Impact of 2023 Lygus Bug Outbreak in California Cotton on Pesticide Use

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Lygus bug (*Lygus hesperus*), or the Western tarnished plant bug, is an important perennial pest of cotton in California. Insecticide applications are the primary means of *Lygus* management; many compounds are registered for use against *Lygus*, with varying efficacy. While *Lygus* is present in all years, specific weather conditions can lead to damaging outbreaks, most recently in 2017 and 2023. In 2023, the wet winter led to Lygus outbreaks in CA cotton, likely from the abundance of wild hosts for *Lygus* and subsequent population buildup. While 2017 *Lygus* outbreaks were treated with sulfoxaflor (product name "Transform" in cotton), a legal challenge to the CA registration of Transform has prevented its use since then. In 2023, growers raised concerns that no available products would be as effective as Transform and that many repeated applications of other products would be needed to suppress the outbreak.

In August 2024, PUR data from the 2023 season became available to OPCA which has confirmed significant increases in use of broad-spectrum insecticides including pyrethroids and organophosphates in cotton, presumably for control of *Lygus*. Despite a ~20% decline to the total harvested acreage of cotton in the state (from an estimated 152,475 acres in 2022 to 124,177 acres in 2023), use of the pyrethroid insecticides bifenthrin and lambda-cyhalothrin more than doubled in 2023 relative to 2022 and use of other broad-spectrum insecticides like dimethoate, acephate, and oxamyl also rose (Table 1). The widespread use of broad-spectrum products can diminish natural enemy populations throughout the region, leaving cotton vulnerable to late-season outbreaks of "secondary" pests like aphids and whiteflies. These pests are particularly concerning as they can cause "sticky cotton", which can damage processing equipment and make cotton from entire regions unsellable.

Despite increased use of broad-spectrum insecticides in 2023, yield for Pima cotton, the high-quality and high-value variety that CA primarily grows, decreased 13.6% from 1558 lb/acre in 2022 to 1346 lb/acre in 2023, representing a 13.6% yield reduction and suggesting that the current management strategies do not control Lygus in an outbreak year. Assuming that registration of Transform/sulfoxaflor would have fully prevented this yield loss from occurring and that prices for Pima cotton were at their peak of $2.35/lb, the value of Pima cotton production in 2023 would have increased from $ 259.3 million to $300.2 million, a gain of $40.9 million. There are many caveats to this assumption as no product is perfectly effective in controlling outbreaks and several factors may have contributed to cotton yield in 2023, including high winter precipitation and flooding in the Tulare Lake basin.

Effective long-term management of *Lygus* in cotton will require a range of chemical and non-chemical management options. The 2023 season indicates that *Lygus* outbreaks can drive significant use of broad-spectrum insecticides with limited ability to prevent yield losses and the

potential for damaging non-target effects, suggesting the current response to outbreaks is both economically and environmentally unsustainable. Developing alternative management practices, which likely would include increasing the availability of safe and effective insecticides, will be essential in improving long-term pest management in cotton.

Table 1. Total Acres Treated and Treatment Intensity for top 20 insecticides used in California cotton in 2022 and 2023.

Active Ingredient	Acres Treated (# Apps)		Treatment Intensity (Treated Acres/Harvested Acres)	
	2022	2023	2022	2023
flonicamid	164,258 (1,811)	161,955 (1,730)	1.08	1.3
abamectin	109,791 (1,746)	91,104 (1,468)	0.72	0.73
novaluron	101,619 (787)	96,795 (1,017)	0.67	0.78
acetamiprid	92,607 (880)	69,464 (632)	0.61	0.56
bifenthrin*	69,098 (555)	107,087 (1,047)	0.45	0.86
afidopyropen	66,533 (834)	80,271 (1,033)	0.44	0.65
buprofezin	64,733 (556)	10,701 (135)	0.42	0.09
pyriproxyfen	52,774 (507)	12,438 (177)	0.35	0.1
naled*	50,553 (404)	56,219 (343)	0.33	0.45
imidacloprid	48,983 (477)	74,774 (788)	0.32	0.6
flupyradifurone	42,595 (356)	30,720 (313)	0.28	0.25
lambda-cyhalothrin*	42,568 (370)	100,560 (927)	0.28	0.81
cyfluthrin*	39,604 (239)	37,041 (241)	0.26	0.3
dimethoate*	32,439 (198)	53,609 (487)	0.21	0.43
indoxacarb*	25,467 (159)	25,155 (139)	0.17	0.2
dinotefuran	23,659 (101)	13,154 (45)	0.16	0.11
malathion*	24,795 (98)	26,344 (123)	0.16	0.21
acephate*	20,657 (275)	47,299 (660)	0.14	0.38
clothianidin	21,483 (368)	22,015 (371)	0.14	0.18
oxamyl*	21,139 (142)	69099 (471)	0.14	0.56

* Indicates AI classified as “broad-spectrum” for this report

Figure 1 presents use data for the top 20 insecticide products used in cotton. We show 2016-2017 and 2022-2023 to highlight how *Lygus* outbreak years (bordered in black) caused spikes in use of some insecticides. Given significant reductions in the total statewide acreage of cotton, we use the metric “treatment intensity”, which represents the total acreage treated with an insecticide divided by the total harvested acreage. This adjusts for changes in cotton acreage between years that would otherwise influence “use” and allows us to compare intensity of insecticide use between years. Notably, the outbreak in 2023 led to higher spikes in broad-spectrum insecticide use relative to the outbreak in 2017, where sulfoxaflor was available.

