Shaughnessy No. 114402

FEB -3 1989

Date Out EAB: _____

TO: G. Werdig
Product Manager 50
Registration Division (TS-767)

FROM: Patrick W. Holden, Chief
Ground-Water Technology Section
Environmental Fate & Ground Water Branch (TS-769C)

THRU: Hank Jacoby, Acting Chief
Environmental Fate & Ground Water Branch (TS-769C)

Attached please find the environmental fate review of:

Reg./File No.: _____

Chemical: Acifluorfen

Type Product: Fungicide

Product Name: Tackle and Blazer

Company Name: Rhone-Poulenc

Purpose: Response to data call-in letter

_____

ACTION CODE: 495

Date Received: 09-23-88 EFGWB # 81040

Date Completed: 01-31-89 Total Review Time: 4 days

Monitoring study requested: / X /

Monitoring study voluntarily conducted by registrant: /___/

Deferrals To: _____ Biological Effects Branch

_____ Science Integration and Policy Staff, EFED

_____ Non-Dietary Exposure Branch, HED

_____ Dietary Exposure Branch, HED

1

REGISTRATION DIVISION DATA REVIEW RECORD

Confidential Business Information — Does Not Contain National Security Information (E.O. 12065)

1. CHEMICAL NAME
ACIFLUORFEN

2. IDENTIFYING NUMBER	3. ACTION CODE	4. ACCESSION NUMBER
114402	495	

TO BE COMPLETED BY PM

5. RECORD NUMBER: 233,125
6. REFERENCE NUMBER:
7. DATE RECEIVED (EPA): 10/3/88
8. STATUTORY DUE DATE:
9. PRODUCT MANAGER (PM): G.Werdig/B.Crompton
10. PM TEAM NUMBER: 50

14. CHECK IF APPLICABLE

- ☐ Public Health/Quarantine
- ☐ Minor Use
- ☐ Substitute Chemical
- ☐ Part of IPM
- ☐ Seasonal Concern
- ☐ Review Requires Less Than 4 Hours

TO BE COMPLETED BY PCB

11. DATE SENT TO HED/TSS: 10-23-88
12. PRIORITY NUMBER: 28
13. PROJECTED RETURN DATE: 11-21-88

15. INSTRUCTIONS TO REVIEWER

A. HED
- ☐ Total Assessment - 3(c)(5)
- ☐ Incremental Risk Assessment - 3(c)(7) and/or E.L. Johnson memo of May 12, 1977.

B. SPRD (Send Copy of Form to SPRD PM)
- ☐ Chemical Undergoing Active RPAR Review
- ☐ Chemical Undergoing Active Registration Standards Review

C. ☐ BFSD
D. ☐ TSS/RD
E. ☐ Other

F. INSTRUCTIONS
Small Scale Prospective Ground Water Monitoring study progress report with raw data for review

16. RELATED ACTIONS

17. 3(c)(1)(D)
- ☐ Use Any or All Available Information
- ☐ Use Only Attached Data
- ☐ Use Only the Attached Data for Formulation and Any or All Available Information on the Technical or Manufacturing Chemical.

18. REVIEWS SENT TO
- ☐ TB
- ☐ EEB
- ☐ EF
- ☐ PL
- ☐ RCB
- ☐ EFB
- ☐ CH
- ☐ BFSD

19.	To	TYPE OF REVIEW	NUMBER OF ACTIONS: Registration	Petition	EUP	SLN	Sec. 18	Inert	MNR. USE	Other
HED		TOXICOLOGY								
HED		ECOLOGICAL EFFECTS								
HED		RESIDUE CHEMISTRY								
HED	X	ENVIRONMENTAL DATE P. Holden								
RD/TSS		CHEMISTRY								
RD/TSS		EFFICACY								
RD/TSS		PRECAUTIONARY LABELING								
BFSD		ECONOMIC ANALYSIS								

20.	21.	22.	23.	24.
☐ Label Submitted with Application Attached	☐ Confidential Statement of Formula	☐ Representative Labels Showing Accepted Uses Attached	Date Returned to RD (to be completed by HED)	Include an Original and 4 (four) Copies of This Completed Form for Each Branch Checked for Review.

EPA Form 8570-13 (Rev. 11-81) PREVIOUS EDITIONS ARE OBSOLETE.

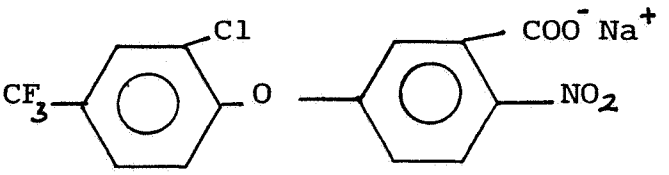
(2)

1. Chemical:

Chemical Name: Sodium 2-(2-chloro-4-(trifluoromethyl)-phenoxy) -2-v nitro benzoate

Common name: Acifluorfen-sodium, Blazer, Tackle

Structure:



2. Test Material:

Tackle Brand Herbicide was used. Analyses showed that 20.75% of the formulation was active ingredient (Acifluorfen-sodium) that is, 98.3% of the label specification of 21.1% active ingredient.

3. Study/Action Type:

This is a progress report on a small-scale prospective ground-water monitoring study submitted by Rhone-Poulenc and BASF for their products Tackle and Blazer, respectively (containing the active ingredient acifluorfen-sodium). Documentation and discussion of the meeting held on 12/21/88 between the Ground-Water Team and Rhone-Poulenc and BASF regarding the status of the study is included here, also.

4. Study Identification:

"A Small-Scale Prospective Field Dissipation and Groundwater Monitoring Study with Acifluoren - Sodium, the Active Ingredient of Tackle Brand Herbicide and Blazer Herbicide," Frank Norris, Ph.D., File No. 40367, Protocol No., MEF-87-010, Progress Report No. 2, September 12, 1988.

5. Reviewed by:

Catherine Eiden
Chemist
Environmental Fate and Ground-Water Branch

6. Approved by:

Patrick Holden, Chief
Ground-Water Technology Section
Environmental Fate and Ground-Water Branch

7. Conclusion:

The registrant believes most of the acifluorfen residue movement is because of preferential flow. There appears to be greater movement of water on the field at the southern end. Most of the wells in the lower end (southern) of the field show positive results for acifluorfen residues, while the well samples taken from wells upgradient at the northern end of the field are negative for acifluorfen residues. There appears to be a general movement of an acifluorfen plume in the direction of shallow ground-water flow to the southwest.

The concentrations are in some cases above the health advisory level (HAL) of 9 ppb. The acifluorfen residues moved quickly under the conditions on the field (sandy soil and irrigation) reaching the ground water within 3-4 months and continuing to increase in concentration at 5 months.

Combined irrigation and rainfall provided ample moisture to move the acifluorfen residues through the soil profile and into shallow ground water. Irrigation started May 18 at planting and continued until August 10th. The type of soil chosen for this study is not usually used for the cultivation of soybeans. Irrigation is necessary to provide the moisture needed for soybean culture. This small-scale prospective ground water study has been conducted under exaggerated worst-case conditions. The registrants are currently planning small-scale retrospective studies to determine the impacts of acifluorfen use under normal agricultural practices.

8. Recommendations:

1. Continue sampling and analyzing groundwater in April '89.

2. Stop collection of soil and soil-pore water now.

3. Continue to monitor for the parent (free acid) form of acifluorfen. There is no need to analyze for metabolites at this point. The detection limit of 1 ppb is adequate.

4. There is no firm consensus between the Agency and the registrants as to whether acifluorfen residues are moving solely because of macropore flow. There may be preferential flow on the field in a southern direction along with the direction of ground water flow. This appears to be the case, but further monitoring and discussion of the results will be necessary. However, at this point there appears to be a plume of acifluoren residues moving in a south westerly direction from the field.

5. The company is carrying out small-scale retrospective studies in North Carolina and Virginia. Three additional sites (North Central, Midwest, and Southern Regions) for the retrospective study will be selected and approved by the Agency. However, the possibility of a site in Florida cannot be discounted, if conditions of use are similar as those at the Wisconsin study site. The Ground-Water Team is currently checking with the state of Florida DER as to possible sites and areas of concern. The preliminary results of these studies will be detailed in another review.

6. The registrant will restrict the sale of acifluorfen products in 8 counties in Wisconsin and 2 counties in New York. The Agency might consider proposing additional regulatory restrictions on acifluorfen uses based on the results of the small-scale retrospective studies' results.

9. Background:

For selective pre- and post-emergence residual weed control of a wide spectrum of annual broadleaf weeds and grasses in soybeans, peanuts, and other large-seeded legumes. Also used for legume establishment in oil palm.

On 12/21/88 the Ground Water Team met with representatives of Rhone-Poulenc and BASF to discuss the submitted progress report and sample data taken after the progress report was submitted. During the meeting, sampling results for the 4.5 and 5 month sampling periods were presented. Those results are discussed in Section 10.

10. Discussion:

A. Study Identification:

"A Small-Scale Prospective Field Dissipation and Groundwater Monitoring Study with Acifluorfen Sodium, the Active Ingredient of TACKLE Brand Herbicide and BLAZER Herbicide", Frank Norris, P.h.D., Rhone-Poulenc Ag Company and BASF Corporation. September 12, 1988.

B. Materials and Methods:

A 1.85 ha. field was chosen in Waushara County near Hancock, Wisconsin and is characterized as a plainfield loamy sand with a water table at 5.5-7.0m. The direction of the ground water flow is southwest. No acifluorfen containing products were used on the field between 1983-1988.

Four clusters of suction lysimeters were placed at 1,2,3 m below the soil surface. Four clusters of ground-water monitoring wells were placed on the field one upgradient, one downgradient and two in mid-field. Details of the construction are given in Rhone-Poulenc Ag Co. Standard Operating Procedure Nos. 92620, 40269, and 92689. Additional wells were constructed later on in the study.

