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 ChlorantraniloproleCoragen, 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.

PPM Coragen Found on Weeds 1/19
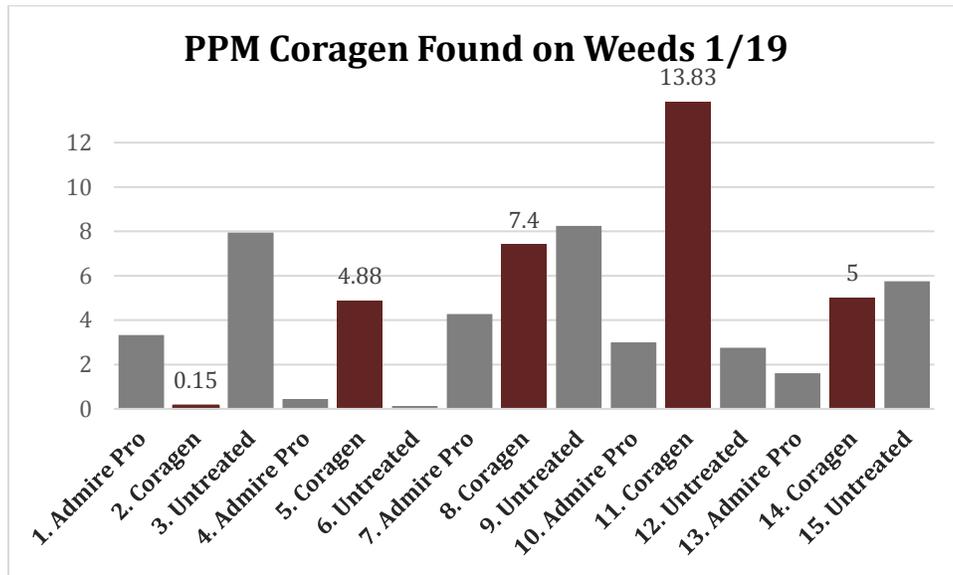
Figure 1

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).
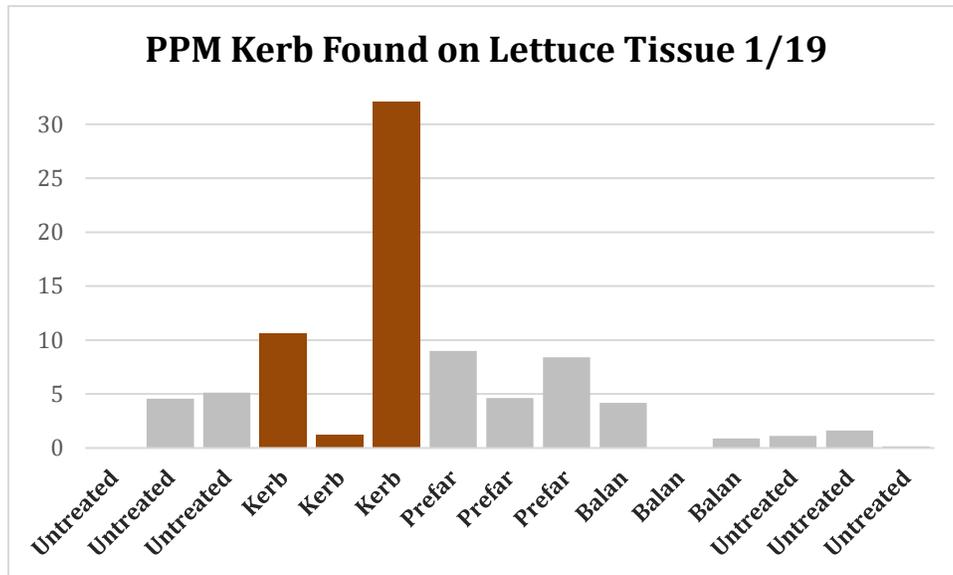
Figure 2

