COLLEGE OF AGRICULTURE & LIFE SCIENCES
Arizona
Experiment Station
Yuma Agricultural Center

Insecticide Usage on Desert Lettuce, 2020-2021

John C. Palumbo, *Department of Entomology*

Introduction: The development of accurate data on insecticide usage is important to the assessment of IPM programs in Arizona. A reliable estimate of insecticide use patterns is one of our most objective tools for assessing changes in management practices. This information allows us to build relevant databases for measuring user behaviors and adoption of new IPM technologies. For PCAs, it can translate their efforts into economic terms for their clientele and confirms their value to the lettuce industry by showing the importance of their cost-effective management in desert lettuce production. This summary provides estimates of insecticide use during the 2020-21 growing season and trends on lettuce IPM over the past 17 years.

Methods: Growers and PCAs normally attend a Lettuce Insect Losses and Impact Assessment Workshop in Yuma to complete surveys in a guided process. This year surveys were sent to PCAs on-line during May and June 2021. This summary presents results from the insecticide use surveys for lettuce produced in Yuma and Maricopa County, AZ and Imperial County, CA. The data were generated by requesting that PCAs estimate the use frequency of various products and the percentage of treated acres for each product. Estimates of total treated acreage were generated using the acreage reported from each survey participant. This data has allowed us to track changes in insecticide use patterns over time in greater detail in both fall and spring lettuce.

Summary: A total of 12 surveys were completed in 2021, representing an estimated total of 22,760 fall acres and 22,013 spring lettuce acres from Yuma, Maricopa, and neighboring Imperial Counties (Holtville/Brawley/Bard/Winterhaven). In general, the most used insecticides in fall and spring lettuce correspond directly to the key pests that typically occur during these growing periods.

When compared by class of chemistry using the IRAC mode of action classification system, the pyrethroids (applied as foliar sprays and sprinkler chemigations) were again the most commonly used insecticide class in fall and spring lettuce **(Tables 1 & 2)**.The reason for this is quite evident; pyrethroids are the most safe and inexpensive broad spectrum insecticide still available for use in tank-mixtures for effective contact control of flea beetles, crickets, plant bugs and some Lepidopterous larvae and adults (cabbage looper and corn earworm). Over the past 17 years, pyrethroid usage has remained consistently high **(Fig. 1 & 5)** in fall and spring lettuce, and accounts for the bulk of broad-spectrum chemistry used to control insects in lettuce **(Fig 6 & 8)**.

Overall, organophosphate/carbamate usage increased slightly compared to 2019-20. On spring lettuce, methomyl (Lannate) usage was higher than the previous 4 years, and acephate usage increased with the threat of INSV on late plantings **(Fig 5)**. Both insecticides remain important rotational partners for western flower thrips management, particularly with the lack of viable alternatives. Their use for control of lepidopterous larvae and aphid control has been displaced primarily by several reduced-risk chemistries, and as noted above, pyrethroids provide a safer, more cost-effective broad-spectrum alternative.

The spinosyns remain the second most used class of insecticides, where 100% of the responding PCAs indicated that they used Radiant on fall lettuce in 2020-21 **(Table 1 and 2).** Radiant usage against both lepidopterous larvae **(Figure 1)** and thrips **(Figure 5)** has remained steady over the past 17 years, averaging over 2 sprays per treated acre. This is presumably due to the early Lep pressure experienced in the fall and the late occurring thrips pressure this spring.

The Diamides (Coragen, Besiege, Minecto Pro, Exirel and Verimark, and Harvanta) were a commonly used chemistry in fall and spring lettuce **(Table 1 and 2).** PCAs have steadily incorporated this new chemical class into their Lepidopterous larvae management programs since becoming available in 2008, and diamides were applied to over 80% of the fall lettuce acreage (**Fig 1)**. Among the diamides, Coragen as a foliar spry was the most used, and a new 3rd generation diamide Harvanta (cyclaniliprole) was the second most used diamide. Belt/Vetica use was not reported in lettuce in 2020-21, and we presume existing stocks have been exhausted. Dimaide soil usage decreased in 2020, and Verimark use was not reported **(Table 3).** The 2nd generation diamide cyantraniliprole pre-mixture, Minecto Pro, was used on about 10% of the seasonal acers, and slightly more than its diamide counterpart, Exirel.

