The Cost of Managing Invasive Pests

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California is fortunate to have relatively few pests that affect avocados and we have no seed or fruit feeding pests. However, the major pests that we do have – persea mite and avocado thrips – are both invasive species originally from Mexico. Persea mite (*Oligonychus persea*) was first found attacking avocados in San Diego County in 1990 and by 1996 had spread north to San Luis Obispo County. Avocado thrips (*Scirtothrips persea*) was first detected in Ventura County in July 1996 and in less than a year had spread south through San Diego County.

Of these two pests, avocado thrips are the most economically damaging because of the fruit peel scarring the insects can cause when left uncontrolled. But high populations of persea mite can cause premature leaf drop resulting in fruit sunburn damage. Fortunately, both pests are generally well-controlled with one well-timed pesticide application annually, but not without a significant cost to the industry.

Annual Acreage Treated for Invasive Thrips and Mites

Abamectin is the most used pesticide for the control of avocado thrips and persea mite on California avocados. According to pesticide use report data from the California Department of Pesticide Regulation (DPR), nearly 20,000 acres of avocados were treated on average annually with abamectin in California during each of the four most recent years for which data are available (Table 1). Other pesticides that could be used for treating avocado thrips and persea mite, but are not exclusively used for those pests, are also listed in Table 1. All combined, these products are used to treat, on average, just more than 25,000 acres of avocados annually. However, it cannot be determined from the publicly available DPR data whether all those acres are unique or if some represent multiple applications to the same acreage.

Table 1. Annual acreage of California avocados treated with pesticides labeled for the control of avocado thrips and/or persea mites.

Active ingredient	Common Trade Name	Organic	Target Pest	Acres Treated[1]				
				2023	2022	2021	2020	Average
Abamectin	Agri-Mek	No	Mites & thrips	20,744	19,876	18,608	19,691	19,729
Azadirachtin	Aza-Direct	Yes	Mites & thrips	0	30	0	183	53
Imidacloprid	Admire	No	Thrips	614	207	225	467	378
Spinetoram	Delegate	No	Thrips	3,193	1,490	3,551	1,354	2,397
Spinosad	Etrust	Yes	Thrips	2,363	1,411	1,688	1,013	1,619
Spirodiclofen	Envidor	No	Mites	385	2,560	703	861	1,127
Spirotetramat	Movento	No	Mites & thrips	58	102	70	199	107
Thiamethoxam	Actara	No	Thrips	16	58	14	22	28
			Annual Total	**27,373**	**25,737**	**24,862**	**23,792**	**25,441**

[1]Data from 2020, 2021, 2022 and 2023 California Department of Pesticide Regulation Annual Statewide Pesticide Use Report Indexed by Commodity.

Table 2. Usage of pesticides primarily used to treat avocado thrips and persea mite in the top five avocado producing counties in California in 2023.

County	Portion of statewide avocado acreage[1]	Percent of total avocado usage[2]							
		Abamectin	Azadirachtin	Imidacloprid	Spinetoram	Spinosad	Spirodiclofen	Spirotetramat	Thiamethoxam
Ventura	40%	54	0	29	19	33	0	0	100
San Diego	26%	9	0	26	35	25	100	0	0
Santa Barbara	13%	20	0	0	2	19	0	100	0
Riverside	9%	< 1	0	29	< 1	1	0	0	0
San Luis Obispo	9%	16	0	16	41	14	0	0	0

[1]Data from the California Avocado Commission 2023 Statewide Avocado Acreage & Condition Analysis.

[2]Data from the California Department of Pesticide Regulation 2023 Annual Statewide Pesticide Use Report Indexed by Commodity for the respective counties listed.

Costs to Manage Invasive Thrips and Mites

Costs for pesticide applications vary considerably across the industry, especially for ground spray applications. A survey of applicators and grove managers found that aerial applications range from about $170 to $250 per acre including abamectin, oil and spreader, with application costs being higher in the southern growing region. Ground applications are much more variable, with terrain and tree size being the major factors that affect costs. Labor and equipment costs for ground sprays range from $90 for young trees on flat ground to as high as $700 for large, old trees on hill sides.

The second most used materials, spinetoram (Delegate®) and spinosad (Entrust®), increase costs for aerial applications by about 50% and 100%, respectively, due to the significantly higher costs for these products.

Table 2 shows the percentage of the various pesticide products used to control avocado thrips and persea mite in the top five avocado producing counties in 2023. These five counties accounted for 97% of California avocado production in 2023. Apart from spinetoram and spinosad, these five counties accounted for 100% of the avocado usage of the products listed. Three percent of the spinetoram usage and 8% of the spinosad usage was in other counties.

