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SUBJECT: PRELIMINARY RESULTS FOR STUDY 221: EFFECT OF CHEMIGATION INJECTION SPEED ON THE EFFICACY AND LEACHING OF THE PRE-EMERGENCE HERBICIDES SIMAZINE AND DIURON

SUMMARY

Chemigation is the application of pesticides through irrigation systems and has been identified in Title 3, California Code of Regulations (3CCR) section 6487.4b as a method to reduce the potential for pesticides to pollute ground water in runoff vulnerable areas. However, most pesticide labels for atrazine, simazine, bromacil, diuron, and norflurazon, the known ground water contaminants listed in 3CCR section 6800a, prohibit application through irrigation systems. In 2003, the Department of Pesticide Regulation (DPR) sponsored a collaborative study with the Center for Irrigation Technology at California State University, Fresno and the pesticide registrants Syngenta Crop Protection and DuPont Crop Protection to improve our understanding of chemigation efficacy and to support label changes that would facilitate the use of this mitigation measure. The pre-emergence herbicides simazine and diuron were chosen because they are commonly used for winter weed control on citrus in runoff vulnerable Ground Water Protection Areas (GWPAs).

The initial study was successful but raised additional questions. In 2004–2005, DPR undertook this study on two Tulare County commercial citrus groves to compare pesticide efficacy and leaching potential between pesticide applications when the same amount of pesticide was injected quickly or slowly into the irrigation system. Pesticide application and soil core data were collected on the fast and slow pesticide injections as well as on one of the standard practice plots. Efficacy ratings were determined on the fast and slow pesticide injection plots, the standard practice plots, and the control plots, providing an opportunity to compare the efficacy of this mitigation measure to the standard practices.

The results from this study did not allow us to determine if it is best to inject the pesticide quickly or slowly. No pesticide residues were detected in any of the soil samples below 61 cm indicating that none of the application methods caused the pesticides to leach below this depth. There was no significant difference in the mass of pesticide recovered per soil core between the fast and slow treatments. But a lower rate of pesticides were applied to the standard practice plot resulting in a significant difference in the mass of diuron recovered from the standard practice plot when compared to the chemigation applications plots. The efficacy of both the fast and slow pesticide injections were similar to the efficacy in the standard practice plots.

INTRODUCTION

Chemigation is becoming an increasingly prevalent application method as more growers convert from flood irrigation to pressurized irrigation systems. In May 2004, DPR implemented regulations that included mitigation measures, such as chemigation, to prevent further ground water contamination of the known ground water contaminants in vulnerable areas. These vulnerable areas have been designated GWPAs and are divided into two pathways for ground water contamination: leaching and runoff. Leaching areas are characterized by coarse, sandy soils that allow pesticides to percolate into ground water. Runoff areas are vulnerable to pesticide contamination because the hardpan layer impedes percolation and can carry pesticide-laden water to dry wells, ditches, ponds, soils with deep cracks, or coarse soil areas. One of the mitigation measures identified in 3CCR section 6487.4b by DPR for runoff vulnerable GWPAs is to incorporate the pesticide by mechanical methods such as by using a disc, harrow, or rotary tiller or through the use of a low flow irrigation system at a rate that does not cause runoff, including chemigation if allowed on the label. This mitigation measure was developed based on studies conducted on small plots in a Fresno citrus orchard. For these low permeability soils, mechanical incorporation was effective in decreasing offsite movement of pre-emergence herbicide residues (Troiano and Garretson, 1998).

Chemigation of the pesticides known to contaminate ground water is considered an acceptable mitigation measure in runoff GWPAs but most of the pesticide products affected by DPRs ground water regulations are not labeled for application through irrigation systems. DPR undertook a series of studies, including this one, to learn more about the efficacy of this method and how it might affect pesticide movement in the soil under different agronomic practices.

The initial chemigation efficacy study, conducted on three Tulare County citrus orchards in 2003–2004, indicated that the weed control obtained through chemigation compared favorably to broadcast applications of simazine and diuron, a standard practice among growers in this area. The majority of simazine and diuron residues in the study were also retained in the upper 7.6 cm of soil (Basinal et al., 2005). Since the efficacy and residue movement results of the initial study were acceptable to DPR and growers, DPR provided this information to the registrants and the Citrus Mutual Growers Association for their use in support of label amendments that eventually allowed

the application of simazine and diuron through chemigation systems in Tulare and Fresno County citrus orchards.

Despite the promising results of the initial study, questions remained about how the operation of the irrigation system affects the efficacy of the injected pesticides. This study, conducted in 2004–2005, sought to determine if the speed of the pesticide injection affects the efficacy and leaching potential of the pre-emergence herbicides. Opinions of growers and advisors differ about whether it is better to inject the pesticide quickly or over a longer period. In this study, simazine and diuron were applied quickly and slowly through a micro sprinkler irrigation system to two Tulare County citrus orchards in November 2004. Study staff used the efficacy rating from the previous year and collected additional information on the standard practice, including application rates and soil samples.

MATERIALS AND METHODS

Study Sites

The study was located in two Tulare County runoff GWPAs. Site 1 was a single 3.6-hectacre block of 65-year-old citrus trees. Site 2 was an 8.9-hectacre citrus orchard divided into 4 blocks of 10-year-old trees. The canopy surface area varied between the two sites because of the difference in tree age. The orchard floor at Site 1 was exposed to less sun with a canopy surface area of 50% to 60% while at Site 2 the canopy surface area was 20% to 25%.

Site 1's irrigation system used spinning head micro sprinklers that covered an area of 35.29 m^2 each (Table 1). Fanjet micro sprinklers with fixed spray patterns that covered an area of 14.29 m^2 each were installed on the irrigation system at Site 2 (Table 1). The micro sprinklers were located in the tree rows with each emitter centered between two trees and covering the area not shaded by the tree canopy.

Simazine and diuron are commonly used by citrus growers in the Central Valley for pre-emergence control of winter weeds. Since the use of micro sprinkler irrigation facilitates weed growth where the irrigation occurs and weeds growing around emitters can adversely affect irrigation distribution, the standard practice is to keep the area around the emitters free of weeds. At both sites, the standard practice consists of broadcasting a three-foot band of pre-emergence or post-emergence herbicides on each side of the tree row from one tree canopy to the other. Contact herbicides are applied if additional control is needed.

Table 1. Pesticide applications

Site	Treatment	Rate (kg/ha)		Area per Emitter (m^2)	# Trees per Plot	Net Area (ha)	Amt Product per Plot (L)		Duration (min)	Date Applied
		Princep 4L[§]	Direx 4L[§§]				Princep 4L	Direx 4L		
1	Fast	4.4	3.6	35.29	88	0.31	2.9	2.3	34	11/08/2004
1	Slow	4.4	3.6	35.29	136	0.48	4.5	3.6	118	11/08/2004
1	Standard	*	*	N/A	N/A	N/A	*	*	N/A	11/12/2004
1	Control	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	Fast	4.4	3.6	14.29	108	0.15	1.4	1.2	24	11/30/2004
2	Slow	4.4	3.6	14.29	108	0.15	1.4	1.2	104	11/30/2004
2	Standard	**	**	**	**	**	**	**	**	**
2	Control	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A

N/A = Not Applicable
* The grower applied 2.25 kg/ha of Princep Caliber 90 (2.0 kg/ha AI) and 1.1 kg/ha of Karmex DF 80 (0.9 kg/ha AI) in 284 L water/ha.
** The grower did not use simazine or diuron on the standard practice plot.
[§] 4.4 kg/ha product = 4 lbs/A AI
[§§] 3.6 kg/ha product = 3.2 lbs/A AI

Study Design

There were four treatment plots at each study site: fast pesticide injection, slow pesticide injection, standard practice, and control (Table 1). Since the micro sprinklers were placed in the tree rows, the management of the middle rows was not investigated by this study. The chemigated plots were irrigated for approximately 90 minutes before the pesticide injection. For the fast and slow injection treatments, the recommended maximum labeled rate of the pre-emergence herbicides simazine and diuron were injected into the irrigation system for approximately 30 and 120 minutes, respectively (Table 1). At Site 1, the post-application irrigation continued for 120 minutes after the application. At Site 2, the post-application irrigation continued for approximately 18 hours due to an unanticipated need for frost protection. The standard practice treatment of the tree rows differed by site. At Site 1, the grower broadcast simazine and diuron by tractor whereas at Site 2 the grower applied glyphosate for post-emergence weed control. Since the grower did not use simazine or diuron on the standard practice treatment at Site 2, no post application soil samples were collected for this treatment. On the control plots, no herbicides were applied and the weeds were allowed to grow undisturbed. Each treatment plot was subdivided into four subplots and soil cores were taken from each of the subplots.

Pesticide Applications

A Cole-Parmer peristaltic metering pump was used for the fast and slow pesticide injection treatments. The intended application rates for simazine (Princep 4L, EPA Reg. No. 100-526) and diuron (Direx 4L, EPA Reg. No. 1812-257) were 4.4 kg/ha and 3.6 kg/ha, respectively (Table 1). The amount of simazine and diuron applied to each plot was calculated by multiplying the area

covered by a single emitter by the number of trees per plot by the intended rate for each treatment (Table 1).

$$Amount\ of\ Pesticide\ Applied = A_e \times N_t \times R_p$$

where:

A_e = Surface area covered by a single emitter
N_t = Number of trees per plot
R_p = Application rate of pesticide

The calculated amount of pesticide required for each application was measured and injected without dilution into the closest valve to the plot in November 2004 (Table 1). Since simazine and diuron were not labeled for application through irrigation systems at the time of application, these applications were conducted under DPR Pesticide Research Authorization number 410018.

The tree rows of the standard practice plot at Site 1 received a pre-emergence application rate of 2.3 kg/ha of Princep Caliber 90 (simazine) and 1.1 kg/ha of Karmex DF 80 (diuron) in 284 L water/ha as a 3-foot band between the trees in November 2004. The standard practice plot at Site 2 received a post-emergence application of 2% concentration glyphosate to the tree rows in February 2005.

Water Samples

Background: Before the injection of the pre-emergence herbicides, water samples were collected directly into 1 L amber bottles from three randomly selected emitters at each site and analyzed for the presence of simazine and diuron.

Flow Rate: The average flow rate and system pressure were determined at each site. The outputs of five randomly chosen emitters per plot were measured for 30 seconds. The results per site were averaged and converted to the flow rate in ml/min.

Application: After the pesticides were detected at the furthest emitters from the injection point, water samples were collected directly into 1 L amber bottles from six randomly selected emitters at each chemigation treatment plot to determine the concentration of simazine and diuron.

Mass Deposition Sheet Samples

At Site 1, mass deposition sheets (MDS) were used during the pesticide application on the standard practice plot to determine the concentration of simazine and diuron. Since simazine and diuron were not applied on the standard practice treatment at Site 2, no MDS samples were collected at this location. DPR SOP FSOT005.00 for sampling with MDSs was followed (Walters, 2003).

Soil Samples
Where possible, soil cores were obtained to a depth of 152.4 cm with the first two soil segments taken in 7.6-cm increments, the next three segments in 15.2-cm increments, and the next three segments in 30.5-cm increments, unless stated otherwise. The cores were 7.6 cm in diameter and each sample was a composite of two cores. The composite sample for each depth was split into two sub-samples and analyzed for simazine and diuron residues, soil moisture, soil texture and percent organic carbon. DPR SOP FSSO002.00 for soil sampling was followed for each soil sampling event (Garretson, 1999a). The procedure used to measure the percent soil moisture is given in SOP METH001.00 (Garretson, 1999b).

Pre-Application: Two random samples were obtained from each plot before the pesticide applications to determine the background concentrations of the pre-emergence herbicides and the physical properties of the soil.

Post-Application: The first post-application soil samples were randomly sampled from the area wetted by the sprinklers within four days of the pesticide application. Four composite samples were collected to 45.7 cm deep from each of the following plots: fast injection, slow injection, and Site 1 standard practice. The first two soil segments were taken in 7.6-cm increments and the remainder in 15.2-cm increments. To test for subsequent leaching, four composite soil samples from each of the fast and slow injection plots were collected at 34-44 days, 92-98 days, and 126-127 days after the pesticide application. For the last three sampling events, the composite samples were obtained to the 152.4-cm depth when possible. Four composite post-application soil samples were taken at Site 1 from the standard practices plot at 94 and 122 days to the 152.4-cm depth when possible. Since no simazine or diuron was applied on the standard practice treatment at Site 2, post-application soil samples were not taken at this location.

Efficacy
Efficacy was based on a visual rating system that reflected the overall performance of each treatment. The performances of chemigated plots were compared to the control plots and to the standard practice treatments on each evaluation date. Measurements were taken by a team composed of study staff, growers and registrant representatives at 44, 98, 126, and 143 days after

treatment at Site 1 and at 62, 92, and 121 days after treatment at Site 2. Digital photos were taken to illustrate the performance of the treatments. The rating was based on the percent of the area without weeds and ranged from zero percent control to 100% control as listed below:

- 0%: Total lack of control
- 5-30%: Insignificant to poor weed control
- 40-60%: Inadequate weed control
- 70%: Adequate weed control
- 80%: Good weed control
- 90%: Excellent weed control
- 100%: Complete control

Quality Control and Analysis
The quality control procedures for all samples followed SOP QAQC001.00 for Chemistry Laboratory Quality Control (Segawa, 1995).

RESULTS

Water Analysis
Background: All water samples collected before the pesticide injection were negative for both simazine and diuron (Appendix, Table 11).

Flow Rate: The average flow rate for Site 1 was 610 ml/min at 31 psi, and for Site 2 was 720 ml/min at 25 psi (Appendix, Table 12). The raw data for Site 1 was lost after the average had already been calculated.