Another important class of chemistry used in fall and spring lettuce are the neonicotinoids-4A (the 3rd most used chemistry in lettuce in 2020-21) driven primarily by soil-applied imidacloprid for whiteflies and aphids **(Figures 3, 4 & 8)**. The usage of imidacloprid on both fall and spring lettuce has increased markedly since 2009, and increased last season where it was on 80% of fall and spring acres **(Table 3-4).** Foliar neonicotinoid usage increased slightly last season on fall lettuce was down in the spring. However, Movento was applied on a greater number of spring acers in 2020-21 and remains second most used product for sucking insect control **(Fig 4 and 8)**. Sequoia, Sivanto, and PQZ accounted for significant usage this spring and were applied to 33.3,23.9, and 19.2 % of the acreage, respectively. Torac usage was up slightly last spring for thrips management but was only used on less than 2% of the acreage **(Fig 5).**

From an IPM perspective, the local produce industry continues to make great strides in minimizing environmental impacts in lettuce production by continuing to incorporate the newer reduced-risk insecticides into their insect management programs. To date there have been no been no major incidents of field failures or measurable lack of insect susceptibility with these compounds in lettuce due largely to the judicious usage of the key products. This has occurred due to the availability of multiple modes of actions with cost-effective activity against most key pests, and the conscientious efforts of PCAs to alternate application of these chemistries during the crop season. Although the broad spectrum, consumer–friendly pyrethroids have been the predominant chemistry applied to lettuce, for the past eight seasons PCAs treated a greater percentage of their lettuce acreage with selective, reduced-risk products than with the broadly toxic, OP/ carbamate and chemistries **(Fig 8 & 9)**.

Conclusions

In conclusion, selective, reduced risk insecticides will continue to play an increasing role in management of insect pests in desert lettuce. As new active ingredients become available, the industries reliance on the broadly toxic organophosphate and carbamate compounds will likely decline. The availability of new modes of action with activity against western flower thrips would certainly reduce the industries reliance on OPs and carbamates. Fortunately, there are several experimental active ingredients being developed by industry that have shown good residual control of thrips larvae. Because of the intensive pest spectrum that PCAs face in the desert, coupled with the demands for high quality, cosmetically aceptable lettuce, there will still be a need for broad spectrum products (i.e., pyrethroids). A note of caution though, given the importance of the pyrethroids and the trends in their heavy usage, PCAs should only use them when necessary to preserve their susceptibility.

Acknowledgement: *Special thanks go out to all the PCAs and growers who took time away from their busy schedules to participate in these surveys over the 17 years. This is particularly appreciated this year. Without your efforts, this historical data would not exist.*

Table 1. The top insecticide chemistries used on Fall Lettuce, 2020

	Fall Lettuce, 2020				
Insecticide Chemistry	**IRAC group**	**% PCA's Using Products**	**% treated acres**	**No. applications**	**Treated [1] acres**
Carbamates	1A	50	21.9	1.1	5,995
Organophosphates	1B	16.6	8.7	1	1,890
Pyrethroids - Foliar	3A	100	98.2	3.3	79,070
Pyrethroids - Chemigation	3A	100	58.7	1	13,358
Pyrethroids - Total					92,428
Neonicotinoids -Soil	4A	100	80.6	1	18,353
Neonicotinoids -Foliar	4A	100	19.5	1	4,448
Neonicotinoids -Total					22,801
Sulfoxamines	4C	16.6	2.2	1	510
Butenolides	4D	16.6	3.6	1	780
Spinosyns	5	100	99.5	2.1	46,133
Avermectins	6	91.7	57.2	1.2.	16,960
JH mimic	7C	0	0	0	0
Selective feeding blockers	9B	8.3	0.8	1	175
Selective feeding blockers	9D	8.3	0.8	1	175
Selective feed blockers-Total					350
Chitin Synthesis inhibitor	16	0	0	0	0
Ecdysone agonists	18	25	15.9	1	3,624
METI inhibitors	21	0	0	0	0
Na channel blockers	22	8.3	0.1	1	25
Tetramic acids	23	25	3	1	680
Diamides -Soil	28	16.6	7.2	1	1,650
Diamides- Foliar	28	83.3	65	1.1	17,509
Diamides- Total					19,159
Chordotonal organ modulators	29	8.3	0.8	1	175

[1] *Total acres treated estimated by multiplying: % acres treated * number of times treated * acreage estimated by participating PCAs in the survey.*

