Status of IPM programs for blueberry production in the San Joaquin Valley of California

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Citrus thrips

Introduction Citrus thrips, *Scirtothrips citri*, are the primary pest of blueberries in the San Joaquin Valley. Citrus thrips feed at the growth tip of developing shoots and leaves, causing stunting and scarring of new shoots coupled with curling and discoloration of new leaves (Fig 1). Damage occurs after harvest, from late June through early October. Even though citrus thrips do not cause any reductions in fruit quality, it can cause reduction in yield the following spring.

Fig 1. Citrus thrips damage.

Monitoring Monitoring for citrus thrips is conducted weekly starting the last 2 weeks of harvest through September using beat samples (Fig 2). Calculate the average number of thrips per beat sample and apply insecticides after harvest when average thrips reach 25 to 30 thrips per beat sample.

Management There are a number of biological control that attack citrus thrips in citrus, however, they are rarely found in blueberries. Therefore, insecticide treatments are the main control strategy for citrus thrips in blueberries. The insecticides used to control citrus thrips since 2006 have been spinetoram, spinosad, acetamiprid, fenpropathrin and methomyl.

Fig 2. Citrus thrips beat sampling..

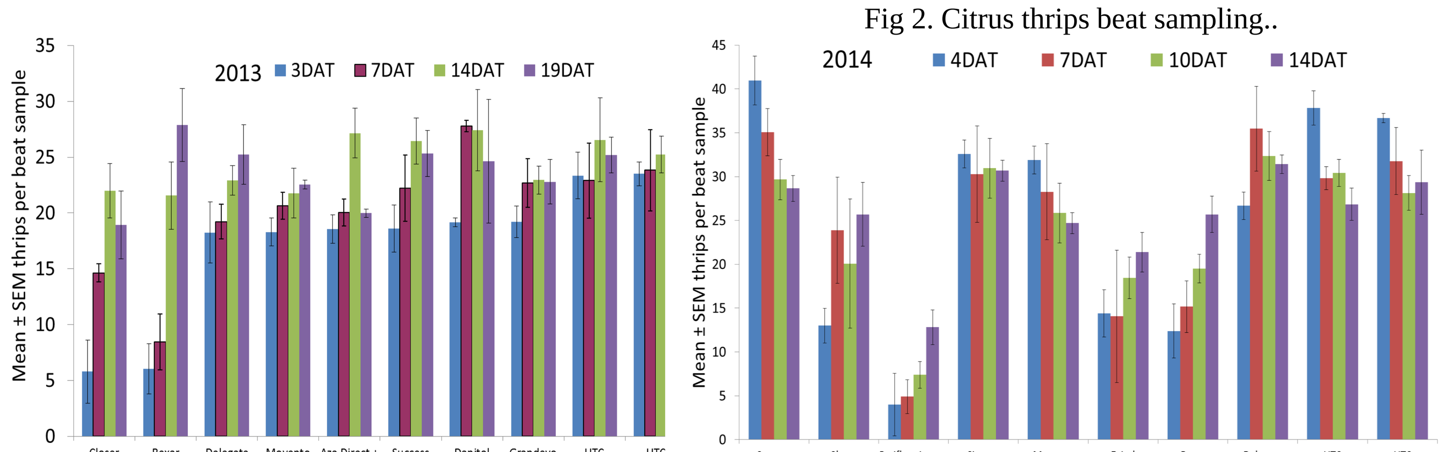


Fig 3, 4. The effects of insecticide treatments on the density of citrus thrips in blueberry, Tulare Co., CA 2013-2014

IPM Concerns Studies conducted in 2013-14 have shown resistance starting in populations of citrus thrips found in blueberries to spinetoram, spinosad and fenpropathrin (Fig 3, 4). Also, products they have been shown to knock down citrus thrips or help keep them at manageable levels are not registered in blueberries (Fig 3, 4). Due to this IPM is in jeopardy. In 2014, a large scale trial was conducted to evaluate two unregistered insecticides against resistance populations of citrus thrips (Fig 5). These products kept citrus thrips under 25 beats per sample until 28 days after treatment. After that populations in all treatments and the untreated check started to decline due to the time of year.