Application: The mass of pesticide applied per emitter was calculated by multiplying the pesticide injection time by the average flow rate and the pesticide concentration. The mass was then divided by the surface area of the emitter to obtain the application rate in kg/ha (Table 2).

$$Pesticide\ application\ rate = \frac{T_i \times F \times C_e}{A_e}$$

Where:
T_i = Pesticide injection time
F = Average flow rate
C_e = Concentration of pesticide measured from emitter
A_e = Surface area covered by the emitter

Table 2. Descriptive statistics for emitter samples

Chemical (kg/ha)	Site	Chemigation Treatment	N	Mean (kg/ha)	Standard Error (kg/ha)	Standard Deviation (kg/ha)	Coefficient Of Variation	Median (kg/ha)
Simazine	1	Fast	6	1.8012	0.0898	0.2199	12.21	1.7777
Simazine	2	Fast	6	2.134	0.424	1.038	48.64	2.025
Simazine	1	Slow	6	2.726	0.231	0.567	20.79	2.075
Simazine	2	Slow	6	3.527	0.245	0.600	17.01	3.494
Simazine	1	Control	3	0	0	0	0	0
Simazine	2	Control	3	0	0	0	0	0
Diuron	1	Fast	6	1.078	0.125	0.305	28.35	1.072
Diuron	2	Fast	6	1.621	0.484	1.184	73.07	1.445
Diuron	1	Slow	6	0.673	0.100	0.245	36.41	0.620
Diuron	2	Slow	6	0.3179	0.0657	0.1609	50.62	0.2799
Diuron	1	Control	3	0	0	0	0	0
Diuron	2	Control	3	0	0	0	0	0

Study staff applied simazine and diuron at a rate of 4.4 kg/ha and 3.6 kg/ha, respectively, to the fast and slow injection treatment plots at both study sites (Table 1). Although each treatment plot received the same application rate, emitter samples indicated an unexpectedly high degree of variability in the pesticide rates sampled from the emitters. The mean rate of simazine sampled from the emitters at the slow treatments was significantly greater than the rate sampled at the fast treatments (Figure 1, Kruskal-Wallis p=0.001). The opposite was true for diuron. The mean rate of diuron sampled from the emitters at the slow treatments was significantly less than the rate sampled at the fast treatments (Figure 2, Kruskal-Wallis p=0.002). There were no significant differences between the sites for simazine or diuron.

The emitter sample results also varied greatly from the actual rate applied. The mean simazine emitter rate was 2.6 kg/ha and the mean diuron emitter rate was 0.9 kg/ha, which were 42% and 75% lower than the theoretical rate, respectively. The coefficient of variations ranged from 12% to 70% for the water samples collected (Table 2).

Since the amount of simazine and diuron injected into the system was specifically calculated to achieve the same rate for each injection treatment and site, there should not have been a difference in the overall application rates between fast and slow treatments measured from the emitter samples. In addition, the measured differences were not consistent between AIs. For example, the simazine concentration was greater for the slow injections whereas the opposite effect was indicated for diuron (Figures 1 and 2).

Figure 1. Simazine water emitter samples separated by treatment

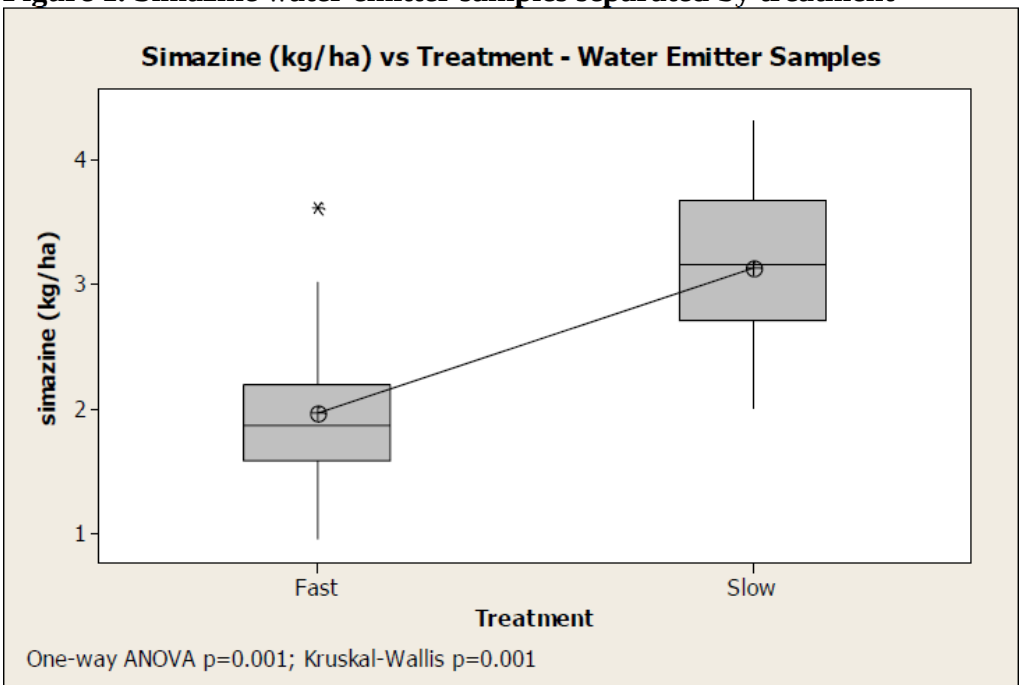
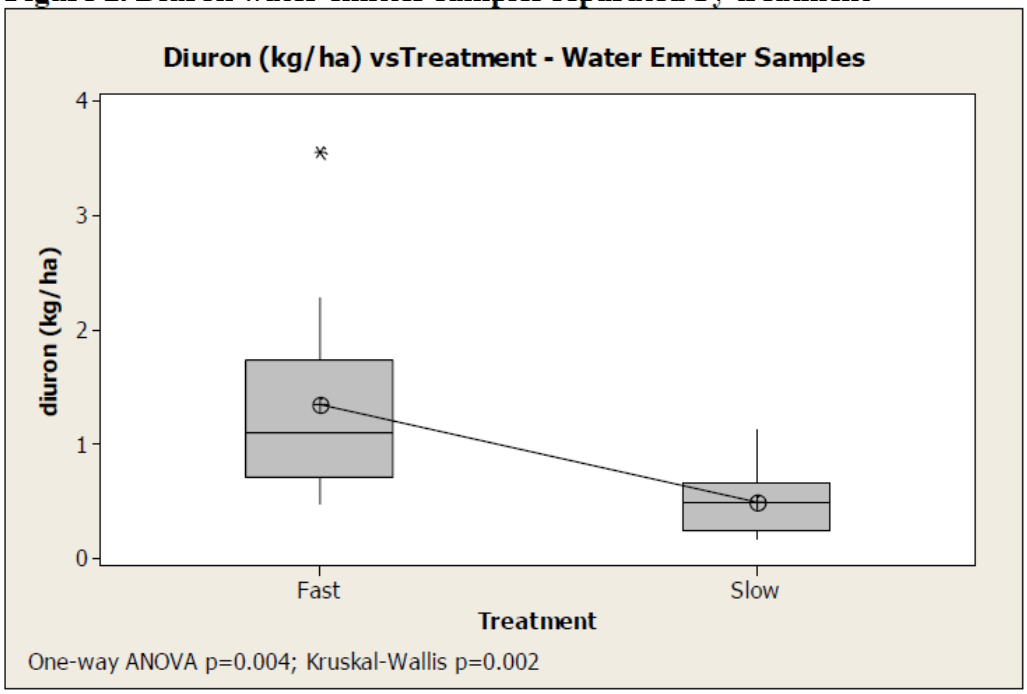


Figure 2. Diuron water emitter samples separated by treatment



Although the exact reason for the unexpected variability is unknown, several factors could have contributed to the variability. The pesticides were injected as part of a research project to better understand the techniques for applying simazine and diuron by chemigation. Since the pesticides were not labeled for use through irrigation systems when these applications occurred, the researchers did not have label instructions for the best method of injecting the pesticides. The injections were made without diluting or agitating the pesticide products, which may have resulted in the products not being thoroughly mixed before being injected into the irrigation system. Also, the injections were made very close to the emitters which also may not have given the pesticide enough time in the irrigation line to become thoroughly mixed and may have contributed to the variation among emitters. Any fluctuations in pressure occurring during the sampling period could also have affected the measurements. Although all of these reasons could have contributed to the variation, they do not explain why the results were consistently detected at a rate lower than the rate applied.

Quality Control: None of the field blanks contained detectable residues of simazine or diuron. Four water samples, one from each injection treatment, were spiked with simazine and diuron. The spiked water samples had a mean recovery rate for simazine of 104% with a standard deviation (SD) of 5.9% and the samples spiked with diuron had a mean recovery rate of 99% with a SD of 11.6% (Table 3).

Table 3. Quality control: percent recovery for spiked water samples

Date	Simazine (% recovery)	Simazine Control Limits	Diuron (% recovery)	Diuron Control Limits	Reporting Limit (ppb)	Treatment	Site
1/3/2005	107	UWL	116	UWL	0.05	Fast	1
1/3/2005	111	UWL	97		0.05	Slow	1
1/7/2005	98.6		94.9		0.05	Fast	2
1/7/2005	100		89.4		0.05	Slow	2
Mean	104		99.3				
SD	5.9		11.6				

UWL = Upper warning limit: Simazine = 100.8%, Diuron = 109.4%
SD = Standard Deviation

Mass Deposition Sheet Analysis

Based on the grower's reported product application rate, the rate of active ingredient applied to the standard practice treatment at Site 1 was calculated to be 2.0 kg/ha of simazine and 0.90 kg/ha of diuron. MDS collection sheets indicated the average simazine rate to be 0.9 kg/ha and the average diuron rate to be 0.57 kg/ha, both approximately half of the growers' reported rate applied (Table 4 and Appendix, Table 13). It is unclear why there was such a large difference between the grower's reported rate and the rate determined by the MDS collection sheets.

Table 4. Descriptive statistics for the mass deposition sheets

Chemical (kg/ha)	N	Mean (kg/ha)	Standard Error (kg/ha)	Standard Deviation (kg/ha)
Simazine	4	0.918	0.134	0.268
Diuron	4	0.5708	0.0436	0.0873

Quality Control: None of the field blanks contained detectable residues of simazine or diuron. Two MDSs were spiked with simazine and diuron. The spiked MDS samples had a mean recovery rate for simazine of 99% with a SD of 3.0% and the samples spiked with diuron had a mean recovery rate of 91% with a SD of 0.6% (Table 5).

Table 5. Quality control: percent recovery for spiked mass deposition sheets

Date	Simazine (% recovery)	Diuron (% recovery)	Reporting Limit (ug/MDS)	Treatment	Site
1/14/2005	101	91.6	0.5	Standard	1
1/14/2005	96.8	90.8	0.5	Standard	1
Mean	98.9	91.2			
SD	3.0	0.6			

Soil Analysis

The soil textures in the study area ranged from sandy loam to sandy clay loam at Site 1 and from sandy loam to clay loam at Site 2 (Appendix, Table 14).

Pre-Application: The background soil sampling indicated no detectable residues at Site 1 but there were some simazine and diuron residues in the top 15.2 cm of soil at Site 2 (Table 6). The background residues at Site 2 included three detections of simazine residues that ranged from 0.021 to 0.100 ppm and seven detections of diuron residues that ranged from 0.016 to 0.268 ppm (Appendix, Table 15). The residues were detected in each of the treatment plots at Site 2. The minimum amount of simazine that can cause symptoms in plants is 0.15–0.2 ppm (A. DaSilva, personal communication, 2008). All of the simazine background residues were below this level so it is unlikely that these simazine residues had an effect on the outcome of the study. At this point, the minimum amount of diuron needed to cause symptoms is unknown but diuron residues were detected in each of the plots at Site 2 indicating that if the results were affected they would have been affected evenly at the site.

Table 6. Descriptive statistics for the soil sample concentrations

Chemical	Site	Days after Application	Treatment	N	Mean (ppm)	Standard Error (ppm)	Standard Deviation (ppm)	Coefficient of Variation	Median (ppm)
Simazine	1	Background	Background	8	nd	*	*	*	nd
Simazine	1	1	Fast	4	1.580	0.538	1.075	68.03	1.233
Simazine	1	45	Fast	4	2.52	1.03	2.05	81.44	2.13
Simazine	1	90	Fast	4	0.1376	0.0404	0.0808	58.72	0.1405
Simazine	1	120	Fast	4	0.0391	0.0279	0.0559	142.96	0.0189
Simazine	1	1	Slow	4	1.441	0.312	0.624	43.26	1.214
Simazine	1	45	Slow	4	3.216	0.340	0.679	21.12	3.098
Simazine	1	90	Slow	4	0.393	0.158	0.316	80.56	0.311
Simazine	1	120	Slow	4	0.133	0.123	0.246	185.80	0.0144
Simazine	1	1	Standard	4	0.835	0.468	0.936	112.06	0.588
Simazine	1	90	Standard	4	0.1202	0.0270	0.0540	44.95	0.1060
Simazine	1	120	Standard	4	0.0660	0.0383	0.0766	116.18	0.0438
Simazine	2	Background	Background	8	0.0161	0.0132	0.0372	231.89	nd
Simazine	2	1	Fast	4	0.684	0.175	0.351	51.29	0.677
Simazine	2	45	Fast	4	0.9622	0.0700	0.1400	14.55	0.9602
Simazine	2	90	Fast	4	0.328	0.126	0.253	77.09	0.232
Simazine	2	120	Fast	4	0.4142	0.0740	0.1479	35.71	0.3902
Simazine	2	1	Slow	4	1.131	0.110	0.219	19.36	1.061
Simazine	2	45	Slow	4	0.513	0.237	0.475	92.46	0.342
Simazine	2	90	Slow	4	0.387	0.104	0.208	53.78	0.450
Simazine	2	120	Slow	4	0.3130	0.0979	0.1958	62.55	0.3392
Diuron	1	Background	Background	8	nd	*	*	*	nd
Diuron	1	1	Fast	4	1.719	0.737	1.473	85.69	1.098
Diuron	1	45	Fast	4	1.607	0.443	0.886	55.14	1.465
Diuron	1	90	Fast	4	0.3611	0.0724	0.1449	40.12	0.3541
Diuron	1	120	Fast	4	0.309	0.122	0.243	78.62	0.261
Diuron	1	1	Slow	4	1.156	0.295	0.590	51.01	0.938
Diuron	1	45	Slow	4	2.459	0.640	1.280	52.05	1.980
Diuron	1	90	Slow	4	0.3846	0.0413	0.0826	21.46	0.3973
Diuron	1	120	Slow	4	0.329	0.110	0.219	66.54	0.332
Diuron	1	1	Standard	4	0.354	0.194	0.389	109.92	0.255
Diuron	1	90	Standard	4	0.0842	0.0278	0.0557	66.12	0.0731
Diuron	1	120	Standard	4	0.08558	0.00661	0.01321	15.44	0.08530
Diuron	2	Background	Background	8	0.0798	0.0366	0.1036	129.83	0.0414
Diuron	2	1	Fast	4	1.066	0.152	0.304	28.54	1.155
Diuron	2	45	Fast	4	1.547	0.571	1.142	73.86	1.263
Diuron	2	90	Fast	4	0.655	0.110	0.220	33.64	0.712
Diuron	2	120	Fast	4	0.4230	0.0699	0.1398	33.05	0.4540
Diuron	2	1	Slow	4	1.253	0.390	0.781	62.33	1.085
Diuron	2	45	Slow	4	0.418	0.154	0.308	73.69	0.330
Diuron	2	90	Slow	4	0.473	0.159	0.318	67.25	0.431
Diuron	2	120	Slow	4	0.451	0.157	0.314	69.72	0.363

nd = not detected

Post-Application: All of the soil samples collected within a day or two after the pesticide application had simazine and diuron residues in the top 7.6 cm of soil. Simazine and diuron residues were measured in several of the deepest soil samples (30.5–45.7 cm depth interval) collected within a day or two after application indicating the possibility that not all of the residues were captured during the sampling event (Figures 3 and 4). At Site 1, one of the soil cores from the standard practice plot and two of the soil cores from the fast chemigation treatment plot had pesticide detections in the deepest soil core segment. At Site 2, one of the soil cores from the fast chemigation treatment plot had pesticide detections in the deepest soil core segment. None of the soil cores in the slow chemigation treatment plots had pesticide detections in the deepest soil core segments (Appendix, Table 15).