Acifluorfen was applied at 0.84 kgai/ha to the field site. The site was irrigated twice weekly from May 18, 1988 (planting) to the study's end. Soybeans were cultivated on the site. Irrigation was necessary at the site, because soybeans are normally grown on heavier soils that retain more moisture than the Plainfield sand soil existing at the site.

Weather data were collected using a Pestcaster weather station. Data collected daily included: rainfall, air and soil temperature, relative humidity, wind speed and direction.

C. Reported Results:

Acifluorfen residues degraded with an apparent half-life of 0.5 months. Acifluorfen residues were detected in suction-lysimeter soil-pore water samples at 1.5-2.0 months at 1-20 ppb. Residues were detected at 3 months initially and increasingly between 4-5 months at 1-23 ppb in several wells. The acifluorfen residues were moving in a plume in a south/westerly direction.

D/E. Reviewer/Author Conclusions:

Acifluorfen-sodium is present in soil-pore and ground water samples taken from shallow wells and suction-lysimeters as seen from the small-scale prospective ground-water monitoring study. Detections are in the upper portion of the water table at 0.3 m below the surface. New wells were installed after 3 months downgradient of and in the direction of ground water flow.

At 3 months the first detection of 3 ppb in well #8 was verified.

At 4 months the first detection(s) of 1.5 ppb in wells #6 & 9 were verified.

At 4.5 months wells 10-25 were sampled and analyzed. Wells 14-20, 21, 23, 24 were positive for acifluorfen residues. These wells were sampled at 5 months; the samples taken from the uppermost wells screened at the water table surface tested positive for acifluorfen

residues for wells 11-19 and 21.

At 5 months, levels generally increased by several ppb. The HAL (9 ppb) was either approached or exceeded in several of the shallower wells. The well upgradient on the field was always clean. Samples taken from downgradient wells, and lysimeters on the lower half of the field frequently show acifluorfen residues. This could be preferential flow on the field. However, there appears to be a plume spreading in the direction of localized ground-water flow, downgradient and south and west of the field . There appear to be concentrated pulses (possibly the result of macropore flow) at certain wells, C9, C11, C15, C18. These 3 wells had 19, 14, 15 and 23 ppb acifluorfen residues in the well water at 5 months, respectively.

Data from the suction-lysimeter water samples are not as consistent as the well water data regarding acifluorfen residue detection. Four lysimeters were implanted at the site at 1, 1.5, 2 and 3 m depths. At some point during the 2 months the lysimeters were sampled, acifluorfen residues were detected at some depth. The 2 lysimeters on the southside of the field picked up acifluorfen residues that were at higher concentrations and more frequently than those in the northside of the field. This could be evidence of preferential flow on the field in a southerly direction. Often, the lysimeters at the north end of the field were dry and enough sample volume could not be collected for analysis.

Concentrations of acifluorfen residues were very low in the samples collected from the two lysimeters on the north side of the field, (a few ppb) and much higher 4-20 ppb from the lysimeter samples collected from the southside of the field. Although these concentrations are in the same range as those found in the well water sample, we cannot predict groundwater concentrations from suction-lysimeter samples. Ground water (the saturated zone) at this site lies at 5.5- 7m (16-21 feet). At 1.5-2 months the higher concentrations of acifluorfen residues were found in the lysimeter samples taken from the southern end of the field; at 5 months residues between 1-23 ppb were found in the uppermost wells placed on the southern part of the field.

Residues appear to be moving with the southwesterly direction of the shallow ground-water flow and increasing over time, initially. Ground-water samples should continue in April '89' to track apparent plume movement. Soil and soil pore-water sampling can stop.

Acifluorfen

Page _____ is not included in this copy.

Pages __8__ through _10__ are not included in this copy.

The material not included contains the following type of information:

_____ Identity of product inert ingredients.

_____ Identity of product inert impurities.

_____ Description of the product manufacturing process.

_____ Description of product quality control procedures.

_____ Identity of the source of product ingredients.

_____ Sales or other commercial/financial information.

_____ A draft product label.

_____ The product confidential statement of formula.

_____ Information about a pending registration action

__X__ FIFRA registration data.

_____ The document is a duplicate of page(s) _____

_____ The document is not responsive to the request.

The information not included is generally considered confidential by product registrants. If you have any questions, please contact the individual who prepared the response to your request.

(01)

PROGRESS REPORT

STUDY TITLE

A Small Scale Prospective Field Dissipation and Groundwater Monitoring Study With Acifluorfen-Sodium, the Active Ingredient of TACKLE® Brand Herbicide and BLAZER® Herbicide

DATA REQUIREMENT

Response to Data Call In
No Guideline Number

AUTHOR

Frank A. Norris, Ph.D.
Principal Scientist
Special Environmental Projects
Rhône-Poulenc Ag Company

PROGRESS REPORT COMPLETED ON

September 12, 1988

PERFORMING LABORATORY

Rhône-Poulenc Ag Company
Environmental Chemistry Department
P.O. Box 12014, 2 T. W. Alexander Drive
Research Triangle Park, North Carolina 27709

ON THE BEHALF OF

Rhône-Poulenc Ag Company

and

BASF Corporation, Agricultural Chemicals

RHONE-POULENC AG COMPANY PROJECT IDENTIFICATION

File Number 40367
Protocol Number MEF-87-010
Progress Report Number 2

11

Acifluorfen

Page _____ is not included in this copy.

Pages _12_ through _15_ are not included in this copy.

The material not included contains the following type of information:

_____ Identity of product inert ingredients.

_____ Identity of product inert impurities.

_____ Description of the product manufacturing process.

_____ Description of product quality control procedures.

_____ Identity of the source of product ingredients.

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__X__ FIFRA registration data.

_____ The document is a duplicate of page(s) _____

_____ The document is not responsive to the request.

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TABLE OF CONTENTS

ABSTRACT

A small scale prospective field dissipation and groundwater monitoring study with acifluorfen-sodium was initiated on an irrigated sand soil at the University of Wisconsin Agricultural Research Farm near Hancock, Wisconsin. Acifluorfen-sodium was applied at the maximum use rate of 0.84 kgai/ha to soybeans. The soil was sampled immediately after application, then at 0.25, 0.5, 1 and 2 months after application of the herbicide. The half-life of the parent herbicide in the soil is about 0.5 month. Within two months after the application, the total residue in the soil declined to near the analytical limit of detection with only 0.017 kgai/ha remaining in the soil. No herbicide metabolites were detected in any of the soil samples at a limit of detection of 0.01 µg/g. The herbicide did not move significantly below the upper 0.3 m of soil with only trace levels of 0.002 to 0.016 µg/g of the parent herbicide found in the 0.3 to 0.6 m depth. After two months, no acifluorfen-sodium or metabolites had been detected in groundwater samples from monitoring wells beneath or downgradient from the treated field. Even though the soil moisture content was high due to irrigation, only small volumes of unsaturated zone water could be collected from some of the suction lysimeters, subsequently the analytical detection limits for acifluorfen-sodium or metabolites was dependent on the volume available. However by analyzing what water could be obtained, acifluorfen-sodium was detected in several of the samples drawn from the suction lysimeters. Because of the pattern of the residue detects in the lysimeter samples along with the low volumes and inconsistent nature of the lysimeter samples, a proper evaluation of the significance of the observations can not be made without the results of the analysis of subsequent water samples from the suction lysimeters and the groundwater monitoring wells as defined in the protocol.

INTRODUCTION

On September 15, 1987, Rhône-Poulenc Ag Company received a "Data Call In Notice for Groundwater Monitoring Data on Acifluorfen" from the EPA. This notice requires the EPA approval of a protocol for a "Small Scale Prospective Study" with the study to be completed within three years of the EPA approval of the protocol. A detailed protocol including standard operating procedures (Appendix 1.) was approved with minor changes during a February 16,1988 meeting with the EPA and in a letter from the EPA dated July 8, 1988. An agreement between Rhône-Poulenc Ag Co. and BASF Corp. allows both companies full access and use of the data.

The project objective is to conduct a carefully controlled study in a soil susceptible to vertical solute movement where acifluorfen-sodium is applied at the maximum labelled rate of 0.84 kgai/ha to a registered crop, soybeans, using standard agronomic practices. The rate of dissipation, and extent of soil mobility and probability of acifluorfen-sodium and/or primary metabolites to reach groundwater in a low organic sandy soil will be determined.

MATERIALS AND METHODS

Field Site:

A 1.85 ha. field on the University of Wisconsin Agricultural Research Farm in Waushara County near Hancock, Wisconsin was selected for the small scale prospective study with acifluorfen-sodium. The research farm is located in the central sand region of Wisconsin, (Figure 1.) an area characterized by low organic sandy soils and moderate to shallow water tables. The research farm is a collection of small fields (Figure 2.) designed for research studies. Excellent crop and agrochemical use history is available for each field. The field chosen for the small scale prospective study with acifluorfen-sodium was field W-2 (See Figure 2.). The soil type of this field was classified as a Plainfield loamy sand by the Soil Conservation Service. Previous studies on this field have shown groundwater at a depth of about 5.5 to 7.0 m flowing toward the southwest. No acifluorfen-sodium or derivative has been used on this field for at least four years. The agrochemical use on the potatoes grown during the 1985, 1986 and 1987 seasons is presented as Table 1. Field W-2 is 240 m x 76 m (788 ft x 248 ft) oriented in a north-south direction (Figure 3.). The field was visually divided into four subplots by bisecting the field both longitudinally and latitudinally.

Installation of Suction Lysimeters:

On April 19, 1988 a cluster of suction lysimeters (vacuum soil water samplers) was installed near the center of each subplot (as defined above under the field site, see figure 3.). Each cluster includes three individual suction lysimeters placed with the porous tip at 1.0, 2.0 or 3.0 m below the surface of the soil. Each lysimeter was prepared and installed as described in Rhône-Poulenc Ag Co. Standard Operating Procedure No. 92588 (Appendix 1.). On July 25, 1988 an additional lysimeter was placed in each subplot at a depth of 1.5 m. A schematic of a suction lysimeter is presented as Figure 4.

