurement template to assess each eucalyptus leaves in this study.

Twelve leaves off each of 4 sample branches from all 16 Eucalyptus trees were measured by length, width, and assessed to indicate a severity of D/I rating. (Table 1, Figure 2) Four leaves from each of proximal, medial, and distal sections of sample branches were measured and evaluated to provide a maximum of 12 replicates for each branch. Branches with less than 12 viable leaves for evaluation were evenly divided into the proximal, medial, and distal sections within that branch. Example: A branch with 9 viable leaves to evaluate had 3 replicates in each of the 3 sections.


**Figure 1. Number 3 (standard) Arborplug™ used with the Arborjet devices. Arborplug™ ports were set into a drilled hole in the bark and cambial tissue. The Arborjet needle was then inserted through the septa inside the plugs, Ima-jet was delivered at an accurate dose rate, and the needle was removed without loss of injected Ima-jet.**

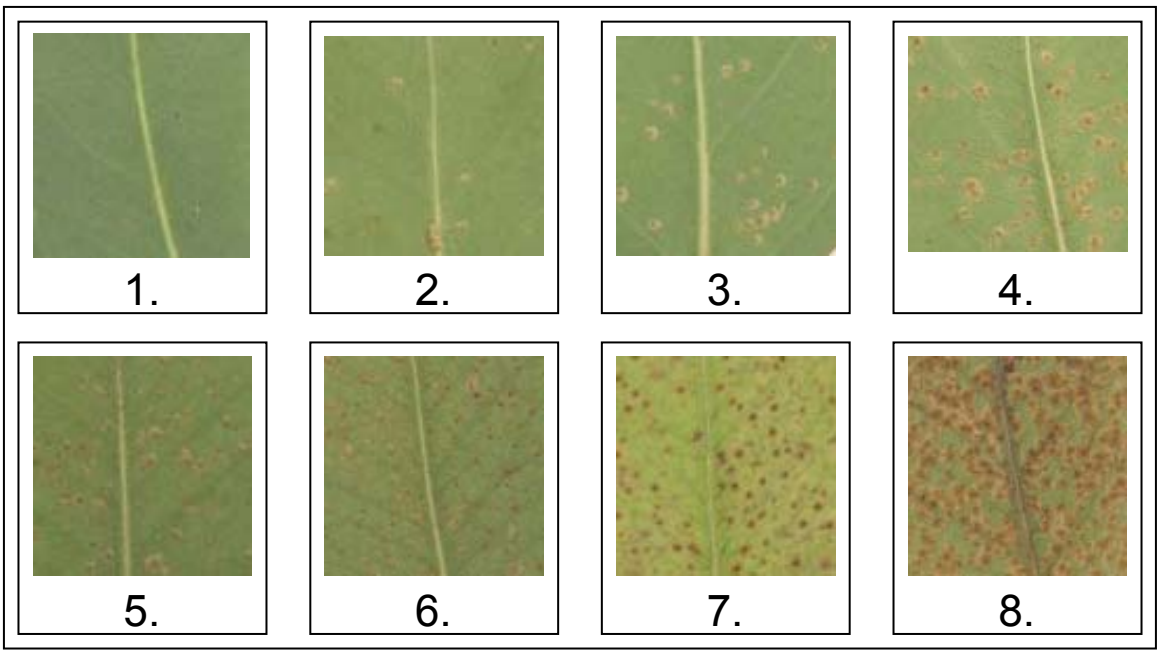


**Figure 1. Template leaves used for the damage/infestation (D/I) severity rating scale of red gum lerp psyllid (RGLP) on red gum eucalyptus. Leaves were collected from both injected and non-injected trees used in the study. Images are 1.5 $cm^2$ sections from the center of the template leaves magnified 4 times. The most severely damaged/infested leaf was given a rating of 8, while the least severe was given a rating of 1.**

