

Arizona Iceberg Lettuce Research Council

Research Report

Evaluation of The Effect of Weeds and Herbicides on The Uptake of Soil Applied Insecticides in Lettuce.

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Purpose

Almost all of the lettuce grown in the low deserts of Arizona and California are treated with insecticides that are applied to the soil and taken up by the roots of the crop. Many factors can affect the ability of the crop to take up and translocate these products. Two of these factors are 1- weeds that intercept the insecticide and reduce the availability to the crop and 2- soil applied herbicides that inhibit crop root development and reduce it's ability to uptake the insecticide. The affect of these two factors has not previously been measured and will depend on the type and infestation level of the weeds present and the herbicide(s) and rate(s) used. To address this issue, this project focused on: 1) the use of herbicides that can restrict root development of the crop and reduce the crops ability to absorb insecticides, and 2) the presence of weed roots that can potentially intercept the insecticide and reduce availability to the crop. The principal herbicides used in the production of lettuce in Arizona are Pronamide (Kerb), Bensulide (Prefar) and Benefin (Balan). All three of these are mitotic inhibitors that stop cell division in the roots of developing seedlings. Root development is inhibited in most weed species more than it is in lettuce, which is generally tolerant at recommended use rates. It is not uncommon, however, for lettuce root development to be restricted by these herbicides if they are exposed to toxic levels or

if the crop is weakened. When this occurs, it is likely that the ability of the crop to absorb soil-applied insecticides is reduced. The effect of soil-applied herbicides on the absorption of soil-applied insecticides has not previously been evaluated. Additionally soil systemic insecticides such as Imidacloprid (Admire Pro) have been used for many years on desert lettuce for control of aphids and whiteflies. Chlorantraniliprole (Coragen, DuPont) was registered in 2008 for control of worms and leafminers. When both of these products are properly applied residual control of these insects can be expected for 25-30 days. Although we understand many of the factors which influences residual control provided by these insecticides, the impact that competition from weeds and or volunteer plants was the goal of this research.

Procedure

This project was initiated on November 17, 2015 At the University of Arizona, Yuma Agriculture Center with the support of the Arizona Iceberg Lettuce Research Council. An HPLC (High Pressure Liquid Chromatograph) was available for use in the pesticide diagnostics laboratory at the Yuma Agriculture Center. We applied pre-emergence herbicides benefin (Balan, Loveland) and bensulide (Prefar, Gowan). Also soil-applied insecticides Imidacloprid (Admire Pro, Bayer) and Chlorantraniliprole (Coragen, DuPont) were applied at planting and sprinkler irrigation started for crop and weed germination. On November 25, 2015 a delayed application of pronamide (Kerb, Dow) at the rate of 1.3 pt. per acre was done.

Table 1 Treatments Applied at Yuma Agriculture Center

Insecticide	Herbicide	Weed Control
1. Admire Pro	Untreated	None
2. Coragen	Untreated	None
3. Untreated	Untreated	None
4. Admire Pro	Kerb	Chemical
5. Coragen	Kerb	Chemical
6. Untreated	Kerb	Chemical
7. Admire Pro	Prefar	Chemical
8. Coragen	Prefar	Chemical
9. Untreated	Prefar	Chemical
10. Admire Pro	Balan	Chemical
11. Coragen	Balan	Chemical
12. Untreated	Balan	Chemical
13. Admire Pro	Untreated	Manual
14. Coragen	Untreated	Manual
15. Untreated	Untreated	Manual

Soil, lettuce and weed samples were collected between Jan.13, 2016 and Jan. 18, 2016

for analysis in the HPLC (High Pressure Liquid Chromatograph). The extraction procedures were started for the first sampling date. The samples consisted of 10grams of the second position leaves for the head lettuce. The only weed that was widespread in this trial was Nettleleaf Goosefoot (*Chenopodium murale*), and we decided to sample this species only. The weed sample was taken at the 2 in height for the first sample. Our soil samples consisted of 10grams. of top-

soil in the seed line to be analyzed for 5 compounds which were Imidachlorpid, Chlorantraniprole, Bensulide, Pronamide, and Benefin, which are Admire, Coragen, Prefar, Kerb and Balan. Whitefly and lepidopterous insect pressure was not sufficiently uniform to observe differences between treatments and insect monitoring was not performed. On February 12, 2016 manual weed control was done in treatments 13-15th. Two more tissue, weed and soil samples were taken the week of February 8, and March 15, 2016. The data from the first soil, plant tissue and weed evaluations is contained in the figures and tables that follow and the laboratory continues running the soil and plant materials from the second and third evaluations. After the March 15th sample the sampling was concluded and the crop was disked.

During the months of April, we continued the extraction laboratory procedures from samples and running the samples in the HPLC. A chemist and a technician from Shimadzu Corporation, manufacturers of the HPLC were called for maintenance to our instruments due to mechanical problems with sampler. The samples consisted of 15 treatments replicated 4 times with subsamples A and B for each plot for a total of 120 samples. The samples were run twice using five methods for detecting our five different active ingredients. The HPLC would have to run for 6000 minutes or 100 hours non-stop for each sampling date in addition to the preparation time in the laboratory.

The amounts detected by the chromatograph did not reflect statistical differences between treatments (Appendix A). Due to variability of the data it is difficult to conclude that the highly weedy treatments contained lower concentrations of the soil applied insecticides Admire or Coragen.