For the sampling events at approximately 45, 90, and 120 days after the pesticide application no pesticide residues were detected in the soil samples below 61 cm indicating that the pesticides did not leach below this depth even at Site 2 which received the longer post-application frost protection irrigation (Appendix, Table 15).

Figure 3. Concentration of simazine (ug) recovered at each sampling depth over time separated by site

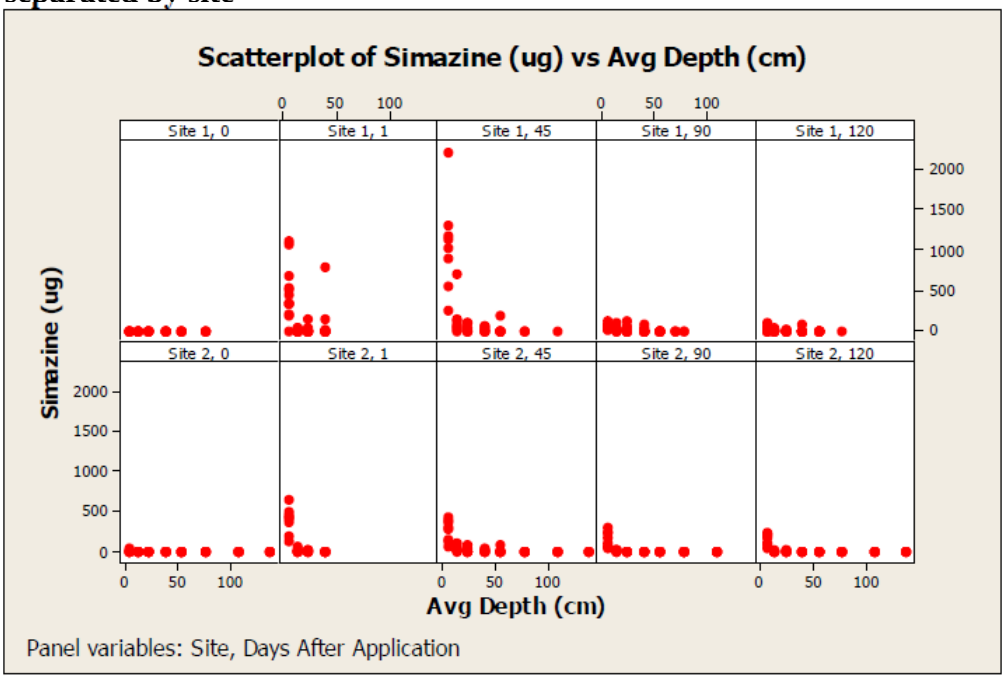
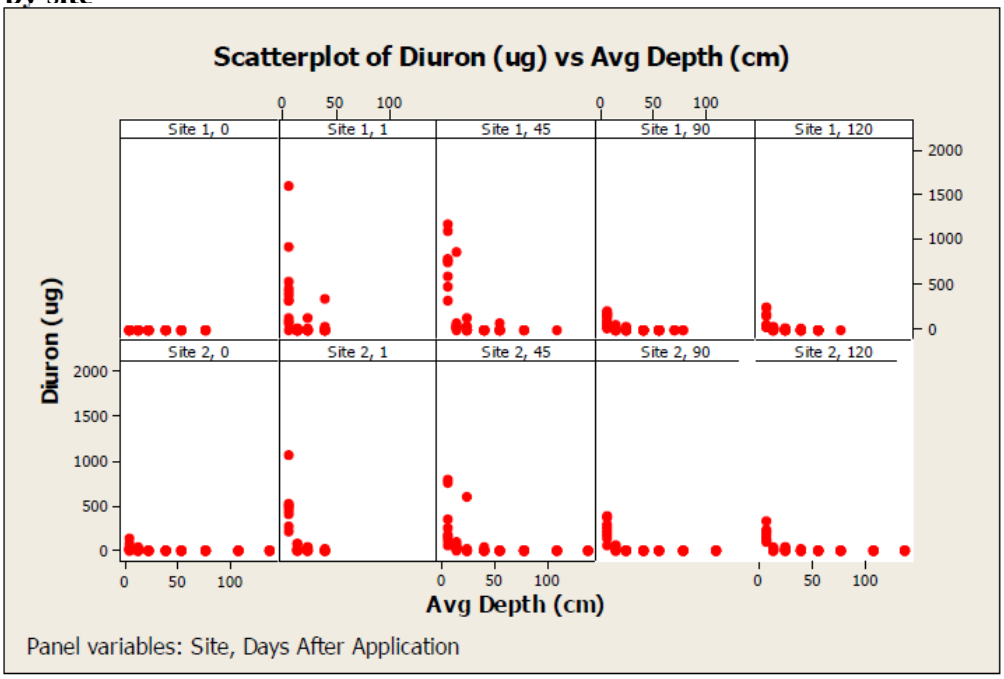


Figure 4. Concentration of diuron (ug) recovered at each sampling depth over time separated by site



The mass of the pesticide recovered per soil core was calculated by multiplying the soil bulk density (Appendix, Table 14) by the core depth and by the concentration of pesticide per core. The mass was then divided by the core surface area to obtain the application rate in kg/ha.

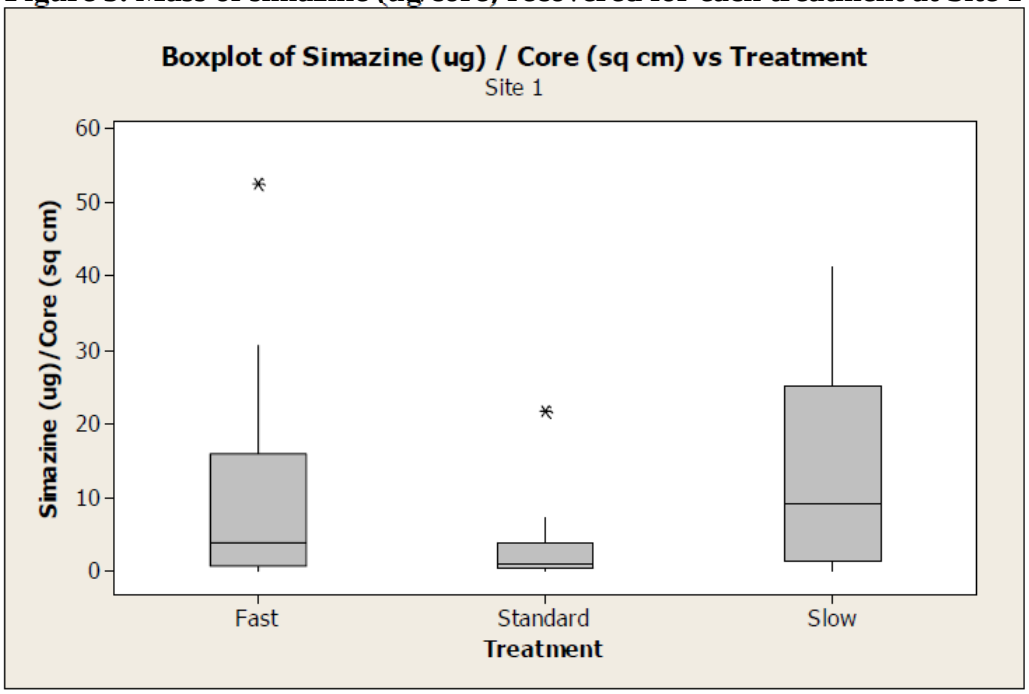
$$Application\ rate = \frac{\rho \times D \times C_s}{A_c}$$

Where:

ρ = Bulk density
D = Core depth
C_s = Pesticide concentration from the soil core
A_c = Core surface area

The mass of simazine and diuron recovered per soil core was not significantly different between the fast and slow treatments at either site (Figures 5-8). At Site 1, the mass of diuron recovered per soil core from the standard practice plot was significantly different ($p=0.011$) from the mass of diuron recovered from the fast and slow treatments (Figure 7). This difference can be explained by the different application rates between treatments (Table 1). There was no significant difference in the mass of simazine recovered from any of the treatments at Site 1 (Figure 5).

Figure 5. Mass of simazine (ug/core) recovered for each treatment at Site 1



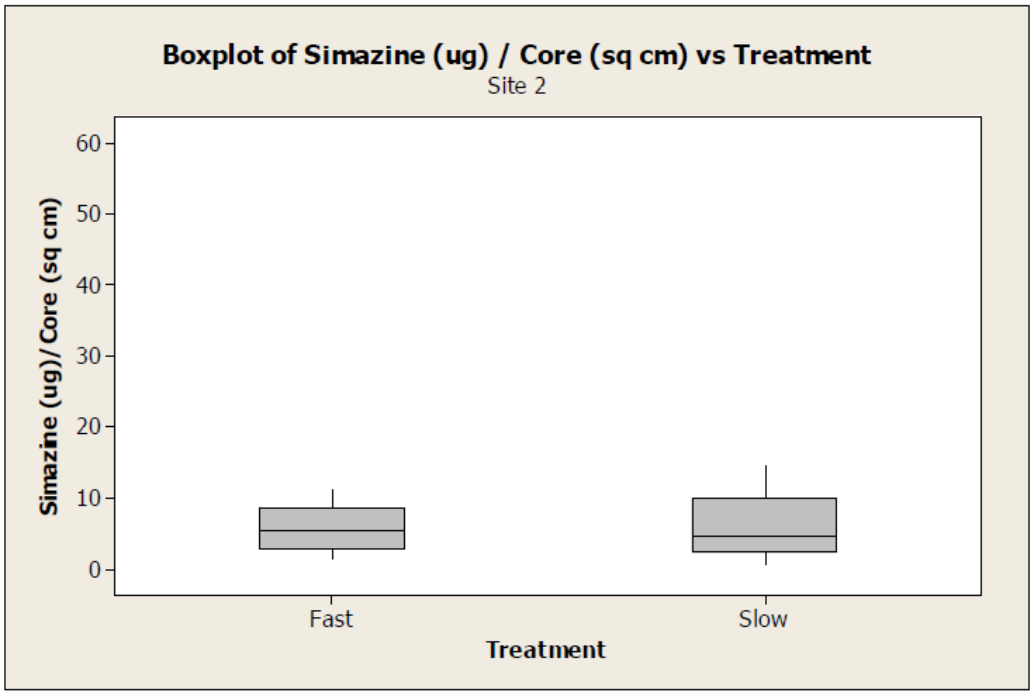
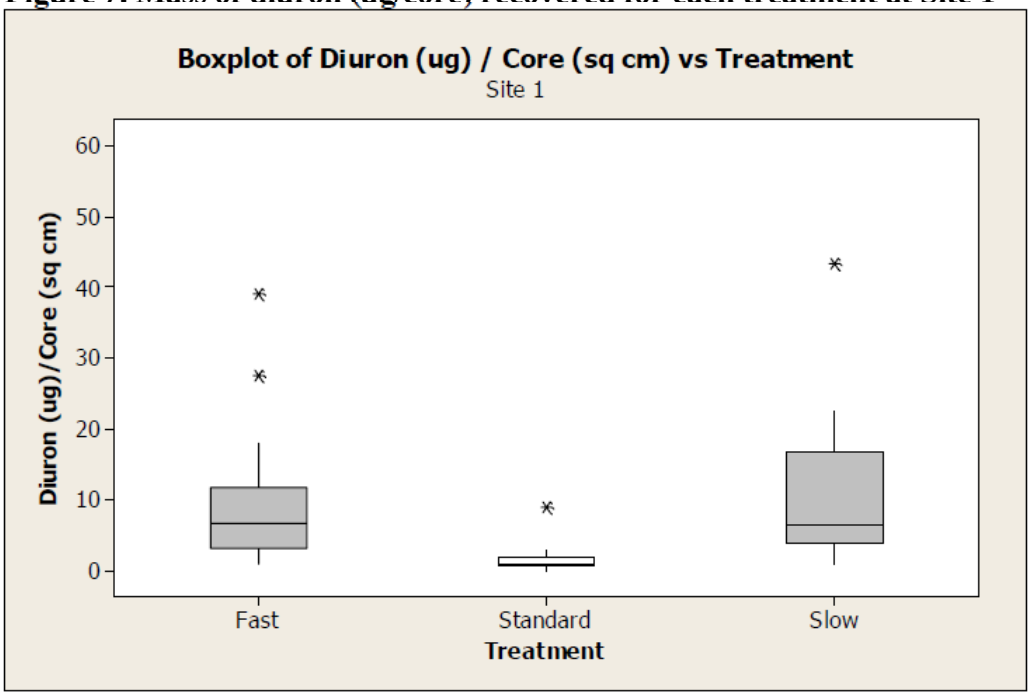
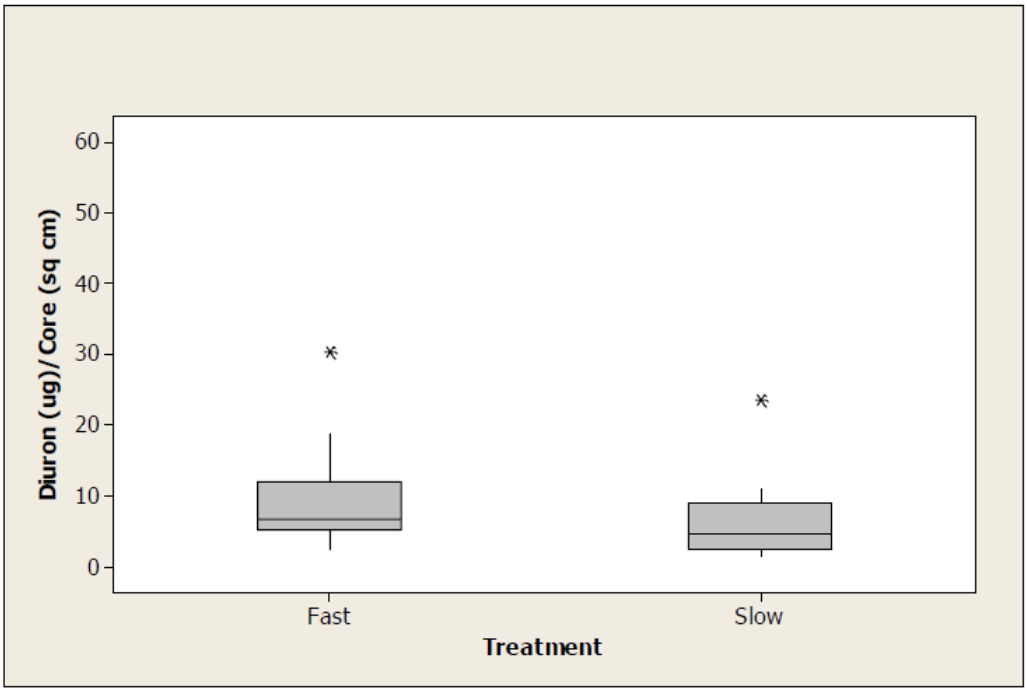


