Exirel® Insect Control

Powered by Cyazypyr® active

CITRUS

Technical Information Update.

Impact of Exirel® insect control powered by Cyazypyr® active on transmission of greening disease by Asian citrus psyllid.

The Asian citrus psyllid (ACP), *Diaphorina citri Kuwayama*, is an invasive citrus pest in the U.S. It vectors the bacteria *Candidatus Liberibacter asiaticus*, which causes huanglongbing (HLB) or citrus greening, known as the most devastating disease of citrus in the world. Citrus greening was detected first in Florida citrus in August 2005. Since then, it has appeared in Texas (January 2012) and California (March 2012).

- Managing populations of ACP with insect control products is a recommended practice for reducing the impact of greening on citrus production.
- Exirel insect control was granted reduced-risk classification by EPA for all registered crops and is selective for beneficial arthropods, except bees.
- Exirel insect control has been assigned to IRAC Group 28 (ryanodine receptor modulators). It delivers a novel mode of action for psyllids and other sucking pests with no cross resistance to existing chemistries.
- Exirel insect control impacts insects by impairing muscle function. Intoxicated insects stop feeding rapidly, resulting in excellent plant protection and the reduction of some insect-vectored diseases.

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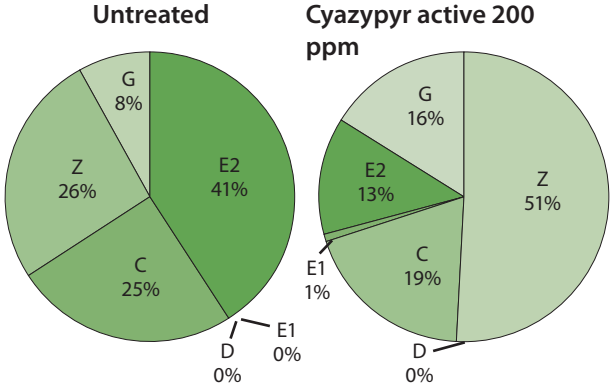
Results from laboratory studies conducted by USDA, IFAS University of Florida and private researchers on the impact of Exirel® insect control powered by Cyazypyr® active to reduce transmission of HLB by Asian citrus psyllid in citrus

Determining the Potential to Reduce Transmission of Greening Disease by Asian citrus psyllid Using Electrical Penetration Graph Studies



Z = nonprobing/nonwalking; C = stylet penetration; D = phloem penetration; E1 = phloem salivation; E2 = phloem ingestion; G = xylem ingestion

Average time calculated using only insects that exhibited specific behavior.

Source: Dr. Marcelo Miranda, Fundecitrus, Sao Paulo, Brazil, and Dr. Rosana Serikawa, DuPont Brazil

* Capoor, S. P., D. G. Rao, and S. M. Viswanath. 1974. "Greening disease of citrus in the Deccan Trap Country and its relationship with the vector, *Diaphorina citri* Kuwayama," pp. 43–49. In L. G. Weathers and M. Cohen [eds.], *Proceedings of the 6th Conference of the International Organization of Citrus Virologists,* 21–28 August 1973, Swaziland. Division of Agricultural Science, University of California, Berkeley, CA.

Buitendag, C. H., and L. A. von Broembsen. 1993. "Living with citrus greening in South Africa." Citrus J. 3: 29–32.

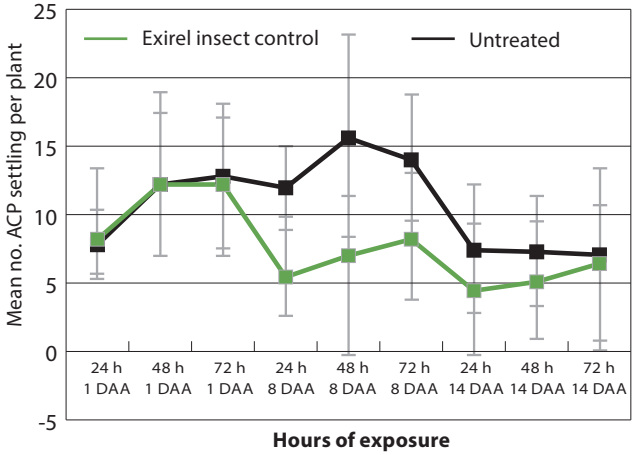
Pelz-Stelinski, K. S., R. H. Brlansky, T. A. Ebert, and M. E. Rogers 2010. "Transmission parameters for *Candidatus* Liberibacter asiaticus by Asian citrus psyllid (Hemiptera: Psyllidae)". *J. Econ. Entomol.* 103(5): 1531–1541.