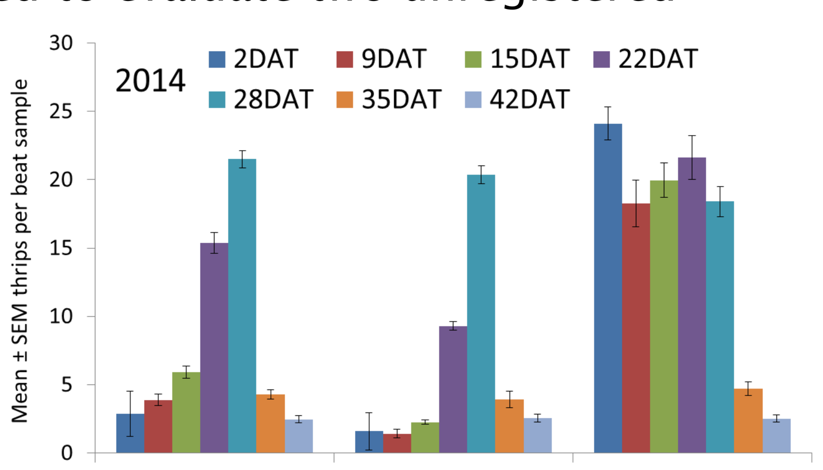


Fig 5. The effects of two unregistered insecticide treatments on the density of citrus thrips in blueberry, Tulare Co., CA 2014.

Spotted wing drosophila

Introduction, Spotted wing drosophila (SWD), *Drosophila suzukii,* is a significant new pest of thin-skinned fruit such as cherries, blueberries and raspberries. Damage occurs when adult female flies lay eggs in fruit that hatch into larvae prior to harvest. Once larvae are in fruit it is nearly impossible to remove them. For that reason, growers are encouraged to adopt monitoring programs to identify the presence of adult SWD so that treatments to adult flies can be made before they lay eggs.

Fig 6. bucket-style trap with lure.

Monitoring The most effective systems use bucket-style traps that contain a fermenting liquid as both the attractant as well as drowning solution for the flies. The two most common liquid baits are a) apple cider vinegar or b) a fermenting concoction. However, there is a new option, lure-based trapping which adds a lure over a bucket-style trap (Fig 6).

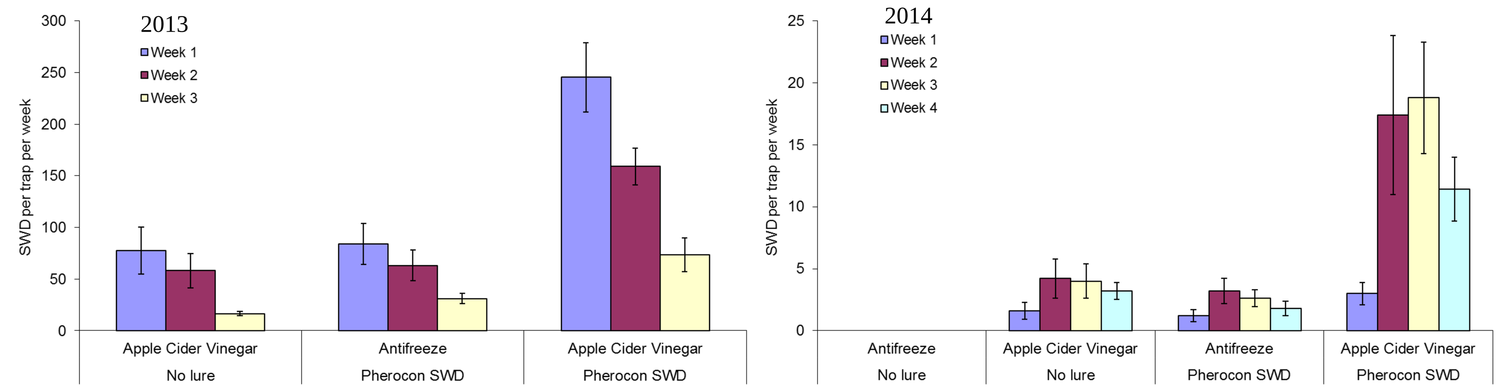


Fig 7, 8. Captures of *D. suzukii* using apple cider vinegar, lure or both in Kern Co., CA 2013-2014

In 2013-14 a study was conducted with a lure-based trap that contained a lure over a non-attractive liquid (antifreeze) that captured approximately the same number of flies that were captured in the standard Trap containing apple cider vinegar. When the lures were places over apple cider vinegar the traps captured two to three times more SWD than when either attractant was used individually (Fig 7, 8).

