COLLEGE OF AGRICULTURE & LIFE SCIENCES
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Insecticide Usage on Desert Lettuce, 2019-2020

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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 trends on lettuce over the past 16 years.

Methods: Growers and PCAs normally attend a Head 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. 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 15 surveys were completed in the 2019 workshop, representing an estimated total of 22,070 fall acres and 25,520 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 and 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 control of flea beetles, crickets, plant bugs and some Lepidopterous larvae and adults (cabbage looper and corn earworm). Over the past 15 years, pyrethroid usage has remained consistently high **(Fig 1 and 5)**, and accounts for the bulk of broad-spectrum chemistry used to control insects in lettuce **(Fig 6 and 8)**.

Overall, organophosphate/carbamate usage decreased slightly compared to 2018-19. Methomyl (Lannate) usage was similar to the previous three years, but acephate usage noticeably decreased on spring lettuce this season lighter thrips pressure **(Fig 5)**. However, both insecticides remain important rotational alternatives for western flower thrips management. 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 2019 **(Table 1 and 2).** Radiant usage against both lepidopterous larvae **(Figure 1)** and thrips **(Figure 5)** has remained steady over the past 15 years, averaging over 2 sprays per treated acre, and usage increased in 2019-20. 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, Exirel and Verimark, Vetica, and Belt) 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 usage increased by about 20% on fall lettuce in 2019 (**Fig 1)**. Among the diamides, Coragen as a foliar spry was the most used, and a new 3rd generation diamide Harvanta (cylcaniliprole)was the second most used diamide. Belt/Vetica use was not reported in lettuce in 2019-20. We presume existing stocks have been exhausted. Coragen soil usage increased in 2019, and Verimark was used on less than 1% of the fall acers **(Table 3).** The 2nd generation diamide cyantraniliprole pre-mixture, Minecto Pro, was used on about 14% of the seasonal acers, and slightly more than it's diamide counterpart, Exirel.

Another important class of chemistry used in fall and spring lettuce are the neonicotinoids-4A (the 3rd most commonly used chemistry in lettuce in 2019-20) driven primarily by soil-applied imidacloprid for whiteflies and aphids **(Figures 3, 4 and 8)**. The usage of imidacloprid on both fall and spring lettuce has increased markedly since 2009, but usage decreased significantly last season where it was used on less than 70% pf lettuce acers **(Table 3-4).** Foliar neonicotinoid usage increased slightly last season. However, Sequoia (sulfoxamine-4C) accounted for significant usage this spring due and was applied to 44.1 % of the acreage. Although less Movento was used on fall and spring lettuce in 2019-20, it remains second most commonly used product for sucking insect control **(Fig 4 and 8)**. 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)**.

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 16 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, 2019

Insecticide Chemistry	IRAC group	% PCA's Using Products	% treated acres	No. applications	Treated [1] acres
	Fall Lettuce, 2019				
Carbamates	1A	60.0	47.0	1.1	11,040
Organophosphates	1B	6.7	1.6	1.0	342
Pyrethroids - Foliar	3A	100.0	100.0	3.8	81,141
Pyrethroids - Chemigation	3A	93.3	78.2	1.1	18,368
Pyrethroids - Total					99,509
Neonicotinoids -Soil	4A	86.7	73.3	1.0	15,652
Neonicotinoids -Seed treatment	4A	6.7	7.0	1.0	1,495
Neonicotinoids -Foliar	4A	53.8	36.0	1.0	7,687
Neonicotinoids -Total					24,834
Sulfoxamines	4C	6.7	1.0	1.0	214
Butenolides	4D	20.0	3.3	1.0	705
Spinosyns	5	100.0	100.0	2.3	49,112
Avermectins	6	66.7	47.1	1.2	12,069
JH mimic	7C	0	0	0	0
Selective feeding blockers	9B	6.7	3.3	1.0	705
Selective feeding blockers	9D	0	0	0	0
Selective feeding blockers-Total					705
Chitin Synthesis inhibitor	16	0	0	0	0
Ecdysone agonists	18	33.3	29.7	1	6,342
METI inhibitors	21	0	0	0	0
Na channel blockers	22	13.3	8.4	1	1,794
Tetramic acids	23	20	2.4	1	512
Diamides -Soil	28	50.0	12.2	1.0	2,605
Diamides- Foliar	28	80.0	83.9	1.0	17,915
Diamides- Total					20,520
Chordotonal organ modulators	29	13.3	1.4	1	300