The HPLC (High Pressure Liquid Chromatograph) analysis showed that the soil applied insecticide was detected in the treated weeds. However it also was identified in some of the insecticide untreated plots, which could be due to the proximity of the plots and/or the solubility and mobility of the soil-applied insecticides (Fig.1). Plots were 4 rows by 30 ft. The buffer between plots were 6.67ft between replications and 3ft between plots. Only the two middle rows of the plots were treated, therefore the separation between replications was 13.3ft.

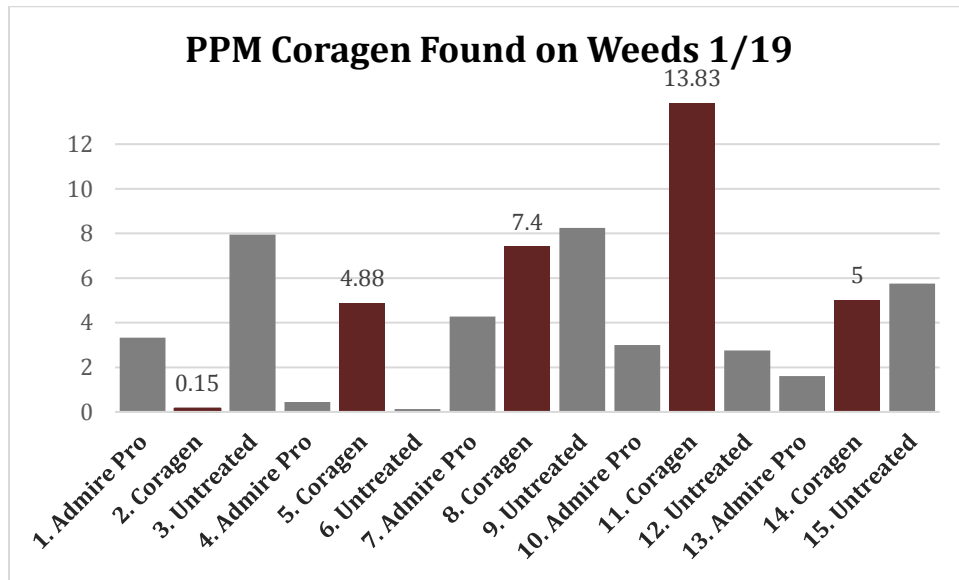


Figure 1

We have seen in the past that soil analysis is far more accurate and consistent than is tissue analysis for these three evaluated herbicides. All three are applied to soil where they are picked up in the roots of the weeds and the crop. Only Pronamide moves much in the plant. Benefin and Bensulide move very little. Seedling plants are hard to sample and the amount we found in them was extremely variable.

The active ingredient pronamide (Kerb) was found in lettuce tissue samples. Similarly, this active ingredient was found in other plots where no pronamide was applied. Interestingly the highest concentration of pronamide was detected in the insecticide untreated plots followed by the pronamide Admire and finally pronamide Coragen (Fig. 2).

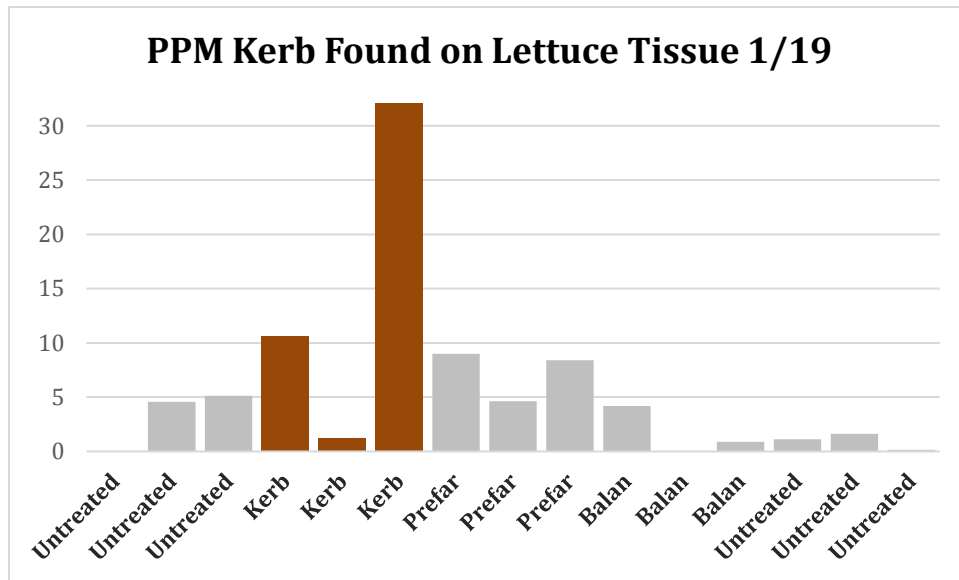


Figure 2

Prefar on weeds was detected on January 19, 2016 only in the insecticide untreated plots (Fig. 3). Interestingly the Kerb concentration was also higher in the insecticide untreated plots.