Installation of Monitoring Wells:

Five clusters of monitoring wells were installed on April 19 and 20, 1988. As indicated on the field map (Figure 3.), one cluster (C5) was placed to the north, upgradient, of the field; two clusters (C6 and C7) were placed within the field; and one cluster each was placed to the south and southwestern downgradient sides of the field. Each cluster included three wells placed at 0.3 m, 1.5 m, or 3.0 m beneath the water table (level as determined at well installation). The construction and installation of the monitoring wells is described in Rhône-Poulenc Ag Co. Standard Operating Procedure No. 92602 (Appendix 1.). The materials used in the construction and sampling of the wells were shown NOT to adsorb acifluorfen or metabolites. (Rhône-Poulenc Ag Co, report, file no. 40269, attached as appendix 12.) The wells in the fields were cut and capped about 0.5 m below the soil surface so that the well casings would not interfere with the normal tillage and planting practices. As part of the one month sampling interval, the wells in the fields were extended to about 0.3 m above the soil surface. Groundwater samples were drawn from each

monitoring well as described by Rhône-Poulenc Ag Co. Standard Operating Procedure No. 92689.

Fertilization:

Fertilizer use was based on soil tests conducted during the fall of 1987. For the selected site, the soil tests indicated 15.68 metric tons/ha of organic matter, 349 kg/ha phosphorous, 280 kg/ha of potassium and a pH of 5.8. The 1988 fertilizer program was:

a. Preplant: Approximately one month prior to planting, 224 kg/ha of 0-0-60 fertilizer was broadcast with a Gandy spreader prior to discing the rye cover crop and incorporated during the discing operation.
b. At planting: 112 kg/ha of 6-24-24 Fertilizer was applied 5 cm below and 5 cm offset to the side of each row. A John Deere 7000 planter was used.

Tillage and Planting:

On the day prior to seeding, the field was plow-packed in a single operation using a mold-board plow set to operate at 0.2 to 0.25 m deep followed by a roller-type packer to level the surface and prepare a smooth seedbed.

Soybeans, variety Hodgeson 78 produced by the Hancock Experiment Station in 1987, was seeded on May 18, 1988. Using a John Deere 7000 planter, the seeding rate was 26 to 30 seeds/m on 0.91 m (36 in) centers at a seeding depth of 5 cm. Eighty rows were planted in a north-south orientation with exception of the headlands which were planted in an east-west direction.

Irrigation:

The site was irrigated twice weekly (on Tuesdays and Fridays),from planting (May 18,1988) using a Water Winch 9000 fitted with a Nelson End Gun operating at 552 kPa and delivering 1440 L/min. Irrigator specifications indicate that speeds of 1.07, 1.22 and 1.37 m/min produce final irrigation rates of 1.78, 1.56 and 1.39 mm of water.

Climatic Data:

Climatic data was collected using a PESTCASTER® weather station (Neogen Food Tech Corp.). The solar powered weather station recorded air and soil temperature, rainfall, relative humidity, and wind speed and direction. The output of the instrument, supplemented by data from the University of Wisconsin weather station, is summarized as Table 3. with the raw data presented in Appendix 3. The Wisconsin State Climatologist estimated the Total Reference Evapotranspiration from the Priestly-Taylor formula using data obtained at the Hancock research farm.

Test Substance:

On March 7,1988 one case containing five 1 gallon bottles of TACKLE® Brand Herbicide (Lot No. PO2217009) was received at the Rhône-Poulenc Ag Co. Research and Development Laboratories, Research Triangle Park, North Carolina from Cascio Storage and Warehouse, Greenville, Mississippi. The case was stored at room temperature in a laboratory. One bottle from the case of five was randomly selected for analysis by Rhône-Poulenc Ag Co. Analytical Method No. 86ARL01. The analytical results (Appendix 4.) indicated a titer of 20.75% active ingredient by weight or 98.3% of the labelled specification of 21.1%. A sample of the test material is maintained in the Rhône-Poulenc Ag Co. chemical archives at Research Triangle Park, North Carolina.. On May 26, 1988 the case containing the four remaining bottles of TACKLE® Brand Herbicide was sent to the University of Wisconsin Agricultural Research Farm where it was stored in a locked pesticide storage shed.

Calibration of Application Equipment:

To an International Harvester tractor was mounted a Meyers Model 100TMG Field Sprayer equipped with a 7.2 m boom fitted with eight flood jet nozzles (TK 2.5) spaced on 0.91 m centers. On June 7, 1988 the application equipment was calibrated with well water.

a. Ground Speed: A measured distance of 201 m was indicated by posts along a driveway. A speed setting was taken at which the tractor covered the measured distance in 120 ± 5 seconds. This calculates to be 6.04 kmph.
b. Effective Spray Pattern Width: Specifications for the TK 2.5 flood jet nozzles call for a 0.5 m boom height for an effective spray pattern width of 0.91 m. This would produce a pattern with 100% overlap with nozzles spaced 0.91 m apart. During calibration the spray pattern did show a 100% overlap with adjacent nozzles at a boom height of 0.5 m.
c. Nozzle Output: The output of each nozzle on the boom was caught in duplicate for 30 seconds and its volume accurately measured and recorded. Individual nozzle output of all nozzles was totalled to obtain the output of the boom.

SPRAYER CALIBRATION (Volume in ml)

nozzle	volume 1	volume 2	average
1	735	735	735
2	745	745	745
3	715	705	710
4	750	740	745
5	730	735	733
6	740	740	740
7	720	720	720
8	690	690	690
Total Volume of all nozzles			5818 ml for 30 seconds
Nozzle Average Volume			727 ml for 30 seconds

d. Calculation of Sprayer Output: The output of the sprayer was calculated from the spray volume and tractor speed as follows:

$$\frac{5818\ ml}{0.5\ min} \times \frac{1\ Liter}{1000\ ml} \times \frac{2\ minutes}{(201.1\ m \times 7.32\ m)} \times \frac{(100\ m)^2}{1\ ha} = 158\ L/ha$$

Calculation of Amount of Test Material Required:

For a 1.85 ha field, rate of 0.84 kgai/ha, 2 lb/gal (240 g/L) formulation:

$$\frac{1.85\ ha}{field} \times \frac{0.84\ kgai}{1\ ha} \times \frac{1\ L}{0.24\ kg} = 6.475\ L\ of\ TACKLE\ required$$

$$\frac{1.85\ ha}{field} \times \frac{158\ L}{1\ ha} = 292.3\ L\ of\ spray\ solution\ required$$

However, to allow the sprayer to operate at full efficiency over the complete field an overage was required. Hence two full gallons of TACKLE® Brand Herbicide was diluted to 340 L with water for the application.

$$\frac{2\ gal\ TACKLE}{diluted} \times \frac{3.785\ L}{1\ gal} \times \frac{292.3\ L\ spray\ required}{6.475\ L\ TACKLE\ req.} = 341.8\ L\ final\ dilution$$

Application of TACKLE® Brand Herbicide:

On June 8, 1988, to approximately 300 L of water was added 2 gallons of TACKLE® Brand Herbicide. The bottles were triple rinsed and the rinsate added to the spray tank. The final volume of the spray tank was taken to 340 L. The sprayer pump was started in the recirculation mode for thorough mixing of the solution before spraying.

The field conditions at the time of application are summarized in the following table:

Observed Conditions at Time of Application

Time of mixing and application	June 8, 1988; 8:00 to 9:00 AM
Crop growth stage	First trifoliate (V-1)
Soil surface cover	Bare with small weeds (grass and broadleaf)
Soil surface tilth	Smooth
Soil surface and subsurface moisture	Damp
Soil temperature	21.1 °C at 7.5 cm; 23.1 °C at 30 cm depth
Air temperature	15.1 °C at 8:00 AM to 16.2 °C at 9:00 AM
Relative humidity	60 % at 9:00 AM
Wind speed and direction	Estimated 0 to 24 kmph from 92 to 97 °
Sky conditions	Partly cloudy
Dilutant water; pH and temperature	6.5 and 8 °C.

Some spray drift was observed in subplot 1 with spray drift probable in subplot 3. Subplots 2 and 4 were protected by the tree line on the eastern edge of the field.

After the field was sprayed, approximately 45 - 57 L of spray solution remained in the tank. (By calculation, 53 L should be left in the tank.) The excess solution was sprayed on soybeans on the outer part of an irrigation circle in field G (See Figure 3.) which was remote and not upgradient from the test field.

Sampling of Soil:

On April 20, 1988 a single soil core (8.25 cm diameter) was taken to the water table in each subplot. Each core was segmented into 0.3 m lengths to a depth of 0.6 m, then in 0.6 m lengths to the water table. Portions of each segment were sent to A & L Laboratories for soil characterization See Table 2. for a summary of the soil characterization results (Appendix 2.). Portions of each segment were sent to Rhône-Poulenc Ag Co. for determination of acifluorfen-sodium and metabolites.

At each sampling interval after the pretreatment interval, sixteen soil cores were taken, four in each of the four subplots, using the bucket auger technique as described in Rhône-Poulenc Ag Co. Standard Operating Procedure No. 92694 (Appendix 1.). The location of each core was predetermined by a computerized random number technique which paired a stake number and a row number (Appendix 5.) At time 0 (within an hour of application) the soil cores consisted of a single segment taken to a depth of 0.2 m. At 0.25 months each core was comprised of a 0.0 to 0.3 m and a 0.3 to 0.6 m segment. The 0.5, 1.0 and 2.0 month samplings consisted of 0.0 to 0.3, 0.3 to 0.6 and 0.6 to 1.2 m core segments. Each segment was packaged separately and frozen for shipment to the analytical laboratory.