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

Table 2. The top insecticide chemistries used on Spring Lettuce, 2020

Insecticide Chemistry	Spring Lettuce, 2020				
	IRAC group	% PCA's Using Products	% treated acres	No. applications	Treated [1] acres
Carbamates	1A	67.7	38.9	1.32	12,609
Organophosphates	1B	6.7	0.8	1.0	198
Pyrethroids - Foliar	3A	92.3	95.6	3.3	77,987
Pyrethroids - Chemigation	3A	40.0	15.3	1.1	4,160
Pyrethroids - Total					82,147
Neonicotinoids -Soil	4A	80.0	70.0	1.0	17,304
Neonicotinoids -Seed treatment	4A	6.7	6.5	1.0	1,607
Neonicotinoids -Foliar	4A	38.5	44.1	1.0	10,902
Neonicotinoids -Total					29,812
Sulfoxamines	4C	80.0	44.1	1.2	12,537
Butenolides	4D	66.7	26.5	1.2	7,861
Spinosyns	5	100.0	99.0	1.9	46,498
Avermectins	6	33.3	27.5	1.2	8,158
JH mimic	7C	0	0	0	0
Selective feeding blockers	9B	40	5.6	1	1387
Selective feeding blockers	9D	13.3	5.3	1.0	1,310
Selective feeding blockers-Total					2,697
Chitin Synthesis inhibitor	16	0	0	0	0
Ecdysone agonists	18	33.3	29.2	1.0	7,218
METI inhibitors	21	6.7	1.7	1.0	420
Na channel blockers	22	20.0	11.6	1.0	2,868
Tetramic acids	23	86.7	56.5	1.5	20,950
Diamides -Soil	28	30.7	5.8	1.0	1,434
Diamides- Foliar	28	84.6	83.1	1.0	20,542
Diamides- Total					21,976
Chordotonal organ modulators	29	66.7	23.9	1.3	7,681

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

Table 3. Insecticides applied to Fall Lettuce, 2019.

Insecticide Product	Fall Lettuce, 2019				
	IRAC group	% PCA's Using Product	% treated acres	No. applications	Treated[1] acres
Pyrethroids - Foliar	3A	100	100	3.8	81,141
Radiant	5	100	100	2.3	49,112
Pyrethroids - Chemigation	4A	93.3	78.2	1	18,368
Imidacloprid -Soil	3A	86.7	69.9	1	15,173
Proclaim	6	66.7	44.1	1.1	11,420
Lannate (methomyl)	1A	60.0	28.5	1.2	10,096
Harvanta	28	20.0	17.0	1.3	7,040
Intrepid	18	33.3	29.7	1	6,350
Coragen (Foliar)	28	40.0	27.7	1	5,923
Besiege	28+3	33.3	13.5	1	2,870
Coragen (Soil)	28	33.3	13.0	1	2,770
Imidacloprid - Foliar	4A	13.3	12.9	1	2,750
Endigo	4A+3	26.7	10.6	1	2,252
Avaunt	22	13.3	8.4	1	1,800
NipsIt seed treatment	4A	6.7	6.9	1	1,500
Assail	4A	26.7	6.5	1	1,380
Venom / Scorpion (foliar)	4A	13.3	6.1	1	1,300
Exirel (foliar)	28	20.0	5.2	1	1,100
Minecto Pro	28+6	6.7	3.7	1	800
Sivanto	4D	20.0	3.3	1	700
PQZ	9B	6.7	3.3	1	700
Venom / Scorpion (soil)	28	6.7	2.3	1	500
Movento	28	20.0	2.3	1	512
Orthene (acephate)	1B	6.7	1.6	1	350
Beleaf	29	13.3	1.4	1	300
Sequoia	4C	6.7	1.0	1	214
Verimark (soil)	28	20.0	0.9	1	190
Dimethoate	1A	0.0	0.0	0	0
Malathion	1B	0.0	0.0	0	0
Actara	4A	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
Cormoran	15+4A	0.0	0.0	0	0
Fulfill	9B	0.0	0.0	0	0
Versys	9D	0.0	0.0	0	0
Torac	21.0	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.*

Table 4. Insecticides applied to Spring Lettuce, 2020.