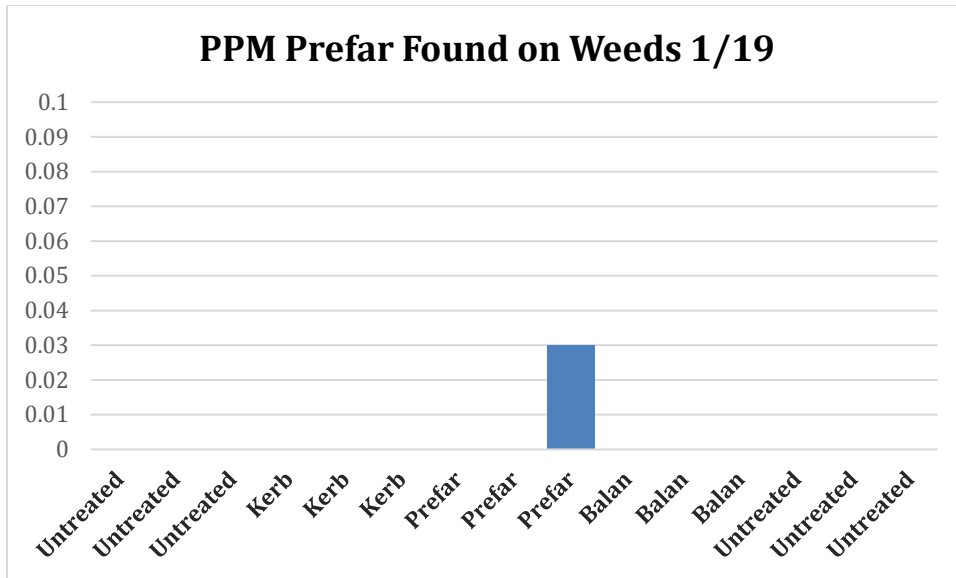


Figure 3

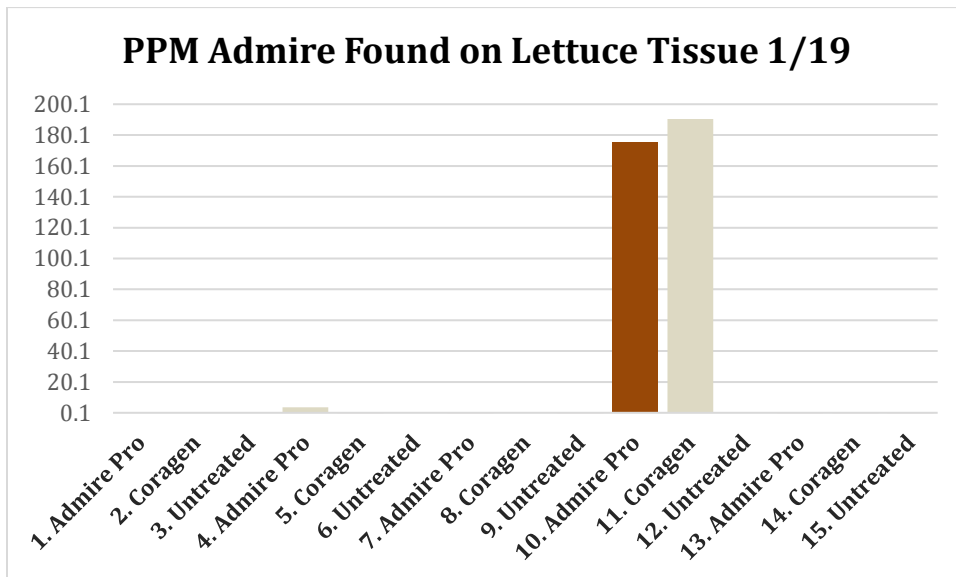


Figure 4

The soil-applied insecticide Imidacloprid (Admire) concentration was higher in the combination with the herbicide Balan (treatment 10). The amount detected in the Admire treated plots without

herbicide was lower (Treatment 1). Additionally the treatments treated with Kerb (Pronamide) contained lower Admire residues (Fig. 4).

Discussion

It makes sense to think that roots from weeds would intercept some of the insecticides applied in the soil to protect lettuce. It also makes sense to think that if lettuce roots were injured by root pruning herbicides that this too would reduce the uptake of systemic insecticides. There was no correlation found between weed infestation, insecticides or herbicides in this trial. In fact, Coragen and Kerb were detected in soil and plant tissue where it had not even been applied. This is hard to explain and some of it may be because we were measuring an extremely small part of a very heterogeneous soil environment. Unlike the air above it, the soil is made up of variable amounts of sand, silt, clay, organic matter, water, gases and microorganisms. All of these interact to create constantly changing microenvironments. The five pesticides that we measured in this trial all react differently in this complex soil environment. They must be absorbed by roots and transported into the rest of the plant. If and when this occurs, they enter into another highly complex and variable environment. We have all seen spots in the field where dead plants are right next to healthy ones. We may have had a lot of precision and little accuracy. There are 43,560 square feet in an acre and a cubic foot of soil weighs about 100 pounds depending on soil type and moisture. An acre of lettuce at harvest weighs about 16 tons. Our plots were 4 beds wide and 30 feet long or 420 square feet. From this we analyzed 10 grams of soil or plant tissue for parts per million of the pesticide. There was a 4 ft. buffer around each plot although when analyzing for parts per million there is always the possibility of some off target moment in the air, water or soil. Stan Heathman, the first Extension Weed Specialist in Arizona, use to say that conducting more than one trial would only confuse you. It is obvious from these results, however, that our procedure needs to be reassessed and this trial conducted again.