Figure 2 maps the region containing the majority of statewide cotton production and presents the average number of insecticide treatments applied to fields within each square mile section in 2022 and 2023. Fig. 2a-b include all insecticide applications, while Fig. 2c-d include only pyrethroid, organophosphate, and carbamate applications

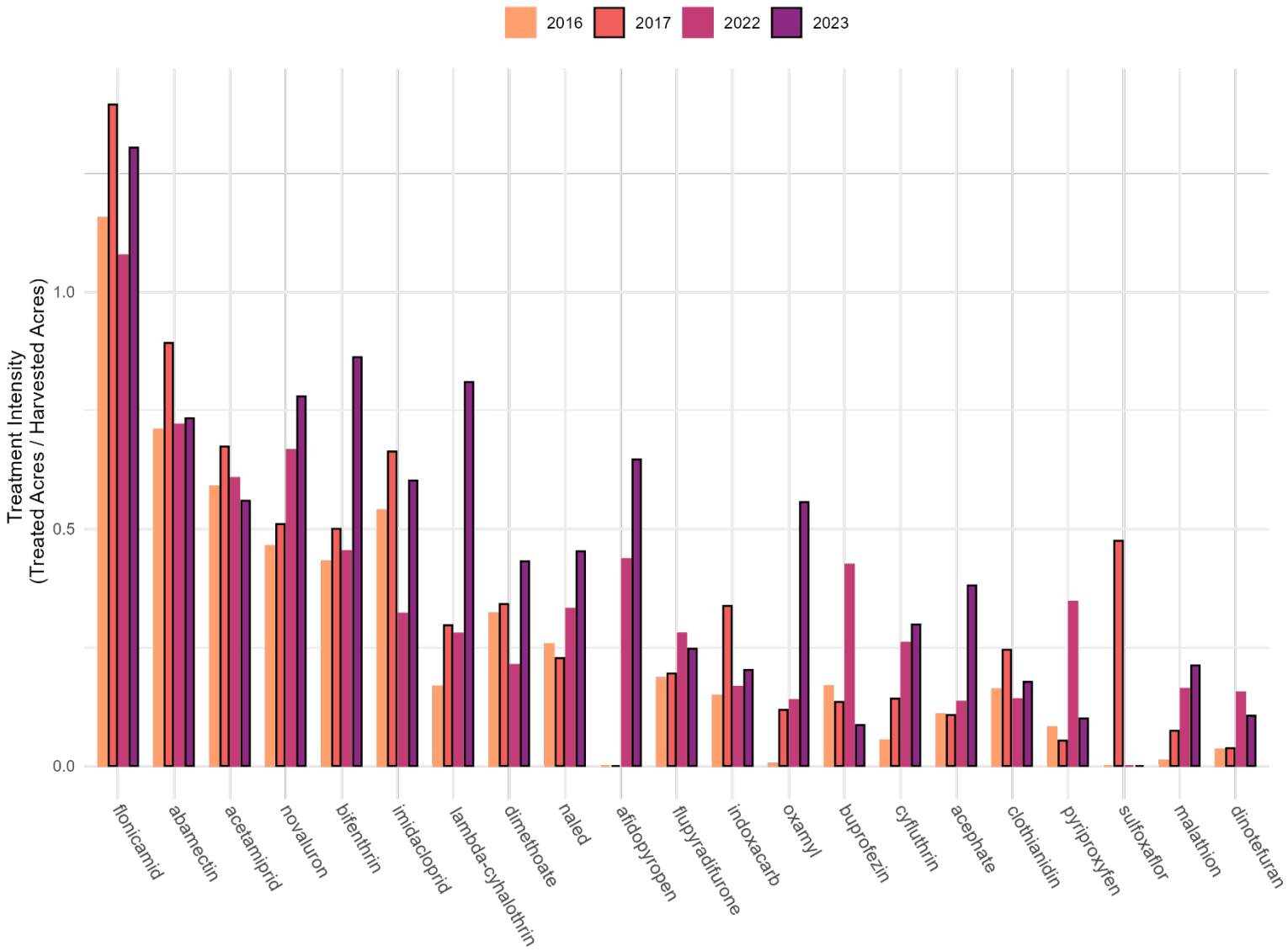

Figure 1. Statewide Insecticide Treatment Intensity in California Cotton in 2016-2017 and 2022-2023

Figure 2. Comparison of (a-b.) all insecticide use and (c-d.) broad-spectrum insecticide use (pyrethroids, organophosphates, and carbamates) on California Cotton in 2022 and 2023. Colors represent the average number of insecticide applications per-field within each square mile.