Insecticide Product	Spring Lettuce, 2020				
	IRAC group	% PCA's Using Product	% treated acres	No. applications	Treated [1] acres
Pyrethroids - Foliar	3A	92.3	95.6	3.3	77,987
Radiant	5	100	99.0	1.9	46,498
Movento	28+16	86.7	56.5	1.5	20,950
Imidacloprid -Soil	3A	80.0	68.2	1	16,862
Lannate (methomyl)	1A	67.7	38.9	1.3	12,609
Sequoia	4C	80.0	44.1	1.2	12,537
Sivanto	4D	66.7	26.5	1.2	7,861
Beleaf	29	66.7	23.9	1.3	7,681
Intrepid	18	33.3	29.2	1	7,218
Coragen -Foliar	28	40.0	20.5	1.2	6,875
Proclaim	6	33.3	19.8	1.2	6,400
Beseige	28+3	40.0	24.5	1	6,065
Assail	4A	20.0	23.1	1	5,700
Harvanta	22	6.7	20.2	1	5,000
Imidacloprid - Foliar	4A	13.3	14.7	1	3,625
Pyrethroids - Chemigation	3	40.0	15.3	1.1	3,594
Avaunt	22	20.0	11.6	1	2,875
Minecto Pro	28+6	13.3	7.3	1	1,800
NipsIt seed treatment	4A	6.7	6.5	1	1,600
Venom / Scorpion -Foliar	4A	6.7	6.1	1	1,500
Versys	9D	13.3	5.3	1	1,300
PQZ	9B	33.3	4.8	1	1,193
Coragen -Soil	28	20.0	4.2	1	1,030
Exirel -Foliar	28	13.3	2.4	1	600
Venom / Scorpion -Soil	4A	6.7	2.0	1	500
Torac	21	6.7	1.6	1	400
Endigo	4A+3	13.3	0.9	1.0	230
Dimethoate	1A	6.7	0.8	1	200
Fulfill	9B	6.7	0.8	1	200
Verimark (soil)	28	13.3	0.3	1	65
Actara	4A	6.7	0.2	1	48
Orthene (acephate)	1B	0.0	0.0	0.0	0.0
Malathion	1B	0.0	0.0	0.0	0.0
Oberon	23	0.0	0.0	0.0	0.0
Knack	7C	0.0	0.0	0.0	0.0
Courier	16	0.0	0.0	0.0	0.0
Cormoran	15+4A	0.0	0.0	0.0	0.0
Agri-Mek, Abba	6	0.0	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.*

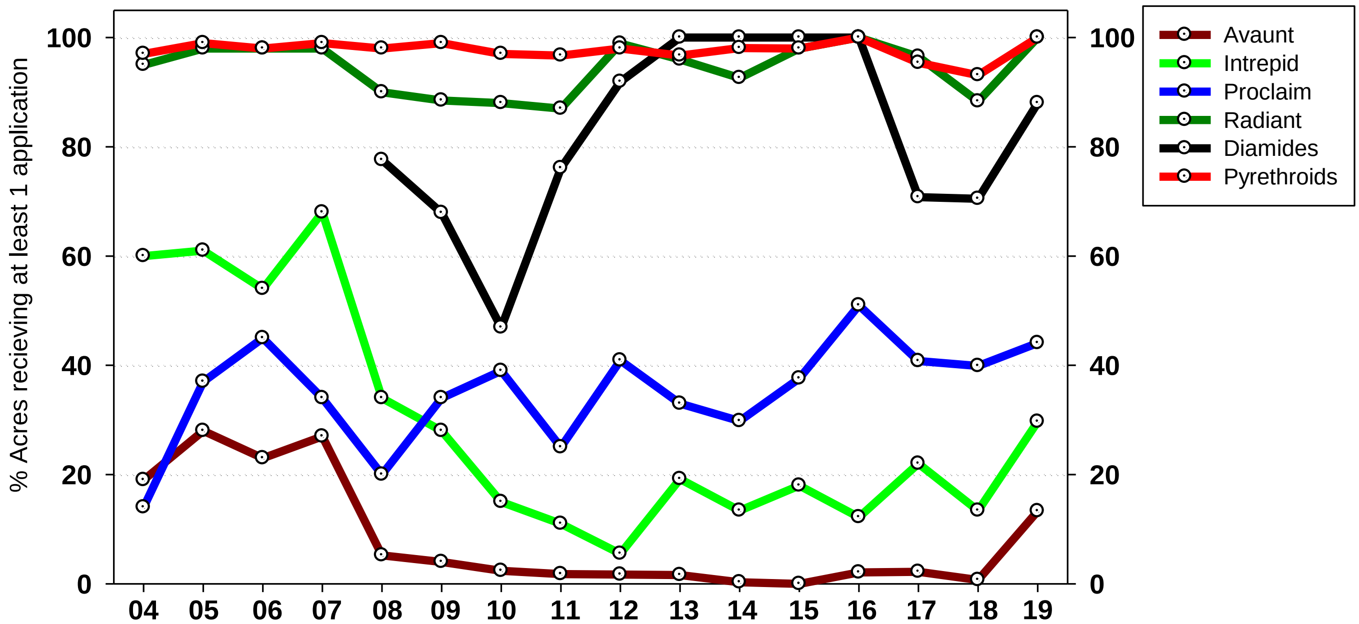

Figure 1. Trends in insecticide use for control of **Lepidopterous larvae** in Fall lettuce, 2004-2019.

