Idaho State Department of Agriculture
Surface Water Quality Program

Evaluation of Pesticide Residues Within Weiser Flat Weiser, Idaho

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ISDA Technical Report Summary W-20 December, 2007

Introduction

The Idaho State Department of Agriculture (ISDA), with discretionary funding provided by the U.S. Environmental Protection Agency (EPA) Region X, conducted a surface water quality monitoring program for pesticide residues within the Weiser Flat area, Idaho (Figure 1). Monitoring was conducted on a bi-weekly schedule from April 3 through August 28, 2007. Four Creeks and one major irrigation return drain were evaluated during this program (Figure 1).

The four creeks; Hog Creek (HC-1), Warm Springs Creek (WS-1), Scott Creek (SC-1), and Jenkins Creek (JC-1) are currently listed on the State of Idaho's 303(d) list for impaired water bodies. A total maximum daily load (TMDL) was approved for these creeks by EPA in August of 2003. All four creeks were listed for impairment caused by nutrients, sediment, and bacteria.

The four creeks along with a major irrigation return drain (BD-1) make up the majority of drainages within Weiser Flat. The four creeks generally experience periods of high flow correlated with spring runoff, followed by a decrease in flow until irrigation return waters augment the summer discharge. Weiser Flat is dominated by surface irrigated agricultural activities and these irrigation return flows are what were targeted for this pesticide residue evaluation. Agricultural acreage within Weiser Flat consists of 10,307 acres (IASCD, 2004) and is primarily surface irrigated cropland (Table 1).

Table 1. Weiser Flat Watershed Agricultural Acreage.

Activity/Acres	Hog Creek	Warm Springs Creek	Scott Creek	Jenkins Creek
Surface irrigated	165.4	539.3	2068.9	1306.6
Irrigated pasture	6.7	49.5	49.5	66.2
Sprinkler irrigated	0	115.8	119	383.4
Total agricultural acres	172.1	704.6	2237.4	1756.2

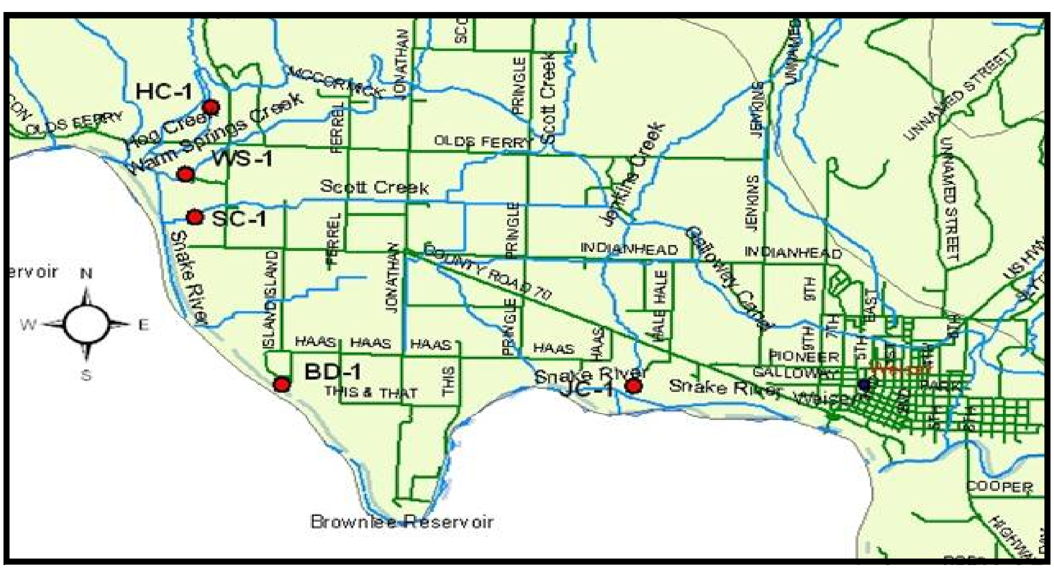

Figure 1. Weiser Flat monitoring sites

Analytical Methods and Quality Assurance

All analytical testing for this study were completed by the University of Idaho Analytical Science Laboratory (ASL) Moscow, Idaho. ASL follows strict quality control guidelines that require the extraction and analysis of samples be accompanied by laboratory fortified blanks, laboratory reagent blanks, laboratory fortified sample matrix (matrix spikes) quality control samples, and performance check solutions to evaluate and document data quality. Analytical methods and techniques used for this study consisted of the following: EPA method 507 modified, EPA 632 modified, EPA 508 modified, and EPA 515.2.