Table 2. The top insecticide chemistries used on Spring Lettuce, 2021

Insecticide Chemistry	Spring Lettuce, 2021				
	IRAC group	% PCA's Using Products	% treated acres	No. applications	Treated [1] acres
Carbamates	1A	83.3	46.2	1.4	19,527
Organophosphates	1B	41.7	6.7	1	1185
Pyrethroids - Foliar	3A	100	96.3	2.8	65,741
Pyrethroids - Chemigation	3A	16.6	18.1	1	3,987
Pyrethroids - Total					69,728
Neonicotinoids -Soil	4A	100	80	1	17,600
Neonicotinoids -Foliar	4A	33	22.2	1	4,880
Neonicotinoids -Total					22,480
Sulfoxamines	4C	83.3	33.3	1.1	7,900
Butenolides	4D	83.3	23.9	1.1	5,824
Spinosyns	5	100	99.4	2.3	47,426
Avermectins	6	58.3	21.9	1	4,820
JH mimic	7C	16.6	1.1	1	232
Selective feeding blockers	9B	33.3	19.2	1.3	7,070
Selective feeding blockers	9D	33.3	5.8	1	1,286
Selective feeding blockers-Total					8,356
Chitin Synthesis inhibitor	16	0	0	0	0
Ecdysone agonists	18	25	17.9	1	3,936
METI inhibitors	21	8.3	3.6	1	800
Na channel blockers	22	8.3	0.2	1	36
Tetramic acids	23	100	64	1.1	17,223
Diamides -Soil	28	0	0	0	0
Diamides- Foliar	28	75	45.1	1.1	13,355
Diamides- Total					13,355
Chordotonal organ modulators	29	58.3	19.2	1	4228

*[1] Total acres treated estimated by multiplying: % acres treated * number of times treated * acreage estimated by participating PCAs in the survey.*

Table 3. Insecticides applied to Fall Lettuce, 2020.

Insecticide Product	IRAC group	% PCA's Using Product	% Treated acres	No. applications	Treated [1] acres
	Fall Lettuce, 2020				
Pyrethroids - Foliar	3A	100	98.2	3.3	75,548
Radiant	5	100	99.5	2.1	46,133
Imidacloprid -Soil	4A	100	80.6	1.0	18,353
Proclaim	6	75.0	47.1	1.2	14,660
Pyrethroids – Chemigation	3A	100	58.7	1.0	13,358
Harvanta	28	33.3	15.2	1.3	6,445
Lannate (methomyl)	1A	50.0	21.9	1.1	5,995
Coragen (Foliar)	28	50.0	21.6	1.0	5,067
Intrepid	18	25.0	15.9	1.0	3,624
Besiege	28+3A	41.7	15.5	1.0	3,522
Endigo	4A+3A	16.6	11.4	1.0	2,600
Minecto Pro	28+6	25.0	10.1	1.0	2,300
Orthene (acephate)	1B	16.6	8.5	1.0	1,850
Assail	4A	8.3	7.7	1.0	1,750
Coragen (Soil)	28	16.6	7.2	1.0	1,650
Sivanto	4D	16.6	3.6	1.0	780
Movento	28	25.0	3.0	1.0	680
Sequoia	4C	16.6	2.2	1.0	510
PQZ	9B	8.3	0.8	1.0	175
Versys	9D	8.3	0.8	1.0	175
Beleaf	29	8.3	0.8	1.0	175
Exirel (foliar)	28	16.6	0.8	1.0	175
Venom / Scorpion (foliar)	4A	8.3	0.4	1.0	98
Dimethoate	1A	8.3	0.2	1.0	40
Avaunt	22	8.3	0.1	1.0	24
Senstar	23+7C	0	0	0	0
Torac	21.0	0	0	0	0
Imidacloprid (foliar)	4A	0	0	0	0
Venom / Scorpion (soil)	4A	0	0	0	0
Verimark (soil)	28	0	0	0	0
Malathion	1B	0	0	0	0
Actara	4A	0	0	0	0
Oberon	23	0	0	0	0
Knack	7C	0	0	0	0
Courier	16	0	0	0	0
Fulfill	9B	0	0	0	0
Agri-Mek (abamectin)	6	0	0	0	0

*[1] Total acres treated estimated by multiplying: % acres treated * number of times treated * acreage estimated by participating PCAs in the survey.*

Table 4. Insecticides applied to Spring Lettuce, 2021.

	Spring Lettuce, 2021				
Insecticide Product	**IRAC group**	**% PCA's Using Product**	**% Treated acres**	**No. applications**	**Treated [1] acres**
Pyrethroids - Foliar	3A	100.0	96.3	2.8	61,401
Radiant	5	100.0	99.4	2.3	47,426
Lannate (methomyl)	1A	83.3	46.2	1.4	19,527
Imidacloprid -Soil	3A	100.0	80.0	1	17,600
Movento	28+16	100.0	63.6	1.1	16,991
Sequoia	4C	83.3	33.3	1.1	7,900
Harvanta	28	25.0	17.1	1.3	7,180
PQZ	9B	33.3	19.2	1.3	7,070
Sivanto	4D	83.3	23.9	1.1	5,824
Besiege	28+3A	41.7	19.7	1	4,340
Beleaf	29	58.3	19.2	1	4,228
Assail	4A	16.6	18.2	1	4,000
Proclaim	6	41.7	18.2	1	4,000
Pyrethroids - Chemigation	3	58.3	18.1	1	3,987
Intrepid	18	25.0	17.9	1	3,936
Versys	9D	33.3	5.8	1	1,286
Orthene (acephate)	1B	33.3	5.0	1	1,060
Coragen -Foliar	28	8.3	4.8	1	1,055
Endigo	4A+3	16.6	4.0	1	880
Torac	21	8.3	3.6	1	800
Minecto Pro	28+6	16.6	3.5	1	780
Senstar	23+7C	16.6	1.1	1	232
Dimethoate	1A	16.6	0.6	1	125
Agri-Mek (abamectin)	6	8.3	0.2	1	40
Avaunt	22	8.3	0.2	1	36
Imidacloprid - Foliar	4A	0.0	0	0	0.0
Venom/Scorpion -Foliar/Soil	4A	0.0	0	0	0.0
Coragen -Soil	28	0.0	0	0	0.0
Fulfill	9B	0.0	0	0	0.0
Verimark (soil)	28	0.0	0	0	0.0
Actara	4A	0.0	0	0	0.0
Exirel -Foliar	28	0.0	0	0	0.0
Malathion	1B	0.0	0	0	0.0
Oberon	23	0.0	0	0	0.0
Knack	7C	0.0	0	0	0.0
Courier	16	0.0	0	0	0.0