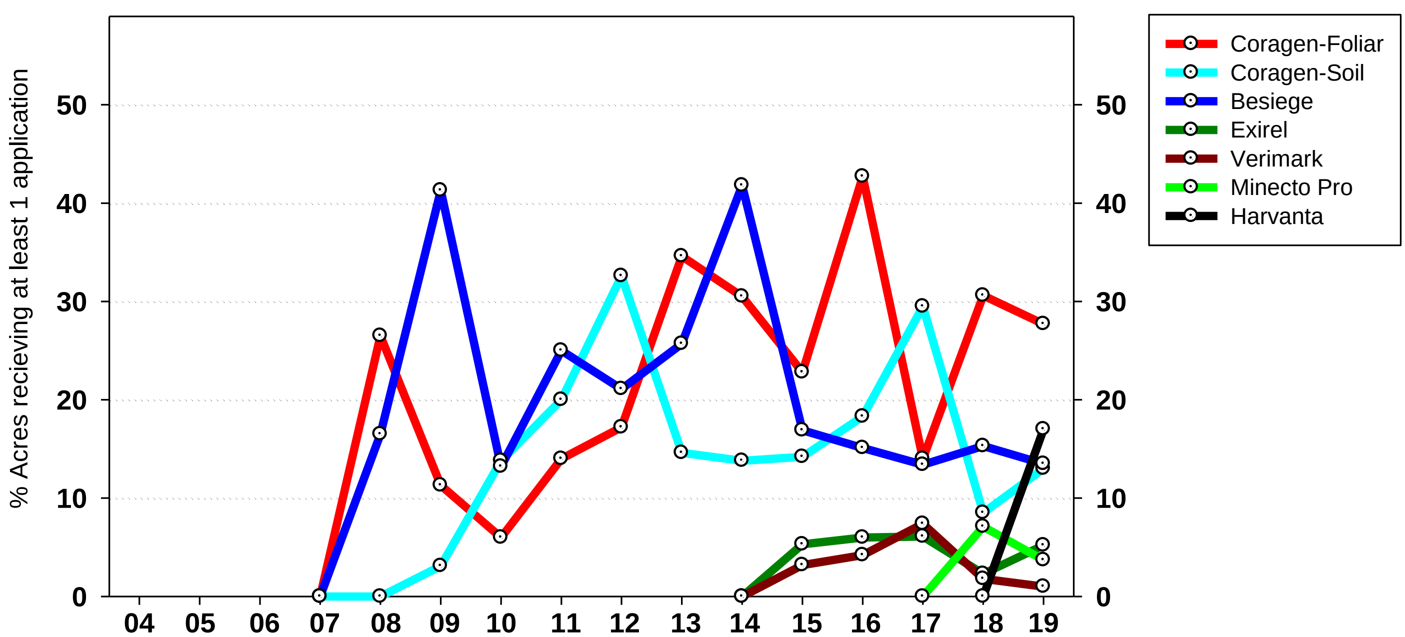

Figure 2. Trends in **Diamide** insecticide use for control of **Lepidopterous larvae** in Fall lettuce, 2004-2019.