Figure 7. Mass of diuron (ug/core) recovered for each treatment at Site 1





If the pesticide does not leach below the sampling area, it is often possible to use the mass of pesticide recovered at each sampling period to determine a degradation rate of the pesticide in the soil. It was not possible to determine the degradation rate of the pesticides for this study because the mass of simazine and diuron in each core did not follow the normal exponential decay curve. In fact, in several of the sites, the mass of pesticide recovered from the combined segments of each core was greater 45 days after application than on the day after application (Table 7). Since the grower's standard practice plot was not sampled 45 days after application we were unable to determine the reason for the higher mass recovered 45 days after application than on the day after application.

Table 7. Mass of pesticide per soil core

			Simazine (kg/ha)				Diuron (kg/ha)			
Site	**Treatment**	**Replicate**	**Day 1**	**Day 45**	**Day 90**	**Day 120**	**Day 1**	**Day 45**	**Day 90**	**Day 120**
1	Fast	1	3.075	2.838	0.223	0.038	3.915	1.802	0.539	0.615
1	Fast	2	0.781	1.415	0.096	0.000	1.021	1.127	0.307	0.101
1	Fast	3	1.652	0.567	0.185	0.119	1.174	0.738	0.197	0.395
1	Fast	4	0.813	5.258	0.047	0.000	0.767	2.761	0.401	0.127
1	Slow	1	2.360	4.125	0.107	0.000	2.027	4.328	0.384	0.222
1	Slow	2	1.163	3.299	0.354	0.029	0.933	1.549	0.273	0.571
1	Slow	3	1.265	2.896	0.842	0.502	0.943	2.239	0.471	0.442
1	Slow	4	0.978	2.545	0.268	0.000	0.721	1.720	0.410	0.082
1	Standard	1	0.446	N/A	0.197	0.035	0.206	N/A	0.030	0.095
1	Standard	2	0.729	N/A	0.072	0.176	0.304	N/A	0.084	0.099
1	Standard	3	2.164	N/A	0.097	0.052	0.905	N/A	0.062	0.073
1	Standard	4	0.000	N/A	0.116	0.000	0.000	N/A	0.161	0.075
2	Fast	1	1.076	0.882	0.300	0.262	1.082	0.639	0.751	0.399
2	Fast	2	0.867	1.039	0.164	0.614	1.320	1.878	0.343	0.548
2	Fast	3	0.487	1.117	0.693	0.418	1.228	0.648	0.852	0.236
2	Fast	4	0.306	0.812	0.154	0.362	0.634	3.021	0.673	0.509
2	Slow	1	1.444	1.213	0.374	0.079	2.347	0.859	0.475	0.195
2	Slow	2	0.958	0.316	0.527	0.452	1.068	0.288	0.386	0.485
2	Slow	3	1.006	0.157	0.550	0.226	0.494	0.152	0.897	0.241
2	Slow	4	1.117	0.367	0.098	0.495	1.102	0.373	0.133	0.882

N/A = Not available. Soil samples were not collected.

Quality Control: None of the field blanks had detectable levels of simazine or diuron. The percent recoveries for the samples are listed in Table 8 and the descriptive statistics are outlined in Table 9. The spiked soil samples had a mean recovery rate for simazine of 91.3% with a SD of 2.3% and the samples spiked with diuron had a mean recovery rate of 92.5% with a SD of 9.2%. Many of the soil samples spiked with diuron were above the upper warning limit, especially on the samples analyzed 45 days after the pesticide application (Table 8). There was a significant difference between the

percent diuron recovered from the soil samples spiked the day after application (median = 86.7%) and the ones spiked 45 days after the application (median = 100%) (Table 9) (Kruskal-Wallis, p = 0.015). Even though the soil samples spiked with simazine were within the control limits, the soil cores still showed an increase in simazine and diuron on day 45. This result indicates that the laboratory analysis was not the reason the soil cores had a higher mass of pesticides 45 days after application than 1 day after application.

Table 8. Quality control: percent recovery for spiked soil samples

Date	Simazine (% recovery)	Simazine Control Limits	Diuron (% recovery)	Diuron Control Limits	Reporting Limit (ppm)	Days After Application
12/23/2004	90		103	UWL	0.015	0
12/23/2004	93.3		90		0.015	0
12/24/2004	86.7		83.3		0.015	0
12/27/2004	90		96.7		0.015	0
1/3/2005	93.3		96.7		0.015	0
1/3/2005	93.3		103	UWL	0.015	0
1/3/2005	86.7		80		0.015	0
1/3/2005	86.7		86.7		0.015	1
1/3/2005	83.3		83.3		0.015	1
1/5/2005	86.7		80		0.015	1
1/5/2005	93.3		100	UWL	0.015	1
1/7/2005	86.7		93.3		0.015	1
1/18/2005	93.3		96.7		0.015	1
1/18/2005	83.3		76.7		0.015	1
1/21/2005	86.7		100	UWL	0.015	1
1/21/2005	96.7		80		0.015	1
1/7/2005	96.7		100	UWL	0.015	45
1/14/2005	90		100	UWL	0.015	45
1/13/2005	93.3		100	UWL	0.015	45
1/13/2005	83.3		83.3		0.015	45
1/13/2005	93.3		100	UWL	0.015	45
3/9/2005	93.3		96.7		0.015	45
3/9/2005	90		107	UCL	0.015	45
3/10/2005	90		96.7		0.015	45
3/10/2005	86.7		100	UWL	0.015	45
3/11/2005	100		100	UWL	0.015	45
3/15/2005	80		76.7		0.015	90
3/15/2005	100		103	UWL	0.015	90
3/23/2005	83.3		80		0.015	90
3/23/2005	103	UWL	96.7		0.015	90
3/23/2005	93.3		80		0.015	90
3/23/2005	86.7		86.7		0.015	90

Date	Simazine (% recovery)	Simazine Control Limits	Diuron (% recovery)	Diuron Control Limits	Reporting Limit (ppm)	Days After Application
3/23/2005	90		83.3		0.015	90
3/23/2005	100		103	UWL	0.015	90
3/23/2005	90		86.7		0.015	90
3/23/2005	103	UWL	103	UWL	0.015	90
5/5/2005	86.7		96.7		0.015	120
5/5/2005	90		80		0.015	120
5/5/2005	96.7		96.7		0.015	120
5/5/2005	86.7		100	UWL	0.015	120
5/5/2005	100		96.7		0.015	120
5/5/2005	86.7		76.7		0.015	120
5/5/2005	90		93.3		0.015	120
5/5/2005	96.7		96.7		0.015	120
5/5/2005	93.3		96.7		0.015	120
5/5/2005	96.7		90		0.015	120
Mean	91.3		92.5			
SD	2.3		9.2			

UWL = Upper warning limit
UCL = Upper control limit

Table 9. Descriptive statistics for soil quality control percent recovery

Chemical	Days After Application	N	Mean (%)	SE Mean (%)	St Dev (%)	Median (%)
Simazine	0	7	90.47	1.12	2.97	90.00
Simazine	1	9	88.52	1.58	4.75	86.70
Simazine	45	10	91.66	1.51	4.78	91.65
Simazine	90	10	92.93	2.62	8.29	91.65
Simazine	120	10	92.35	1.57	4.98	91.65
Diuron	0	7	93.24	3.45	9.12	96.70
Diuron	1	9	88.52	3.05	9.14	86.70
Diuron	45	10	98.37	1.89	5.99	100.00
Diuron	90	10	89.91	3.33	10.52	86.70
Diuron	120	10	92.35	2.49	7.87	96.70

Efficacy

Observations of the efficacy of the pesticide applications are given in Table 10. Figures 9–14 are photos of the control and chemigation treatment areas. The grower at Site 1 was especially satisfied with the results of the slow injection treatment where efficacy was rated at 95% at 143 days after application. At this site, the slow injection treatment outperformed the other treatments by as much as 10% while there was little difference in efficacy between the fast injection treatment and the standard practice. The application rate for the standard practice was much less than the application rate for the chemigation treatments. The similar efficacy observed on the standard practice plot and

the fast injection treatment occurred with a considerably lower rate of active ingredient applied on the standard practice plot. At Site 2 the fast injection treatment and the standard practice using glyphosate controlled a similar percent of weeds whereas the slow injection treatment controlled fewer weeds.

Table 10. Efficacy

# Days After Treatment	Site	% of Weeds Controlled by Treatment			
		Control	Fast	Slow	Standard
44	1	0	100	100	100
98	1	0	85	95	85
126	1	0	80	95	85
143	1	0	85	95	85
62	2	0	90	80	90
92	2	0	90	80	90
121	2	0	90	80	85

Figure 9. Site 1 Control

Figure 10. Site 2 Control

Figure 11. Site 1 Fast Treatment

Figure 12. Site 2 Fast Treatment

Figure 13. Site 1 Slow Treatment

Figure 14. Site 2 Slow Treatment

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APPENDIX

Table 11. Pesticide application water emitter sample results

Date Collected	Simazine (ppb)	Diuron (ppb)	MDL (ppb)	Site	Treatment	Simazine (kg/ha)	Diuron (kg/ha)
11/30/04	nd	nd	0.05	2	Control	N/A	N/A
11/30/04	nd	nd	0.05	2	Control	N/A	N/A
11/30/04	nd	nd	0.05	2	Control	N/A	N/A
11/8/04	nd	nd	0.05	1	Control	N/A	N/A
11/8/04	nd	nd	0.05	1	Control	N/A	N/A
11/8/04	nd	nd	0.05	1	Control	N/A	N/A
11/30/04	249000	149000	0.05	2	Fast	3.010	1.801
11/30/04	299000	294000	0.05	2	Fast	3.615	3.554
11/30/04	185000	189000	0.05	2	Fast	2.237	2.285
11/30/04	150000	39400	0.05	2	Fast	1.813	0.476
11/30/04	97200	43100	0.05	2	Fast	1.175	0.521
11/30/04	78900	90000	0.05	2	Fast	0.954	1.088
11/8/04	324000	70900	0.05	1	Fast	1.904	0.857
11/8/04	352000	106000	0.05	1	Fast	2.069	1.281
11/8/04	265000	85900	0.05	1	Fast	1.557	1.038
11/8/04	281000	91500	0.05	1	Fast	1.651	1.106
11/8/04	275000	54500	0.05	1	Fast	1.616	0.659
11/8/04	342000	126000	0.05	1	Fast	2.010	1.523
11/30/04	52300	13100	0.05	2	Slow	2.740	0.158
11/30/04	60900	29700	0.05	2	Slow	3.190	0.359
11/30/04	59700	16600	0.05	2	Slow	3.128	0.201
11/30/04	82200	36200	0.05	2	Slow	4.306	0.438
11/30/04	76400	15900	0.05	2	Slow	4.002	0.192
11/30/04	72500	46300	0.05	2	Slow	3.798	0.560
11/8/04	98000	35400	0.05	1	Slow	1.999	0.428
11/8/04	148000	57300	0.05	1	Slow	3.018	0.693
11/8/04	103000	45200	0.05	1	Slow	2.101	0.546
11/8/04	132000	44600	0.05	1	Slow	2.692	0.539
11/8/04	161000	58400	0.05	1	Slow	3.284	0.706
11/8/04	160000	93100	0.05	1	Slow	3.263	1.126

nd = not detected
N/A = not available

Table 12. Flow rate results

Site	Treatment	Flow Rate (ml / 30 sec)
1	Fast	N/A
1	Fast	N/A
1	Fast	N/A
1	Fast	N/A
1	Fast	N/A
1	Slow	N/A
1	Slow	N/A
1	Slow	N/A
1	Slow	N/A
1	Slow	N/A
2	Fast	360
2	Fast	360
2	Fast	355
2	Fast	365
2	Fast	355
2	Slow	370
2	Slow	375
2	Slow	370
2	Slow	370
2	Slow	365

