LABORATORY AND FIELD EVALUATIONS OF NEONICOTINOID INSECTICIDES AGAINST THE GLASSY-WINGED SHARPSHOOTER

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ABSTRACT

Imidacloprid is still the most widely used neonicotinoid for the protection of grapevines against glassy-winged sharpshooter (GWSS) feeding and Pierce's disease (PD) transmission. This insecticide has now entered the generic age and within the past year, several new formulations of imidacloprid have been launched onto the market. To assist with grower acceptance of these new formulations, we are currently evaluating the uptake of different products in table and wine grapes. Bayer CropScience introduced Admire Pro to replace their original Admire 2F formulation. In Coachella Valley, the imidacloprid uptake profiles for vines treated with either Admire Pro or Admire 2F were similar, with peak uptake occurring within four days. In a further study, the uptake profile for Admire 2F was also consistent with a second soluble concentrate formulation (Nuprid 2F, marketed by Nufarm Americas Inc.).

We evaluated the performance of the neonicotinoid thiamethoxam (applied as Platinum) at three rates of application in a Temecula Valley wine grape vineyard. The concentrations of thiamethoxam in xylem fluid extracts were highest at the top application rates, and would provide good protection to vines against a sharpshooter infestation.

INTRODUCTION

Effective vector management through the use of the neonicotinoid insecticide, imidacloprid, has played a pivotal role in suppressing glassy-winged sharpshooter (GWSS) populations in California vineyards and citrus orchards (Castle et al., 2005; Byrne and Toscano, 2006). This in turn has greatly decreased the incidence of new Pierce's disease (PD) outbreaks in vineyards. With the expiry of the imidacloprid patent, there are now more formulations of this active ingredient becoming available to growers. To assist with grower confidence in the new products, we are evaluating their performances by measuring the uptake into vines (table and wine grapes) by extracting xylem fluid and quantifying the insecticide concentrations therein.

There are several insecticides within the neonicotinoid class with good systemic activity and each has its own distinct chemical properties that influence the efficacy with which the insecticide will work in the field. Systemic insecticides are commonly applied to vines through drip irrigation systems. This type of application is designed to deliver the insecticide close to the roots of the vines where more effective uptake into the plant xylem system can occur. In this way, systemic insecticides can directly exploit the xylophagous feeding behavior of the sharpshooter. Distribution of the insecticides within the plant xylem system can also provide more effective coverage of sharpshooter feeding sites and better persistence compared with foliar applications of the same product. As the number of available neonicotinoids increases, it is important to continue research efforts in order to better understand their behavior in California vineyards and to optimize their use by growers. Our studies in Coachella and Napa, for example, have shown that imidacloprid does not work consistently under all conditions experienced in California vineyards (Toscano and Byrne, 2005; Weber et al., 2005). We have, therefore, established a research program to examine the behavior of the different neonicotinoid insecticides within California vineyards.

In this report, we provide data on (1) the uptake and persistence of imidacloprid applied as different formulations, and (2) the impact of different rates of Platinum application on the uptake of thiamethoxam into grapevines.

OBJECTIVES

1. Determine the impact of soil type and irrigation on the uptake and residual persistence of neonicotinoid insecticides.
2. Develop an ELISA for the detection and quantification of dinotefuran residues within plant tissues.
3. Determine the uptake and persistence of imidacloprid, thiamethoxam and dinotefuran in grapevines in order to maximize protection of vineyards.

RESULTS

Evaluation of Imidacloprid Formulations

We evaluated the uptake of imidacloprid applied as Admire Pro, Admire 2F and Nuprid 2F (Figure 1). Admire Pro was introduced by Bayer CropScience to replace Admire 2F, while Nuprid 2F was introduced by Nufarm Americas Inc to compete for the Admire 2F market. Nuprid 2F and Admire 2F are both formulated as soluble concentrates.

In a study conducted at a Coachella Valley vineyard (two year old Superior), the profiles for the uptake and persistence of imidacloprid applied as either Admire Pro or Admire 2F were similar. Peak levels within the xylem fluid were reached within four days and persisted within the vines at sharpshooter threshold levels of 10 ppb for approximately 30 days.