*[1] Total acres treated estimated by multiplying: % acres treated * number of times treated * acreage estimated by participating PCAs in the 2016 survey.*

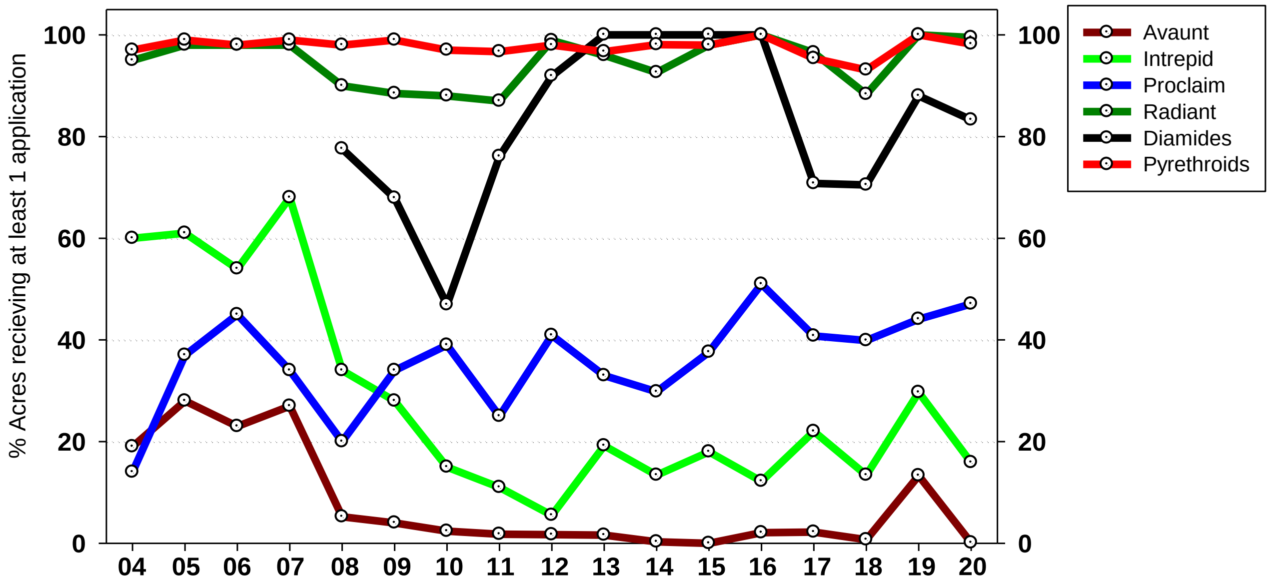

Figure 1. Trends in insecticide use for control of **Lepidopterous larvae** in Fall lettuce, 2004-2020.