N/A = not available

Table 13. Results from mass deposition sheets from the standard practice plot at Site 1

Date Collected	Simazine (ug/MDS)	Diuron (ug/MDS)	MDL (ug/MDS)	Site	Simazine (kg/ha)	Diuron (kg/ha)
11/12/04	7770	5670	0.5	1	0.835275	0.609525
11/12/04	12200	6150	0.5	1	1.3115	0.661125
11/12/04	6590	4250	0.5	1	0.708425	0.456875
11/12/04	7600	5170	0.5	1	0.817	0.555775

Table 14. Soil physical properties

Site	% of Sample >2mm	Texture of portion of Sample <2mm			Depth (cm)	Texture	Calculated Bulk Density	% Organic Carbon
		% Sand	% Silt	% Clay				
1	4.9	49.0	32.0	19.0	0 – 7.6	Loam	1.43	1.3
1	3.2	46.0	30.0	24.0	7.6 – 15.2	Loam	1.39	0.3
1	3.0	46.0	31.0	23.0	15.2 – 30.5	Loam	1.40	0.3
1	13.9	46.0	32.0	22.0	30.5 – 45.7	Loam	1.40	0.2
1	3.7	49.0	31.0	20.0	45.7 - 61	Loam	1.42	0.1
1	9.1	53.0	30.0	17.0	61 – 91.4	Sandy loam	1.46	0.1
1	8.7	51.0	31.0	18.0	0 – 7.6	Loam	1.44	2.3
1	9.5	51.0	30.0	19.0	7.6 – 15.2	Loam	1.44	0.3
1	11.1	55.0	24.0	21.0	15.2 – 30.5	Sandy clay loam	1.43	0.3
1	9.2	51.0	30.0	19.0	30.5 – 45.7	Loam	1.44	0.2
1	9.3	52.0	32.0	16.0	0 – 7.6	Loam	1.46	1.6
1	6.5	51.0	30.0	19.0	7.6 – 15.2	Loam	1.44	0.5
1	10.8	51.0	32.0	17.0	15.2 – 30.5	Loam	1.45	0.4
1	2.4	51.0	33.0	16.0	30.5 – 45.7	Loam	1.46	0.2
1	2.7	49.0	32.0	19.0	45.7 - 61	Loam	1.43	0.1
1	7.5	53.0	30.0	17.0	61 –91.4	Sandy loam	1.46	0.2
1	12.0	65.0	24.0	11.0	0 – 7.6	Sandy loam	1.54	1.1
1	3.9	54.0	29.0	17.0	7.6 – 15.2	Sandy loam	1.46	0.5
1	7.8	51.0	33.0	16.0	15.2 – 30.5	Loam	1.46	0.4
1	2.4	49.0	35.0	16.0	30.5 – 45.7	Loam	1.46	0.2
1	3.7	53.0	34.0	13.0	45.7 - 61	Sandy loam	1.50	0.2
1	1.3	53.0	26.0	21.0	61 –91.4	Sandy clay loam	1.42	0.2
1	3.9	56.0	32.0	12.0	0 – 7.6	Sandy loam	1.55	2.0
1	11.9	56.0	28.0	16.0	7.6 – 15.2	Sandy loam	1.47	0.4
1	3.7	55.0	28.0	17.0	15.2 – 30.5	Sandy loam	1.46	0.4
1	11.2	57.0	28.0	15.0	30.5 – 45.7	Sandy loam	1.48	0.2
1	18.0	52.0	29.0	19.0	45.7 - 61	Loam	1.44	0.2
1	12.1	56.0	31.0	13.0	0 – 7.6	Sandy loam	1.50	0.3
1	24.2	57.0	28.0	15.0	7.6 – 15.2	Sandy loam	1.48	0.6
1	17.5	54.0	29.0	17.0	15.2 – 30.5	Sandy loam	1.48	0.4
1	9.0	57.0	26.0	17.0	30.5 – 45.7	Sandy loam	1.46	0.3
1	15.7	55.0	25.0	20.0	45.7 - 61	Sandy clay loam	1.44	0.4
1	3.4	53.0	30.0	17.0	61 –76.2	Sandy loam	1.46	1.2
1	6.0	50.0	32.0	18.0	91.4 –106.7	Loam	1.44	0.7
1	1.6	49.0	29.0	22.0	106.7 – 121.9	Loam	1.41	0.4
1	5.7	48.0	29.0	23.0	121.9 –137.2	Loam	1.40	N/A
1	3.4	50.0	29.0	21.0	137.2 – 152.4	Loam	1.42	N/A
1	12.1	56.0	31.0	13.0	0 – 7.6	Sandy loam	1.50	2.5
1	8.6	54.0	31.0	15.0	7.6 – 15.2	Sandy loam	1.48	0.6
1	7.8	55.0	30.0	15.0	15.2 – 30.5	Sandy loam	1.48	0.3
1	7.3	51.0	30.0	19.0	30.5 – 45.7	Loam	1.44	0.3

Site	% of Sample >2mm	Texture of portion of Sample <2mm			Depth (cm)	Texture	Calculated Bulk Density	% Organic Carbon
		% Sand	% Silt	% Clay				
1	8.7	51.0	34.0	15.0	45.7 - 61	Loam	1.41	0.3
1	4.7	49.0	31.0	20.0	61 –91.4	Loam	1.42	0.2
2	1.7	56.0	26.0	18.0	0 – 7.6	Sandy loam	1.45	1.1
2	1.5	55.0	25.0	20.0	7.6 – 15.2	Sandy clay loam	1.44	0.7
2	1.7	56.0	24.0	20.0	15.2 – 30.5	Sandy clay loam	1.44	0.5
2	1.2	54.0	28.0	18.0	30.5 – 45.7	Sandy loam	1.45	0.5
2	1.3	58.0	24.0	18.0	45.7 - 61	Sandy loam	1.46	0.3
2	1.3	60.0	25.0	15.0	61 –91.4	Sandy loam	1.49	0.1
2	0.9	65.0	23.0	12.0	91.4 - 121.9	Sandy loam	1.53	0.1
2	0.8	66.0	14.0	20.0	121.9 – 152.4	Sandy clay loam	1.46	0.1
2	0.6	42.0	32.0	26.0	0 – 7.6	Loam	1.37	1.0
2	0.7	48.0	26.0	26.0	7.6 – 15.2	Sandy clay loam	1.38	0.3
2	0.3	47.0	29.0	24.0	15.2 – 30.5	Loam	1.39	0.5
2	0.2	44.0	34.0	22.0	30.5 – 45.7	Loam	1.40	0.2
2	0.2	36.0	32.0	32.0	45.7 - 61	Clay loam	1.33	0.1
2	0.5	28.0	30.0	42.0	61 –91.4	Clay	N/A	0.1
2	1.6	32.0	31.0	37.0	91.4 - 121.9	Clay loam	1.30	0.1
2	4.7	40.0	36.0	24.0	121.9 – 152.4	Loam	1.38	0.1
2	1.0	43.0	29.0	28.0	0 – 7.6	Clay loam	1.36	1.1
2	0.5	44.0	27.0	29.0	7.6 – 15.2	Clay loam	1.36	0.9
2	0.3	45.0	28.0	27.0	15.2 – 30.5	Clay loam	1.37	0.4
2	0.2	46.0	28.0	26.0	30.5 – 45.7	Loam	1.38	0.4
2	0.1	48.0	28.0	24.0	45.7 - 61	Loam	1.40	0.2
2	0.4	41.0	30.0	29.0	61 –91.4	Clay loam	1.35	0.2
2	0.1	38.0	32.0	30.0	91.4 - 121.9	Clay loam	1.34	0.2
2	0.1	41.0	43.0	16.0	121.9 – 152.4	Loam	1.44	0.0

N/A = not available

Table 15. Soil core results

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
11/2/04	nd	nd	16.3	Background	0 – 7.6	1	Background	1
11/2/04	nd	nd	12.2	Background	7.6 – 15.2	1	Background	1
11/2/04	nd	nd	14.1	Background	15.2 – 30.5	1	Background	1
11/2/04	nd	nd	13.7	Background	30.5 – 45.7	1	Background	1
11/2/04	nd	nd	15	Background	45.7 - 61	1	Background	1
11/2/04	nd	nd	12.9	Background	61 –91.4	1	Background	1
11/2/04	nd	nd	17.6	Background	0 – 7.6	1	Background	2
11/2/04	nd	nd	12.3	Background	7.6 – 15.2	1	Background	2
11/2/04	nd	nd	11.9	Background	15.2 – 30.5	1	Background	2
11/2/04	nd	nd	12.3	Background	30.5 – 45.7	1	Background	2
11/2/04	nd	nd	13.8	Background	0 – 7.6	1	Background	3
11/2/04	nd	nd	12.5	Background	7.6 – 15.2	1	Background	3
11/2/04	nd	nd	13.3	Background	15.2 – 30.5	1	Background	3
11/2/04	nd	nd	12.8	Background	30.5 – 45.7	1	Background	3
11/2/04	nd	nd	12.1	Background	45.7 - 61	1	Background	3
11/2/04	nd	nd	14.3	Background	61 –91.4	1	Background	3
11/2/04	nd	nd	15	Background	0 – 7.6	1	Background	4
11/2/04	nd	nd	12	Background	7.6 – 15.2	1	Background	4
11/2/04	nd	nd	10.1	Background	15.2 – 30.5	1	Background	4
11/2/04	nd	nd	7.68	Background	30.5 – 45.7	1	Background	4
11/2/04	nd	nd	7.3	Background	45.7 - 61	1	Background	4
11/2/04	nd	nd	11.5	Background	61 –91.4	1	Background	4
11/2/04	nd	nd	18.9	Background	0 – 7.6	1	Background	5
11/2/04	nd	nd	11.1	Background	7.6 – 15.2	1	Background	5
11/2/04	nd	nd	10.3	Background	15.2 – 30.5	1	Background	5
11/2/04	nd	nd	7.23	Background	30.5 – 45.7	1	Background	5
11/2/04	nd	nd	8.4	Background	45.7 - 61	1	Background	5
11/2/04	nd	nd	17.7	Background	0 – 7.6	1	Background	6
11/2/04	nd	nd	11.8	Background	7.6 – 15.2	1	Background	6
11/2/04	nd	nd	10.2	Background	15.2 – 30.5	1	Background	6
11/2/04	nd	nd	9.76	Background	30.5 – 45.7	1	Background	6
11/2/04	nd	nd	7.91	Background	45.7 - 61	1	Background	6
11/2/04	nd	nd	9.46	Background	61 –91.4	1	Background	6
11/2/04	nd	nd	14.7	Background	0 – 7.6	1	Background	7
11/2/04	nd	nd	11.2	Background	7.6 – 15.2	1	Background	7
11/2/04	nd	nd	16.9	Background	15.2 – 30.5	1	Background	7
11/2/04	nd	nd	9.37	Background	30.5 – 45.7	1	Background	7
11/2/04	nd	nd	18.7	Background	0 – 7.6	1	Background	8
11/2/04	nd	nd	11.8	Background	7.6 – 15.2	1	Background	8
11/2/04	nd	nd	9.41	Background	15.2 – 30.5	1	Background	8
11/2/04	nd	nd	11.6	Background	30.5 – 45.7	1	Background	8
11/2/04	nd	nd	11.6	Background	45.7 - 61	1	Background	8
11/2/04	nd	nd	10.2	Background	61 –91.4	1	Background	8

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
11/5/04	nd	0.016	20.5	Background	0 – 7.6	2	Background	1
11/5/04	nd	nd	17.7	Background	7.6 – 15.2	2	Background	1
11/5/04	nd	nd	15.0	Background	15.2 – 30.5	2	Background	1
11/5/04	nd	nd	12.2	Background	30.5 – 45.7	2	Background	1
11/5/04	nd	nd	10.3	Background	45.7 - 61	2	Background	1
11/5/04	nd	nd	9.58	Background	61 –91.4	2	Background	1
11/5/04	nd	nd	10.4	Background	91.4 - 121.9	2	Background	1
11/5/04	nd	nd	11.1	Background	121.9 – 152.4	2	Background	1
11/5/04	nd	nd	18.7	Background	0 – 7.6	2	Background	2
11/5/04	nd	nd	18	Background	7.6 – 15.2	2	Background	2
11/5/04	nd	nd	14.3	Background	15.2 – 30.5	2	Background	2
11/5/04	nd	nd	12.5	Background	30.5 – 45.7	2	Background	2
11/5/04	nd	nd	10.3	Background	45.7 - 61	2	Background	2
11/5/04	nd	nd	8.52	Background	61 –91.4	2	Background	2
11/5/04	nd	nd	9.6	Background	91.4 - 121.9	2	Background	2
11/5/04	nd	nd	9.12	Background	121.9 – 152.4	2	Background	2
11/5/04	nd	nd	17.5	Background	0 – 7.6	2	Background	3
11/5/04	nd	0.059	15.6	Background	7.6 – 15.2	2	Background	3
11/5/04	nd	nd	13.5	Background	15.2 – 30.5	2	Background	3
11/5/04	nd	nd	11	Background	30.5 – 45.7	2	Background	3
11/5/04	nd	nd	8.93	Background	45.7 - 61	2	Background	3
11/5/04	nd	nd	7.18	Background	61 –91.4	2	Background	3
11/5/04	nd	nd	4.75	Background	91.4 - 121.9	2	Background	3
11/5/04	0.021	0.137	14.3	Background	0 – 7.6	2	Background	4
11/5/04	nd	nd	14.5	Background	7.6 – 15.2	2	Background	4
11/5/04	nd	nd	13.6	Background	15.2 – 30.5	2	Background	4
11/5/04	nd	nd	13.7	Background	30.5 – 45.7	2	Background	4
11/5/04	nd	nd	12.8	Background	45.7 - 61	2	Background	4
11/5/04	nd	nd	15	Background	61 –91.4	2	Background	4
11/5/04	nd	nd	14.1	Background	91.4 - 121.9	2	Background	4
11/5/04	nd	nd	12	Background	121.9 – 152.4	2	Background	4
11/5/04	nd	0.036	13.3	Background	0 – 7.6	2	Background	5
11/5/04	nd	nd	10.1	Background	7.6 – 15.2	2	Background	5
11/5/04	nd	nd	11.5	Background	15.2 – 30.5	2	Background	5
11/5/04	nd	nd	13.3	Background	30.5 – 45.7	2	Background	5
11/5/04	nd	nd	11.8	Background	45.7 - 61	2	Background	5
11/5/04	nd	0.018	12.8	Background	0 – 7.6	2	Background	6
11/5/04	nd	nd	9.74	Background	7.6 – 15.2	2	Background	6
11/5/04	nd	nd	7.04	Background	15.2 – 30.5	2	Background	6
11/5/04	nd	nd	8.22	Background	30.5 – 45.7	2	Background	6
11/5/04	nd	nd	8.43	Background	45.7 - 61	2	Background	6
11/5/04	nd	nd	8.27	Background	61 –91.4	2	Background	6
11/5/04	nd	nd	6.38	Background	91.4 - 121.9	2	Background	6
11/5/04	nd	nd	6.54	Background	121.9 – 152.4	2	Background	6