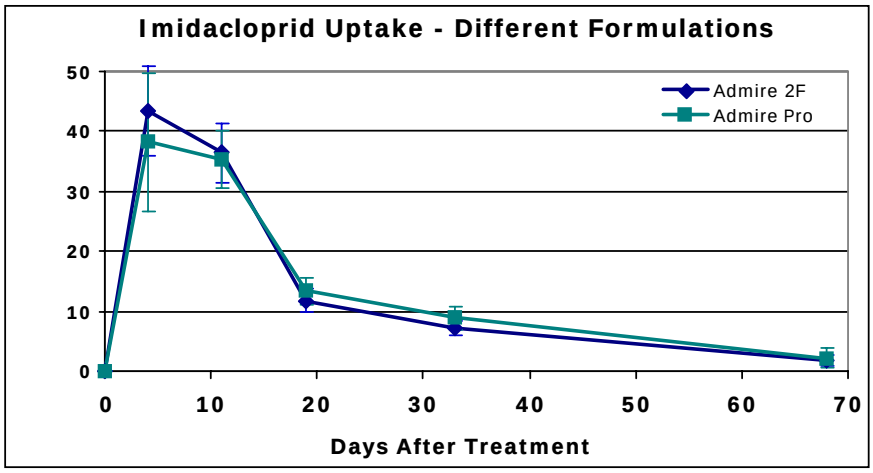

Figure 1. Uptake of imidacloprid applied as Admire Pro (7 fl oz/acre) and Admire 2F (16 fl oz/acre) to two-year old Superior table grapevines in a Coachella Valley vineyard. Although the product application rates were different, they deliver the same amount of active ingredient to the vines. Each point represents the mean (± SEM) for six vines.

In a second Coachella Valley vineyard (20 year old Perlettes), we compared the uptake of imidacloprid applied as either Admire 2F or Nuprid 2F. The uptake and persistence profiles for both products tracked each other well (Figure 2). Although the target thresholds for sharpshooter mortality were reached within five days, the peak uptake was not observed until about 12 days after the applications were made. The differences in uptake dynamics between the two sites (Figures 1 and 2) are likely to reflect differences in vine age.

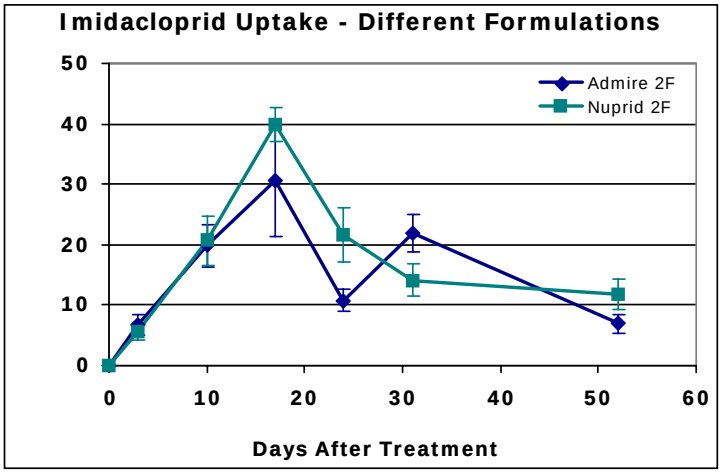

Figure 2. Uptake of imidacloprid applied as Admire 2F and Nuprid 2F to 20-year old Perlette table grapevines in a Coachella Valley vineyard. Each product was applied at 16 fl oz/acre. Each point represents the mean (± SEM) for 6 vines.

In a wine grape vineyard in Temecula Valley, we compared the uptake of Admire Pro and Admire 2F applied by chemigation. The profiles of imidacloprid uptake for both products tracked each other very well (Figure 3). The initial rate

of uptake was disappointing; however, the study was conducted in a commercial vineyard under normal operating practices. Water was minimal for several weeks following the initial application. The major peak in uptake coincided with increased water usage during a very hot period in the local weather. The data reinforce our earlier affirmation that irrigation is absolutely necessary to drive the imidacloprid into the vines.