During this study, all analytes spikes and surrogate standard recoveries were within acceptable ranges (70-120%) indicating that pesticide residues were accurately recovered. All field blanks submitted during this study resulted in non detectable results indicating both field and laboratory activities were free from contamination. Relative percent difference (RPD) calculated on duplicate samples submitted to ASL had an overall mean of 11%, and a median of 9%.

Sampling Methods

All of the creeks and the irrigation return drain within Weiser Flat are incised, shallow, relatively narrow, and have a low cubic feet per second (CFS) discharge rate. The average CFS for each site is as follows: JC-1 (7.39 cfs), BD-1 (3.54 cfs), SC-1 (9.3 cfs), WS-1 (5.9 cfs), and HC-1 (4.98 cfs).

Due to the small size of these creeks and the low discharge rate, all samples were collected by hand directly from a well mixed section of each reach. Three laboratory cleaned, one-liter glass amber sample bottles were collected at each site. Each bottle was slowly lowered through the water column until filled, avoiding contact with the creek bottom.

Duplicate samples were collected by compositing creek water into a clean 2.5 gallon glass carboy. The resultant composite was then mixed and carefully poured off into 6 one-liter amber bottles. Cleaning of the carboy between sampling events consisted of a thorough washing with deionized water and Liqui-Nox detergent, followed by a deionized water rinse, acetone rinse, and a final deionized rinse. Field bottle blanks were collected by transferring deionized water directly from a Nalgene carboy into three clean one-liter amber bottles. All blanks and duplicates were submitted to the lab as blind samples.

All of the resultant samples from each study were placed within a cooler, on ice, for shipment directly to the University of Idaho ASL in Moscow, Idaho. All samples were shipped priority overnight and Chain-of-Custody forms accompanied each sample set.

Overall Evaluation

Over the five month study period a total of 19 separate pesticides were identified (Table 2). Numerous detections of the these 19 pesticides were detected throughout the study period within each creek and the irrigation return drain.

The following overall results section lists the pesticides detected, the highest concentration detected, and various aquatic life bench marks or risk quotients (RQ) that have been established by the EPA for pesticides (EPA, 2007). In order to better understand the criteria the following classifications describe how RQ and aquatic benchmarks were established.

Table 2. Detected pesticides within Weiser Flat.

Detected Pesticides	Type of Pesticide	Trade Name
Atrazine	Herbicide	Aatrex
Desethyhl Atrazine	metabolite of atrazine	NA
Pendimethalin	Herbicide	Prowl
Bromoxynil	Herbicide	Buctril
MCPA	Herbicide	Banlene
Diuron	Herbicide	Karmex
Chlorpyrifos	Insecticide	Dursban
Methyl Parathion	Insecticide	Declare
Methomyl	Insecticide	Lannate
2,4-D	Herbicide	Weedar 64
Oxyfluorfen	Herbicide	Goal
Hexazinone	Herbicide	Velpar
Dicamba	Herbicide	Banvel
Carbofuran	Insecticide	Furaden
Malathion	Insecticide	Cythion
Metolachlor	Herbicide	Dual
Dimethoate	Insecticide	Cygon
Bentazon	Herbicide	Basagran
Metalaxy	Fungicide	Subdue

Acute Fish — Toxicity value x level of concern (LOC). Value is generally the lowest 96-hour LC50 in a standardized test (usually with rainbow trout, fathead minnows, or blue gill). The LOC is 0.5. The 96-hour LC50 refers to the level of pesticide exposure that is lethal to 50% of the population over a 96 hour period.
Acute Risk Quotients in fish = Peak water concentration / most sensitive organism LC50 or effective concentration (EC50) = risk quotient (RQ) (EPA 2006).

Chronic Fish **—** Toxicity value x LOC. Toxicity value is usually the lowest no-observed-adverse-effects concentration (NOEAC) from a life-cycle or early life test. Same species as for acute fish. The LOC is 1.