Sampling of Monitoring Well Water:

Each well was sampled in accordance with the Rhône-Poulenc Ag Company Standard Operating Procedure No. 92689 (Appendix 1.) at one and two months after the application of acifluorfen-sodium. After collection, the samples were placed in an ice bath. As soon as the pH and conductivity of each sample was measured, the samples were frozen for shipment to the analytical laboratory. The physical parameters for each well at each sampling interval are presented as appendix 6.

Sampling of the Suction Lysimeters:

Each suction lysimeter was sampled in accordance with the Rhône-Poulenc Ag Company Standard Operating Procedure No. 92591 (Appendix 1.) beginning at 0.5 months after the application of acifluorfen-sodium. After collection, the samples were placed in an ice bath until the samples could be frozen for shipment to the analytical laboratory. The volumes collected from each lysimeter at each sampling interval are presented as part of table 5 and appendix 10.

Quality Assurance, Field Portion:

The installation of the groundwater monitoring wells and the unsaturated zone suction lysimeters as well as the pretreatment soil and water sampling was witnessed for adherence to the protocol and standard operating procedures by the

Rhône-Poulenc Ag Company Quality Assurance Group. BASF Corporation also had a participant present at this time. The application of TACKLE® Brand Herbicide and the immediate post-treatment soil sampling was also witnessed by the Quality Assurance Group. BASF Corporation representatives participated at the two month sampling interval.

Analysis of Water Samples:

All water samples were analyzed by Rhône-Poulenc Ag Company Analytical Residue Method No. 1001 (Appendix 7.). A known volume of water is passed through a C-18 Sep-Pak®. The Sep-Pak® is eluted with methanol. An aliquot of the eluate is taken for quantitation of LS-82-5281 (MC-14621) by a high performance liquid chromatographic (HPLC) method using a fluorescence detector. The remaining eluate is taken to dryness, dissolved in ether, then derivatized with diazomethane before quantitation of the parent herbicide, LS-82-5276 (MC-10109) and metabolite LS-82-5283 (MC-10879) using a gas chromatographic (GC) method utilizing an electron capture detector. A second gas chromatograph fitted with a Hall detector in the halogen mode was used to confirm detects found using the electron capture detector.

When the whole sample was used for the analysis, as was the case for most of the lysimeter samples, the sample container was rinsed at least twice with 10 ml portions of water and the rinsates passed through the same Sep-Pak as the original sample.

Analysis of Soil Samples:

Soil was analyzed by Rhône-Poulenc Ag Company Analytical Residue Method No. 1002 (Appendix 8.). A known weight of soil is extracted first with aqueous hydrochloric acid in acetone then with methanol. The combined filtrates are concentrated to aqueous before passing through a C-18 Sep-Pak®. The Sep-Pak® is eluted with methanol and the eluate analyzed for acifluorfen and metabolites as described under the analysis of water samples.

Quality Assurance of Laboratory Procedures

Both the analytical chemistry laboratory and the residue chemistry laboratory have undergone quality assurance reviews. Portions of the analyses presented in this progress report were part of that quality assurance review.

RESULTS AND DISCUSSION

Field Site:

The small scale prospective field dissipation and groundwater study was initiated on the University of Wisconsin Agricultural Research Farm near Hancock, Wisconsin. Characterization of the soils as summarized in Table 2., confirm the uniformity of the unsaturated zone profile with a soil texture that is a sand from the surface to the water table. The organic matter in the top 0.3 m averages 0.6 %, 0.3 %

in the 0.3 to 0.6 m depth, dropping to 0.1 % in the deeper soil segments. The bulk density measurements were "disturbed bulk density" and indicative of a low organic soil, but the degree of compaction in the field can not be determined from these measurements. The field capacity and wilting point measurements are typical of low organic coarse textured soils and demonstrate the low moisture holding capacity of such soils. In such soils there is a poor correlation between laboratory field capacity and wilting point determinations and the points of zero drainage or plant availability in the field. During the current study, the soil was heavily irrigated and the moisture level in the soil at the 1 m depth ranged from 2.4 to 5.5 %. Even though this moisture level was well above the "field capacity" and the soil was visibly moist, little moisture could be drawn from the soil using suction lysimeters.

Irrigation:

Due to the dry conditions, approximately 18 mm of irrigation were applied at each irrigation event with the irrigation events scheduled twice a week. A weather station was used to monitor each irrigation event as well rainfall events. For the first two months of the study, the irrigation and rainfall amounted to approximately 317 % of the ten year average rainfall. However the irrigation was necessary to maintain a viable crop on the sandy soil which has a low water retention capacity. Irrigation barely replaced evapotranspiration during the two months after application confirming that the heavy irrigation schedule was required. Rainfall, irrigation and evapotranspiration are summarized in the table below.

Rainfall, Irrigation and Evapotranspiration (mm)

Interval after Application	Ten Year Ave. for interval	Irrigation during interval	Rainfall during interval	Total	Percent of Ten year ave.	Evapo-Transpiration
0.25	20.6	38.1	0.0	38.1	185	37.6
0.50	20.6	42.7	7.1	49.8	242	36.6
1.00	40.4	87.6	21.1	108.7	269	72.6
2.00	101.1	190.2	192.7	382.9	379	150.7
Totals	182.7	358.6	220.9	579.5	317	297.5

Soil Analysis:

The results of the analysis of the soil samples are summarized as Table 6 with supporting tables 6A through 6E. A copy of the chromatographic results from the analysis of the soils is presented as Appendix 11.

All soil analyses are reported in terms of acifluorfen-sodium in dry soil. Although the residue method is written with a limit of detection of 0.01 µg/g, for this research study, the limit of detection for acifluorfen-sodium in soil ranged from 0.002 to 0.005 µg/g. The limit of detection for the metabolites ranged from 0.004 to 0.010 µg/g in soil.

The results of the analysis of the soil segments for acifluorfen-sodium and metabolites are summarized as Table 6. (No residues of metabolites were found.) Accompanying tables 6A through 6E relate the analytical results from terms of acifluorfen acid (LS-82-5276) in fresh soil to units of acifluorfen-sodium in dry soil.

$$\frac{\mu g/g \text{ LS-82-5276 found}}{\text{in fresh soil}} \times \frac{383.65\ \mu g/\mu m \text{ LS-80-1213}}{361.66\ \mu g/\mu m \text{ LS-82-5276}} \times \frac{100 \text{ g fresh soil}}{(100\text{-}\%SM)\text{ g}} = \frac{\mu g/g \text{ LS-80-1213}}{\text{in dry soil}}$$

As shown in tables 6A through 6E, the soil residues were converted from units of weight/weight to units of weight per area to allow the addition of residues from core segments of different lengths. These results are also summarized on Table 6.

The analysis of the zero time soil samples for acifluorfen-sodium and metabolites averaged 0.141 µg/g of the parent herbicide only, a residue level which corresponds to 4.2 µg/cm^2 or 0.42 kgai/ha, which is 50 % of the nominal application rate of 0.84 kgai/ha. Variations of this magnitude are not unusual for this type of study. The soil residue of the parent herbicide in the upper segment (0.0 to 0.3 m) of soil dropped from 0.141 µg/g to 0.004 µg/g during the first month after application. In the 0.3 to 0.6 m depth segment, trace residues of the parent herbicide of 0.016 µg/g and 0.014 µg/g were found in one of four composite soil samples at 0.25 month and 0.5 month respectively. At 1 month, residues in the 0.3 to 0.6 m depth segment ranged from 0.002 to 0.010 µg/g to less than 0.002 µg/g at month two. No residues greater than 0.002 µg/g were detected below the 0.6 m depth. Residues of the acifluorfen metabolites, LS-82-5281 and LS-82-5283, were not detected in any soil sample. (See the protocol, Appendix 1, for the chemical structures of the metabolites.)

The dissipation of acifluorfen-sodium was shown to follow first order kinetics by graphing the logarithm of the total residue versus day after application. The linearity of the regression line and the value of the correlation coefficient confirm that this plot is a good representation of the data. The following kinetic parameters were computed for the linear regression equation.

Intercept, regression constant term:	0.310 kgai/ha
Slope, regression coefficient, rate constant:	-0.047 days^{-1}
Correlation coefficient:	-0.984
Half Life of Acifluorfen-sodium in the soil:	14.8 days

Groundwater Analysis:

All groundwater analyses are reported in terms of acifluorfen-sodium. The analytical residue method is written with a limit of detection of 1 µg/L. However for this research study, by careful extraction and instrument tuning, the limit of detection of acifluorfen-sodium and metabolites in water ranged from 0.05 to 0.10 µg/L. No detects of acifluorfen-sodium or metabolites were found in any groundwater sample.

Table 4. summarizes the results of the analyses of the water from the monitoring wells. Copies of the raw chromatographic results from the monitoring well portion of the study are presented as appendix 9.

Lysimeter Water Samples:

All lysimeter water analyses are reported in terms of acifluorfen-sodium. The analytical residue method is written with a limit of detection of 1 µg/L with a sample volume of 250 ml. However for this research study the limit of detection of acifluorfen-sodium and metabolites in water was maintained in the range of 1 to 2 µg/L, depending on the volume of sample available for analysis, by extreme tuning of the instrumentation. In many cases, no sample or only a very small sample could be drawn from the lysimeter even when the sampling was conducted during and immediately after an irrigation or rainfall event. However by analyzing what water could be obtained, residues in the range of 1 to 20 µg/L of acifluorfen-sodium were detected in several of the water samples drawn from the lysimeters.

Interpretation of the lysimeter data is made difficult because samples could not be collected at many intervals and samples, when collected, were of low volume. When found, detects of acifluorfen-sodium were generally associated with the first sample collected from a given lysimeter. Detects were not found in all clusters as would be expected in such a homogeneous field. Also there was no increase or decrease in the magnitude of the residue with time as would be expected of a well-defined plume movement through the soil. These observations suggest that the residue detects may not be the result of solute flow through the soil, but could be the result of preferential flow either through channelling in the soil or along the casing of the lysimeter. Such preferential flow would be accentuated by the vacuum of the suction lysimeters.