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
11/5/04	nd	0.042	17.2	Background	0 – 7.6	2	Background	7
11/5/04	nd	nd	15.7	Background	7.6 – 15.2	2	Background	7
11/5/04	nd	nd	15.1	Background	15.2 – 30.5	2	Background	7
11/5/04	nd	nd	13.4	Background	30.5 – 45.7	2	Background	7
11/5/04	nd	nd	16.1	Background	45.7 - 61	2	Background	7
11/5/04	nd	nd	18.1	Background	61 –91.4	2	Background	7
11/5/04	nd	nd	18.3	Background	91.4 - 121.9	2	Background	7
11/5/04	nd	nd	16.9	Background	121.9 – 152.4	2	Background	7
11/5/04	0.100	0.268	15.5	Background	0 – 7.6	2	Background	8
11/5/04	nd	0.025	13.7	Background	7.6 – 15.2	2	Background	8
11/5/04	nd	nd	12.3	Background	15.2 – 30.5	2	Background	8
11/5/04	nd	nd	11.3	Background	30.5 – 45.7	2	Background	8
11/5/04	nd	nd	10.3	Background	45.7 - 61	2	Background	8
11/5/04	nd	nd	10.6	Background	61 –91.4	2	Background	8
11/5/04	nd	nd	13.5	Background	91.4 - 121.9	2	Background	8
11/5/04	nd	nd	11.4	Background	121.9 – 152.4	2	Background	8
11/16/04	0.403	0.186	16.7	Standard	0 – 7.6	1	1-Day	1
11/16/04	nd	nd	11.6	Standard	7.6 – 15.2	1	1-Day	1
11/16/04	nd	nd	11	Standard	15.2 – 30.5	1	1-Day	1
11/16/04	nd	nd	9.55	Standard	30.5 – 45.7	1	1-Day	1
11/16/04	0.658	0.274	24.9	Standard	0 – 7.6	1	1-Day	2
11/16/04	nd	nd	9.22	Standard	7.6 – 15.2	1	1-Day	2
11/16/04	nd	nd	11.5	Standard	15.2 – 30.5	1	1-Day	2
11/16/04	nd	nd	8.86	Standard	30.5 – 45.7	1	1-Day	2
11/16/04	0.362	0.136	21.5	Standard	0 – 7.6	1	1-Day	3
11/16/04	nd	nd	12.4	Standard	7.6 – 15.2	1	1-Day	3
11/16/04	nd	nd	12.4	Standard	15.2 – 30.5	1	1-Day	3
11/16/04	0.804	0.344	11.8	Standard	30.5 – 45.7	1	1-Day	3
11/16/04	nd	nd	16.9	Standard	0 – 7.6	1	1-Day	4
11/16/04	nd	nd	12.2	Standard	7.6 – 15.2	1	1-Day	4
11/16/04	nd	nd	12.3	Standard	15.2 – 30.5	1	1-Day	4
11/16/04	nd	nd	11.2	Standard	30.5 – 45.7	1	1-Day	4
11/10/04	2.220	3.18	18.7	Fast	0 – 7.6	1	1-Day	1
11/10/04	nd	nd	13.3	Fast	7.6 – 15.2	1	1-Day	1
11/10/04	0.138	0.135	13.2	Fast	15.2 – 30.5	1	1-Day	1
11/10/04	0.142	0.043	15.3	Fast	30.5 – 45.7	1	1-Day	1
11/10/04	0.689	0.922	14.8	Fast	0 – 7.6	1	1-Day	2
11/10/04	0.016	nd	13.7	Fast	7.6 – 15.2	1	1-Day	2
11/10/04	nd	nd	12.5	Fast	15.2 – 30.5	1	1-Day	2
11/10/04	nd	nd	13.5	Fast	30.5 – 45.7	1	1-Day	2
11/10/04	1.350	1.06	21.2	Fast	0 – 7.6	1	1-Day	3
11/10/04	0.026	nd	13.2	Fast	7.6 – 15.2	1	1-Day	3
11/10/04	0.039	nd	11	Fast	15.2 – 30.5	1	1-Day	3
11/10/04	0.019	nd	16.2	Fast	30.5 – 45.7	1	1-Day	3

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
11/10/04	0.663	0.661	13.7	Fast	0 – 7.6	1	1-Day	4
11/10/04	0.070	0.031	11.5	Fast	7.6 – 15.2	1	1-Day	4
11/10/04	nd	nd	8.01	Fast	15.2 – 30.5	1	1-Day	4
11/10/04	nd	nd	7.53	Fast	30.5 – 45.7	1	1-Day	4
11/10/04	2.130	1.83	18.3	Slow	0 – 7.6	1	1-Day	1
11/10/04	nd	nd	12.5	Slow	7.6 – 15.2	1	1-Day	1
11/10/04	nd	nd	10.9	Slow	15.2 – 30.5	1	1-Day	1
11/10/04	nd	nd	10.9	Slow	30.5 – 45.7	1	1-Day	1
11/10/04	1.050	0.842	21.7	Slow	0 – 7.6	1	1-Day	2
11/10/04	nd	nd	15.1	Slow	7.6 – 15.2	1	1-Day	2
11/10/04	nd	nd	12.6	Slow	15.2 – 30.5	1	1-Day	2
11/10/04	nd	nd	7.7	Slow	30.5 – 45.7	1	1-Day	2
11/10/04	1.030	0.775	21.4	Slow	0 – 7.6	1	1-Day	3
11/10/04	0.067	0.044	11.1	Slow	7.6 – 15.2	1	1-Day	3
11/10/04	0.022	0.016	11.3	Slow	15.2 – 30.5	1	1-Day	3
11/10/04	nd	nd	8.04	Slow	30.5 – 45.7	1	1-Day	3
11/10/04	0.883	0.651	22	Slow	0 – 7.6	1	1-Day	4
11/10/04	nd	nd	11	Slow	7.6 – 15.2	1	1-Day	4
11/10/04	nd	nd	12	Slow	15.2 – 30.5	1	1-Day	4
11/10/04	nd	nd	11.5	Slow	30.5 – 45.7	1	1-Day	4
12/1/04	0.875	0.843	20.8	Fast	0 – 7.6	2	1- Day	1
12/1/04	0.138	0.176	19.0	Fast	7.6 – 15.2	2	1- Day	1
12/1/04	nd	nd	16.3	Fast	15.2 – 30.5	2	1- Day	1
12/1/04	nd	nd	13.5	Fast	30.5 – 45.7	2	1- Day	1
12/1/04	0.757	1.08	20.1	Fast	0 – 7.6	2	1- Day	2
12/1/04	0.060	0.163	19.1	Fast	7.6 – 15.2	2	1- Day	2
12/1/04	nd	nd	15.3	Fast	15.2 – 30.5	2	1- Day	2
12/1/04	nd	nd	12.5	Fast	30.5 – 45.7	2	1- Day	2
12/1/04	0.394	1.04	24.1	Fast	0 – 7.6	2	1- Day	3
12/1/04	0.020	nd	21.5	Fast	7.6 – 15.2	2	1- Day	3
12/1/04	0.022	0.039	15.6	Fast	15.2 – 30.5	2	1- Day	3
12/1/04	nd	0.019	14.6	Fast	30.5 – 45.7	2	1- Day	3
12/1/04	0.272	0.577	21.4	Fast	0 – 7.6	2	1- Day	4
12/1/04	0.016	0.02	20.3	Fast	7.6 – 15.2	2	1- Day	4
12/1/04	nd	nd	14.5	Fast	15.2 – 30.5	2	1- Day	4
12/1/04	nd	nd	13.2	Fast	30.5 – 45.7	2	1- Day	4
12/1/04	1.36	2.21	23.3	Slow	0 – 7.6	2	1- Day	1
12/1/04	nd	nd	13.5	Slow	7.6 – 15.2	2	1- Day	1
12/1/04	nd	nd	10.2	Slow	15.2 – 30.5	2	1- Day	1
12/1/04	nd	nd	11	Slow	30.5 – 45.7	2	1- Day	1
12/1/04	0.864	0.946	19.5	Slow	0 – 7.6	2	1- Day	2
12/1/04	nd	nd	15.6	Slow	7.6 – 15.2	2	1- Day	2
12/1/04	0.019	0.03	11.3	Slow	15.2 – 30.5	2	1- Day	2
12/1/04	nd	nd	13.9	Slow	30.5 – 45.7	2	1- Day	2

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
12/1/04	0.93	0.444	20.6	Slow	0 – 7.6	2	1- Day	3
12/1/04	0.017	0.021	16.1	Slow	7.6 – 15.2	2	1- Day	3
12/1/04	nd	nd	15.2	Slow	15.2 – 30.5	2	1- Day	3
12/1/04	nd	nd	10.9	Slow	30.5 – 45.7	2	1- Day	3
12/1/04	1.02	0.998	21.2	Slow	0 – 7.6	2	1- Day	4
12/1/04	nd	nd	16.8	Slow	7.6 – 15.2	2	1- Day	4
12/1/04	0.016	0.020	13.4	Slow	15.2 – 30.5	2	1- Day	4
12/1/04	nd	nd	10.9	Slow	30.5 – 45.7	2	1- Day	4
12/22/04	2.250	1.56	24.2	Fast	0 – 7.6	1	45-Day	1
12/22/04	0.266	0.066	16.7	Fast	7.6 – 15.2	1	45-Day	1
12/22/04	nd	nd	13.1	Fast	15.2 – 30.5	1	45-Day	1
12/22/04	0.022	nd	12.5	Fast	30.5 – 45.7	1	45-Day	1
12/22/04	nd	nd	13.3	Fast	45.7 - 61	1	45-Day	1
12/22/04	1.120	0.95	17.8	Fast	0 – 7.6	1	45-Day	2
12/22/04	0.156	0.067	10.2	Fast	7.6 – 15.2	1	45-Day	2
12/22/04	nd	nd	13.7	Fast	15.2 – 30.5	1	45-Day	2
12/22/04	nd	nd	12.7	Fast	30.5 – 45.7	1	45-Day	2
12/22/04	nd	nd	13.4	Fast	45.7 - 61	1	45-Day	2
12/22/04	0.512	0.666	18.1	Fast	0 – 7.6	1	45-Day	3
12/22/04	nd	nd	13.8	Fast	7.6 – 15.2	1	45-Day	3
12/22/04	nd	nd	13.2	Fast	15.2 – 30.5	1	45-Day	3
12/22/04	nd	nd	11.8	Fast	30.5 – 45.7	1	45-Day	3
12/22/04	nd	nd	12.6	Fast	45.7 - 61	1	45-Day	3
12/22/04	nd	nd	13.3	Fast	61 –91.4	1	45-Day	3
12/22/04	4.410	2.35	17	Fast	0 – 7.6	1	45-Day	4
12/22/04	0.274	0.064	13.9	Fast	7.6 – 15.2	1	45-Day	4
12/22/04	0.030	0.039	13.8	Fast	15.2 – 30.5	1	45-Day	4
12/22/04	nd	nd	12.8	Fast	30.5 – 45.7	1	45-Day	4
12/22/04	nd	nd	15	Fast	45.7 - 61	1	45-Day	4
12/22/04	2.330	2.17	18.6	Slow	0 – 7.6	1	45-Day	1
12/22/04	1.380	1.72	10.1	Slow	7.6 – 15.2	1	45-Day	1
12/22/04	nd	nd	12	Slow	15.2 – 30.5	1	45-Day	1
12/22/04	nd	nd	11.3	Slow	30.5 – 45.7	1	45-Day	1
12/22/04	nd	nd	10.6	Slow	45.7 - 61	1	45-Day	1
12/22/04	nd	nd	10.5	Slow	61 –91.4	1	45-Day	1
12/22/04	2.620	1.18	21.3	Slow	0 – 7.6	1	45-Day	2
12/22/04	0.034	0.151	13.4	Slow	7.6 – 15.2	1	45-Day	2
12/22/04	0.100	0.033	10.6	Slow	15.2 – 30.5	1	45-Day	2
12/22/04	0.063	nd	11.6	Slow	30.5 – 45.7	1	45-Day	2
12/22/04	nd	nd	11.9	Slow	45.7 - 61	1	45-Day	2
12/22/04	1.810	1.55	19.5	Slow	0 – 7.6	1	45-Day	3
12/22/04	0.096	0.033	12.7	Slow	7.6 – 15.2	1	45-Day	3
12/22/04	0.109	0.138	11.3	Slow	15.2 – 30.5	1	45-Day	3
12/22/04	0.057	nd	13.1	Slow	30.5 – 45.7	1	45-Day	3