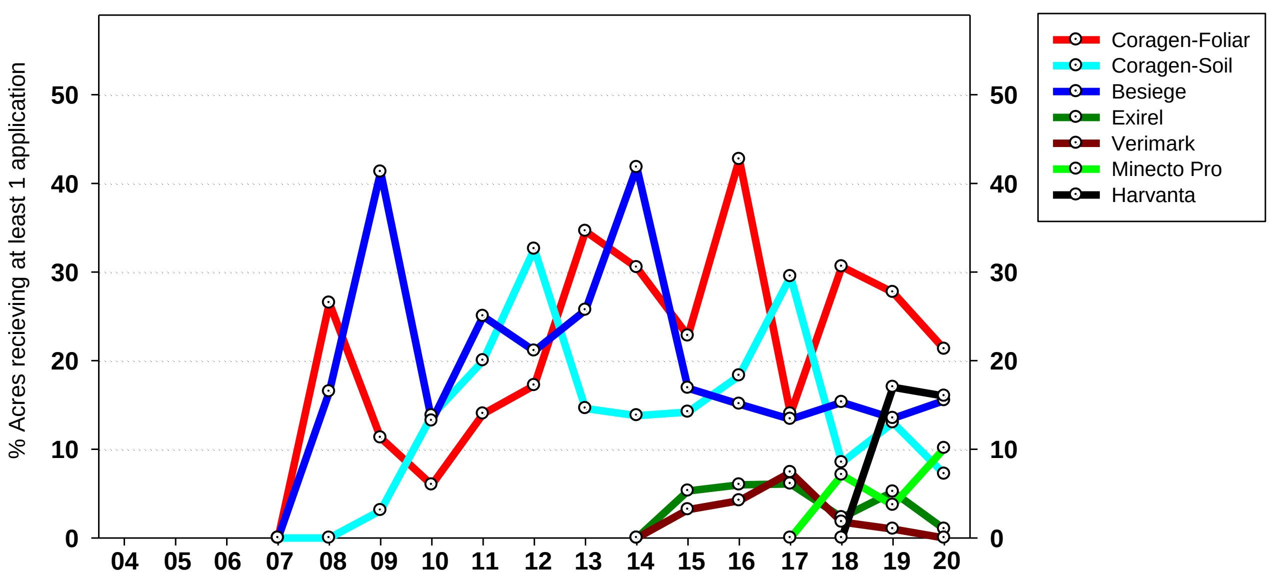

Figure 2. Trends in **Diamide** insecticide use for control of **Lepidopterous larvae** in Fall lettuce, 2004-2020.

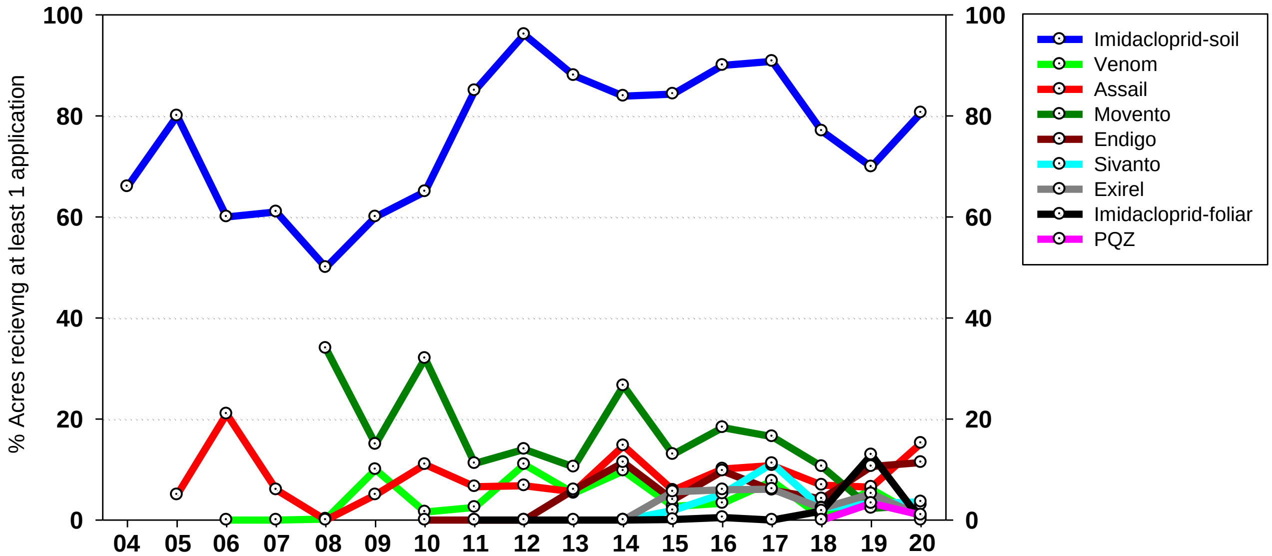

Figure 3. Trends in insecticide use for control of ***Bemisia* Whiteflies and other sucking pests i**n Fall lettuce, 2004-2020.