In 2023, 90% of the abamectin usage was in the northern growing area (Ventura, Santa Barbara and San Luis Obispo Counties; Table 2). This is estimated to be about 18,700 acres (90% of the total 20,744 acres that were treated with abamectin in 2023, Table 1). If we assume an average treatment cost of $200 per acre, this equates to $3.74 million. If we assume the remaining 2,050 acres treated in San Diego and Riverside Counties had an average application cost of $250 per acre, this equates to $512,500. Combined, abamectin treatments for the north and south in 2023 cost the industry an estimated $4.25 million. This assumes that all these acres were treated aerially, which is most certainly not the case, so the true costs probably exceed $5 million.

Doing similar calculations for spinetoram and spinosad, and assuming aerial applications only, we arrive at total application costs of about $1 million for each of these products, which again is likely on the low end, since not all the treated acres were treated aerially.

All in, the top three pesticides used to control avocado thrips and persea mite cost the California avocado industry at least $6.25 million annually and likely as much as $8 to $9 million dollars when other minor use chemicals and ground applications are included.

Peel scarring caused by avocado thrips.

An avocado leaf with persea mite damage.

Beyond the costs of treating these pests, there are hidden costs such as pest monitoring and downgraded fruit due to peel scarring. Commercial Pest Control Advisor (PCA) services generally range from about $3.50 to $5.50 per acre per month. Some smaller growers may do their own scouting rather than hire a PCA, but the cost of their time must still be considered. If we assume only producing acres are scouted at an average cost of $4.50 per acre per month, then scouting the 47,988 producing acres in 2023 cost the industry an additional $2.5 million.

Trying to estimate the cost of downgraded fruit from peel scarring due to thrips damage or sunburn due to leaf loss from persea mite is nearly impossible. Packinghouses don't record the specific causes of #2 and cull fruit and the price differential between #1 and #2 fruit fluctuates throughout the season. However, if we assume that this cost is a very modest 1% of the crop value, then in 2023 this would have been $2.37 million.

Altogether, it is no exaggeration to estimate that persea mite and avocado thrips cost the California avocado industry $10 to $20 million annually. Since their arrival in the 1990s, these two pests have probably cost the industry at least $300 million — nearly the value of an entire season's crop.

Avocado leaves with avocado lace bug damage.

Continued Threat of Invasive Pests

Unfortunately, persea mite and avocado thrips are not the only invasive pests the California avocado industry has to worry about. A growing number of growers in San Diego and Santa Barbara Counties are having to manage avocado lace bug (ALB; *Pseudacysta perseae*). This invasive insect pest was first found in California on backyard avocado trees in Chula Vista and National City in southern San Diego County in 2004. DNA analysis found that this population of ALB matched populations in the state of Nayarit in Mexico.

For more than a decade, this pest didn't move out of southern San Diego County, but in 2017 it was discovered in commercial avocado groves in northern San Diego County and southern Riverside County. Although the damage caused by these new populations was similar to what was seen in southern San Diego County, these new populations were much more aggressive. Subsequent DNA analysis matched these more aggressive ALB populations to ALB populations in Florida, the Caribbean, French Guyana and the Yucatan peninsula in Mexico. Today, this more aggressive ALB is known to be present in San Diego, Riverside, Los Angeles and Santa Barbara Counties.

Although invasive pests are a costly problem for the California avocado industry, we have been fortunate that the invasive pests we have been faced with to date are foliar pests that can cause cosmetic damage to fruit. However, fruit feeding pests exist and pose a serious threat now more than ever.

Threats from Avocado Seed Weevils and Moths

As most California avocado growers are likely aware, in mid-to-late 2024, U.S. Department of Agriculture inspectors were withdrawn from Mexican avocado groves. This change ended a nearly 30-year-old policy of USDA employed inspectors conducting grove inspections in Mexico to certify groves were following agreed upon phytosanitary policies that protect California avocado growers from invasive pests. Over time, USDA employed inspectors' presence in Mexican packinghouses also was scaled back.

These policy changes directly led to potentially invasive pest detections in Mexican avocado packinghouses beginning in late October 2024 and continuing into 2025 on at least four separate occasions. In November 2024, USDA Administrator Michael Watson acknowledged the correlation between the policy changes and pest detections, stating, "The number of recent interceptions is notable given the infrequency of such interceptions over the history of the program."

The pests of greatest concern are seed weevils and moths, which lay eggs on or inside fruit. Their larvae bore through the fruit flesh and seed making the fruit completely unusable. If pests of this nature were to become established in California they would, at best, greatly increase the need for multiple pesticide applications per season dramatically increasing production costs. At worst, the California avocado industry could be destroyed.

An avocado fruit with a female avocado seed weevil drilling into the fruit. Photo courtesy of Dr. Mark Hoddle.