Laboratory studies were conducted using electrical penetration graph (EPG) technology to monitor ACP feeding as a way to evaluate the impact of Cyazypyr active on reducing the transmission of greening disease.

During a six-hour study, citrus psyllid adults (n = 20 ACP adults/treatment tested) feeding on Cyazypyr active treated citrus spent 13 percent of the time (all behaviors = 1,435 minutes) feeding in the phloem (E2) as compared to 41 percent of the time (all behaviors = 1,523 minutes) when feeding on untreated citrus. It has been determined that HLB transmission requires 15 minutes to seven hours of feeding in the phloem (Capoor, et al., 1974; Buitendag and von Broembsen, 1993*), thus this data indicate that foliar applications of Exirel insect control may reduce the ability of ACP adults to transmit HLB. Furthermore, Exirel insect control is highly effective and provides long-lasting residual control of ACP nymphs. Studies have shown that ACP nymphs also play a key role in the transmission of greening (K. S. Pelz-Stelinski, et al., 2010*).

Determining the potential of Exirel insect control to reduce transmission of greening disease by studying the settling preference of adult citrus psyllids on treated citrus plants

To evaluate the settling behavior of ACP on Exirel insect control-treated versus untreated citrus, adults were tested using one-year-old "Valencia" *Citrus sinensis* plants. Citrus plants were sprayed with Exirel insect control at 0.25 ppm ai and then compared to plants sprayed with the same carrier without Exirel insect control (untreated). Plants were allowed to air dry before moving into cages. Treatments were randomly arranged within each cage as a choice test. The test was repeated at one, eight and 14 days after treatment with Exirel insect control. There were five cages with each cage representing a single replicate. There were four replicates for the test performed 14 days after application. Fifty ACP adults were released into the center of each cage. The cages were housed under temperature-controlled conditions of 25 ± 2°C and 50 ± 5 percent relative humidity with a 14:10 hour light:dark photo period. The total number of ACP settling on each plant was recorded 24, 48 and 72 hours after release.



Source: IFAS, University of Florida, Lake Alfred, Fla., 2014.

*Tiwari, S., and L. L. Stelinski. 2013. "Effects of cyantraniliprole, a novel anthranilic diamide insecticide, against Asian citrus psyllid under laboratory and field conditions." *Pest Management Science.*

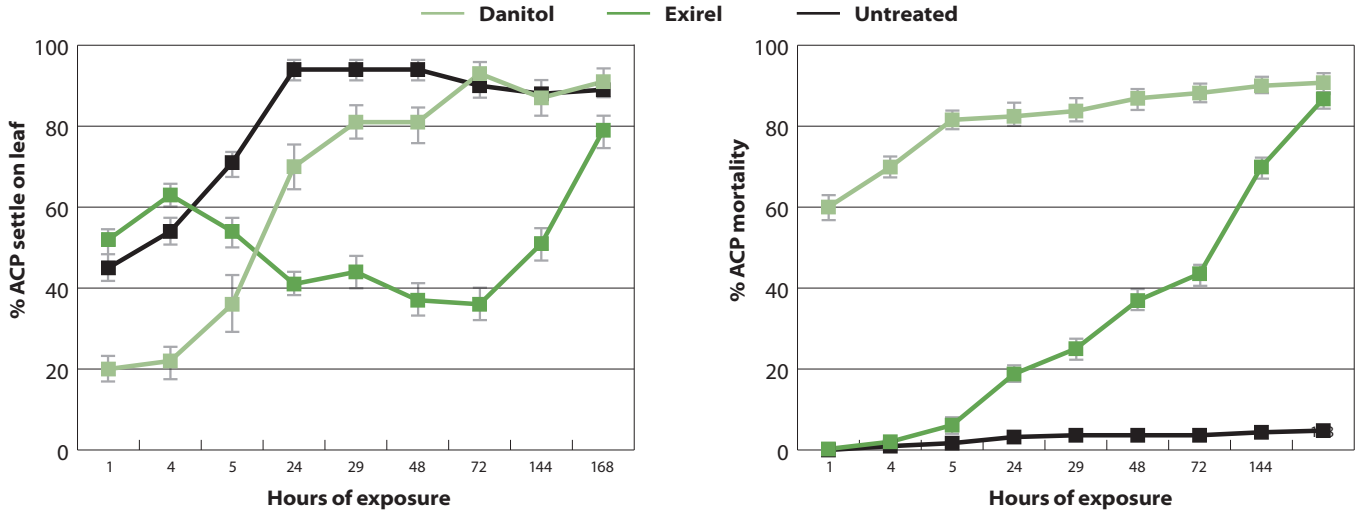
Except for the one day after application timing, ACP adults showed a lack of preference for Exirel insect control-treated plants as compared to untreated plants 24, 48 and 72 hours after exposure at eight and 14 days after application. While these differences were not statistically significant (CI p = 0.1 overlapped), similar results were reported earlier by Tiwari and Stelinski (2013)* and El-Desouky (2014, reported here), further supporting the evidence for lack of preference of ACP adults for Exirel insect control treated plants.