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.
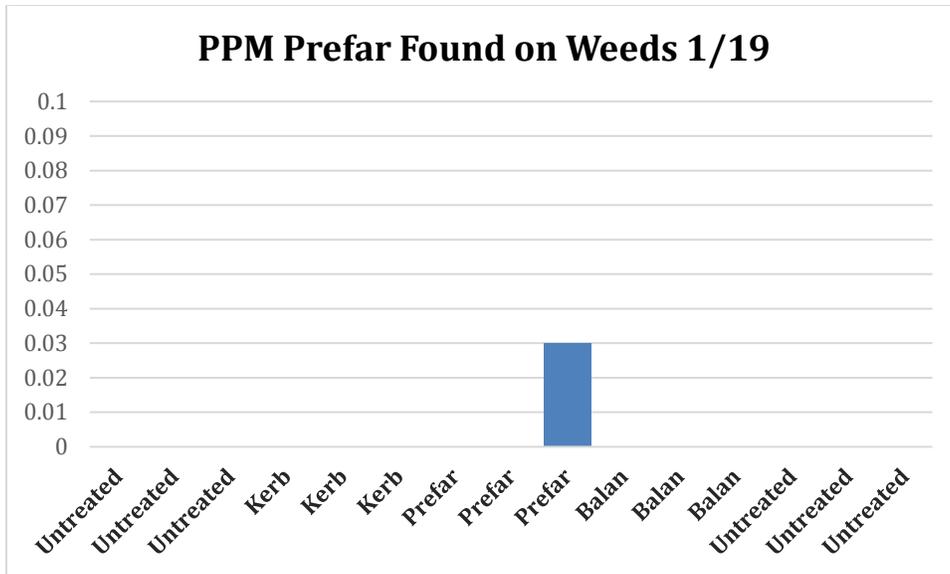
Figure 3
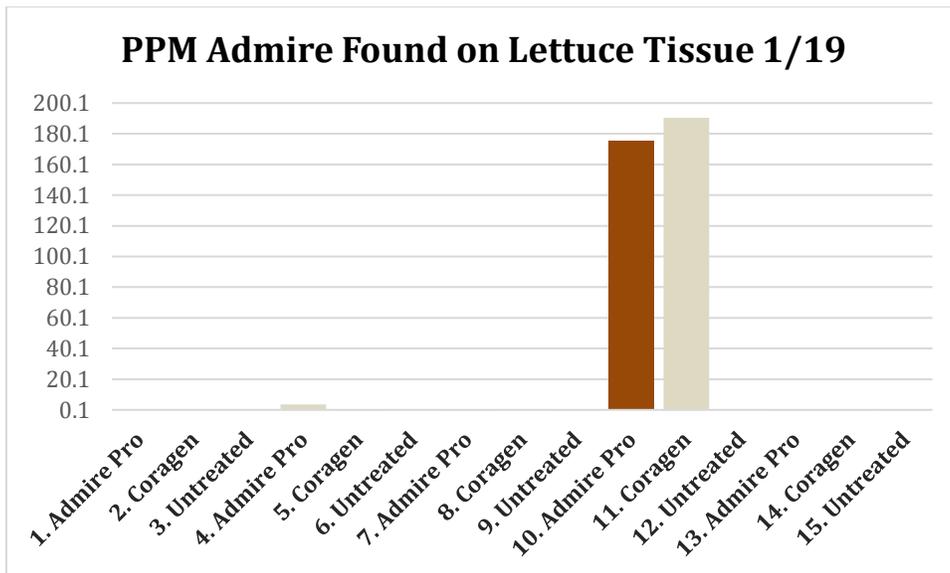
Figure 4

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					
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 Tickes
             Sponsor Contact:

Pest Type						
Pest Code	KERB	KERB	KERB	PREFAR	PREFAR	PERFAR
Crop Name	Lettuce	Soil	Weeds	Lettuce	Soil	Weeds
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	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 Treatment	Rate			
No. Name	Unit	13	14	15
1 Admire+ UTC+ no weed ctr		0.0000 a	0.0 a	0.2250 a
2 Coragen+ UTC+no weed ctr		0.0125 a	0.0 a	0.1125 a
3 UTC+UTC+no weed ctr		0.0250 a	0.0 a	0.1875 a
4 Admire+ Kerb+Chemical wc		0.0500 a	0.0 a	0.1125 a
5 Coragen+ Kerb+Chem		0.0000 a	0.0 a	0.2250 a
6 UTC+Kerb+Chem		0.0000 a	0.0 a	0.1250 a
7 Admire+ Prefar+Chem		0.0000 a	0.0 a	0.0800 a
8 Coragen+ Prefar+Chem		0.0750 a	0.0 a	0.0575 a
9 UTC+Prefar+Chem		0.0000 a	0.0 a	3.7750 a
10 Admire+ Balan+Chem		0.0100 a	0.0 a	0.1250 a
11 Coragen+ Balan+Chem		0.0250 a	0.0 a	0.1163 a
12 UTC+Balan+Chem		0.0000 a	0.0 a	0.0625 a
13 Admire+ UTC+Manual		0.0000 a	0.0 a	0.1000 a
14 Coragen+UTC+Manual		0.0213 a	0.0 a	0.0500 a
15 UTC+UTC+Manual		0.0000 a	0.0 a	0.0838 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					
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	0.0000
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	0.6500
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	0.0250
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	1.0000
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	1.1325
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	0.7525
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	3.7625
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	0.7750

The University of Arizona

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

Pest Type			O Other					
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

13

The University of Arizona

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

Pest Type Pest Code Crop Name Rating Date Number of Subsamples			KERB Lettuce Jan-19-2016 1	KERB Soil Jan-19-2016 1	KERB Weeds Jan-19-2016 1	PREFAR Lettuce Jan-19-2016 1	PREFAR Soil Jan-19-2016 1	PERFAR Weeds Jan-19-2016 1
Trt No. Treatment Name	Rate 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:
Project ID: Investigator: Barry Tickes
            Sponsor Contact:

Pest Type Pest Code Crop Name Rating Date Number of Subsamples			KERB Lettuce Jan-19-2016 1	KERB Soil Jan-19-2016 1	KERB Weeds Jan-19-2016 1	PREFAR Lettuce Jan-19-2016 1	PREFAR Soil Jan-19-2016 1	PERFAR Weeds Jan-19-2016 1
Trt Treatment No. Name	Rate 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

15

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

16

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
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		

17