**Table 1. Severity of damage/infestation (D/I) rating scale. The D/I assessed in the eucalyptus is a result of red gum lerp psyllid (RGLP). Leaves were assessed by the percent of damage and the number of lerps/piercings present on a 1.5$cm^2$ section of each leaf. Treatment recommendations are based on an entire tree showing a mean of the indicated D/I rating.**

| Severity of D/I Rating | Number of Lerps/Piercings On Template Leaves Used | Range of Lerps/Piercings (1.5$cm^2$) used to Rate Sample Leaves | % Tissue Affected | Qualitative Description | Recommended Treatment |
|---|---|---|---|---|---|
| 1 | 0 | 0 | 0 | Healthy, normal growth, with no sign of D/I | No treatment, and regularly monitor |
| 2 | 6 | 1 – 12 | 1-10 | Minimal D/I with some impact on leaf health. | Treatment necessary, and monitor |
| 3 | 20 | 13 – 25 | 11-25 | Medium D/I with moderate impact on leaf health. | Treatment crucial, and monitor |
| 4 | 45 | 26 – 50 | 26-50 | Significant leaf tissue D/I. | Treatment crucial, and monitor |
| 5 | 60 | 51 – 75 | 51-75 | Major D/I with major impact to leaf tissue | May be beyond treatment |
| 6 | 90 | 76 – 100 | 76-90 | Uniform D/I over entire leaf, decline has begun. | May be beyond treatment |
| 7 | 122 | 101 – 125 | 91-99 | Severely uniform D/I. | Beyond treatment |
| 8 | 150 | 126 - > | 100 | Maximum D/I, minimal green tissue. | Beyond treatment |

## Results

Non-injected eucalyptus trees had a mean severity of D/I rating of 2.51 with a high of 8 and a low of 1. The mean severity of D/I rating for 4 injected trees with Ima-jet (5% imidacloprid) at the 4mL dose rate was 1.70 with a high of 5 and a low of 1. The mean severity of D/I rating for 4 trees with Ima-jet at the 6mL dose rate was 1.68 with a high of 4 and a low of 1. The mean severity of D/I rating for 4 trees with Ima-jet at the 8mL dose rate was 1.45, with a high of 4 and a low of 1. (Table 2)

Leaves on branches from both injected and non-injected eucalyptus showed a decrease in severity of D/I rating from a proximal to distal position on the branch. When treated trees are compared to untreated trees by leaf position, Ima-jet trunk injected trees showed a lower severity of D/I rating than those non-injected. (Figure 2)

Comparing average treated and untreated trees by leaf position, the average difference between each leaf is 0.9 on the severity of D/I scale.

**Table 2. Mean results of 4 eucalyptus trees in each of 3 micro-injected rates plus 4 non-injected trees. Damage/infestation caused from red gum lerp psyllid or glassy-winged sharpshooter. Severity of damage/infestation (D/I) rating scale designates 8 as the most severely damaged/infested leaf and 1 as the least severe. Severity of D/I rating above 2.0 may indicate a need for intervention.**

| Treatment | #of Trees | Mean Actual Dose (mL/cal inch) | Mean Tree DBH | Mean DBH/ x | Mean #Plugs/Tree | Mean Total mL | Mean mL/Plug Site | Mean Severity of Damage/ Infestation (D/I) |
|---|---|---|---|---|---|---|---|---|
| **Non-injected** | 4 | NA | 13.5 | NA | NA | NA | NA | **2.51** |
| **4mL 5% Ima-jet/ cal inch** | 4 | 4.37 | 13 | 2.6 | 5 | 56.75 | 11.33 | **1.70** |
| **6mL 5% Ima-jet/ cal inch** | 4 | 6.28 | 14.25 | 2.4 | 6 | 89.50 | 15.53 | **1.68** |
| **8mL 5% Ima-jet/ cal inch** | 4 | 8.30 | 14.25 | 2.5 | 5.75 | 118.25 | 20.20 | **1.45** |