Management At most one insecticide treatment is needed in blueberries and this is rare; most growers do not treat, because the seasonal flights of SWD in the San Joaquin Valley in blueberries is very low (Fig 9). This is probably due to the dry, hot conditions during blueberry harvest and even if populations are high in cherries (Fig 10) that are less than 30 ft from blueberry fields still have very low SWD captures (Fig 9). However, now with the new lure-based trap growers can have even more confidence that they do not need to spray due to low capture rates of SWD.

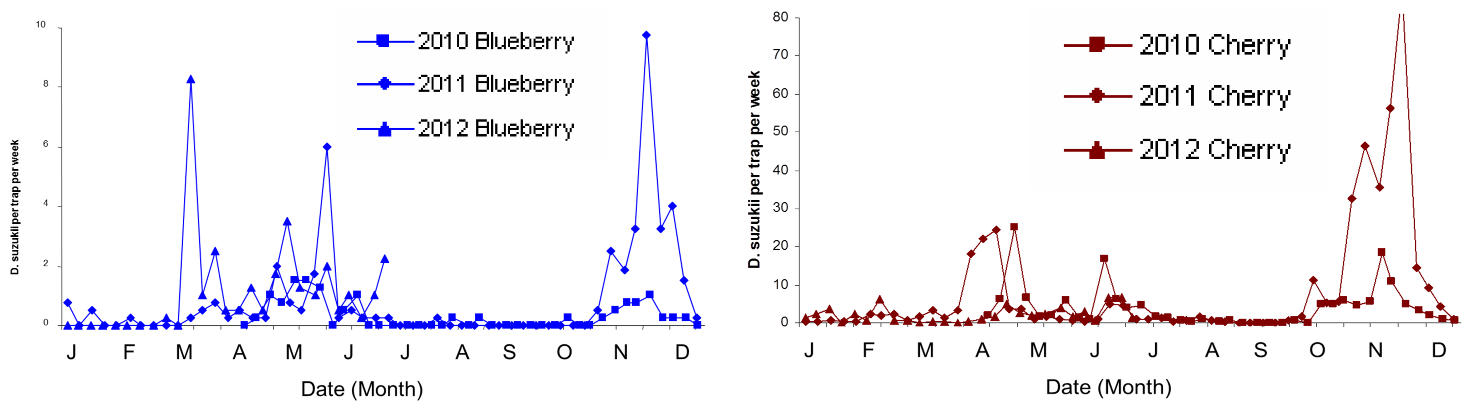


Fig 9, 10. *D. suzukii* catches per week in blueberries and cherries in Kern Co., CA 2010-2012.

Masked Chafer (white grub)

Introduction Southern highbush blueberries provide an excellent host environment for white grubs (*Cyclocephala longula* LeConte), because the grubs thrive in an environment containing shallow roots, high organic matter and high moisture. The first several years of production, there was little to no recognition of grubs as a pest. However, in 2007, growers recognized them as a pest in newly planted fields adjacent to mature fields.

Monitoring To monitor for adults black-light traps can be placed at the beginning of June until the first of August. This will determine if the field has *C. longula*. Adult *C. longula* flight start about one week into June until the beginning of August with the highest number of beetles flying in a 3-week period in June (Fig 11). If beetles are present, then field collections of life stages in the soil prior to and just after flight can be conducted by digging around the plant and searching for the grubs. Data from our 2009-10 study showed that field collections of grubs were consistent based on the flight (Table 1).