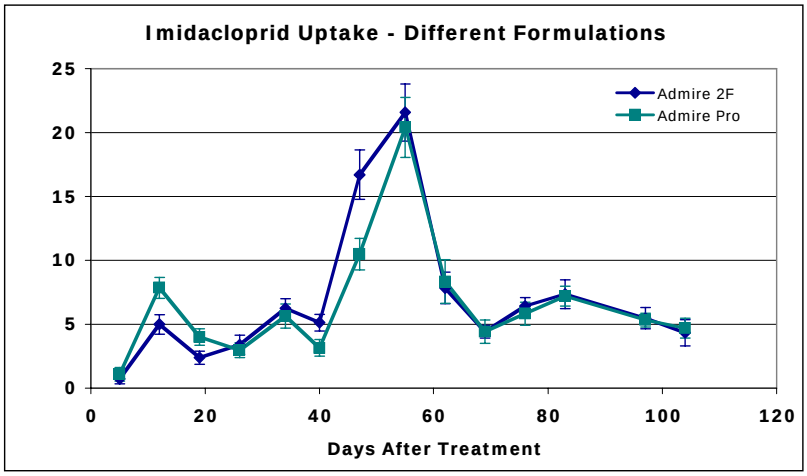

Figure 3. Uptake of imidacloprid applied as Admire Pro (7 fl oz/acre) and Admire 2F (16 fl oz/acre) to seven-year old Cabernet wine grapevines in a Temecula Valley vineyard. Although the product application rates were different, they deliver the same amount of active ingredient to the vines. Each point represents the mean (± SEM) for 16 vines.

We assessed the uptake of thiamethoxam (Platinum) applied by chemigation at three rates (Figure 4). The detection of thiamethoxam within extracts of xylem fluid was again determined by the frequency of irrigation, with peaks in concentrations matching the water usage. The 8 fl oz application rate provided an average of least five ppb thiamethoxam throughout the assessment period. This concentration of insecticide should provide good protection to vines against the glassy-winged sharpshooter given the two-fold greater level of toxicity of thiamethoxam compared to imidacloprid (Byrne and Toscano, 2004).

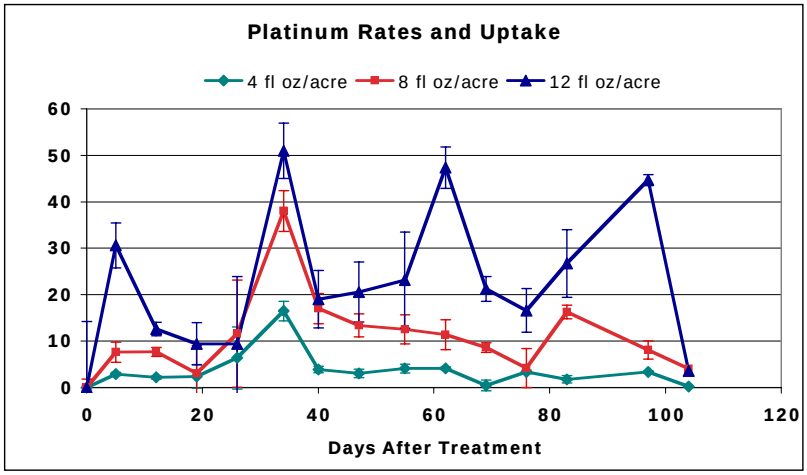

Figure 4. Uptake of thiamethoxam applied as Platinum to seven-year old Cabernet wine grapevines in a Temecula Valley vineyard. Each point represents the mean (± SEM) for 8 vines.

CONCLUSIONS

Management of sharpshooter populations is key to minimizing the spread of PD. The neonicotinoids have been effective at achieving area-wide management of this important disease vector, resulting in a dramatic decrease in the incidence of PD. In our studies, the newer imidacloprid formulations performed equally well in both table and wine grape vineyards. Thus, growers can be confident that, if correct application guidelines are adhered to, the use of generic formulations of imidacloprid will provide them with continued success in their efforts at managing the glassy-winged sharpshooter.

The use of Platinum in vineyards looks extremely promising. At application rates lower than those for the imidacloprid formulations, there was excellent uptake and persistence of thiamethoxam in the xylem system at levels toxic to GWSS. Applications of Platinum at rates much lower than the maximum allowable label rate will also minimize potential residue problems that were a concern to us in our previous studies.