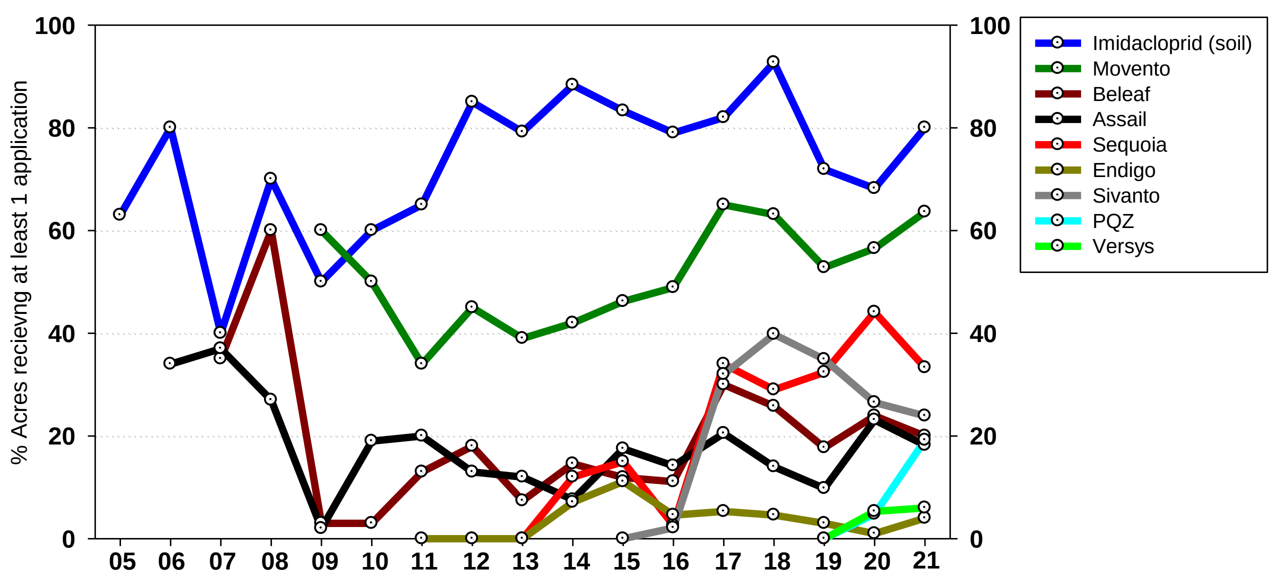

Figure 4. Trends in insecticide use for control of **Aphids** in Spring lettuce, 2005-2021.

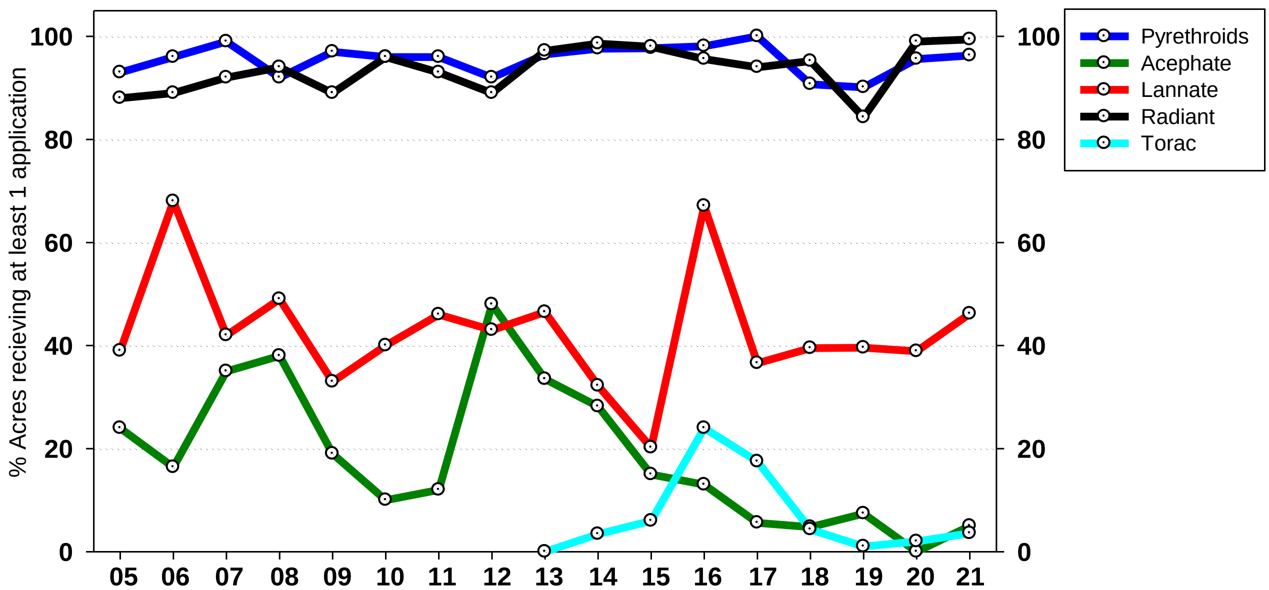

Figure 5. Trends in insecticide use for control of **Western Flower Thrips** in Spring lettuce, 2005-2021.