As part of an unrelated study in a nearby field, lysimeters installed at a depth of 1.5 m routinely yielded significant volumes of water. Therefore, 1.5 months after the application of the herbicide, an additional lysimeter was installed in each subplot to a depth of 1.5 m in an attempt to optimally locate a producing lysimeter. These lysimeters did not yield well either, and could be susceptible to contamination during installation. If detects from the lysimeters installed after application are not considered, then the detects greater than 4 µg/L of acifluorfen-sodium are in only one cluster, again implying preferential flow and not plume movement.

On the other hand, the above observations may possibly indicate the leading edge of a residue plume. Therefore the collection and analysis of subsequent samples from the suction lysimeters and the groundwater monitoring wells must be evaluated before a conclusion can be drawn regarding the significance of the detects in the water samples collected from the suction lysimeters. The additional water samples from the lysimeters and monitoring wells will also determine if significant amounts of herbicide residues have actually moved to depths greater than that indicated by the soil samples.

Tables 5 presents the actual sampling schedule, volumes obtained and the results of the analyses of the water from the suction lysimeters. Copies of the raw chromatographic results from the lysimeter portion of the study is attached as appendix 10.

OTHER OBSERVATIONS

At the time of the application of acifluorfen-sodium, the soybeans were in the V-1 or first trifoliate leaf stage. The following week there was a leaf crinkle injury on the second and third trifoliates throughout the field. Such injury is typical of this class of herbicides but does not effect later growth of the soybeans. The observation demonstrated the uniformity of the application. The weed control due to the single application of acifluorfen-sodium was such that no other herbicide was required on the field during the 1988 crop season. Although there was some mild insect pressure (red spider mite), no insecticide was applied.

CONCLUSIONS

The small scale prospective field dissipation and groundwater monitoring study with acifluorfen-sodium demonstrated that even in a sand soil with ample sprinkler irrigation, acifluorfen-sodium did not leach significantly from the upper 0.3 m of soil. The half-life of acifluorfen-sodium in the field soil was about 0.5 month, consistent with earlier soil dissipation studies. No residues of the metabolites of acifluorfen-sodium were found in any of the soil samples taken as part of this study. No residues of acifluorfen-sodium or metabolites were found in groundwater samples drawn within two months after the application of the herbicide to the sandy soil. Even though the soil moisture content was high due to irrigation, only small volumes of unsaturated zone water could be collected from some of the suction lysimeters, subsequently the analytical detection limits for acifluorfen-sodium or metabolites was dependent on the volume available. However by analyzing what water could be obtained, acifluorfen-sodium was detected in several of the samples drawn from the suction lysimeters. Because of the pattern of the residue detects in the lysimeter samples along with the low volumes and inconsistent nature of the lysimeter samples, a proper evaluation of the significance of the observations can not be made without the results of the analysis of subsequent water samples from the suction lysimeters and the groundwater monitoring wells as defined in the protocol.

TABLE 1. PRIOR CROP AND AGROCHEMICAL USE HISTORY

1987 SEASON, Crop: Potatoes, Swanee Russet Burbank, Planted: 24 April 1987
Harvested: September, 1987

Days under Irrigation: 78
Total Irrigation: 11.70 inches in 21 applications
Total Rainfall: 8.96 inches during crop season
Total Precipitation: 20.66 inches during crop season

Date	Products	Rates	Application Method
20 Aug	Diquat with Activate Plus	2 pt/A + 0.5 pt/A	Foliar Spray
03 Aug	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
27 July	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
20 July	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
14 July	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
07 July	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
30 June	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
23 June	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
22 June	Fusilade	0.25 lb/A	Foliar Spray
11 June	Pydrin	0,20 lb/A	Foliar Spray
26 May	Mocap 10 G	40.0 lb/A	At Hilling
26 May	34-0-0 Fertilizer	300 lb/A	Side Dress
12 May	34-0-0 Fertilizer	300 lb/A	Side Dress
11 May	Lorox	1 pt/A	Directed Spray
24 April	6-24-24 Fertilizer	624 lb/A	In Row at Planting

1986 SEASON, Crop: Potatoes, Swanee Russet Burbank, Planted: 24 April 1986
Harvested: September, 1986

Days under Irrigation: 127
Total Irrigation: 15.80 inches in 24 applications
Total Rainfall: 13.61 inches during crop season
Total Precipitation: 29.41 inches during crop season

Date	Products	Rates	Application Method
28 Aug	Diquat with X 77	1 pt/A + 0.5 pt/A	Foliar Spray
21 Aug	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
19 Aug	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
12 Aug	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
12 Aug	Guthion	0.5 lb/A	Foliar Spray
04 Aug	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
28 July	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
28 July	Monitor	0.75 lb/A	Foliar Spray
21 July	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
14 July	Dithane M45 and Duter	2 lb/A + 8 oz/A	Foliar Spray

07 July	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
30 June	Pydrin	0.10 lb/A	Foliar Spray
24 June	Dithane M45 and Duter	1 lb/A + 8 oz/A	Foliar Spray
22 June	Fusilade	0.25 lb/A	Foliar Spray
21 June	Guthion	0.5 lb/A	Foliar Spray
03 June	34-0-0 Fertilizer	300 lb/A	Side Dress
20 May	Mocap 10 G	40.0 lb/A	At Hilling
16 May	34-0-0 Fertilizer	300 lb/A	Side Dress
12 May	Lorox	1 pt/A	Directed Spray
24 April	6-24-24 Fertilizer	600 lb/A	In Row at Planting
22 April	0-0-60 Fertilizer	400 lb/A	At Disking

1985 SEASON, Crop: Potatoes, Swanee Russet Burbank, Planted: 18 April 1985
Harvested: 18 September, 1985

Days under Irrigation: 155
Total Irrigation: 18.31 inches in 30 applications
Total Rainfall: 15.85 inches during crop season
Total Precipitation: 34.16 inches during crop season

Date	Products	Rates	Application Method
04 Sept	Diquat with oil	2 pt/A	Foliar Spray
13 Aug	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
06 Aug	Pydrin	0.10 lb/A	Foliar Spray
06 Aug	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
30 July	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
26 July	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
19 July	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
12 July	Dithane M45 and Duter	2 lb/A + 10 oz/A	Foliar Spray
05 July	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
28 June	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
21 June	Pydrin	0.10 lb/A	Foliar Spray
21 June	Dithane M45 and Duter	1 lb/A + 10 oz/A	Foliar Spray
13 June	Pydrin	0.10 lb/A	Foliar Spray
03 June	34-0-0 Fertilizer	300 lb/A	Side Dress
20 May	Mocap 10 G	40.0 lb/A	At Hilling
14 May	34-0-0 Fertilizer	300 lb/A	Side Dress
06 May	Lorox	1 pt/A	Directed Spray
18 April	6-24-24 Fertilizer	600 lb/A	In Row at Planting
17 April	Eptam	3 lb/A	Spray
16 April	0-0-50 Fertilizer	300 lb/A	At Disking

1984 SEASON, Crop: Potatoes, Agrochemical program similar to 1985. No acifluorfen or derivatives used.

1983 SEASON, Crop: Potatoes and Corn. No acifluorfen or derivatives used.

TABLE 2. Soil Characterization
(Summary of data presented as appendix 2.)

Field Subplot	Segment Depth (cm)	Soil Texture	Percent Sand	Percent Silt	Percent Clay	Percent O.M.	pH	CEC	Bulk Density	Field Capacity	Wilting Point
I	0 - 30	sand	93	3	4	0.5	6.1	2.1	1.12	3.23	1.19
I	30 - 60	sand	95	1	4	0.3	6.2	1.4	1.13	3.23	0.98
I	60 - 120	sand	97	1	4	0.2	6.4	0.7	1.21	1.11	0.49
I	120 - 180	sand	97	1	4	0.2	7.4	0.8	1.23	0.84	0.35
I	180 - 240	sand	97	1	4	0.1	7.5	0.6	1.23	0.69	0.25
I	240 - 300	sand	97	1	4	0.1	7.4	0.7	1.22	0.74	0.31
I	300 - 360	sand	97	1	4	0.1	7.3	0.4	1.22	0.40	0.18
I	360 - 390	sand	97	1	4	0.1	7.4	0.5	1.27	0.49	0.25
II	0 - 30	sand	95	1	4	0.5	6.8	2.2	1.12	3.22	1.28
II	30 - 60	sand	95	1	4	0.2	6.7	1.3	1.13	2.42	1.01
II	60 - 120	sand	97	1	4	0.1	6.7	0.2	1.22	1.02	0.37
II	120 - 180	sand	97	1	4	0.1	6.6	0.3	1.22	0.93	0.39
II	180 - 240	sand	97	1	4	0.1	6.8	0.4	1.22	0.61	0.21
II	240 - 300	sand	97	1	4	0.1	7.0	0.6	1.22	0.80	0.33
II	300 - 360	sand	97	1	4	<0.1	7.2	0.5	1.24	0.74	0.29
III	0 - 30	sand	93	3	4	0.7	5.4	2.7	1.11	3.62	1.27
III	30 - 60	sand	95	1	4	0.3	6.0	2.0	1.13	2.75	1.09
III	60 - 120	sand	97	1	4	0.2	6.3	0.4	1.22	1.19	0.50
III	120 - 180	sand	97	1	4	0.1	6.4	0.3	1.19	0.84	0.29
III	180 - 240	sand	97	1	4	<0.1	6.5	0.4	1.25	1.01	0.23
III	240 - 300	sand	97	1	4	0.1	6.7	0.4	1.23	0.69	0.31
III	300 - 360	sand	97	1	4	0.3	6.8	0.4	1.23	0.68	0.18
III	360 - 390	sand	97	1	4	0.1	6.8	0.3	1.24	0.49	0.15
III	420 - 465	sand	97	1	4	0.1	6.7	0.4	1.21	0.60	0.23
IV	0 - 30	sand	93	3	4	0.7	5.9	2.7	1.11	3.39	1.22
IV	30 - 60	sand	95	1	4	0.2	6.7	1.4	1.12	2.05	0.93
IV	60 - 120	sand	97	1	4	0.1	6.6	0.8	1.19	1.30	0.60
IV	120 - 180	sand	97	1	4	<0.1	6.3	0.4	1.22	0.66	0.23
IV	180 - 240	sand	97	1	4	<0.1	7.5	0.7	1.23	0.91	0.23
IV	240 - 300	sand	97	1	4	<0.1	7.8	0.8	1.22	0.57	0.13
IV	300 - 360	sand	97	1	4	<0.1	8.0	0.9	1.25	0.91	0.26
IV	360 - 420	sand	97	1	4	0.2	8.0	1.1	1.22	0.52	0.16
IV	420 - 480	sand	97	1	4	0.1	7.8	0.4	1.23	0.48	0.14

Notes:

Percent Silt, Minimum measurement was 1%.
Percent Clay, Minimum measurement was 4%.
Bulk Density is a "Disturbed Bulk Density" Measurement.