APPENDIX "A"

Jun-27-2016 (Effect of weeds and herbicides in the uptake of insecticides)

AOV Means Table

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
 Project ID: Investigator: Barry Tickes
 Sponsor Contact:

Pest Type	O Other	ADMIRE	ADMIRE	CORAGEN	CORAGEN	CORAGEN	
Pest Code	ADMIRE	ADMIRE	ADMIRE	CORAGEN	CORAGEN	CORAGEN	
Crop Name	Soil	Weeds	Lettuce	Soil	Weeds	Lettuce	
Rating Date	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	
Number of Subsamples	1	1	1	1	1	1	
Trt Treatment	Rate						
No. Name	Unit	1	2	3	4	5	6
1	Admire+ UTC+ no weed ctr	2.75 a	0.00 a	0.25 a	1.53 a	3.33 a	0.0000 a
2	Coragen+ UTC+no weed ctr	3.63 a	13.13 a	0.63 a	2.75 a	0.15 a	0.6500 a
3	UTC+UTC+no weed ctr	4.50 a	0.00 a	0.25 a	2.18 a	7.95 a	0.0250 a
4	Admire+ Kerb+Chemical wc	3.75 a	0.63 a	3.75 a	1.88 a	0.45 a	1.0000 a
5	Coragen+ Kerb+Chem	3.50 a	0.00 a	0.00 a	2.25 a	4.88 a	1.1325 a
6	UTC+Kerb+Chem	4.13 a	0.00 a	0.13 a	2.45 a	0.13 a	0.7525 a
7	Admire+ Prefar+Chem	4.00 a	0.00 a	0.00 a	3.00 a	4.28 a	3.7625 a
8	Coragen+ Prefar+Chem	4.00 a	0.38 a	0.50 a	2.25 a	7.40 a	0.7750 a
9	UTC+Prefar+Chem	3.75 a	4.50 a	0.00 a	2.00 a	8.25 a	1.3000 a
10	Admire+ Balan+Chem	3.13 a	0.00 a	175.63 a	1.78 a	3.00 a	1.2750 a
11	Coragen+ Balan+Chem	3.75 a	0.00 a	190.50 a	1.75 a	13.83 a	0.6625 a
12	UTC+Balan+Chem	4.13 a	0.00 a	0.25 a	2.50 a	2.75 a	1.0500 a
13	Admire+ UTC+Manual	3.63 a	0.00 a	0.00 a	1.63 a	1.60 a	1.3788 a
14	Coragen+UTC+Manual	3.63 a	7.75 a	6.50 a	2.25 a	5.00 a	0.2575 a
15	UTC+UTC+Manual	4.00 a	0.00 a	0.13 a	2.63 a	5.75 a	3.7500 a
LSD (P=.05)	1.120	10.471	183.663	1.365	8.127	4.02649	
Standard Deviation	0.783	7.327	128.520	0.955	5.687	2.81758	
CV	20.89	416.72	509.33	43.68	124.12	237.82	
Bartlett's X2	25.833	27.886	244.689	14.138	45.682	59.172	
P(Bartlett's X2)	0.018*	0.001*	0.001*	0.439	0.001*	0.001*	
Replicate F	0.733	1.647	2.213	1.024	5.579	4.188	
Replicate Prob(F)	0.5380	0.1930	0.1007	0.3915	0.0026	0.0111	
Treatment F	1.178	1.100	0.997	0.813	1.703	0.643	
Treatment Prob(F)	0.3261	0.3854	0.4735	0.6511	0.0917	0.8135	

Means followed by same letter do not significantly differ (P=.05, Student-Newman-Keuls)

Mean comparisons performed only when AOV Treatment P(F) is significant at mean comparison OSL.

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
 Project ID: Investigator: Barry Ticks
 Sponsor Contact:

Pest Type	KERB Lettuce	KERB Soil	KERB Weeds	PREFAR Lettuce	PREFAR Soil	PERFAR Weeds		
Pest Code								
Crop Name								
Rating Date	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016		
Number of Subsamples	1	1	1	1	1	1		
Trt No.	Treatment	Rate Unit	7	8	9	10	11	12
1	Admire+ UTC+ no weed ctr		0.0025 a	0.2000 a	0.125 a	3.500 a	1.78 a	0.00 a
2	Coragen+ UTC+no weed ctr		4.5625 a	0.2125 a	0.038 a	4.500 a	2.75 a	0.00 a
3	UTC+UTC+no weed ctr		5.1250 a	0.3625 a	0.175 a	4.125 a	1.68 a	0.00 a
4	Admire+ Kerb+Chemical wc		10.6500 a	0.2375 a	0.113 a	2.625 a	1.88 a	0.00 a
5	Coragen+ Kerb+Chem		1.2500 a	0.3213 a	0.150 a	3.750 a	2.75 a	0.00 a
6	UTC+Kerb+Chem		32.4250 a	0.0875 a	0.050 a	4.000 a	1.58 a	0.00 a
7	Admire+ Prefar+Chem		9.0000 a	1.0375 a	0.063 a	1.063 a	1.78 a	0.00 a
8	Coragen+ Prefar+Chem		4.6338 a	0.1625 a	0.000 a	4.875 a	2.00 a	0.00 a
9	UTC+Prefar+Chem		8.4000 a	0.1500 a	0.013 a	2.475 a	2.50 a	0.03 a
10	Admire+ Balan+Chem		4.2000 a	0.3375 a	0.088 a	5.000 a	2.50 a	0.00 a
11	Coragen+ Balan+Chem		0.0000 a	0.7500 a	1.625 a	5.200 a	2.25 a	0.00 a
12	UTC+Balan+Chem		0.8750 a	0.3000 a	0.788 a	5.500 a	2.13 a	0.00 a
13	Admire+ UTC+Manual		1.1325 a	0.2375 a	0.113 a	1.925 a	2.50 a	0.00 a
14	Coragen+UTC+Manual		1.6250 a	0.1088 a	0.225 a	2.038 a	2.50 a	0.00 a
15	UTC+UTC+Manual		0.1613 a	0.3000 a	0.400 a	3.175 a	2.25 a	0.00 a
LSD (P=.05)	20.25119	0.79713	1.2199	4.7727	1.397	0.018		
Standard Deviation	14.17096	0.55780	0.8537	3.3397	0.977	0.013		
CV	252.92	174.13	323.15	93.2	44.7	774.6		
Bartlett's X2	122.872	44.581	102.829	13.462	13.633	0.0		
P(Bartlett's X2)	0.001*	0.001*	0.001*	0.491	0.40	.		
Replicate F	7.025	4.207	5.508	12.092	0.978	1.000		
Replicate Prob(F)	0.0006	0.0109	0.0028	0.0001	0.4120	0.4023		
Treatment F	1.334	0.821	0.994	0.643	0.642	1.000		
Treatment Prob(F)	0.2288	0.6426	0.4766	0.8131	0.8143	0.4708		