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
12/22/04	0.190	0.082	10.9	Slow	45.7 - 61	1	45-Day	3
12/22/04	2.030	1.49	23	Slow	0 – 7.6	1	45-Day	4
12/22/04	0.139	0.062	14.3	Slow	7.6 – 15.2	1	45-Day	4
12/22/04	0.027	nd	11.1	Slow	15.2 – 30.5	1	45-Day	4
12/22/04	0.037	nd	11.4	Slow	30.5 – 45.7	1	45-Day	4
12/22/04	nd	nd	12.5	Slow	45.7 - 61	1	45-Day	4
12/22/04	nd	nd	10.6	Slow	61 –91.4	1	45-Day	4
12/22/04	nd	nd	12.1	Slow	91.4 - 121.9	1	45-Day	4
1/31/05	0.743	0.528	22.3	Fast	0 – 7.6	2	45-Day	1
1/31/05	0.047	0.074	18.8	Fast	7.6 – 15.2	2	45-Day	1
1/31/05	nd	nd	17.1	Fast	15.2 – 30.5	2	45-Day	1
1/31/05	0.020	nd	16.7	Fast	30.5 – 45.7	2	45-Day	1
1/31/05	nd	nd	15.8	Fast	45.7 - 61	2	45-Day	1
1/31/05	nd	nd	15.4	Fast	61 –91.4	2	45-Day	1
1/31/05	nd	nd	11.6	Fast	91.4 - 121.9	2	45-Day	1
1/31/05	nd	nd	11.6	Fast	121.9 – 152.4	2	45-Day	1
1/31/05	0.826	1.647	20.7	Fast	0 – 7.6	2	45-Day	2
1/31/05	0.118	0.122	19.1	Fast	7.6 – 15.2	2	45-Day	2
1/31/05	0.017	nd	18.2	Fast	15.2 – 30.5	2	45-Day	2
1/31/05	nd	nd	18.8	Fast	30.5 – 45.7	2	45-Day	2
1/31/05	nd	nd	14	Fast	45.7 - 61	2	45-Day	2
1/31/05	nd	nd	15.6	Fast	61 –91.4	2	45-Day	2
1/31/05	0.579	0.372	20.3	Fast	0 – 7.6	2	45-Day	3
1/31/05	0.233	0.194	18.9	Fast	7.6 – 15.2	2	45-Day	3
1/31/05	0.083	0.022	15.8	Fast	15.2 – 30.5	2	45-Day	3
1/31/05	0.036	nd	17.8	Fast	30.5 – 45.7	2	45-Day	3
1/31/05	nd	nd	17.1	Fast	45.7 - 61	2	45-Day	3
1/31/05	nd	nd	14.4	Fast	61 –91.4	2	45-Day	3
1/31/05	nd	nd	12.7	Fast	91.4 - 121.9	2	45-Day	3
1/31/05	0.638	1.575	19.4	Fast	0 – 7.6	2	45-Day	4
1/31/05	0.034	0.016	21.2	Fast	7.6 – 15.2	2	45-Day	4
1/31/05	0.046	0.624	17.1	Fast	15.2 – 30.5	2	45-Day	4
1/31/05	nd	nd	12.4	Fast	30.5 – 45.7	2	45-Day	4
1/31/05	nd	nd	20.7	Fast	45.7 - 61	2	45-Day	4
1/31/05	nd	nd	19.9	Fast	61 –91.4	2	45-Day	4
1/31/05	0.881	0.714	12.3	Slow	0 – 7.6	2	45-Day	1
1/31/05	0.042	nd	18.1	Slow	7.6 – 15.2	2	45-Day	1
1/31/05	nd	nd	17.4	Slow	15.2 – 30.5	2	45-Day	1
1/31/05	0.028	0.047	17.5	Slow	30.5 – 45.7	2	45-Day	1
1/31/05	0.081	nd	18.6	Slow	45.7 - 61	2	45-Day	1
1/31/05	nd	nd	22.4	Slow	61 –91.4	2	45-Day	1
1/31/05	nd	nd	9.6	Slow	91.4 - 121.9	2	45-Day	1
1/31/05	nd	nd	12.9	Slow	121.9 – 152.4	2	45-Day	1
1/31/05	0.274	0.254	24	Slow	0 – 7.6	2	45-Day	2

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
1/31/05	0.024	0.017	16.9	Slow	7.6 – 15.2	2	45-Day	2
1/31/05	nd	nd	16.2	Slow	15.2 – 30.5	2	45-Day	2
1/31/05	nd	nd	19.6	Slow	30.5 – 45.7	2	45-Day	2
1/31/05	nd	nd	21.4	Slow	45.7 - 61	2	45-Day	2
1/31/05	nd	nd	11.4	Slow	61 –91.4	2	45-Day	2
1/31/05	nd	nd	12.9	Slow	91.4 - 121.9	2	45-Day	2
1/31/05	nd	nd	9.1	Slow	121.9 – 152.4	2	45-Day	2
1/31/05	0.131	0.099	14.7	Slow	0 – 7.6	2	45-Day	3
1/31/05	0.017	0.044	13.6	Slow	7.6 – 15.2	2	45-Day	3
1/31/05	nd	nd	13.8	Slow	15.2 – 30.5	2	45-Day	3
1/31/05	nd	nd	20.5	Slow	30.5 – 45.7	2	45-Day	3
1/31/05	nd	nd	16.6	Slow	45.7 - 61	2	45-Day	3
1/31/05	nd	nd	17.3	Slow	61 –91.4	2	45-Day	3
1/31/05	nd	nd	18.3	Slow	91.4 - 121.9	2	45-Day	3
1/31/05	nd	nd	16.7	Slow	121.9 – 152.4	2	45-Day	3
1/31/05	0.317	0.321	23.5	Slow	0 – 7.6	2	45-Day	4
1/31/05	0.029	0.03	17	Slow	7.6 – 15.2	2	45-Day	4
1/31/05	nd	nd	18	Slow	15.2 – 30.5	2	45-Day	4
1/31/05	nd	nd	18.5	Slow	30.5 – 45.7	2	45-Day	4
1/31/05	nd	nd	19.7	Slow	45.7 - 61	2	45-Day	4
1/31/05	nd	nd	18.5	Slow	61 –91.4	2	45-Day	4
1/31/05	nd	nd	17.7	Slow	91.4 - 121.9	2	45-Day	4
1/31/05	nd	nd	16.8	Slow	121.9 – 152.4	2	45-Day	4
2/14/05	0.116	0.027	19.1	Standard	0 – 7.6	1	90-Day	1
2/14/05	0.061	nd	14	Standard	7.6 – 15.2	1	90-Day	1
2/14/05	nd	nd	11.3	Standard	15.2 – 30.5	1	90-Day	1
2/14/05	nd	nd	12.6	Standard	30.5 – 45.7	1	90-Day	1
2/14/05	nd	nd	13.1	Standard	45.7 - 61	1	90-Day	1
2/14/05	0.065	0.076	19.2	Standard	0 – 7.6	1	90-Day	2
2/14/05	nd	nd	12.7	Standard	7.6 – 15.2	1	90-Day	2
2/14/05	nd	nd	11.1	Standard	15.2 – 30.5	1	90-Day	2
2/14/05	nd	nd	11.6	Standard	30.5 – 45.7	1	90-Day	2
2/14/05	nd	nd	11.7	Standard	45.7 - 61	1	90-Day	2
2/14/05	0.072	0.056	16.1	Standard	0 – 7.6	1	90-Day	3
2/14/05	0.015	nd	11.6	Standard	7.6 – 15.2	1	90-Day	3
2/14/05	nd	nd	10.4	Standard	15.2 – 30.5	1	90-Day	3
2/14/05	nd	nd	11.1	Standard	30.5 – 45.7	1	90-Day	3
2/14/05	nd	nd	11.5	Standard	45.7 - 61	1	90-Day	3
2/14/05	nd	nd	12.1	Standard	61 –91.4	1	90-Day	3
2/14/05	0.072	0.13	17.7	Standard	0 – 7.6	1	90-Day	4
2/14/05	0.032	0.015	11.8	Standard	7.6 – 15.2	1	90-Day	4
2/14/05	nd	nd	12	Standard	15.2 – 30.5	1	90-Day	4
2/14/05	nd	nd	11.2	Standard	30.5 – 45.7	1	90-Day	4
2/14/05	nd	nd	10.8	Standard	45.7 - 61	1	90-Day	4

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
2/14/05	0.175	0.434	18.2	Fast	0 – 7.6	1	90-Day	1
2/14/05	0.026	0.052	11.6	Fast	7.6 – 15.2	1	90-Day	1
2/14/05	nd	nd	12.3	Fast	15.2 – 30.5	1	90-Day	1
2/14/05	nd	nd	11.8	Fast	30.5 – 45.7	1	90-Day	1
2/14/05	nd	nd	12.5	Fast	45.7 - 61	1	90-Day	1
2/14/05	0.037	0.257	13.9	Fast	0 – 7.6	1	90-Day	2
2/14/05	0.049	0.02	11.1	Fast	7.6 – 15.2	1	90-Day	2
2/14/05	nd	nd	12.2	Fast	15.2 – 30.5	1	90-Day	2
2/14/05	nd	nd	12.8	Fast	30.5 – 45.7	1	90-Day	2
2/14/05	nd	nd	12.6	Fast	45.7 - 61	1	90-Day	2
2/14/05	0.063	0.162	12	Fast	0 – 7.6	1	90-Day	3
2/14/05	0.040	0.016	11.3	Fast	7.6 – 15.2	1	90-Day	3
2/14/05	0.032	nd	13	Fast	15.2 – 30.5	1	90-Day	3
2/14/05	nd	nd	12	Fast	30.5 – 45.7	1	90-Day	3
2/14/05	nd	nd	11.6	Fast	45.7 - 61	1	90-Day	3
2/14/05	nd	nd	12.7	Fast	61 –76.2	1	90-Day	3
2/14/05	0.042	0.362	22	Fast	0 – 7.6	1	90-Day	4
2/14/05	nd	nd	13.2	Fast	7.6 – 15.2	1	90-Day	4
2/14/05	nd	nd	12.7	Fast	15.2 – 30.5	1	90-Day	4
2/14/05	nd	nd	12.3	Fast	30.5 – 45.7	1	90-Day	4
2/14/05	nd	nd	13.1	Fast	45.7 - 61	1	90-Day	4
2/14/05	nd	nd	12.5	Fast	61 –76.2	1	90-Day	4
2/14/05	0.044	0.347	25.3	Slow	0 – 7.6	1	90-Day	1
2/14/05	0.017	nd	12.9	Slow	7.6 – 15.2	1	90-Day	1
2/14/05	0.018	nd	11.8	Slow	15.2 – 30.5	1	90-Day	1
2/14/05	nd	nd	11.6	Slow	30.5 – 45.7	1	90-Day	1
2/14/05	nd	nd	11	Slow	45.7 - 61	1	90-Day	1
2/14/05	nd	nd	13.3	Slow	61 –76.2	1	90-Day	1
2/14/05	0.121	0.181	15.5	Slow	0 – 7.6	1	90-Day	2
2/14/05	0.035	nd	10.8	Slow	7.6 – 15.2	1	90-Day	2
2/14/05	0.051	0.033	11.4	Slow	15.2 – 30.5	1	90-Day	2
2/14/05	0.031	nd	11.6	Slow	30.5 – 45.7	1	90-Day	2
2/14/05	nd	nd	10.9	Slow	45.7 - 61	1	90-Day	2
2/14/05	nd	nd	12	Slow	61 –91.4	1	90-Day	2
2/14/05	0.179	0.286	16.4	Slow	0 – 7.6	1	90-Day	3
2/14/05	0.194	0.106	10.4	Slow	7.6 – 15.2	1	90-Day	3
2/14/05	0.119	0.016	10	Slow	15.2 – 30.5	1	90-Day	3
2/14/05	0.075	nd	10.8	Slow	30.5 – 45.7	1	90-Day	3
2/14/05	nd	nd	11.3	Slow	45.7 - 61	1	90-Day	3
2/14/05	0.242	0.35	20.5	Slow	0 – 7.6	1	90-Day	4
2/14/05	nd	0.02	12.5	Slow	7.6 – 15.2	1	90-Day	4
2/14/05	nd	nd	11.5	Slow	15.2 – 30.5	1	90-Day	4
2/14/05	nd	nd	11.3	Slow	30.5 – 45.7	1	90-Day	4
2/14/05	nd	nd	12.6	Slow	45.7 - 61	1	90-Day	4

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
3/2/05	0.242	0.588	19.4	Fast	0 – 7.6	2	90-Day	1
3/2/05	0.041	0.119	17.5	Fast	7.6 – 15.2	2	90-Day	1
3/2/05	nd	nd	15.2	Fast	15.2 – 30.5	2	90-Day	1
3/2/05	nd	nd	18.1	Fast	30.5 – 45.7	2	90-Day	1
3/2/05	nd	nd	17.9	Fast	45.7 - 61	2	90-Day	1
3/2/05	nd	nd	15.3	Fast	61 –91.4	2	90-Day	1
3/2/05	nd	nd	19.9	Fast	91.4 - 121.9	2	90-Day	1
3/2/05	0.123	0.296	19.2	Fast	0 – 7.6	2	90-Day	2
3/2/05	0.031	0.027	16.9	Fast	7.6 – 15.2	2	90-Day	2
3/2/05	nd	nd	17.7	Fast	15.2 – 30.5	2	90-Day	2
3/2/05	nd	nd	17.3	Fast	30.5 – 45.7	2	90-Day	2
3/2/05	nd	nd	17.6	Fast	45.7 - 61	2	90-Day	2
3/2/05	nd	nd	16.9	Fast	61 –91.4	2	90-Day	2
3/2/05	nd	nd	17	Fast	91.4 - 121.9	2	90-Day	2
3/2/05	0.629	0.763	19.4	Fast	0 – 7.6	2	90-Day	3
3/2/05	0.024	0.039	16.3	Fast	7.6 – 15.2	2	90-Day	3
3/2/05	nd	nd	16.8	Fast	15.2 – 30.5	2	90-Day	3
3/2/05	nd	nd	15.1	Fast	30.5 – 45.7	2	90-Day	3
3/2/05	nd	nd	14.4	Fast	45.7 - 61	2	90-Day	3
3/2/05	nd	nd	11.9	Fast	61 –91.4	2	90-Day	3
3/2/05	nd	nd	10.8	Fast	91.4 - 121.9	2	90-Day	3
3/2/05	0.126	0.517	15.7	Fast	0 – 7.6	2	90-Day	4
3/2/05	0.019	0.117	16.8	Fast	7.6 – 15.2	2	90-Day	4
3/2/05	nd	nd	18	Fast	15.2 – 30.5	2	90-Day	4
3/2/05	nd	nd	18.2	Fast	30.5 – 45.7	2	90-Day	4
3/2/05	nd	nd	17.5	Fast	45.7 - 61	2	90-Day	4
3/2/05	nd	nd	16.2	Fast	61 –91.4	2	90-Day	4
3/2/05	nd	nd	21.2	Fast	91.4 - 121.9	2	90-Day	4
3/2/05	0.352	0.447	17.1	Slow	0 – 7.6	2	90-Day	1
3/2/05	nd	nd	16.1	Slow	7.6 – 15.2	2	90-Day	1
3/2/05	nd	nd	17.2	Slow	15.2 – 30.5	2	90-Day	1
3/2/05	nd	nd	20	Slow	30.5 – 45.7	2	90-Day	1
3/2/05	nd	nd	18.4	Slow	45.7 - 61	2	90-Day	1
3/2/05	nd	nd	21.4	Slow	61 –91.4	2	90-Day	1
3/2/05	nd	nd	18.7	Slow	91.4 - 121.9	2	90-Day	1
3/2/05	0.496	0.349	14.7	Slow	0 – 7.6	2	90-Day	2
3/2/05	nd	0.015	13.3	Slow	7.6 – 15.2	2	90-Day	2
3/2/05	nd	nd	14.7	Slow	15.2 – 30.5	2	90-Day	2
3/2/05	nd	nd	16.4	Slow	30.5 – 45.7	2	90-Day	2
3/2/05	nd	nd	17.6	Slow	45.7 - 61	2	90-Day	2
3/2/05	nd	nd	19.7	Slow	61 –91.4	2	90-Day	2
3/2/05	nd	nd	20.2	Slow	91.4 - 121.9	2	90-Day	2
3/2/05	0.492	0.801	18	Slow	0 – 7.6	2	90-Day	3
3/2/05	0.026	0.044	16.6	Slow	7.6 – 15.2	2	90-Day	3

