Benefits of Pyrethroids to Citrus

PYRETHROID WORKING GROUP

Pyrethroids Benefits Project

The Pyrethroid Working Group contracted an extensive analysis of the benefits of pyrethroids to agriculture. A multitude of data was analyzed with different methodologies to determine the value of pyrethroids and the costs to growers if they were no longer available. These analyses determined: (1) costs to the grower of key insect pest management practices with and without pyrethroids, (2) yield benefits of pyrethroids, (3) monetary and non-monetary value of pyrethroids based on a farmer survey, and (4) a multi-market analysis to project the aggregate economic benefits of pyrethroids to the U.S. economy. Below are the primary benefits of pyrethroids to citrus from these analyses.

Benefits to Citrus

1. Costs with and without pyrethroids

- The total market value of production of citrus in the U.S. in 2015 was $3.4 billion according to USDA-NASS.
- Of the citrus producing acres in the US from 2012-2014, 17% of the acreage was treated with pyrethroids, on average. However, nearly all acres in Florida are treated at least once with pyrethroids since the spread of citrus greening carried by Asian citrus psyllid, and almost 80% of the acres in California were treated in 2016, the bulk of which for Asian citrus psyllid.
- With 10 insecticide chemistries available, pyrethroids were still a significant part of insect management for citrus.
- The cost advantage of use of pyrethroids in citrus is $10 per product acre, a cost advantage of 53% over the non-pyrethroid only scenario
- The cost advantage of use of pyrethroids in citrus is $13 per planted acre.
- The overall cost to the citrus industry to replace pyrethroid use would be $10.3 million, a 10% increase in costs.

2. Yield Benefits

- For Asian citrus psyllid (ACP) in Florida citrus, pyrethroids are an effective “knock down” insecticide class that also provides relatively long-lasting residual control.
- For control of ACP in Florida citrus, pyrethroid insecticides provided the largest average population reduction (85.4%) and longest average duration of control (32.4 days) when compared to all the other insecticides.
- Pyrethroids give citrus a 5% yield benefit over other insecticides
- Meta-analyses show a relative advantage for pyrethroids, from 15.4% to 21%, when compared to other chemistries for reducing pest abundance for the Asian citrus psyllid (Diaphorina citri).
- Average decrease in pest abundance for citrus for treatments using only pyrethroid insecticides was 77%, relative to untreated controls in small plot data.
- For nymphs, the average duration for pyrethroids (23.0 days) is noticeably longer than for all other insecticides.

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3. Monetary and Non-Monetary Value to Growers (Case Studies)

Insights from Florida Citrus Production

- The Florida citrus industry must use chemical controls to manage the ACP — the vector of Huanglongbing (HLB) disease (also known as citrus greening). Pyrethroids are efficacious, cost-effective and critical for resistance management.
- Pyrethroid and organophosphate (primarily chlorpyrifos) insecticides are the most effective and economical active ingredients for adult ACP control during the mid- to-late growing season and dormant period.
- Pyrethroids have multiple use patterns, may be applied close to harvest and have globally established MRLs that are required for export; many of the newer active ingredients materials lack established MRLs for key export markets.
- Pyrethroids are efficacious at lower temperatures, which is critical for area-wide dormant spray programs administered during winter months.
- Since pyrethroids and organophosphates are the primary options for ACP control during the dormant period, their loss would reduce the number of effective Modes of Action (MOA) by one-half — resulting in increased resistance, unsustainable control costs and accelerated loss of citrus acreage.

Insights from California Citrus Production

- The loss of broad spectrum insecticidal tools such as pyrethroids, neonicotinoids and chlorpyrifos would lead to significant increases in pesticide applications, resistance development, sharp rises in production costs and eventual economic decline.
- Pyrethroids can be used close to harvest and have globally established MRLs that are required for export; many of the newer active ingredients materials lack established MRLs for key export markets.
- Pyrethroids can provide ACP suppression and resistance management season-long including as dormant sprays at lower winter temperatures.
- Pyrethroids are essential alternatives for early-season ACP control if neonicotinoids are restricted.
- Soil treatment of pyrethroids (bifenthrin) as barrier sprays are the sole application option for control of Fuller rose beetles, an important quarantine containment for the export market.
- Pyrethroids control overwintering populations of glassy-winged sharpshooter in citrus, preventing its movement to adjacent grape fields where it is the vector of Pierce's Disease.
- Pyrethroids provide control of sporadically occurring pests in California citrus, such as Fuller rose beetle, for which there are no effective alternatives.