Chronic Risk Quotients in fish = 56-day or 60-day average water concentration / Fish early life-stage or full life cycle toxicity no-observed-effects concentration (NOEC).

Acute Invertebrate — Toxicity value x LOC. Toxicity value is usually the lowest 48 or 96 hour EC50 (50% effect concentration) or LC50 (50% lethal concentration) usually with midges, scud, or daphnids. The LOC is 0.5.
Acute Risk Quotients in invertebrates = Peak water concentration / most sensitive organism LC50 or EC50 = risk quotient (RQ).

Chronic Invertebrate — Toxicity value x LOC. Toxicity value is usually the lowest NOEC from a life-cycle or early life test. Same species as for acute invertebrate. The LOC is 1.
Chronic Risk Quotients in invertebrates = 21-day average water concentration / Aquatic invertebrate chronic toxicity NOEC = RQ.

The LOC set by the EPA are presented in Table 3 and are used to assess the potential risk of a pesticide to non-target organisms.

Table 3. Risk quotient criteria for direct and indirect effects on threatened and endangered fish.

Test Data	Risk Quotient	Presumptions
Acute LC50	>0.5	Potentially high acute risk
Acute LC50	>0.1	Risk that may be mitigated through restricted use classifications
Acute LC50	>0.05	Endangered species may be affected acutely, including sub-lethal effects
Chronic NOEC	>1	Chronic risk; endangered species may be affected chronically, including reproduction and effects on progeny.
Acute invertebrate LC50	>0.5	May be indirect effects on threatened and endangered fish through food supply reduction

(Turner, 2003)

Overall Results

Jenkins Creek (JC-1)

Jenkins Creek watershed encompasses approximately 22, 867 acres. It is a third order moderately sinuous stream originating at approximately 3,500 feet elevation, south of the Hitt Mountains. The main stem of Jenkins Creek is 13 miles in length with an additional 9.7 miles of mostly seasonal tributaries (IDEQ, 2003). The agricultural area encompassed by this study consists of approximately 5.6 river miles and 1,756.2 of agricultural acres (Koberg 2004).

There were a total of 38 detections of pesticides from the Jenkins Creek watershed. Chlorpyrifos exceeded the acute and chronic level for invertebrates while Methomyl exceeded the invertebrate chronic level (Table 4).

Table 4. JC-1 pesticide detections.

JC-1	Number of	Maximum Detection	Fisheries ug/L		Invertebrates ug/L	
Detected Pesticide	Detections	ug/L	Acute	Chronic	Acute	Chronic
Atrazine	4	0.035	2650	62	360	62
Desethyl Atrazine	4	0.095	5300	65	ND[1]	ND
Bromoxynil	3	0.61	11.5	9	5.5	2.5
Chlorpyrifos	6	0.068	0.9	0.57	0.05	0.04
Diuron	3	0.17	355	26	80	160
MCPA	1	0.85	380	12000	90	11000
Methomyl	3	2.3	265	57	4.4	0.4
Methyl Parathion	3	0.9	500	80	0.07	0.02
Oxyfluorfen	2	0.075	100	38	40	13
Pendimethalin	8	1.1	69	6.3	140	14.5
2,4-D	1	0.79	50500	14200	12500	16400

ND = No data

Boat Dock Road Drain (BD-1)

BD-1 is a small drain that parallels Boat Dock Road prior to discharging into the Snake River. The acreage that it drains is unknown at this time. BD-1 average CFS (3.54 cfs) is slightly lower than Hog Creek (4.98) so it is assumed, for this report, that BD-1 drains somewhat less acreage than Hog Creek (172.1). Although its CFS is lower than Hog Creek, BD-1 had a total of 36 pesticide detection during this study. BD-1 exceeded chronic invertebrate for Chlorpyrifos, exceeded acute and chronic invertebrate for Malathion, and exceeded invertebrate chronic for Methyl Parathion.

Table 5. BD-1 pesticide detections.