TABLE 3. Climatic Data (1)

Date in 1988	Rainfall incl. irrig. cm. (2)	Irrigation Nominal cm. (3)	Evapo-transpiration cm. (4)	Air Temperature Ave °C.	Air Temperature Min °C.	Air Temperature Max °C.	Soil Temp., 7.5 cm. Ave °C.	Soil Temp., 7.5 cm. Min °C.	Soil Temp., 7.5 cm. Max °C.	Soil Temp., 30 cm. Ave °C.	Soil Temp., 30 cm. Min °C.	Soil Temp., 30 cm. Max °C.
04 May	0.00		0.33	17.5	10.3	22.0	17.2	10.1	19.3	12.8	8.3	13.6
05 May	0.00		0.56	16.2	7.5	24.2	17.4	13.6	21.8	13.7	13.4	14.5
06 May	0.00		0.41	17.4	7.0	26.7	18.1	14.5	21.8	14.6	14.3	15.1
07 May	0.00		0.33	18.0	9.9	25.8	17.9	15.6	20.4	15.2	14.9	15.3
08 May	1.57		0.28	17.7	12.1	25.3	17.9	16.0	20.6	15.4	15.1	15.6
09 May	0.58		0.08	11.5	10.1	12.7	14.2	12.7	16.0	14.9	14.3	15.6
10 May	0.00		0.51	14.3	4.0	21.5	14.5	5.7	18.7	13.4	7.0	14.0
11 May	0.00		0.43	14.0	5.3	22.4	15.3	11.2	19.5	13.9	13.4	14.3
12 May	0.00		0.41	19.2	11.4	25.8	17.6	13.8	21.3	14.5	14.3	15.1
13 May	0.00		0.51	10.9	4.4	17.1	18.0	13.6	22.2	15.4	15.1	15.8
14 May	0.41		0.33	13.6	4.9	20.2	16.4	13.4	18.9	15.5	15.1	16.0
15 May	0.00		0.43	19.1	12.7	25.3	17.8	14.7	22.0	15.3	14.9	15.8
16 May	0.00		0.20	12.4	9.4	15.1	16.6	15.3	18.0	15.7	15.3	16.0
17 May	0.00		0.51	11.6	2.5	19.8	16.9	12.1	22.6	15.2	14.7	15.6
18 May	0.00	Planting (5)	0.53	14.9	2.7	24.2	18.5	13.8	23.5	15.8	15.3	16.4
19 May	0.00		0.56	17.2	5.1	27.1	19.9	15.1	25.1	16.5	16.2	17.1
20 May	0.00		0.58	19.7	7.7	28.9	21.3	16.9	25.8	17.4	17.1	18.0
21 May	0.00		0.46	21.3	11.2	29.6	22.3	19.1	25.5	18.3	18.2	18.9
22 May	0.00		0.43	20.7	13.6	28.0	22.6	19.8	25.5	19.0	18.9	19.3
23 May	0.00		0.56	19.7	13.2	26.7	23.0	19.8	26.7	19.4	19.1	19.8
24 May	1.52 •	1.52	0.48	13.6	7.0	18.7	20.5	17.3	23.1	19.8	19.3	20.0
25 May	0.00		0.48	12.3	6.8	20.6	17.2	12.9	21.3	18.1	15.6	19.5
26 May	0.00		0.51	20.0	10.5	28.2	19.3	14.7	24.6	17.7	17.1	18.2
27 May	0.00		0.30	21.3	17.8	25.8	21.6	19.5	23.3	18.8	18.4	19.3
28 May	4.06 •	1.32	0.51	21.5	14.5	29.3	21.9	18.9	24.9	19.3	18.9	20.0
29 May	0.00		0.61	23.7	14.9	30.2	22.3	18.9	25.8	19.8	19.3	20.2
30 May	0.00		0.51	24.0	17.8	30.0	23.6	20.0	27.1	20.4	20.0	20.9

Date in 1988	Rainfall incl. irrig. cm. (2)	Irrigation Nominal cm. (3)	Evapo-transpiration cm. (4)	Air Temperature Ave °C.	Air Temperature Min °C.	Air Temperature Max °C.	Soil Temp., 7.5 cm. Ave °C.	Soil Temp., 7.5 cm. Min °C.	Soil Temp., 7.5 cm. Max °C.	Soil Temp., 30 cm. Ave °C.	Soil Temp., 30 cm. Min °C.	Soil Temp., 30 cm. Max °C.
31 May	0.00		0.61	24.5	17.8	31.6	25.4	21.8	29.3	21.3	21.1	22.2
01 June	2.36 •	2.36	0.61	23.9	16.0	32.0	25.5	19.3	29.6	22.2	19.8	22.9
02 June	0.18		0.25	14.7	8.8	20.4	22.9	20.6	24.9	22.4	22.0	22.9
03 June	0.00		0.53	15.3	6.6	22.9	20.5	16.9	24.4	20.8	20.2	22.0
04 June	0.00		0.58	19.2	10.7	27.3	22.1	18.0	26.4	20.5	20.0	20.9
05 June	0.00		0.58	22.5	13.4	30.9	24.3	20.6	28.2	21.3	20.9	22.0
06 June	0.00		0.64	23.5	14.7	31.6	25.9	22.6	29.3	22.3	22.0	22.9
07 June	1.07 •	1.91	0.66	23.4	13.2	30.9	25.6	21.8	28.2	23.1	21.1	23.3
08 June	0.03	Application (6)	0.25	14.0	8.3	18.7	22.2	19.8	24.6	22.7	22.0	23.5
09 June	0.00		0.53	14.2	5.1	22.4	19.6	15.8	23.3	20.8	20.2	22.0
10 June	0.89 •	1.91	0.51	15.4	4.7	24.9	20.9	17.1	25.3	20.3	20.0	20.6
11 June	0.00		0.58	20.2	10.5	28.0	21.1	17.8	24.2	20.5	20.0	20.7
12 June	0.00		0.64	23.8	14.9	30.5	22.4	18.9	26.2	20.6	20.2	21.1
13 June	0.00		0.64	26.7	18.7	33.4	25.0	22.0	28.2	21.6	21.1	22.4
14 June	1.93 •	1.91	0.61	26.8	20.9	32.5	25.9	23.3	28.7	22.9	22.4	23.3
15 June	0.46		0.41	20.5	14.0	23.8	24.0	22.4	25.8	23.0	22.6	23.5
16 June	0.00		0.56	19.0	12.5	25.5	22.6	29.8	25.5	22.2	21.8	22.9
17 June	1.30 •	1.91	0.51	19.3	11.2	27.6	23.0	19.5	26.7	21.9	21.5	22.2
18 June	0.00		0.53	23.5	14.9	30.0	23.0	20.9	25.3	22.1	22.0	22.4
19 June	0.25		0.43	25.5	21.5	30.2	23.4	21.5	25.3	22.1	22.0	22.4
20 June	0.00		0.71	26.9	19.3	34.8	25.8	22.9	29.3	22.6	22.2	23.3
21 June	0.30 •	2.36	0.51	28.5	20.2	36.6	26.8	24.6	28.9	23.8	23.5	24.2
22 June £	weather station failed		0.64									
23 June	0.00		0.46	21.2	12.9	27.1	24.3	22.0	26.2	23.9	21.5	24.6
24 June	0.89 •	1.91	0.51	24.6	16.7	31.8	24.7	22.2	27.6	23.5	23.1	23.8
25 June	0.00		0.61	26.8	17.6	34.5	25.3	24.2	27.1	23.9	23.8	24.0
26 June	0.00		0.46	18.3	11.6	23.8	23.3	21.1	25.3	23.5	23.1	24.0
27 June	0.00		0.46	19.9	10.7	27.3	23.1	20.6	25.8	22.9	22.4	23.3