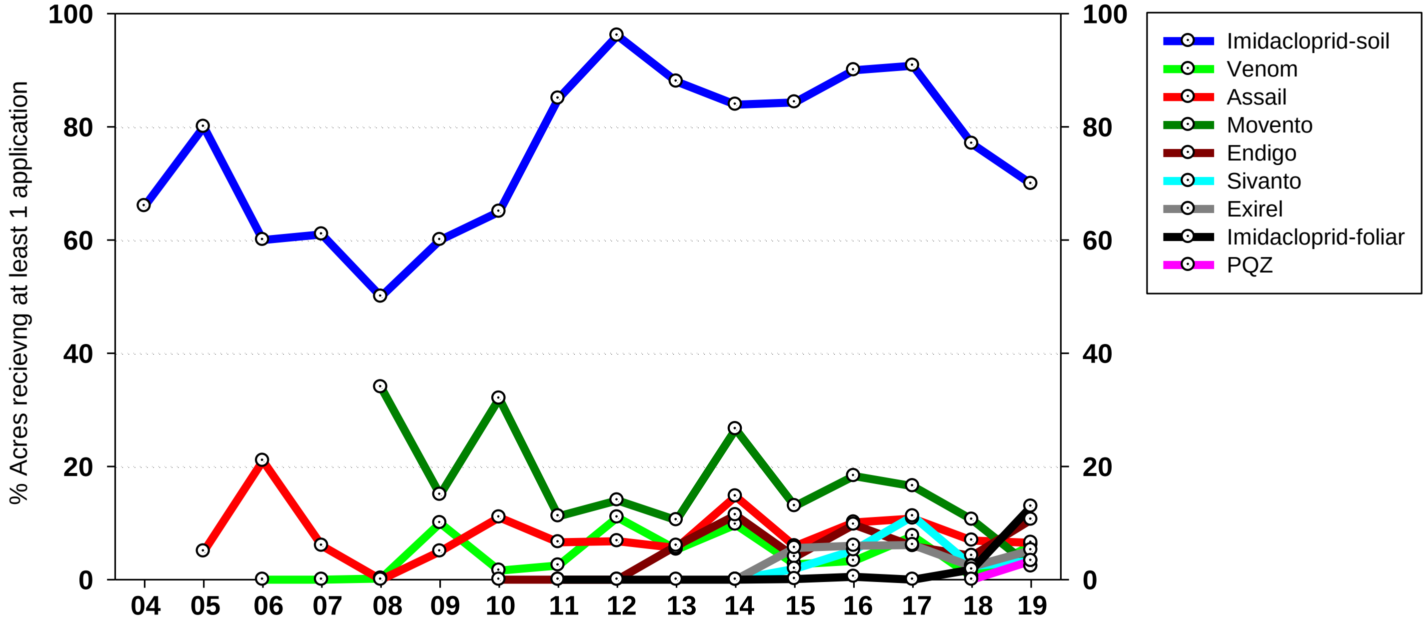

Figure 3. Trends in insecticide use for control of ***Bemisia* Whiteflies i**n Fall lettuce, 2004-2019.

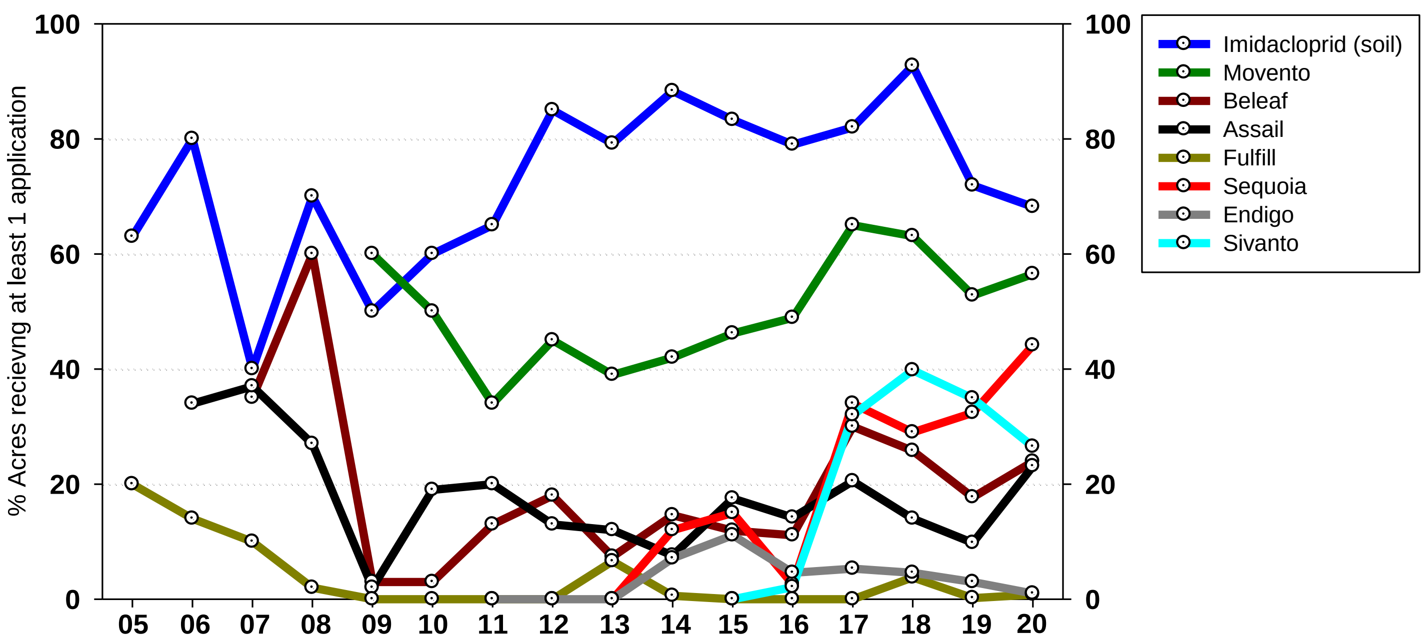

Figure 4. Trends in insecticide use for control of **Aphids** in Spring lettuce, 2005-2020.