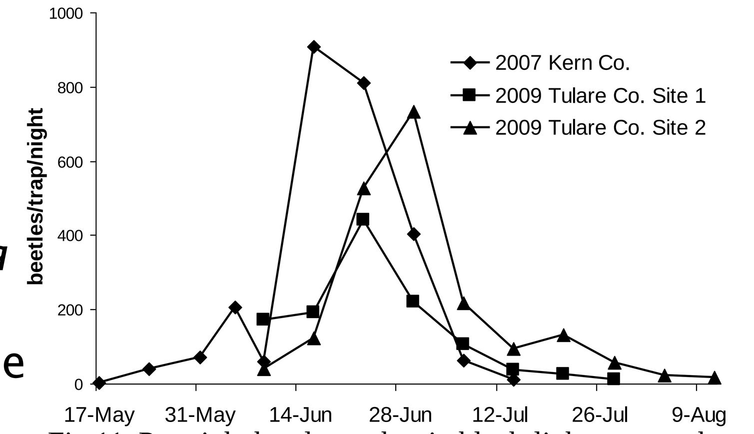
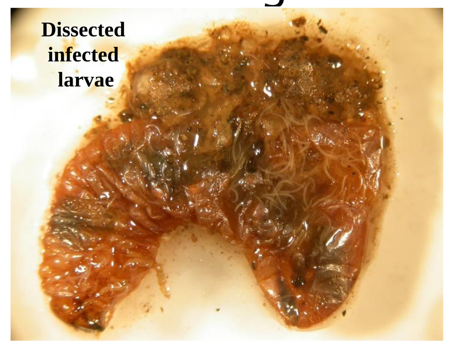


Fig 11. Per night beetle catches in black-light traps at three sites in the lower San Joaquin Valley.

Table 1. Percentage life stages in soil prior to and just after flight.

6 May		2 June		13 July	
70.7%	3rd instar larva	85.5%	Teneral/ young adults	14.7%	adults
29.3%	pupae	4.0%	pupae	22.7%	eggs
		10.7%	Larvae	55.7%	1st instar larvae
				6.8%	2nd instar larvae

Management In 2009-10, we found that applications of a entomopathogenic nematode, *Heterochabditis bacteriophora*, are highly effective to control masked chafers as well as imidacloprid (Table 2, Fig 12). An August timing of imidacloprid would also not be detrimental to any *Tiphia spp*. parasitoids that may or may not begin to provide control of *C. longula* in commercial blueberries as they do in other hosts (Rogers and Potter 2003).



IPM Combining monitoring and management information, California blueberry growers should have the basic tools to successfully monitor for *C. longula* and should successfully reduce pest populations to levels below economic damage.

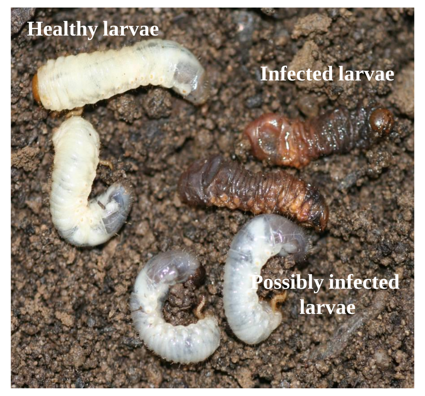


Fig 12. Masked chafer larvae infected with *H. bacteriophora* vs healthy larvae

Table 2. The effects of fall 2009 treatments on larvae density in June 2010.

Treatment	Rate per treated ha	Average ± SEM	
		No. larvae per ten plants	Percentage excavation holes with larvae
Admire® Pro	167ml	5.5 ± 1.9 a	16.3 ± 1.3a
Terranem™	1 billion infective juveniles	3.5 ± 1.3a	12.5 ± 3.2a
Untreated Check	--	19.0 ± 4.3b	42.5 ± 4.3b
F		29.76	17.69
df		2,6	2,6
P		0.0008	0.0030

Means in a column followed by the same letter are not significantly different (P > 0.05, Fisher's protected LSD)

Literature Cited Rogers, M. E. and D. A. Potter. 2003. Effects of spring imidacloprid application for white grub control on parasitism of Japanese beetle (Coleoptera: Scarabaeidae) by Tiphia vernalis (Hymenoptera: Tiphiidae). J. Econ. Entomol. 96(5): 1412-1419.

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