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
 Project ID: Investigator: Barry Tickes
 Sponsor Contact:

Pest Type	W Weed	W Weed	W Weed
Pest Code	BALAN	BALAN	BALAN
Crop Name	Lettuce	Soil	Weeds
Rating Date	Jan-19-2016	Jan-19-2016	Jan-19-2016
Number of Subsamples	1	1	1
Trt No.	Treatment Name	Rate Unit	
		13	14
			15
1	Admire+ UTC+ no weed ctr	0.0000 a	0.0 a
2	Coragen+ UTC+no weed ctr	0.0125 a	0.0 a
3	UTC+UTC+no weed ctr	0.0250 a	0.0 a
4	Admire+ Kerb+Chemical wc	0.0500 a	0.0 a
5	Coragen+ Kerb+Chem	0.0000 a	0.0 a
6	UTC+Kerb+Chem	0.0000 a	0.0 a
7	Admire+ Prefar+Chem	0.0000 a	0.0 a
8	Coragen+ Prefar+Chem	0.0750 a	0.0 a
9	UTC+Prefar+Chem	0.0000 a	0.0 a
10	Admire+ Balan+Chem	0.0100 a	0.0 a
11	Coragen+ Balan+Chem	0.0250 a	0.0 a
12	UTC+Balan+Chem	0.0000 a	0.0 a
13	Admire+ UTC+Manual	0.0000 a	0.0 a
14	Coragen+UTC+Manual	0.0213 a	0.0 a
15	UTC+UTC+Manual	0.0000 a	0.0 a
LSD (P=.05)	0.06957	0.00	2.74207
Standard Deviation	0.04868	0.00	1.91879
CV	333.81	0.0	529.32
Bartlett's X2	16.098	0.0	197.873
P(Bartlett's X2)	0.013*	.	0.001*
Replicate F	0.206	0.000	1.306
Replicate Prob(F)	0.8920	1.0000	0.2849
Treatment F	0.831	0.000	0.972
Treatment Prob(F)	0.6331	1.0000	0.4969

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
 Project ID: Investigator: Barry Tickes
 Sponsor Contact:

Pest Type		O Other	ADMIRE	ADMIRE	CORAGEN	CORAGEN	CORAGEN
Pest Code		ADMIRE	ADMIRE	ADMIRE	CORAGEN	CORAGEN	CORAGEN
Crop Name		Soil	Weeds	Lettuce	Soil	Weeds	Lettuce
Rating Date		Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016
Number of Subsamples		1	1	1	1	1	1
Trt Treatment	Rate						
No. Name	Unit Plot	1	2	3	4	5	6
1 Admire+ UTC+ no weed ctr	101	0.00	0.00	0.00	0.10	0.30	0.0000
	207	4.00	0.00	1.00	0.00	13.00	0.0000
	304	3.00	0.00	0.00	2.00	0.00	0.0000
	402	4.00	0.00	0.00	4.00	0.00	0.0000
	Mean =		2.75	0.00	0.25	1.53	3.33
2 Coragen+ UTC+no weed ctr	102	3.00	0.00	0.00	4.00	0.30	2.0000
	203	3.00	5.50	2.00	2.00	0.30	0.0000
	301	4.50	47.00	0.50	3.00	0.00	0.6000
	405	4.00	0.00	0.00	2.00	0.00	0.0000
	Mean =		3.63	13.13	0.63	2.75	0.15
3 UTC+UTC+no weed ctr	103	5.00	0.00	0.00	0.70	0.30	0.1000
	211	5.00	0.00	1.00	4.00	15.00	0.0000
	305	4.00	0.00	0.00	2.00	0.00	0.0000
	411	4.00	0.00	0.00	2.00	16.50	0.0000
	Mean =		4.50	0.00	0.25	2.18	7.95
4 Admire+ Kerb+Chemical wc	104	4.00	0.00	0.00	2.50	1.80	0.0000
	201	4.00	2.50	15.00	2.00	0.00	0.0000
	315	3.00	0.00	0.00	2.00	0.00	4.0000
	406	4.00	0.00	0.00	1.00	0.00	0.0000
	Mean =		3.75	0.63	3.75	1.88	0.45
5 Coragen+ Kerb+Chem	105	4.00	0.00	0.00	2.00	4.00	0.0000
	206	3.00	0.00	0.00	2.00	15.50	3.5000
	307	4.00	0.00	0.00	3.00	0.00	1.0000
	408	3.00	0.00	0.00	2.00	0.00	0.0300
	Mean =		3.50	0.00	0.00	2.25	4.88
6 UTC+Kerb+Chem	106	4.00	0.00	0.00	0.80	0.50	0.0000
	209	4.50	0.00	0.50	3.00	0.00	0.0000
	313	4.00	0.00	0.00	3.00	0.00	3.0000
	404	4.00	0.00	0.00	3.00	0.00	0.0100
	Mean =		4.13	0.00	0.13	2.45	0.13
7 Admire+ Prefar+Chem	107	4.50	0.00	0.00	3.00	0.60	0.0500
	205	4.00	0.00	0.00	4.00	16.50	0.0000
	310	3.50	0.00	0.00	3.00	0.00	15.0000
	412	4.00	0.00	0.00	2.00	0.00	0.0000
	Mean =		4.00	0.00	0.00	3.00	4.28
8 Coragen+ Prefar+Chem	108	5.00	1.50	0.00	2.00	0.60	0.0500
	204	4.00	0.00	2.00	3.00	19.00	0.0000
	308	3.00	0.00	0.00	2.00	10.00	3.0000
	403	4.00	0.00	0.00	2.00	0.00	0.0500
	Mean =		4.00	0.38	0.50	2.25	7.40