BD-1	Number of	Maximum Detection	Fisheries ug/L		Invertebrates ug/L	
Detected Pesticide	Detections	ug/L	Acute	Chronic	Acute	Chronic
Dicamba	4	0.37	14000	ND	17,300	ND
Hexazinone	1	0.19	180000	17000	151600	20000
Bromoxynil	2	1.6	11.5	9	5.5	2.5
Chlorpyrifos	1	0.043	0.9	0.57	0.05	0.04
Diuron	7	0.3	355	26	80	160
MCPA	1	0.29	380	12000	90	11000
Methyl Parathion	1	0.052	500	80	0.07	0.02
Pendimethalin	8	0.83	69	6.3	140	14.5
Methomyl	3	0.15	265	57	4.4	0.4
Dimethoate	1	0.12	3000	430	21.5	40
2,4-D	3	1.4	50500	14200	12500	16400
Alachlor	1	0.078	900	187	1600	110
Carbofuran	1	0.1	44	5.7	1.115	0.75
Malathion	1	1.2	2	4	0.25	0.06
Metolachlor	1	0.13	1950	780	25100	ND

Scott Creek (SC-1)

Scott Creek is a second order intermittent stream originating at 4,590 feet elevation from the southern end of the Hitt Mountains. The main stem of SC-1 is 15.6 miles in length and there are an additional 14.4 miles of mostly seasonal tributaries. Portions of upper Scott Creek are intermittent (IDEQ, 2003). The lower portion of SC-1 that is considered agriculture consists of 7.2 stream miles and 2,237.4 total agricultural acres (Koberg, 2004). Scott Creek had a total of 43 pesticide detections. Chlorpyrifos exceeded chronic for invertebrates, Methyl Parathion exceeded both chronic and acute invertebrates, and Methomyl exceeded chronic invertebrates (Table 6).

Table 6. SC-1 pesticide detections.

SC-1	Number of	Maximum Detection	Fisheries ug/L		Invertebrates ug/L	
Detected Pesticide	Detections	ug/L	Acute	Chronic	Acute	Chronic
Diuron	5	0.24	355	26	80	160
Chlorpyrifos	4	0.049	0.9	0.57	0.05	0.04
Metolachlor	7	1.00	1950	780	25100	ND
Pendimethalin	9	0.53	69	6.3	140	14.5
Bromoxynil	2	0.47	11.5	9	5.5	2.5
2,4-D	5	1.4	50500	14200	12500	16400
Carbofuran	1	0.15	44	5.7	1.115	0.75
Oxyfluorfen	3	0.12	100	38	40	13
Methyl Parathion	1	0.096	500	80	0.07	0.02
Dicamba	2	0.2	14000	ND	17000	ND
Methomyl	3	2.5	265	57	4.4	0.4
Bentazon	1	0.25	50000	ND	50000	ND

Warm Springs (WS-1)

Warm Springs is a third order, moderately sinuous stream originating at 3,900 feet elevation, south of the Hitt Mountains. The main stem of Warm Springs is 12.6 miles in length and there are an additional 25.1 miles of mostly seasonal tributaries (IDEQ, 2003). The total length of the stream within the Weiser Flat agricultural area is 3.8 miles. The Warm Springs watershed contains 704.6 acres of agricultural land (Koberg, 2004). WS-1 had Chlorpyrifos exceeding acute levels for invertebrates while Methomyl and Methyl Parathion exceeded the acute and chronic levels for invertebrates (Table 7).

Table 7. WS-1 pesticide detections.

WS-1	Number of	Maximum Detection	Fisheries ug/L		Invertebrates ug/L	
Detected Pesticide	Detections	ug/L	Acute	Chronic	Acute	Chronic
Desethyl Atrazine	1	0.032	5300	65	ND	ND
Diuron	3	0.052	355	26	80	160
Chlorpyrifos	3	0.049	0.9	0.57	0.05	0.04
Metolachlor	9	2.6	1950	780	25100	ND
Pendimethalin	10	0.34	69	6.3	140	14.5
2,4-D	5	1.3	50500	14200	12500	16400
Bromoxynil	3	0.61	11.5	9	5.5	2.5
MCPA	1	0.35	380	12000	90	11000
Oxyfluorfen	5	0.45	100	38	40	13
Dicamba	2	0.3	14000	ND	17000	ND
Methomyl	5	5.7	265	57	4.4	0.4
Metalaxy	1	0.089	100000	ND	ND	ND
Methyl Parathion	1	0.4	500	80	0.07	0.02
Dimethoate	1	0.13	3000	430	21.5	40