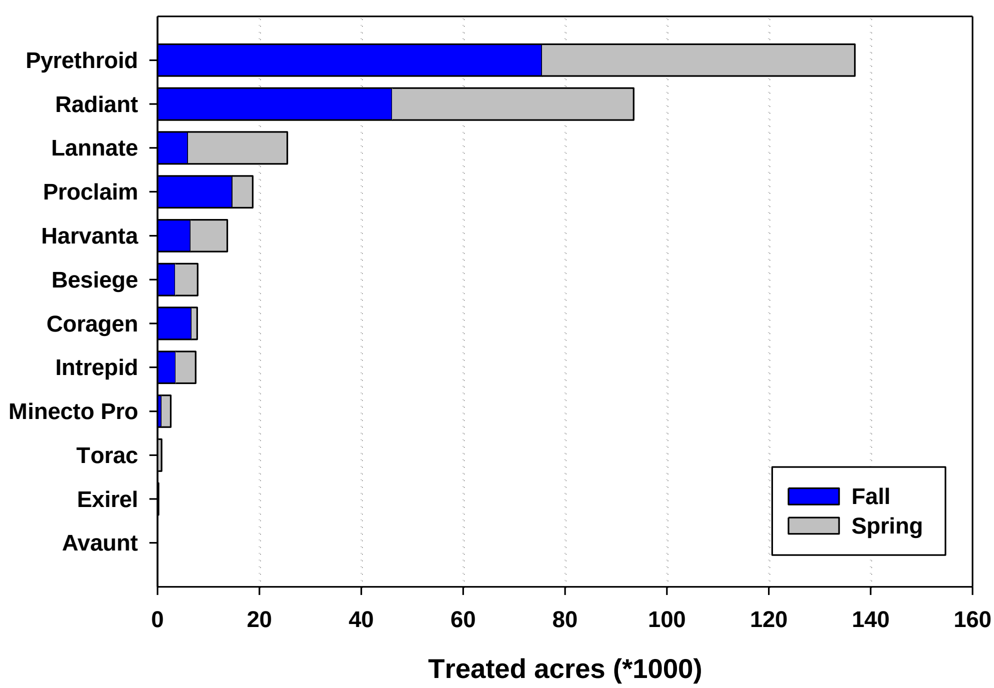

Figure 6. Estimates of insecticide use for Chewing and Contact insect control on Lettuce, 2020-2021.

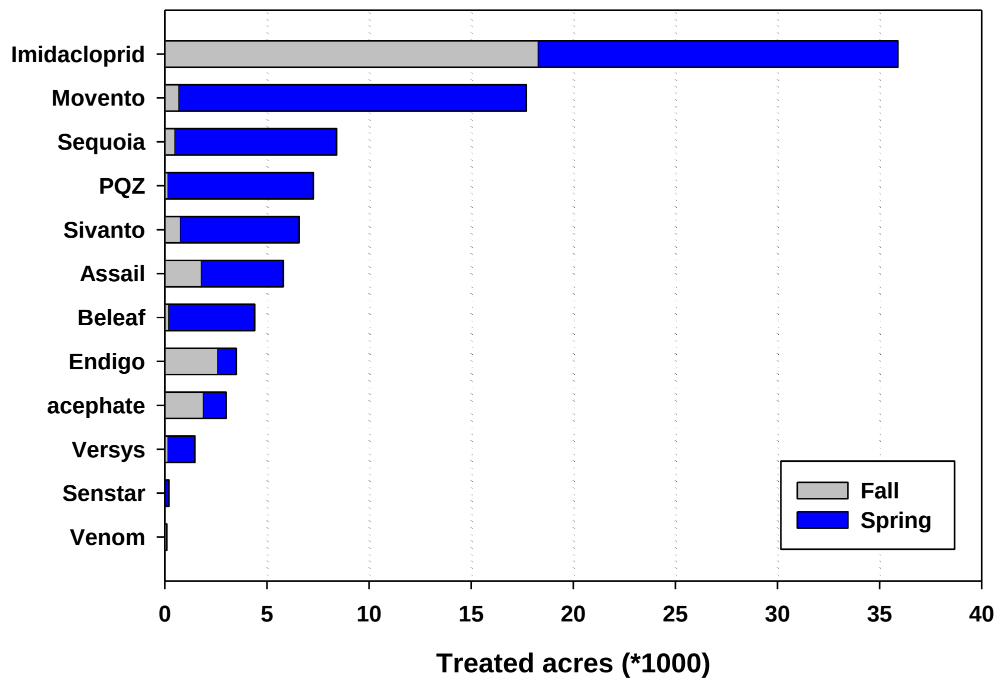

Figure 7. Estimates of insecticide use for sucking insect control on Lettuce, 2020-2021