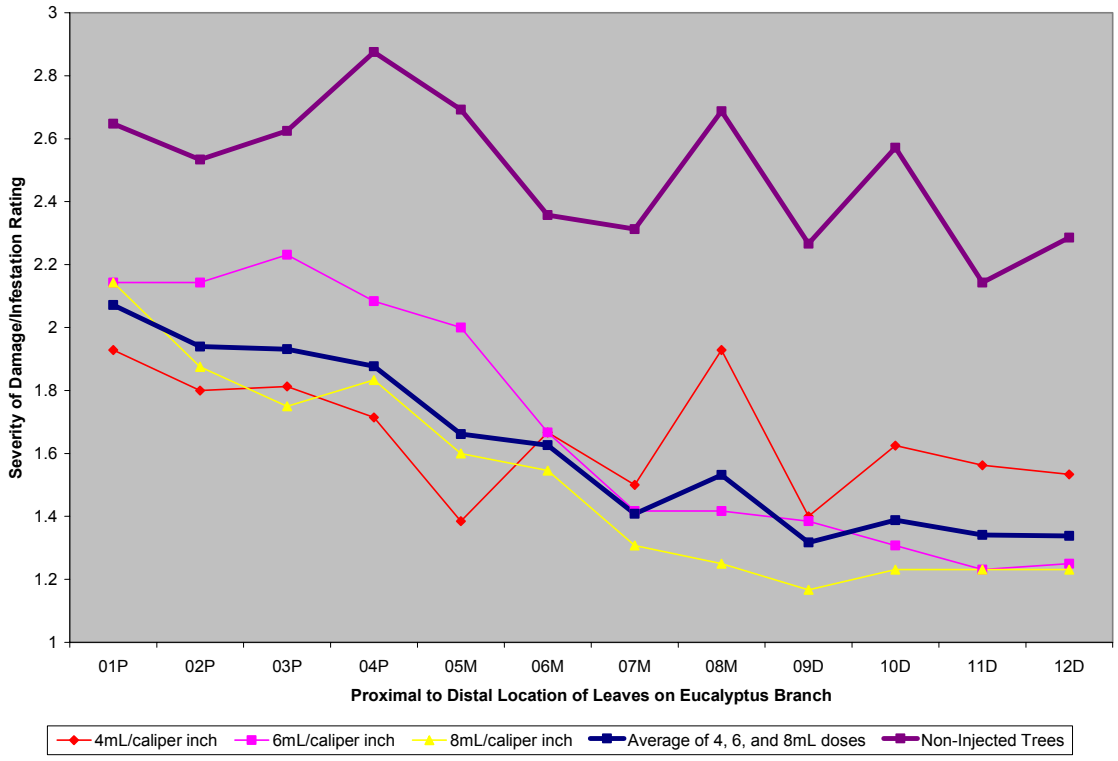


**Figure 2. Mean severity of damage/infestation (D/I) from RGLP and by leaf location of 5% Ima-jet micro-injected *Eucalyptus spp.* at rates of 4, 6, and 8mL/caliper inch and non-injected trees. Severity of damage/infestation rating scale designates 8 as the most severely damaged/infested leaf and 1 as the least severe. Twelve leaves from each sample branch were given a severity of damage/infestation rating and each assigned a number and letter to designate a proximal, medial, or distal position.**