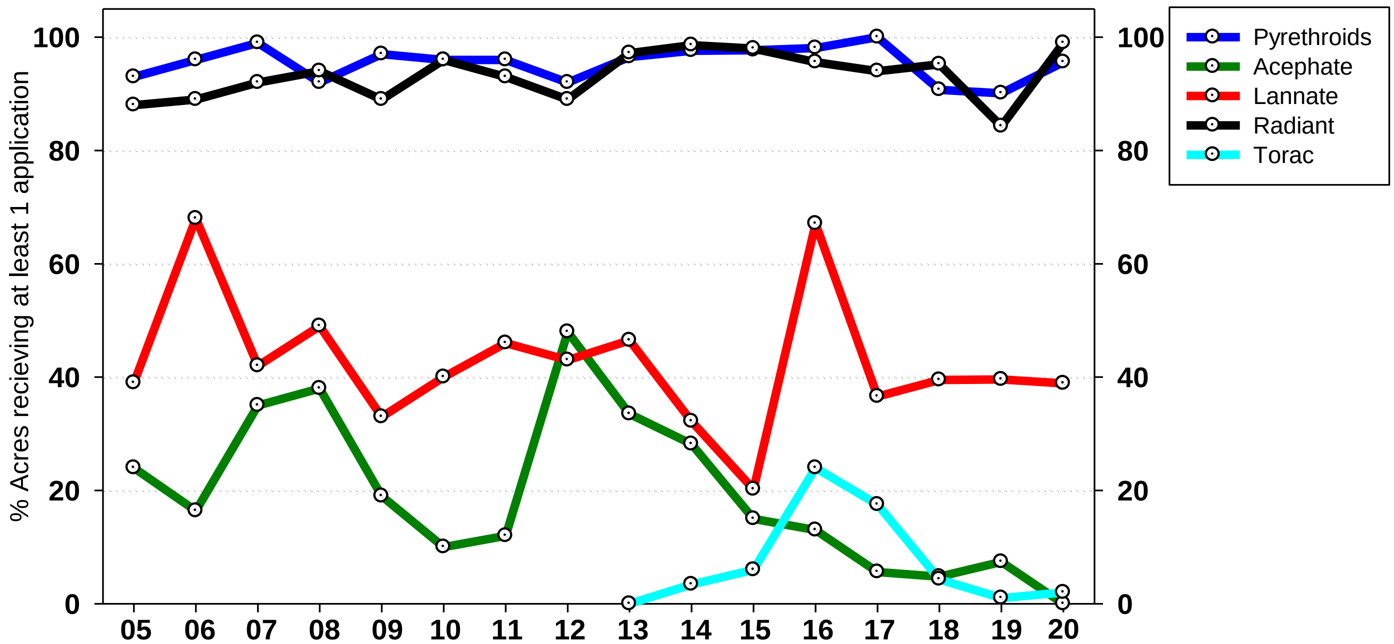

Figure 5. Trends in insecticide use for control of **Western Flower Thrips** in Spring lettuce, 2005-2020.

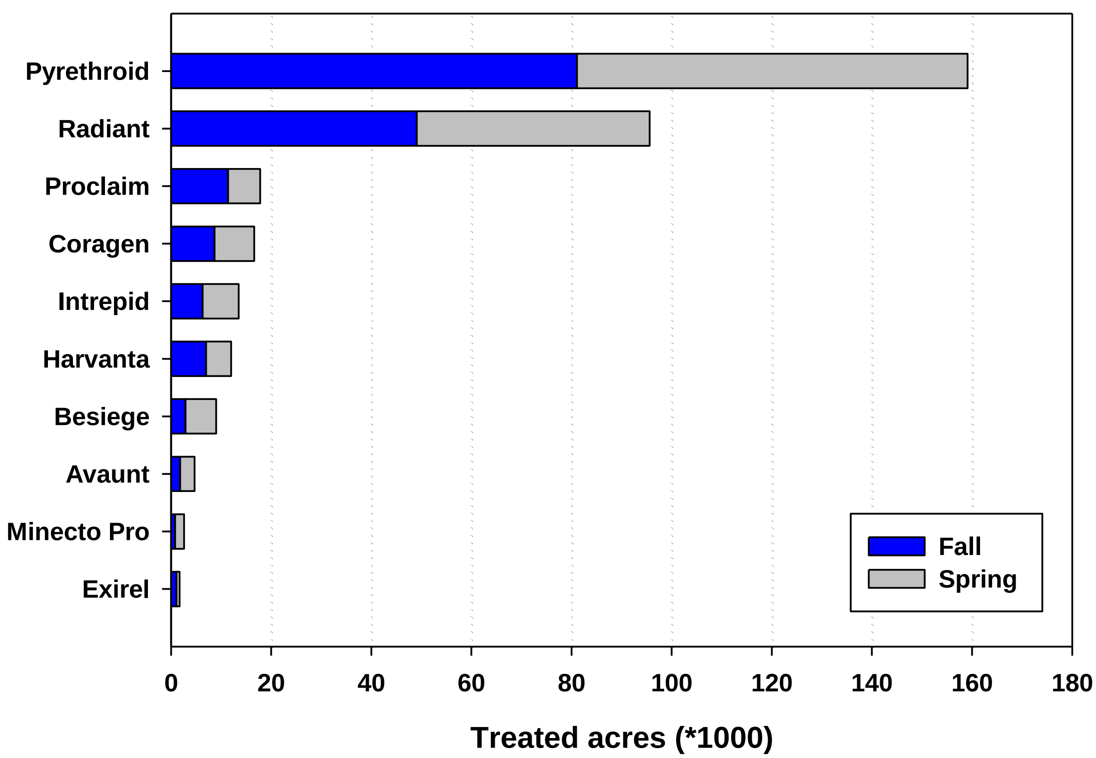

Figure 6. Estimates of insecticide use for Chewing insect control on Lettuce, 2019-2020