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
 Project ID: Investigator: Barry Tickes
 Sponsor Contact:

Pest Type		O Other	ADMIRE	ADMIRE	CORAGEN	CORAGEN	CORAGEN
Pest Code		ADMIRE	ADMIRE	ADMIRE	CORAGEN	CORAGEN	CORAGEN
Crop Name		Soil	Weeds	Lettuce	Soil	Weeds	Lettuce
Rating Date		Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016
Number of Subsamples		1	1	1	1	1	1
Trt Treatment	Rate						
No. Name	Unit Plot	1	2	3	4	5	6
9 UTC+Prefar+Chem	109	4.00	0.00	0.00	3.00	9.00	0.0000
	202	4.00	18.00	0.00	2.00	9.00	0.0000
	311	4.00	0.00	0.00	2.00	0.00	5.0000
	415	3.00	0.00	0.00	1.00	15.00	0.2000
	Mean =	3.75	4.50	0.00	2.00	8.25	1.3000
10 Admire+ Balan+Chem	110	4.00	0.00	0.00	2.00	1.00	0.0000
	213	3.50	0.00	1.00	3.00	11.00	4.5000
	306	1.00	0.00	0.00	0.10	0.00	0.0000
	413	4.00	0.00	701.50	2.00	0.00	0.6000
	Mean =	3.13	0.00	175.63	1.78	3.00	1.2750
11 Coragen+ Balan+Chem	111	4.00	0.00	0.00	0.50	0.80	0.0000
	215	4.00	0.00	1.00	2.00	13.00	2.5000
	303	3.00	0.00	0.00	3.00	25.00	0.0000
	414	4.00	0.00	761.00	1.50	16.50	0.1500
	Mean =	3.75	0.00	190.50	1.75	13.83	0.6625
12 UTC+Balan+Chem	112	4.00	0.00	0.00	2.00	11.00	0.0000
	210	4.00	0.00	1.00	3.00	0.00	4.0000
	309	4.00	0.00	0.00	2.00	0.00	0.0000
	410	4.50	0.00	0.00	3.00	0.00	0.2000
	Mean =	4.13	0.00	0.25	2.50	2.75	1.0500
13 Admire+ UTC+Manual	113	3.00	0.00	0.00	2.00	0.40	0.0000
	214	4.00	0.00	0.00	2.00	6.00	4.0000
	312	4.00	0.00	0.00	1.50	0.00	1.5000
	409	3.50	0.00	0.00	1.00	0.00	0.0150
	Mean =	3.63	0.00	0.00	1.63	1.60	1.3788
14 Coragen+UTC+Manual	114	4.00	0.00	0.00	2.00	4.00	0.0000
	208	3.00	0.00	0.00	2.00	16.00	0.0000
	302	3.50	31.00	0.00	2.00	0.00	1.0000
	401	4.00	0.00	26.00	3.00	0.00	0.0300
	Mean =	3.63	7.75	6.50	2.25	5.00	0.2575
15 UTC+UTC+Manual	115	4.00	0.00	0.00	2.00	11.00	0.0000
	212	4.00	0.00	0.00	3.50	12.00	0.0000
	314	4.00	0.00	0.00	3.00	0.00	15.0000
	407	4.00	0.00	0.50	2.00	0.00	0.0000
	Mean =	4.00	0.00	0.13	2.63	5.75	3.7500

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
 Project ID: Investigator: Barry Tickes
 Sponsor Contact:

Pest Type			KERB	KERB	KERB	PREFAR	PREFAR	PERFAR
Pest Code			Lettuce	Soil	Weeds	Lettuce	Soil	Weeds
Crop Name			Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016
Rating Date								
Number of Subsamples			1	1	1	1	1	1
Trt	Treatment	Rate						
No.	Name	Unit Plot	7	8	9	10	11	12
1	Admire+ UTC+ no weed ctr	101	0.0000	0.0000	0.000	0.000	0.10	0.00
		207	0.0000	0.7500	0.500	7.000	4.00	0.00
		304	0.0100	0.0000	0.000	7.000	2.00	0.00
		402	0.0000	0.0500	0.000	0.000	1.00	0.00
		Mean =	0.0025	0.2000	0.125	3.500	1.78	0.00
2	Coragen+ UTC+no weed ctr	102	18.0000	0.2500	0.000	0.000	4.00	0.00
		203	0.0000	0.5000	0.150	6.000	4.00	0.00
		301	0.2500	0.0000	0.000	4.000	2.00	0.00
		405	0.0000	0.1000	0.000	8.000	1.00	0.00
		Mean =	4.5625	0.2125	0.038	4.500	2.75	0.00
3	UTC+UTC+no weed ctr	103	20.5000	0.0000	0.000	0.000	0.70	0.00
		211	0.0000	0.8000	0.700	15.500	2.00	0.00
		305	0.0000	0.5500	0.000	1.000	3.00	0.00
		411	0.0000	0.1000	0.000	0.000	1.00	0.00
		Mean =	5.1250	0.3625	0.175	4.125	1.68	0.00
4	Admire+ Kerb+Chemical wc	104	38.0000	0.0000	0.000	0.000	2.50	0.00
		201	0.0000	0.6000	0.450	4.000	0.00	0.00
		315	0.1000	0.2500	0.000	5.000	3.00	0.00
		406	4.5000	0.1000	0.000	1.500	2.00	0.00
		Mean =	10.6500	0.2375	0.113	2.625	1.88	0.00
5	Coragen+ Kerb+Chem	105	5.0000	0.0350	0.000	0.000	2.00	0.00
		206	0.0000	1.0000	0.600	7.000	3.00	0.00
		307	0.0000	0.1000	0.000	7.500	3.00	0.00
		408	0.0000	0.1500	0.000	0.500	3.00	0.00
		Mean =	1.2500	0.3213	0.150	3.750	2.75	0.00
6	UTC+Kerb+Chem	106	116.5000	0.0000	0.000	0.000	0.80	0.00
		209	0.0000	0.3500	0.200	6.000	2.00	0.00
		313	0.2000	0.0000	0.000	4.000	1.50	0.00
		404	13.0000	0.0000	0.000	6.000	2.00	0.00
		Mean =	32.4250	0.0875	0.050	4.000	1.58	0.00
7	Admire+ Prefar+Chem	107	31.5000	0.0000	0.000	0.000	3.00	0.00
		205	0.0000	0.5000	0.250	4.000	2.00	0.00
		310	0.0000	3.5000	0.000	0.250	0.10	0.00
		412	4.5000	0.1500	0.000	0.000	2.00	0.00
		Mean =	9.0000	1.0375	0.063	1.063	1.78	0.00
8	Coragen+ Prefar+Chem	108	15.0000	0.0000	0.000	0.000	2.00	0.00
		204	0.0000	0.6000	0.000	4.000	2.00	0.00
		308	0.0000	0.0500	0.000	1.500	2.00	0.00
		403	3.5350	0.0000	0.000	14.000	2.00	0.00
		Mean =	4.6338	0.1625	0.000	4.875	2.00	0.00

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
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 Sponsor Contact:

Pest Type			KERB	KERB	KERB	PREFAR	PREFAR	PERFAR
Pest Code			Lettuce	Soil	Weeds	Lettuce	Soil	Weeds
Crop Name			Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016	Jan-19-2016
Rating Date			1	1	1	1	1	1
Number of Subsamples								
Trt Treatment	Rate							
No. Name	Unit Plot		7	8	9	10	11	12
9 UTC+Prefar+Chem	109		26.0000	0.0000	0.000	0.000	3.00	0.00
	202		0.0000	0.4000	0.050	8.500	2.00	0.00
	311		0.1000	0.0000	0.000	0.900	3.00	0.10
	415		7.5000	0.2000	0.000	0.500	2.00	0.00
	Mean =		8.4000	0.1500	0.013	2.475	2.50	0.03
10 Admire+ Balan+Chem	110		16.5000	0.1000	0.000	0.000	2.00	0.00
	213		0.0000	0.3500	0.350	12.500	2.00	0.00
	306		0.3000	0.5000	0.000	3.000	3.00	0.00
	413		0.0000	0.4000	0.000	4.500	3.00	0.00
	Mean =		4.2000	0.3375	0.088	5.000	2.50	0.00
11 Coragen+ Balan+Chem	111		0.0000	0.0000	0.000	0.000	0.50	0.00
	215		0.0000	0.4000	6.500	9.000	3.50	0.00
	303		0.0000	2.6000	0.000	0.300	2.00	0.00
	414		0.0000	0.0000	0.000	11.500	3.00	0.00
	Mean =		0.0000	0.7500	1.625	5.200	2.25	0.00
12 UTC+Balan+Chem	112		3.0000	0.1000	0.000	0.000	2.00	0.00
	210		0.0000	1.0000	3.150	8.500	3.00	0.00
	309		0.5000	0.0000	0.000	5.000	2.00	0.00
	410		0.0000	0.1000	0.000	8.500	1.50	0.00
	Mean =		0.8750	0.3000	0.788	5.500	2.13	0.00
13 Admire+ UTC+Manual	113		4.5000	0.0000	0.000	0.000	2.00	0.00
	214		0.0000	0.7000	0.450	4.000	2.00	0.00
	312		0.0300	0.2500	0.000	2.500	2.00	0.00
	409		0.0000	0.0000	0.000	1.200	4.00	0.00
	Mean =		1.1325	0.2375	0.113	1.925	2.50	0.00
14 Coragen+UTC+Manual	114		6.5000	0.0000	0.000	0.000	2.00	0.00
	208		0.0000	0.4000	0.650	3.000	3.00	0.00
	302		0.0000	0.0350	0.250	5.000	3.00	0.00
	401		0.0000	0.0000	0.000	0.150	2.00	0.00
	Mean =		1.6250	0.1088	0.225	2.038	2.50	0.00
15 UTC+UTC+Manual	115		0.0000	0.1000	0.000	0.250	2.00	0.00
	212		0.0000	1.0000	1.600	11.000	3.00	0.00
	314		0.1000	0.0000	0.000	1.000	2.00	0.00
	407		0.5450	0.1000	0.000	0.450	2.00	0.00
	Mean =		0.1613	0.3000	0.400	3.175	2.25	0.00