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
3/2/05	nd	nd	16.4	Slow	15.2 – 30.5	2	90-Day	3
3/2/05	nd	nd	17.3	Slow	30.5 – 45.7	2	90-Day	3
3/2/05	nd	nd	18.7	Slow	45.7 - 61	2	90-Day	3
3/2/05	nd	nd	13.7	Slow	61 –91.4	2	90-Day	3
3/2/05	nd	nd	13.8	Slow	91.4 - 121.9	2	90-Day	3
3/2/05	0.092	0.125	18.8	Slow	0 – 7.6	2	90-Day	4
3/2/05	nd	nd	16.9	Slow	7.6 – 15.2	2	90-Day	4
3/2/05	nd	nd	15.1	Slow	15.2 – 30.5	2	90-Day	4
3/2/05	nd	nd	15.3	Slow	30.5 – 45.7	2	90-Day	4
3/2/05	nd	nd	14.8	Slow	45.7 - 61	2	90-Day	4
3/2/05	nd	nd	18	Slow	61 –91.4	2	90-Day	4
3/14/05	0.032	0.086	16.7	Standard	0 – 7.6	1	120-Day	1
3/14/05	nd	nd	N/A	Standard	7.6 – 15.2	1	120-Day	1
3/14/05	nd	nd	N/A	Standard	15.2 – 30.5	1	120-Day	1
3/14/05	nd	nd	N/A	Standard	30.5 – 45.7	1	120-Day	1
3/14/05	0.077	0.089	16.1	Standard	0 – 7.6	1	120-Day	2
3/14/05	0.028	nd	11.7	Standard	7.6 – 15.2	1	120-Day	2
3/14/05	0.027	nd	11.9	Standard	15.2 – 30.5	1	120-Day	2
3/14/05	nd	nd	N/A	Standard	30.5 – 45.7	1	120-Day	2
3/14/05	nd	nd	N/A	Standard	45.7 - 61	1	120-Day	2
3/14/05	0.032	0.066	24.2	Standard	0 – 7.6	1	120-Day	3
3/14/05	0.015	nd	13.5	Standard	7.6 – 15.2	1	120-Day	3
3/14/05	nd	nd	N/A	Standard	15.2 – 30.5	1	120-Day	3
3/14/05	nd	nd	N/A	Standard	30.5 – 45.7	1	120-Day	3
3/14/05	nd	nd	N/A	Standard	45.7 - 61	1	120-Day	3
3/14/05	nd	0.068	22.7	Standard	0 – 7.6	1	120-Day	4
3/14/05	nd	nd	N/A	Standard	7.6 – 15.2	1	120-Day	4
3/14/05	nd	nd	N/A	Standard	15.2 – 30.5	1	120-Day	4
3/14/05	nd	nd	N/A	Standard	30.5 – 45.7	1	120-Day	4
3/14/05	nd	nd	N/A	Standard	45.7 - 61	1	120-Day	4
3/14/05	0.018	0.504	26.5	Fast	0 – 7.6	1	120-Day	1
3/14/05	0.016	0.017	13.3	Fast	7.6 – 15.2	1	120-Day	1
3/14/05	nd	0.017	13.5	Fast	15.2 – 30.5	1	120-Day	1
3/14/05	nd	nd	N/A	Fast	30.5 – 45.7	1	120-Day	1
3/14/05	nd	nd	N/A	Fast	45.7 - 61	1	120-Day	1
3/14/05	nd	0.068	13.5	Fast	0 – 7.6	1	120-Day	2
3/14/05	nd	0.023	10.8	Fast	7.6 – 15.2	1	120-Day	2
3/14/05	nd	nd	N/A	Fast	15.2 – 30.5	1	120-Day	2
3/14/05	nd	nd	N/A	Fast	30.5 – 45.7	1	120-Day	2
3/14/05	nd	nd	N/A	Fast	45.7 - 61	1	120-Day	2
3/14/05	0.107	0.324	17.7	Fast	0 – 7.6	1	120-Day	3
3/14/05	nd	0.032	10.1	Fast	7.6 – 15.2	1	120-Day	3
3/14/05	nd	nd	N/A	Fast	15.2 – 30.5	1	120-Day	3
3/14/05	nd	nd	N/A	Fast	30.5 – 45.7	1	120-Day	3

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
3/14/05	nd	nd	N/A	Fast	45.7 - 61	1	120-Day	3
3/14/05	nd	0.082	12.7	Fast	0 – 7.6	1	120-Day	4
3/14/05	nd	0.032	11.3	Fast	7.6 – 15.2	1	120-Day	4
3/14/05	nd	nd	N/A	Fast	15.2 – 30.5	1	120-Day	4
3/14/05	nd	nd	N/A	Fast	30.5 – 45.7	1	120-Day	4
3/14/05	nd	nd	N/A	Fast	45.7 - 61	1	120-Day	4
3/14/05	nd	0.124	22	Slow	0 – 7.6	1	120-Day	1
3/14/05	nd	0.032	13.1	Slow	7.6 – 15.2	1	120-Day	1
3/14/05	nd	0.022	12.3	Slow	15.2 – 30.5	1	120-Day	1
3/14/05	nd	nd	N/A	Slow	30.5 – 45.7	1	120-Day	1
3/14/05	nd	nd	N/A	Slow	45.7 - 61	1	120-Day	1
3/14/05	0.026	0.48	22.4	Slow	0 – 7.6	1	120-Day	2
3/14/05	nd	nd	N/A	Slow	7.6 – 15.2	1	120-Day	2
3/14/05	nd	nd	N/A	Slow	15.2 – 30.5	1	120-Day	2
3/14/05	nd	0.018	11.8	Slow	30.5 – 45.7	1	120-Day	2
3/14/05	nd	nd	N/A	Slow	45.7 - 61	1	120-Day	2
3/14/05	0.199	0.31	26	Slow	0 – 7.6	1	120-Day	3
3/14/05	0.057	0.051	13.5	Slow	7.6 – 15.2	1	120-Day	3
3/14/05	0.019	0.019	11.4	Slow	15.2 – 30.5	1	120-Day	3
3/14/05	0.08	nd	11.5	Slow	30.5 – 45.7	1	120-Day	3
3/14/05	nd	nd	N/A	Slow	45.7 - 61	1	120-Day	3
3/14/05	nd	nd	N/A	Slow	61 –91.4	1	120-Day	3
3/14/05	nd	0.074	16.1	Slow	0 – 7.6	1	120-Day	4
3/14/05	nd	nd	N/A	Slow	7.6 – 15.2	1	120-Day	4
3/14/05	nd	nd	N/A	Slow	15.2 – 30.5	1	120-Day	4
3/14/05	nd	nd	N/A	Slow	30.5 – 45.7	1	120-Day	4
3/14/05	nd	nd	N/A	Slow	45.7 - 61	1	120-Day	4
4/6/2005	0.19	0.303	18.8	Fast	0 – 7.6	2	120-Day	1
4/6/2005	0.017	0.041	15.9	Fast	7.6 – 15.2	2	120-Day	1
4/6/2005	0.02	0.016	15.4	Fast	15.2 – 30.5	2	120-Day	1
4/6/2005	nd	nd	N/A	Fast	30.5 – 45.7	2	120-Day	1
4/6/2005	nd	nd	N/A	Fast	45.7 - 61	2	120-Day	1
4/6/2005	nd	nd	N/A	Fast	61 –91.4	2	120-Day	1
4/6/2005	nd	nd	N/A	Fast	91.4 - 121.9	2	120-Day	1
4/6/2005	0.501	0.391	19.6	Fast	0 – 7.6	2	120-Day	2
4/6/2005	0.045	0.067	17.2	Fast	7.6 – 15.2	2	120-Day	2
4/6/2005	0.016	0.029	16.8	Fast	15.2 – 30.5	2	120-Day	2
4/6/2005	nd	nd	N/A	Fast	30.5 – 45.7	2	120-Day	2
4/6/2005	nd	nd	N/A	Fast	45.7 - 61	2	120-Day	2
4/6/2005	nd	nd	N/A	Fast	61 –91.4	2	120-Day	2
4/6/2005	nd	nd	N/A	Fast	91.4 - 121.9	2	120-Day	2
4/6/2005	nd	nd	N/A	Fast	121.9 – 152.4	2	120-Day	2
4/6/2005	0.394	0.222	18.3	Fast	0 – 7.6	2	120-Day	3
4/6/2005	nd	nd	N/A	Fast	7.6 – 15.2	2	120-Day	3

Date Collected	Simazine (ppm)	Diuron (ppm)	% Moisture	Treatment	Depth (cm)	Site	Days After Application	Replicate
4/6/2005	nd	nd	N/A	Fast	15.2 – 30.5	2	120-Day	3
4/6/2005	nd	nd	N/A	Fast	30.5 – 45.7	2	120-Day	3
4/6/2005	nd	nd	N/A	Fast	45.7 - 61	2	120-Day	3
4/6/2005	nd	nd	N/A	Fast	61 –91.4	2	120-Day	3
4/6/2005	nd	nd	N/A	Fast	91.4 - 121.9	2	120-Day	3
4/6/2005	0.341	0.479	18	Fast	0 – 7.6	2	120-Day	4
4/6/2005	nd	nd	N/A	Fast	7.6 – 15.2	2	120-Day	4
4/6/2005	nd	nd	N/A	Fast	15.2 – 30.5	2	120-Day	4
4/6/2005	nd	nd	N/A	Fast	30.5 – 45.7	2	120-Day	4
4/6/2005	nd	nd	N/A	Fast	45.7 - 61	2	120-Day	4
4/6/2005	nd	nd	N/A	Fast	61 –91.4	2	120-Day	4
4/6/2005	nd	nd	N/A	Fast	91.4 - 121.9	2	120-Day	4
4/6/2005	nd	nd	N/A	Fast	121.9 – 152.4	2	120-Day	4
4/6/2005	0.074	0.184	18.4	Slow	0 – 7.6	2	120-Day	1
4/6/2005	nd	nd	N/A	Slow	7.6 – 15.2	2	120-Day	1
4/6/2005	nd	nd	N/A	Slow	15.2 – 30.5	2	120-Day	1
4/6/2005	nd	nd	N/A	Slow	30.5 – 45.7	2	120-Day	1
4/6/2005	nd	nd	N/A	Slow	45.7 - 61	2	120-Day	1
4/6/2005	nd	nd	N/A	Slow	61 –91.4	2	120-Day	1
4/6/2005	nd	nd	N/A	Slow	91.4 - 121.9	2	120-Day	1
4/6/2005	nd	nd	N/A	Slow	121.9 – 152.4	2	120-Day	1
4/6/2005	0.426	0.428	15.1	Slow	0 – 7.6	2	120-Day	2
4/6/2005	nd	0.029	14.8	Slow	7.6 – 15.2	2	120-Day	2
4/6/2005	nd	nd	N/A	Slow	15.2 – 30.5	2	120-Day	2
4/6/2005	nd	nd	N/A	Slow	30.5 – 45.7	2	120-Day	2
4/6/2005	nd	nd	N/A	Slow	45.7 - 61	2	120-Day	2
4/6/2005	nd	nd	N/A	Slow	61 –91.4	2	120-Day	2
4/6/2005	nd	nd	N/A	Slow	91.4 - 121.9	2	120-Day	2
4/6/2005	nd	nd	N/A	Slow	121.9 – 152.4	2	120-Day	2
4/6/2005	0.213	0.227	18.3	Slow	0 – 7.6	2	120-Day	3
4/6/2005	nd	nd	N/A	Slow	7.6 – 15.2	2	120-Day	3
4/6/2005	nd	nd	N/A	Slow	15.2 – 30.5	2	120-Day	3
4/6/2005	nd	nd	N/A	Slow	30.5 – 45.7	2	120-Day	3
4/6/2005	nd	nd	N/A	Slow	45.7 - 61	2	120-Day	3
4/6/2005	0.451	0.691	18.6	Slow	0 – 7.6	2	120-Day	4
4/6/2005	0.015	0.029	19.5	Slow	7.6 – 15.2	2	120-Day	4
4/6/2005	nd	0.031	20.7	Slow	15.2 – 30.5	2	120-Day	4
4/6/2005	nd	0.024	21.6	Slow	30.5 – 45.7	2	120-Day	4
4/6/2005	nd	nd	N/A	Slow	45.7 - 61	2	120-Day	4
4/6/2005	nd	nd	N/A	Slow	61 –91.4	2	120-Day	4
4/6/2005	nd	nd	N/A	Slow	91.4 - 121.9	2	120-Day	4
4/6/2005	nd	nd	N/A	Slow	121.9 – 152.4	2	120-Day	4

nd = not detected
N/A = not available