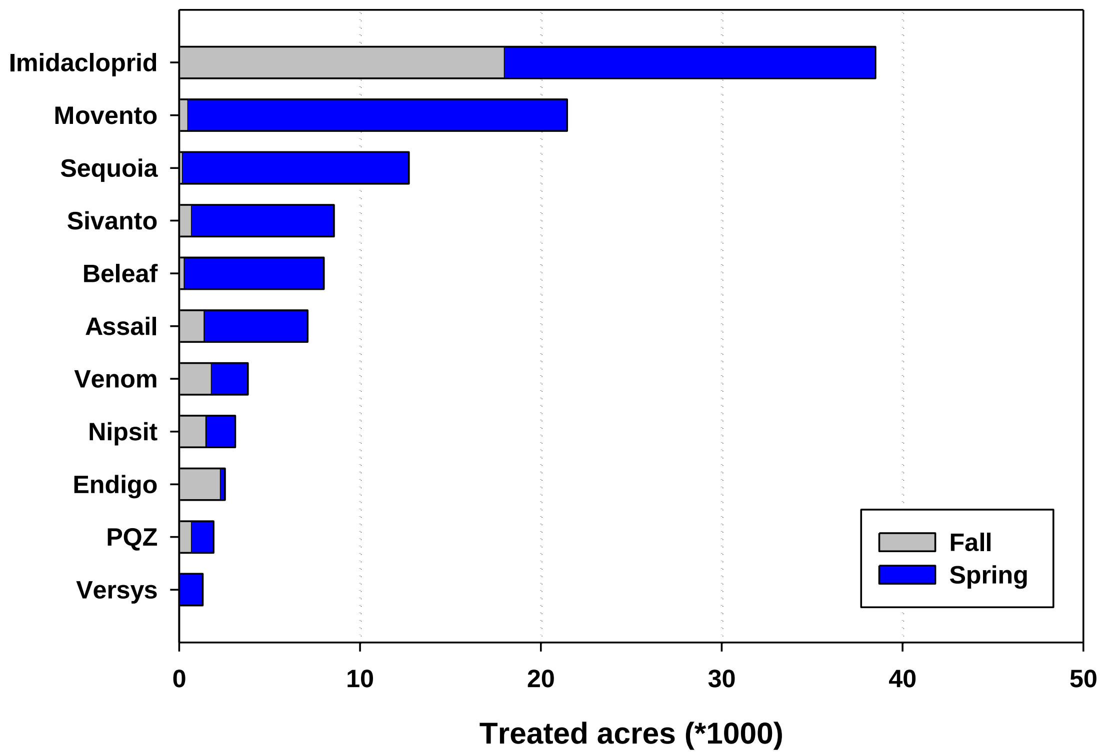

Figure 7. Estimates of insecticide use for sucking insect control on Lettuce, 2019-2020