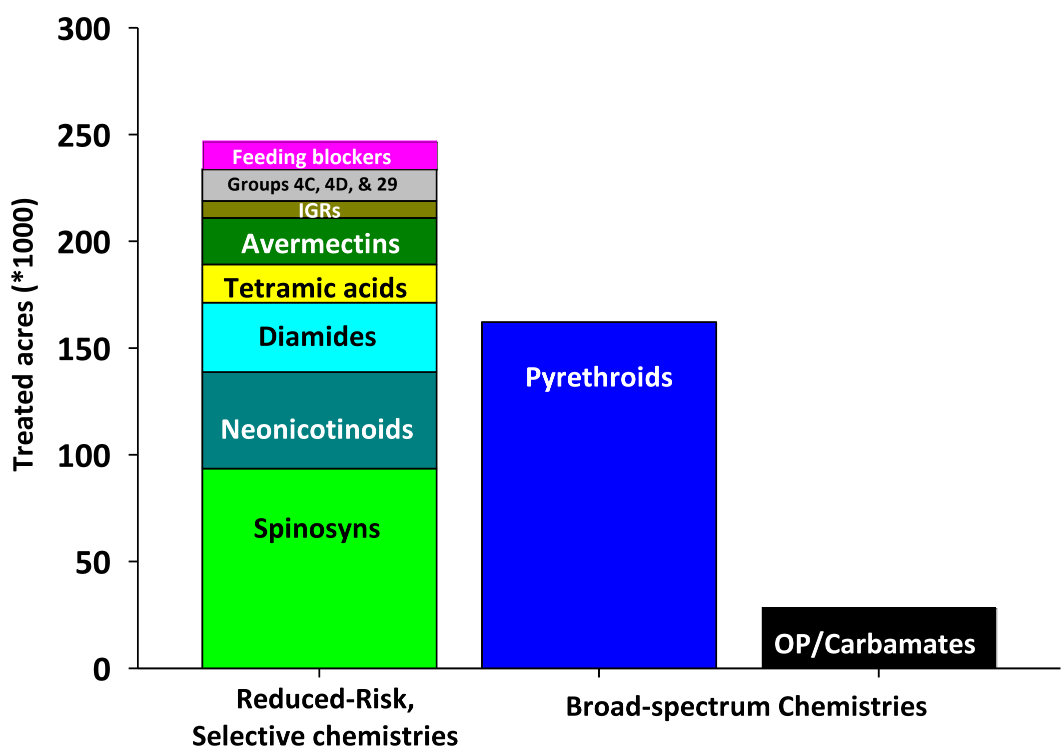

Figure 8. Estimates of total insecticide use for seasonal insect control on Lettuce, 2020-2021.

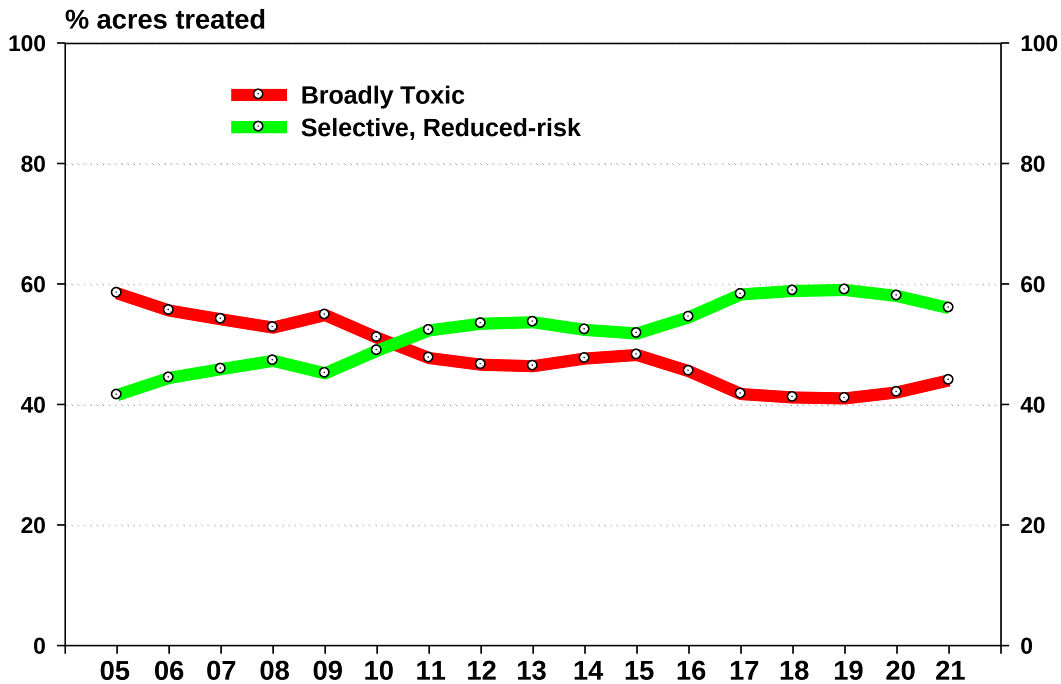

Figure 9. Percentage acreage treated with broad spectrum, and selective, reduced -risk insecticides on desert lettuce, 2005-2021.