Determining the potential of Exirel® insect control powered by Cyazypyr® active to reduce transmission of greening disease by Asian citrus psyllid using the rapid excised leaf "Inoculativity" Assay Method*

Young, medium-sized excised sweet orange leaves were dipped into Exirel insect control (125 ppm) or Danitol® insecticide (450 ppm) solutions, air dried for 24 hours and inoculated with 10 HLB infectious or noninfectious ACP adults per leaf in units shown in the photo on the right.

The number of live adults settled on leaves; live adults not on the leaf; and dead or moribund adults were recorded at 1, 3.5, 5, 24, 29, 48, 72, 144 and 168 hours after exposure.

Effects of Exirel insect control and Danitol insecticide on survival and settling of ACP



These results indicate that ACP adults showed a lack of preference for Exirel insect control treated leaves as compared to Danitol insecticide treated leaves or untreated leaves. ACP adult mortality was initially slower in Exirel insect control, but at 168 hours it became equivalent to Danitol insecticide.

	Mean % HLB transmission[a]	
Treatment	LJ900 primers[b]	HLBasper primers[c]
Exirel	17.5b	12.5b
Danitol	10.0b	2.5b
Positive control	85.0a	47.5a
Negative control[d]	2.5b	0.0b

[a] Means in the same column followed by the same letter are not significantly different according to the Ryan-Einot-Gabriel-Welsch multiple range test, P = 0.05.
[b] F3,3 = 34.2, P = 0.008.
[c] F3,3 = 39.3, P = 0.007.
[d] Only one of 40 leaves tested positive based on the LJ900 primers
Analyses on arcsine transformed percentages, raw percentages presented.

Source: Dr. El-Desouky Ammar and Dr. David G. Hall, ARS-USDA, Fort Piece, FL; Dr. Juan M. Alvarez, DuPont Crop Protection, Newark, DE, 2014

* Ammar, E-D, A. J. Walter, and D. G. Hall. 2013. "A new excised-leaf assay method to test the inoculativity of the Asian citrus psyllid with *Candidatus* Liberibacter asiaticus associated with citrus huanglongbing disease." *J. Econ. Entomol.* 106: 25-35.

Effects of Exirel insect control and Danitol insecticide on HLB transmission by ACP adults

Young, medium-sized excised sweet orange leaves were dipped into Exirel insect control (125 ppm) or Danitol insecticide (450 ppm) solutions, air dried for 24 hours and inoculated with 10 HLB infectious or noninfectious ACP adults per leaf in units shown in photo. The number of live adults settled on leaves; live adults not on the leaf; and dead or moribund adults were recorded at one, three and a half, five, 24, 29, 48, 72, 144 and 168 hours after exposure. Real-time polymerase chain reaction analysis was then conducted on the psyllids and leaves using two primers as a way to determine the presence of HLB bacteria.

These results indicate that while ACP adult mortality was slow in Exirel insect control, HLB transmission was significantly reduced to levels similar to Danitol insecticide, likely due to a combination of feeding cessation, lack of preference for the treated material and mortality.

Summary

Exirel® insect control powered by Cyazypyr® active can reduce the ability of ACP adults to transmit greening disease in multiple ways:

- Rapid feeding cessation, which prevents psyllids from acquiring and or transmitting the bacteria when they feed in the plant's phloem.
- Lack of preference of adult ACP settling on Exirel insect control treated plants.
- Direct control of ACP adults and nymphs, which prevents feeding and secondary spread of the disease.

Exirel insect control benefits in citrus

Economic

- Protection of new flush.
- Protection from greening disease.
- Yield improvement over grower standard program.
- Better fruit quality (less markings on fresh).

Environmental

- Nondisruptive to beneficials, except bees.
- Nonpersistent in the environment and negligible toxicity to mammals, birds, fish and earthworms.*
- New mode of action for sucking insects.

Societal

- Granted reduced-risk classification from EPA under its Reduced Risk Pesticide Program for all registered crops.
- Minimal PPE requirements.

* A buffer zone of 25 feet is required to mitigate toxicity to some aquatic and sediment invertebrates.

Help your trees realize their ultimate potential

Exirel insect control is a groundbreaking new product that provides you with early-season protection from insect pests for healthier and better looking trees. When you put Exirel insect control to work on your operation, you can expect a level of protection unlike anything you've seen before.

For more information, contact your local FMC retailer or representative about Exirel insect control from FMC and visit us at FMCCrop.com.

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