Hog Creek (HC-1)

Hog Creek has the shortest amount of stream miles within the study area (2.1 miles) and has 172 agricultural acreage (Koberg, 2004). Hog Creek originates from springs in the Henley Basin at about 3,500 feet elevation. The main stem is 9.9 miles in length and there are an additional 27.5 miles of mostly seasonal tributaries (IDEQ, 2003). During irrigation season, the Galloway canal discharges into Hog Creek and supplies all of the water within the creek. With the exception of shallow ground water recharge, Hog Creek would be dry during irrigation season if not for Galloway Canal water. In addition, two large holding ponds constructed on the west edge of Hog Creek now control the flow rates within the creek. When irrigation water from these ponds are diverted through various conveyances for irrigation, Hog Creek's flow varies greatly.

Hog Creek had no criteria exceedances during this study (Table 8). This could be partially due to the new sediment ponds and the settling out of suspended sediment which could be transporting pesticide residues. In addition, ISDA could not gain access to property lower in the watershed that would have encompassed more agricultural acreage. The established monitoring station only encompassed approximately .41 miles of Hog Creek below Galloway Canal.

Table 8. HC-1 pesticide detections.

HC-1	Number of	Maximum Detection	sheries ug/L		Invertebrates ug/L	
Detected Pesticide	Detections	ug/L	Acute	Chronic	Acute	Chronic
Pendimethalin	6	0.081	69	6.3	140	14.5
Bromoxynil	2	0.15	11.5	9	5.5	2.5
MCPA	1	0.35	380	12000	90	11000
2,4-D	3	1.6	50500	14200	12500	16400
Dicamba	3	0.53	14000	ND	17000	ND
Chlorpyrifos	1	0.036	0.9	0.57	0.05	0.04
Methomyl	3	0.14	265	57	4.4	0.4
Atrazine	1	0.032	2650	65	360	62
Desethyl Atrazine	1	0.052	5300	65	ND	ND

Observations/Conclusions

The results of this study indicate that insecticides were the primary pesticide that at times exceeded one time acute or chronic benchmarks. The four insecticides detected have a much lower established aquatic life benchmark or risk quotients than most herbicides.

Chlorpyrifos is considered very highly toxic to fish and aquatic invertebrates. It is not readily water soluble and adsorbs strongly to soils. Its half life ranges from 60 to 120 days (Extoxnet, 1998).

Methyl parathion is considered moderately toxic to fish and highly toxic to aquatic invertebrates. It has low persistence in the soil environment and degrades rapidly in water. A representative half-life value for methyl parathion is five days (Extoxnet, 1998).

Methomyl is rated as moderately to highly toxic to fish and highly toxic to aquatic invertebrates. Methomyl has a high solubility in water and low soil bonding affinity. It has an estimated half-life in water of six days (Extoxnet, 1998).

Malathion has a high range of toxicity to fish ranging from highly to moderately toxic. Malathion is highly toxic to aquatic invertebrates and to aquatic stages of amphibians. It has a low persistence in soil with reported field half-lives of 1 to 25 days. Degradation in soil is rapid and related to the degree of soil binding (Extoxnet, 1998).

The establishment of aquatic benchmarks usually require continuous exposure over time (48 to 96 hrs.) to establish an acute or chronic concentration that has a cause and effect result (LC50). Even though there were some one time exceedances of aquatic bench marks, during this study, it is difficult to determine the overall exposure. A bi-weekly monitoring schedule does not allow for the assessment of the temporal component of these criteria.

Overall there were 19 separate pesticides identified during this monitoring program. There were numerous detections of both insecticides and herbicides with Warm Springs Creek having the highest (50) and Hog Creek having the lowest (21). Very little research has been conducted on the effects of numerous pesticide mixtures, as found in Weiser Flat waterways, and their overall impact on aquatic species.

ISDA reminds pesticide applicators that they must adhere to all label requirements and apply all pesticides according to federal and state laws. Every effort should be made to prevent pesticide residues from leaving the area of application and entering any live water.

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