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RIVERSIDE COUNTY GLASSY-WINGED SHARPSHOOTER AREA-WIDE MANAGEMENT PROGRAM IN THE COACHELLA AND TEMECULA VALLEYS

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ABSTRACT
Riverside County has two general areas where citrus groves interface with vineyards, the Coachella and Temecula Valleys. The Coachella Valley with 10,438 acres of table grapes in proximity to 12,000 acres of citrus and the Temecula Valley with 2,000 acres of wine grapes in proximity to 1,600 acres of citrus are vulnerable to Pierce's disease (PD), *Xylella fastidiosa* (*Xf*). The grapes in the Coachella and Temecula areas of Riverside County are in jeopardy because of the glassy-winged sharpshooter (GWSS), the vector of the PD bacterium, build up in adjacent citrus groves. Citrus is an important year around reproductive host of GWSS in Riverside County, but also one that concentrates GWSS populations over the winter months during the time that grapes and many ornamental hosts are dormant. GWSS weekly monitoring in citrus and in grapes began in March 2000 in Temecula Valley and 2003 in Coachella Valley by trapping and visual inspections. Systemic insecticides such as Admire (imidacloprid), gave excellent control. Coachella Valley GWSS populations have increased since the treatment program was initiated in 2003 but have declined substantially relative to the pre-action levels due to insecticide applications.

INTRODUCTION
The glassy-winged sharpshooter (GWSS) vectors a bacterium that causes Pierce's disease (PD). This insect and bacterium are a severe threat to California's 890,000 acres of vineyards and $30 billion dollar industry. An area-wide GWSS management program was initiated in Temecula in 2000 to prevent this vector's spread into other California grape growing regions. In Temecula valley itself, the wine grape industry and its connecting tourist industry generate $100 million of revenue for the economy of the area. GWSS/PD caused a 30% vineyard loss and almost destroyed the connected tourist industry. The area wide GWSS management program initiated in the spring of 2000 saved the industry from a 100% loss. Only a continuation of an area-wide GWSS management program will keep the vineyards viable in Temecula. The table grape industry in the Coachella Valley is represented by 10,465 acres of producing vines, which generate fresh market grapes valued at an average of over $110 million annually. The GWSS was identified in the Coachella Valley in the early 1990's. Population increases of this insect in Coachella Valley in the last three years have increased the danger of PD occurrence in this area, as has occurred in similar situations in the Temecula and San Joaquin Valleys. In July 2002, the occurrence of *Xylella fastidiosa (Xf),* the PD bacterium, was found in 13 vines from two adjacent vineyards in the southeastern part of the Coachella Valley. With this discovery, and the increasing GWSS populations, there was and is a real need to continue an area-wide GWSS/PD management program, to prevent an economic disaster to the work forces and connect small businesses of Mecca, Thermal, Coachella, Indio, etc. that depend upon the vineyards for a big portion of their incomes. Only a continuation of an area wide GWSS/PD management program will keep the vineyards viable in Coachella. At present there are no apparent biological or climatological factors that will limit the spread of GWSS or PD. GWSS has the potential to develop high population densities in citrus. Insecticide treatments in citrus groves preceded and followed by trapping and visual inspections to determine the effectiveness of these treatments are needed to manage this devastating insect vector and bacterium. Approximately 1,750 acres of citrus in Riverside County were treated for GWSS in February through July of 2006 between a cooperative agreement with USDA-APHIS and the Riverside Agricultural Commissioner's Office under the "Area-Wide Management of the Glassy-Winged Sharpshooter in the Coachella and Temecula Valleys." The cost of the 2006 Riverside County GWSS treatments was close to $700,000. This is down from the 5,200 acres treated in 2005 at a cost of $1,000,000.

OBJECTIVES
1. Delineate the areas to be targeted for follow-up treatments to suppress GWSS populations in the Temecula and Coachella Valleys for 2006.
2. Determine the impact of the 2005 GWSS area-wide treatments to suppress GWSS populations in citrus groves and adjacent vineyards.