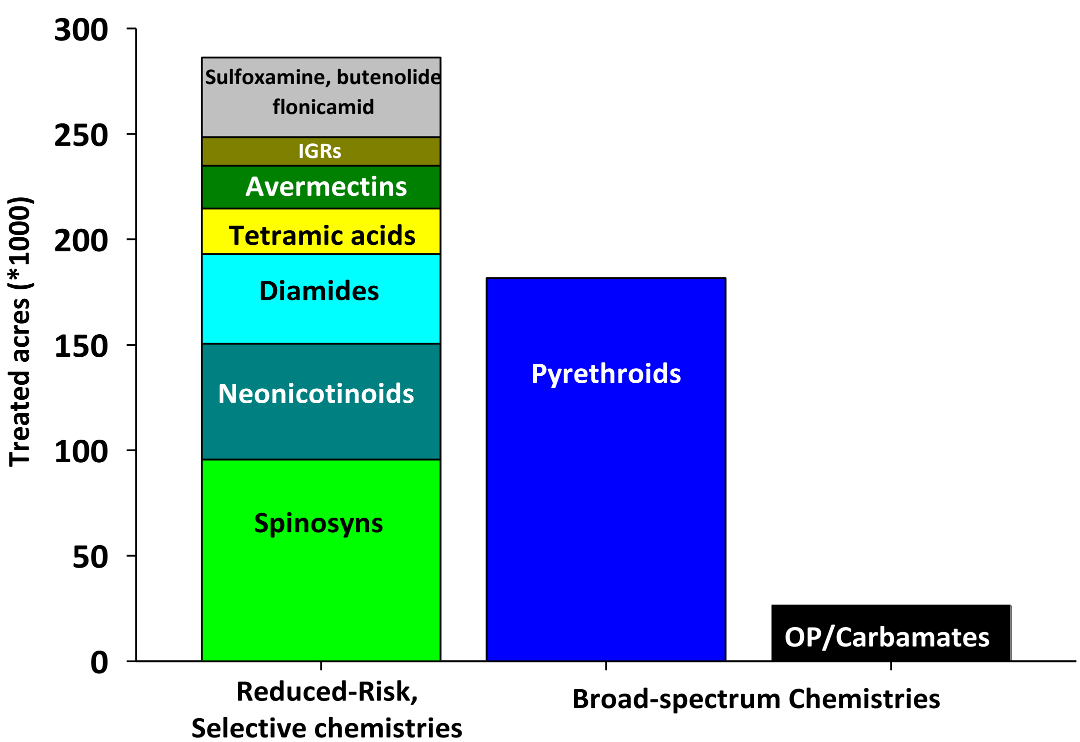

Figure 8. Estimates of total insecticide use for seasonal insect control on Lettuce, 2019-2020.

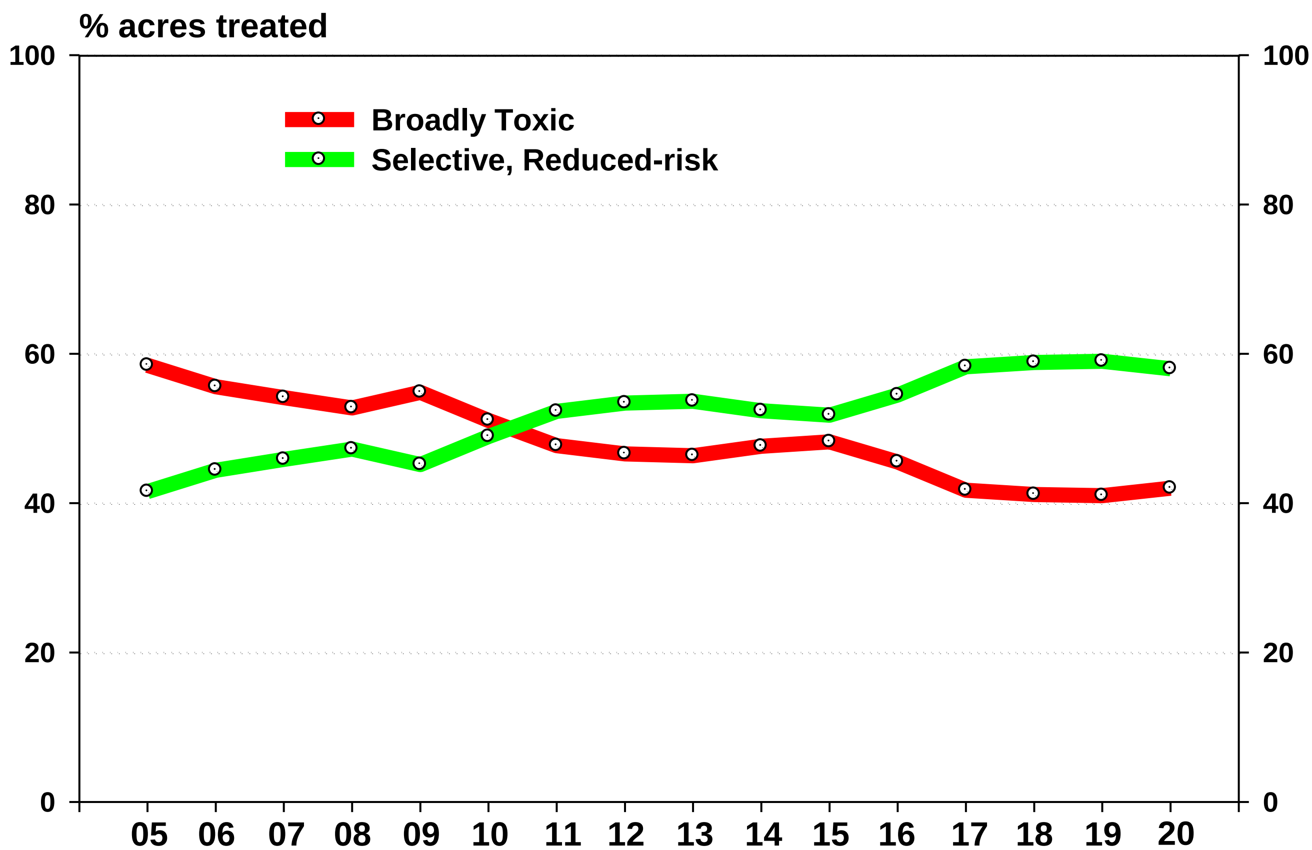

Figure 9. Percentage acreage treated with broad spectrum, and selective, reduced -risk insecticides on desert lettuce, 2005-2020.