4. Direct and Indirect impacts

- Without pyrethroids the citrus industry would likely face an estimated 5-10% yield loss, but with the introduction of the Asian citrus psyllid, the vector for citrus greening, entire groves of trees would be lost amounting to devastating losses to the industry.
- On a per cropped acre basis, the value for citrus is almost $138/A.
- The benefits of using pyrethroids in citrus range from $107 to $215 million for citrus for yield losses of 5-10% respectively if pyrethroids are not available.
- Pyrethroids are cost effective pest control and resistance management tools for the citrus industry.
- Pyrethroids are also important for the management of other damaging pests in citrus production

Insect Pests of Florida Citrus

Pests	When controls are applied	Importance of pyrethroids	Resistance concerns	Alternative management strategies	**Potential impacts of pyrethroid loss**
Key Pests					
Asian citrus psyllid and citrus greening disease are widely distributed	Non-bearing trees, 1-5 years	Control of psyllids when neonics are not yet working or are running out	Concerns for resistance in neonics and pyrethroids but no good alternative	Alternative MoAs available but needed for bearing trees	Infected young trees, tree decline and death
	Bearing trees: Winter area-wide dormant sprays (November-March)	Pyrethroids are only AIs that are effective at low temps and economical for wide area programs to reduce psyllids	None	Organophosphates and carbamates	Higher psyllid populations entering citrus in spring, more sprays increased cost, increased worker safety and environmental risk
	In season (May-September)	Needed for rotation with other MoAs to control other pests and manage resistance in psyllids	Need to rotate with alternative MoAs to achieve efficacy and manage resistance	None	Faster resistance in alternate MoAs, more sprays at greater cost, more greening, lower yield
Pests	**When controls are applied**	**Importance of pyrethroids**	**Resistance concerns**	**Alternative management strategies**	**Potential impacts of pyrethroid loss**
Hemipteran complex Leaf footed bugs, stink bugs and citron bugs	Spring-summer (May-June)	Safest and most effective option	None	Organophosphates and carbamates	Increased worker safety and environmental risk, increased fruit damage
Katydids, crickets	Spring-summer (May-June)	Safest and most effective option	None	Organophosphates and carbamates	Increased worker safety and environmental risk, increased fruit damage

Thrips	Flowering (May-July)	Only effective control	None	Organophosphates and carbamates	Increased worker safety and environmental risk, increased fruit damage, reduced fruit set and quality
Sporadic Pests					
Root Weevils	Early to mid-summer (June-August)	Pyrethroids needed to control adults on trees and larvae on roots, most effective AIs available	None but should be part of rotational program on trees to preserve psyllid effectiveness	Chlorpyrifos	Increased worker safety and environmental risk, more root injury, declining tree health, export contamination concerns- Fuller beetle

Insect Pests of California Citrus

Pests	When controls are applied	Importance of pyrethroids	Resistance concerns	Alternative management strategies	**Potential impacts of pyrethroid loss**
Key Pests					
Asian citrus psyllid established and spreading but HLB not yet on commercial citrus	Fall , winter and spring (November-April) In season (May-October)	Reducing populations before season, low temperature efficacy needed Low psyllid areas: eradicate at source, pyrethroids most effective	None None for eradication	Organophosphates and Carbamates Other broad spectrum	Increased worker risk, faster psyllid spread Increased worker safety risks, failure to stop spread
		Established areas: disinfest to prevent spread to new areas	None	Rotate pyrethroids with other MoAs to manage resistance	Resistance in alternatives, faster spread to new areas, failure to meet quarantine
Glassy-winged sharpshooter	Winter (November-March)	Only effective dormant sprays at low temperatures	None	None	Movement to grapes and Pierce's disease, increased fruit damage

	Spring (April-May)	Supplement neonicotinoids		Organophosphates and carbamates	Increased worker risk, more damage to grapes
Pests	**When controls are applied**	**Importance of pyrethroids**	**Resistance concerns**	**Alternative management strategies**	**Potential impacts of pyrethroid loss**
Thrips	After petal fall (May)	Only effective material to protect small fruit	Use for thrips early to preserve effectiveness of alternates for psyllids	Alternatives used for psyllids later	Increased psyllid resistance, faster establishment
Katydids	Petal fall (May)	Only alternative to protect small fruit	None	None	Increased damage
Diaprepes root weevil	Early season (May-July)	Soil barrier sprays to target emerging adults with follow up foliars to prevent egg laying	None until follow up sprays, which can impact psyllid AIs	None early, psyllid programs later	More root damage, reduced yields, more fruit damage
Fuller rose beetle	Mid-summer (July-August)	Only alternative as soil barrier spray to kill emerging adults	None	None for soil chlorpyrifos for adults on tree	Failure to meet quarantine for export to Korea, increased worker risk at harvest
Sporadic Pests					
Citricola scale (San Joaquin only)	All season (June- September)	Needed if chlorpyrifos not available	40% of populations resistant to organophosphates, pyrethroids are alternatives	Chlorpyrifos and carbamates	Reduced tree vigor, fruit quality, increased worker and environmental risk
Brown marmorated stink bug (potential)	Early season	Pyrethroids only effective option	None	None	Potentially serious fruit injury