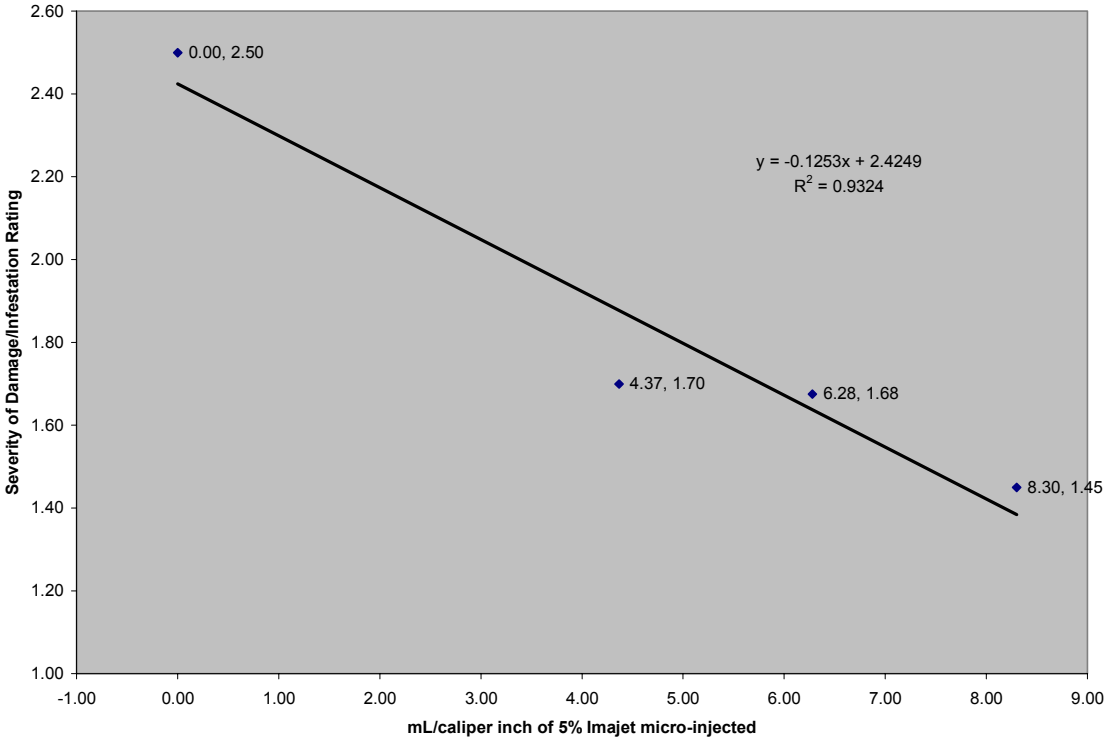


**Figure 3. Mean severity of damage/infestation (D/I) for treatments of 5% Ima-jet at mean rates of 4.37, 6.28, and 8.30 mL/ caliper inch. Means were derived from all leaves assessed from four trees in each of the treatments and control. Severity of damage/infestation rating scale designates 8 as the most severely damaged/infested leaf and 1 as the least severe.**

**Conclusions:**

All three treatments of Ima-jet (5% imidacloprid) injection rates showed biological significance in the reduction of RGLP damage and infestation when compared to the untreated eucalyptus. Table 2 indicated a reduction from the untreated severity of D/I rating of 2.5 to ratings of 1.70, 1.68, and 1.45 for the 4mL, 6mL, and 8mL rates respectively. This suggests that nine months after injection of Ima-jet there is a significant decrease in RGLP population.

By breaking each branch assessed into the leaf location there is stronger evidence that the treatments have an effect on the severity of D/I rating. Each branch assessed showed a decrease in severity of D/I from proximal to distal ends. Proximal leaves on all branches were growth from several years ago, therefore more heavily infested and showing more damage on both treated and untreated trees. Distal leaves represented new growth, therefore were less infested and showed less damage on both treated and untreated trees. (Figure 2)

Since there is a correlation between the severity of D/I and leaf position on all samples, comparing treated and untreated trees by leaf position is an accurate measure of efficacy.

The average difference between treated and untreated trees at each leaf position is 0.9 on the severity of D/I scale which is almost one full point on the scale. Reducing the severity of D/I by almost one point on the scale indicates a significant reduction in the number of lerps/piercings on each leaf.

When comparing treated and untreated damage/infestation by leaf position, Ima-jet shows effective reduction of pest D/I in new leaf growth, and also in old leaf growth.

The RGLP is a piercing sucking insect in the order of Homoptera, which also includes other insects such as cicadas (Cicadidae), leafhoppers (Cicadellidae), jumping plant lice (Psyllidae), white flies (Aleyrodidae), aphids (Aphididae), and scale insects. (Pedigo 1999) The efficacy of Ima-jet on RGLP in this study may indicate similar control effects on these insect families.

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