Date in 1988	Rainfall incl. irrig. cm. (2)	Irrigation Nominal cm. (3)	Evapo-transpiration cm. (4)	Air Temperature Ave °C.	Air Temperature Min °C.	Air Temperature Max °C.	Soil Temp., 7.5 cm. Ave °C.	Soil Temp., 7.5 cm. Min °C.	Soil Temp., 7.5 cm. Max °C.	Soil Temp., 30 cm. Ave °C.	Soil Temp., 30 cm. Min °C.	Soil Temp., 30 cm. Max °C.
28 June	2.01	#	0.08	16.2	13.8	22.0	22.0	20.2	24.2	22.8	22.2	23.1
29 June	0.00		0.56	16.0	8.8	22.2	20.6	18.2	23.5	21.5	21.1	22.2
30 June	0.00		0.56	16.6	8.1	24.0	20.7	18.0	23.8	21.1	20.6	21.5
01 July	5.84 •	1.78	0.53	15.9	7.3	24.0	20.5	17.8	23.5	20.9	20.6	21.3
02 July	4.34		0.56	18.4	8.6	26.4	17.9	14.3	22.0	19.8	19.1	21.1
03 July	0.00		0.58	21.1	12.1	28.7	20.9	18.2	24.0	20.0	19.8	20.4
04 July	0.00		0.61	23.9	14.5	30.9	22.5	19.8	25.5	20.8	20.4	21.3
05 July	3.66•	2.54	0.64	26.0	18.2	34.3	24.3	21.8	27.3	21.8	21.5	22.4
06 July £	1.35		0.61	25.9	18.2	37.3						
07 July	0.00		0.66	25.7	19.6	32.5						
08 July	0.00		0.61	27.2	20.4	36.8						
09 July	3.28 •	2.54	0.33	21.9	17.8	28.4						
10 July	0.23		0.28	21.5	16.9	25.6						
11 July	0.00		0.43	18.8	13.2	26.4						
12 July	7.01	#	0.43	20.9	15.6	25.8	22.1	19.1	24.2	22.1	22.0	22.2
13 July	0.51		0.51	23.3	14.3	31.6	21.2	18.7	24.2	21.6	21.1	22.2
14 July £	0.00		0.64	23.8	15.8	30.2	23.6	21.5	25.5	22.1	21.8	22.4
15 July	2.84 •	2.29	0.41	24.9	19.1	31.1	24.0	22.2	26.0	22.6	22.4	22.9
16 July	7.62		0.15	21.0	17.6	24.2	23.4	22.9	24.9	23.1	22.9	23.3
17 July	0.03		0.48	22.2	15.6	28.7	23.8	22.0	26.0	22.8	22.6	23.1
18 July	0.00		0.28	21.6	17.1	26.4	24.1	23.3	24.9	23.1	23.1	23.3
19 July	0.00		0.43	20.2	15.6	26.2	23.2	21.8	24.6	22.9	22.6	23.3
20 July £	1.32 •	#	0.30	19.6	15.3	24.9	22.6	21.5	23.8	22.6	22.4	22.9
21 July	0.03		0.33	18.1	14.3	24.0	21.5	20.4	22.6	22.2	22.0	22.6
22 July	0.00		0.56	19.8	11.8	28.0	21.5	19.3	24.0	21.7	21.1	22.0
23 July	0.00		–	20.8	13.2	29.1	21.9	20.0	23.8	21.7	21.3	22.0
24 July	0.03		0.33	21.4	15.1	28.7	22.1	20.6	23.5	21.7	21.5	22.0

Date in 1988	Rainfall incl. irrig. cm. (2)	Irrigation Nominal cm. (3)	Evapo-transpiration cm. (4)	Air Temperature Ave °C.	Air Temperature Min °C.	Air Temperature Max °C.	Soil Temp., 7.5 cm. Ave °C.	Soil Temp., 7.5 cm. Min °C.	Soil Temp., 7.5 cm. Max °C.	Soil Temp., 30 cm. Ave °C.	Soil Temp., 30 cm. Min °C.	Soil Temp., 30 cm. Max °C.
25 July £	0.00		0.51	20.0	13.8	27.6	22.2	20.4	24.2	21.7	21.5	21.8
26 July	1.52 •	2.54	0.38	19.2	10.5	27.1	21.8	20.2	23.5	21.7	21.3	22.0
27 July	0.05		0.43	23.8	16.7	31.8	22.2	20.6	24.4	21.6	21.3	21.8
28 July	0.00		0.58	25.2	16.0	33.4	23.4	21.3	25.5	22.0	21.8	22.2
29 July £	1.65 •	1.78	–	26.1	19.8	33.0	24.2	22.4	26.2	22.4	22.2	22.6
30 July	0.00		0.56	24.4	17.6	30.2	24.7	23.5	26.4	22.9	22.6	23.1
31 July	0.00		0.36	23.9	16.2	32.5	23.5	22.2	24.9	23.0	22.6	23.3
01 Aug	0.00		0.61	28.9	21.5	36.8	24.9	23.1	27.1	22.9	22.6	23.3
02 Aug £	2.41 •	2.79	0.61	29.0	22.6	36.8	25.9	24.4	28.2	23.6	23.3	24.0
03 Aug	0.00		0.41	25.2	20.0	33.9	25.9	24.2	27.6	24.1	24.0	24.2
04 Aug	0.08		0.23	24.2	21.1	29.1	25.0	24.4	25.8	24.1	24.0	24.2
05 Aug £	1.30 •	#	0.43	21.8	18.4	26.0	24.2	23.5	25.3	23.7	23.5	24.2
06 Aug	0.00		0.56	22.9	15.3	31.4	23.5	21.5	25.8	23.3	23.1	23.8
07 Aug	0.00		0.56	23.8	14.0	32.0	23.5	21.5	25.8	23.1	22.9	23.3
08 Aug	1.02		0.20	22.9	20.4	26.7	23.8	22.9	24.4	23.0	22.9	23.1
09 Aug	1.45 •	1.91	0.36	21.2	15.3	28.0	23.7	22.6	25.3	23.0	22.9	23.1
10 Aug £	0.00		0.51	21.4	12.7	29.8	22.6	20.4	24.9	22.6	22.2	23.1

Notes:

1. Measurements made in the field using a Pestcaster weather station unless noted otherwise.
2. Irrigation was collected as rainfall by the in-field weather station.
3. Irrigation rate based on output volume and speed that the irrigation boom moved across the field.
4. Total Reference Evapotranspiration estimated using the Priestly-Taylor formula by the Wisconsin State Climatologist.
5. Soybeans were planted on May 18, 1988.
6. Acifluorfen-Sodium was applied on June 8, 1988.

• Denotes a scheduled irrigation day.

# Denotes a day on which a scheduled irrigation was cancelled due to rain.

£ Denotes day that suction lysimeters were sampled.

TABLE 4. SUMMARY OF ACIFLUORFEN-SODIUM RESIDUES IN GROUNDWATER MONITORING WELLS (µg/L)#

Interval	C5			C6			C7			C8			C9		
in Months	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3
pre	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1	<1	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1
2	*	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1

\# Individual Analyses
* Well was Dry

Notes:

C5 Cluster upgradient and north of field.
C6 Cluster in northwest subplot in field.
C7 Cluster in southeast subplot in field.
C8 Cluster downgradient and southwest of field.
C9 Cluster downgradient and south of field.
W1 Well with screen placed approximately 0.3 m (1 ft) below water table◊.
W2 Well with screen placed approximately 1.5 m (5 ft) below water table◊.
W3 Well with screen placed approximately 3.0 m (10 ft) below water table◊.

◊ Water table on April 19,1988.

TABLE 6A
ACIFLUORFEN-SODIUM
Soil residue data, 0.0 month, corrections for soil moisture and molecular weight conversion.

Segment	Subplot	LS-82-5276 Found µg/g	Percent Soil Moisture	LS-80-1213 dry soil Adjusted µg/g
0.0 - 0.2 m	1	0.400	5.6	0.449
0.0 - 0.2 m	1	0.190	4.8	0.212
0.0 - 0.2 m	1	0.023	5.3	0.026
0.0 - 0.2 m	1	0.096	5.5	0.108
0.0 - 0.2 m	2	0.060	5.7	0.067
0.0 - 0.2 m	2	0.101	5.2	0.113
0.0 - 0.2 m	2	0.060	5.7	0.067
0.0 - 0.2 m	2	0.093	6.0	0.105
0.0 - 0.2 m	3	0.083	6.6	0.094
0.0 - 0.2 m	3	0.092	6.3	0.104
0.0 - 0.2 m	3	0.142	7.4	0.163
0.0 - 0.2 m	3	0.061	5.9	0.069
0.0 - 0.2 m	4	0.085	8.1	0.098
0.0 - 0.2 m	4	0.105	6.7	0.119
0.0 - 0.2 m	4	0.336	9.7	0.394
0.0 - 0.2 m	4	0.053	6.3	0.060

Average Residue , 0.0 - 0.2 m depth 0.141 µg/g

0.141 µg/g X 1.5 g/cm^3 X 20 cm = 4.215 µg/cm^2 or 0.422 kgai/ha.

TABLE 6B
ACIFLUORFEN-SODIUM
Soil residue data, 0.25 month, corrections for soil moisture and molecular weight conversion.

Segment	Subplot	LS-82-5276 Found µg/g	Percent Soil Moisture	LS-80-1213 dry soil Adjusted µg/g
0.0 - 0.3 m	1	0.013	5.5	0.015
0.0 - 0.3 m	1	0.009	5.5	0.010
0.0 - 0.3 m	2	0.064	7.8	0.074
0.0 - 0.3 m	2	0.067	7.8	0.077
0.0 - 0.3 m	3	0.036	7.6	0.041
0.0 - 0.3 m	3	0.036	7.6	0.041
0.0 - 0.3 m	4	0.010	7.1	0.011
0.0 - 0.3 m	4	0.008	7.1	0.009
0.3 - 0.6 m	1	<0.002	4.5	<0.002
0.3 - 0.6 m	1	<0.002	4.5	<0.002
0.3 - 0.6 m	2	0.013	6.0	0.015
0.3 - 0.6 m	2	0.014	6.0	0.016
0.3 - 0.6 m	3	<0.002	5.0	<0.002
0.3 - 0.6 m	3	<0.002	5.0	<0.002
0.3 - 0.6 m	4	<0.002	5.4	<0.002
0.3 - 0.6 m	4	<0.002	5.4	<0.002

Average Residue , 0.0 - 0.3 m depth 0.035 µg/g

0.035 µg/g X 1.5 g/cm^3 X 30 cm = 1.575 µg/cm^2 or 0.158 kgai/ha.

Average Residue , 0.0 - 0.6 m depth 0.004 µg/g

0.004 µg/g X 1.5 g/cm^3 X 30 cm = 0.180 µg/cm^2 or 0.018 kgai/ha.