The University of Arizona

Trial ID: Protocol ID:
 Location: Study Director:
 Project ID: Investigator: Barry Tickes
 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed
Pest Code		BALAN	BALAN	BALAN
Crop Name		Lettuce	Soil	Weeds
Rating Date		Jan-19-2016	Jan-19-2016	Jan-19-2016
Number of Subsamples		1	1	1
Trt Treatment	Rate			
No. Name	Unit Plot	13	14	15
1 Admire+ UTC+ no weed ctr	101	0.0000	0.0	0.4500
	207	0.0000	0.0	0.4500
	304	0.0000	0.0	0.0000
	402	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	0.2250
2 Coragen+ UTC+no weed ctr	102	0.0500	0.0	0.2000
	203	0.0000	0.0	0.2500
	301	0.0000	0.0	0.0000
	405	0.0000	0.0	0.0000
	Mean =	0.0125	0.0	0.1125
3 UTC+UTC+no weed ctr	103	0.0000	0.0	0.4000
	211	0.0000	0.0	0.3500
	305	0.0000	0.0	0.0000
	411	0.1000	0.0	0.0000
	Mean =	0.0250	0.0	0.1875
4 Admire+ Kerb+Chemical wc	104	0.1000	0.0	0.3500
	201	0.0000	0.0	0.1000
	315	0.1000	0.0	0.0000
	406	0.0000	0.0	0.0000
	Mean =	0.0500	0.0	0.1125
5 Coragen+ Kerb+Chem	105	0.0000	0.0	0.6000
	206	0.0000	0.0	0.2500
	307	0.0000	0.0	0.0500
	408	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	0.2250
6 UTC+Kerb+Chem	106	0.0000	0.0	0.2000
	209	0.0000	0.0	0.3000
	313	0.0000	0.0	0.0000
	404	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	0.1250
7 Admire+ Prefar+Chem	107	0.0000	0.0	0.3000
	205	0.0000	0.0	0.0200
	310	0.0000	0.0	0.0000
	412	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	0.0800
8 Coragen+ Prefar+Chem	108	0.0000	0.0	0.1000
	204	0.3000	0.0	0.0900
	308	0.0000	0.0	0.0000
	403	0.0000	0.0	0.0400
	Mean =	0.0750	0.0	0.0575

The University of Arizona

Trial ID: Protocol ID:
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 Sponsor Contact:

Pest Type		W Weed	W Weed	W Weed
Pest Code		BALAN	BALAN	BALAN
Crop Name		Lettuce	Soil	Weeds
Rating Date		Jan-19-2016	Jan-19-2016	Jan-19-2016
Number of Subsamples		1	1	1
Trt Treatment	Rate			
No. Name	Unit Plot	13	14	15
9 UTC+Prefar+Chem	109	0.0000	0.0	0.1000
	202	0.0000	0.0	15.0000
	311	0.0000	0.0	0.0000
	415	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	3.7750
10 Admire+ Balan+Chem	110	0.0000	0.0	0.2000
	213	0.0000	0.0	0.3000
	306	0.0400	0.0	0.0000
	413	0.0000	0.0	0.0000
	Mean =	0.0100	0.0	0.1250
11 Coragen+ Balan+Chem	111	0.0000	0.0	0.2500
	215	0.0000	0.0	0.2000
	303	0.0000	0.0	0.0000
	414	0.1000	0.0	0.0150
	Mean =	0.0250	0.0	0.1163
12 UTC+Balan+Chem	112	0.0000	0.0	0.1500
	210	0.0000	0.0	0.1000
	309	0.0000	0.0	0.0000
	410	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	0.0625
13 Admire+ UTC+Manual	113	0.0000	0.0	0.1500
	214	0.0000	0.0	0.2500
	312	0.0000	0.0	0.0000
	409	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	0.1000
14 Coragen+UTC+Manual	114	0.0000	0.0	0.1000
	208	0.0000	0.0	0.1000
	302	0.0000	0.0	0.0000
	401	0.0850	0.0	0.0000
	Mean =	0.0213	0.0	0.0500
15 UTC+UTC+Manual	115	0.0000	0.0	0.1850
	212	0.0000	0.0	0.1500
	314	0.0000	0.0	0.0000
	407	0.0000	0.0	0.0000
	Mean =	0.0000	0.0	0.0838
Mean =		0.00		