Total Acifluorfen-Sodium per area = 1.755 µg/cm^2

TABLE 6C
ACIFLUORFEN-SODIUM
Soil residue data, 0.5 month, corrections for soil moisture and molecular weight conversion.

Segment	Subplot	LS-82-5276 Found µg/g	Percent Soil Moisture	LS-80-1213 dry soil Adjusted µg/g
0.0 - 0.3 m	1	0.016	6.8	0.018
0.0 - 0.3 m	1	0.018	6.8	0.020
0.0 - 0.3 m	2	0.024	6.9	0.027
0.0 - 0.3 m	2	0.023	6.9	0.026
0.0 - 0.3 m	3	0.025	7.8	0.029
0.0 - 0.3 m	3	0.023	7.8	0.026
0.0 - 0.3 m	4	0.014	7.2	0.016
0.0 - 0.3 m	4	0.017	7.2	0.019
0.3 - 0.6 m	1	0.004	5.8	0.005
0.3 - 0.6 m	1	0.006	5.8	0.007
0.3 - 0.6 m	2	0.013	6.4	0.015
0.3 - 0.6 m	2	0.014	6.4	0.016
0.3 - 0.6 m	3	0.006	6.7	0.007
0.3 - 0.6 m	3	0.007	6.7	0.008
0.3 - 0.6 m	4	0.003	5.6	0.003
0.3 - 0.6 m	4	0.003	5.6	0.003
0.6 - 1.2 m	1	<0.002	4.3	<0.002
0.6 - 1.2 m	2	<0.002	4.1	<0.002
0.6 - 1.2 m	3	<0.002	5.5	<0.002
0.6 - 1.2 m	4	<0.002	4.9	<0.002

Average Residue , 0.0 - 0.3 m depth 0.023 µg/g

0.023 µg/g X 1.5 g/cm^3 X 30 cm = 1.035 µg/cm^2 or 0.104 kgai/ha.

Average Residue , 0.0 - 0.6 m depth 0.006 µg/g

0.006 µg/g X 1.5 g/cm^3 X 30 cm = 0.270 µg/cm^2 or 0.027 kgai/ha.

Average Residue , 0.6 - 1.2 m depth <0.002 µg/g

0.002 µg/g X 1.5 g/cm^3 X 60 cm = <0.18µg/cm^2 or <0.018 kgai/ha.

Total Acifluorfen-Sodium per area = 1.305 µg/cm^2

TABLE 6D
ACIFLUORFEN-SODIUM
Soil residue data, 1 month, corrections for soil moisture and molecular weight conversion.

Segment	Subplot	LS-82-5276 Found µg/g	Percent Soil Moisture	LS-80-1213 dry soil Adjusted µg/g
0.0 - 0.3 m	1	0.008	6.3	0.009
0.0 - 0.3 m	1	0.006	6.3	0.007
0.0 - 0.3 m	2	0.009	7.3	0.010
0.0 - 0.3 m	2	0.009	7.3	0.010
0.0 - 0.3 m	3	0.022	7.3	0.025
0.0 - 0.3 m	3	0.023	7.3	0.026
0.0 - 0.3 m	4	0.008	8.4	0.009
0.0 - 0.3 m	4	0.008	8.4	0.009
0.3 - 0.6 m	1	0.005	4.8	0.006
0.3 - 0.6 m	1	0.005	4.8	0.006
0.3 - 0.6 m	2	0.009	5.1	0.010
0.3 - 0.6 m	2	0.009	5.1	0.010
0.3 - 0.6 m	3	0.005	4.2	0.006
0.3 - 0.6 m	3	0.005	4.2	0.006
0.3 - 0.6 m	4	0.002	5.9	0.002
0.3 - 0.6 m	4	0.002	5.9	0.002
0.6 - 1.2 m	1	<0.002	2.8	<0.002
0.6 - 1.2 m	2	<0.002	3.8	<0.002
0.6 - 1.2 m	3	<0.002	4.3	<0.002
0.6 - 1.2 m	4	<0.002	5.1	<0.002

Average Residue , 0.0 - 0.3 m depth 0.013 µg/g

0.013 µg/g X 1.5 g/cm^3 X 30 cm = 0.585 µg/cm^2 or 0.059 kgai/ha.

Average Residue , 0.0 - 0.6 m depth 0.006 µg/g

0.006 µg/g X 1.5 g/cm^3 X 30 cm = 0.270 µg/cm^2 or 0.027 kgai/ha.

Average Residue , 0.6 - 1.2 m depth <0.002 µg/g

0.002 µg/g X 1.5 g/cm^3 X 60 cm = <0.18µg/cm^2 or <0.018 kgai/ha.

Total Acifluorfen-Sodium per area = 0.855 µg/cm^2

TABLE 6E
ACIFLUORFEN-SODIUM
Soil residue data, 2 month, corrections for soil moisture and molecular weight conversion.

Segment	Subplot	LS-82-5276 Found µg/g	Percent Soil Moisture	LS-80-1213 dry soil Adjusted µg/g
0.0 - 0.3 m	1	0.003	6.2	0.003
0.0 - 0.3 m	1	0.003	6.2	0.004
0.0 - 0.3 m	2	0.002	6.7	0.003
0.0 - 0.3 m	2	0.002	6.7	0.003
0.0 - 0.3 m	3	0.003	6.9	0.003
0.0 - 0.3 m	3	0.003	6.9	0.003
0.0 - 0.3 m	4	0.005	6.1	0.006
0.0 - 0.3 m	4	0.005	6.1	0.006
0.3 - 0.6 m	1	<0.002	4.0	<0.002
0.3 - 0.6 m	1	<0.002	4.0	<0.002
0.3 - 0.6 m	2	<0.002	5.8	<0.002
0.3 - 0.6 m	2	<0.002	5.8	<0.002
0.3 - 0.6 m	3	<0.002	5.3	<0.002
0.3 - 0.6 m	3	<0.002	5.3	<0.002
0.3 - 0.6 m	4	<0.002	3.9	<0.002
0.3 - 0.6 m	4	<0.002	3.9	<0.002
0.6 - 1.2 m	1	<0.002	2.4	<0.002
0.6 - 1.2 m	2	<0.002	2.6	<0.002
0.6 - 1.2 m	3	<0.002	3.3	<0.002
0.6 - 1.2 m	4	<0.002	3.1	<0.002

Average Residue , 0.0 - 0.3 m depth 0.004 µg/g

0.004 µg/g X 1.5 g/cm^3 X 30 cm = 0.174 µg/cm^2 or 0.017 kgai/ha.

Average Residue , 0.0 - 0.6 m depth <0.002 µg/g

<0.002 µg/g X 1.5 g/cm^3 X 30 cm = <0.090 µg/cm^2 or <0.009 kgai/ha.

Average Residue , 0.6 - 1.2 m depth <0.002 µg/g

0.002 µg/g X 1.5 g/cm^3 X 60 cm = <0.18µg/cm^2 or <0.018 kgai/ha.

Total Acifluorfen-Sodium per area = 0.174 µg/cm^2

TABLE 6. Summary of Acifluorfen-Sodium Residues in Soil

Acifluorfen-Sodium Residues in Soil in Terms of µg/g (ppm)#

Interval in months	Interval in days	Soil Depth in Meters 0.0 - 0.3	0.3 - 0.6	0.6 - 1.2	Total in kgai/ha
0	0	0.094*	–	–	0.422
0.25	7	0.035	0.004**	–	0.176
0.5	14	0.023	0.006	<0.002	0.140
1	28	0.013	0.006	<0.002	0.086
2	63	0.004	<0.002	<0.002**	0.017

Average of Analysis of Each Composite
* Calculated from 0.141 µg/g in the 0.0 to 0.2 m depth 0 time samples.
** Detects in only one of four composites

Acifluorfen-Sodium Residues in Soil in Terms of kgai/ha

Interval in months	Interval in days	Soil Depth in Meters 0.0 - 0.3	0.3 - 0.6	0.6 - 1.2	Total in kgai/ha
0	0	0.422	–	–	0.422
0.25	7	0.158	0.018	–	0.176
0.5	14	0.104	0.036	<0.018	0.140
1	28	0.059	0.027	<0.018	0.086
2	63	0.017	<0.009	<0.018	0.017

The following parameters are calculated from a linear regression analysis of logarithm of total residue in kgai/ha versus days.

Intercept (e^a), regression constant	0.310 kgai/ha
Slope (b), Regression coefficient, rate constant	-0.047 $days^{-1}$
Correlation coefficient	-0.984
Half-life	14.8 days

TABLE 5. Suction Lysimeter Sample Volumes and Analytical Residue Data

Volumes of Water Drawn from Suction Lysimeters (ml)

Date	Interval in Months	C1				C2				C3				C4			
		L1	L2	L3	L5	L1	L2	L3	L5	L1	L2	L3	L5	L1	L2	L3	L5
22 June	0.5	•	•	•	--	•	•	•	--	•	•	•	--	•	•	•	--
06 July	1.0	•	•	•	--	•	•	•	--	•	•	•	--	•	•	•	--
14 July	1.2	•	21	•	--	•	12	5	--	•	•	•	--	•	•	•	--
20 July	1.4	1	30	•	--	20	40	16	--	•	7	•	--	•	13	15	--
25 July	1.5	15	3	1	--	•	3	14	--	•	2	•	--	•	10	32	--
29 July	1.7	21	8	•	•	•	3	20	•	•	2	•	157	•	•	4	•
02 Aug	1.8	•	8	•	2	•	4	20	•	•	2	•	120	•	•	9	32
05 Aug	1.9	18	4	•	7	•	4	17	30	•	2	•	95	•	•	2	24
10 Aug	2.0	33	10	•	8	•	9	22	28	•	•	•	•	•	•	•	•

Residues of Acifluorfen-Sodium in Water Drawn from Suction Lysimeters (µg/L)
(The limit of detection is a function of the volume available for analysis)

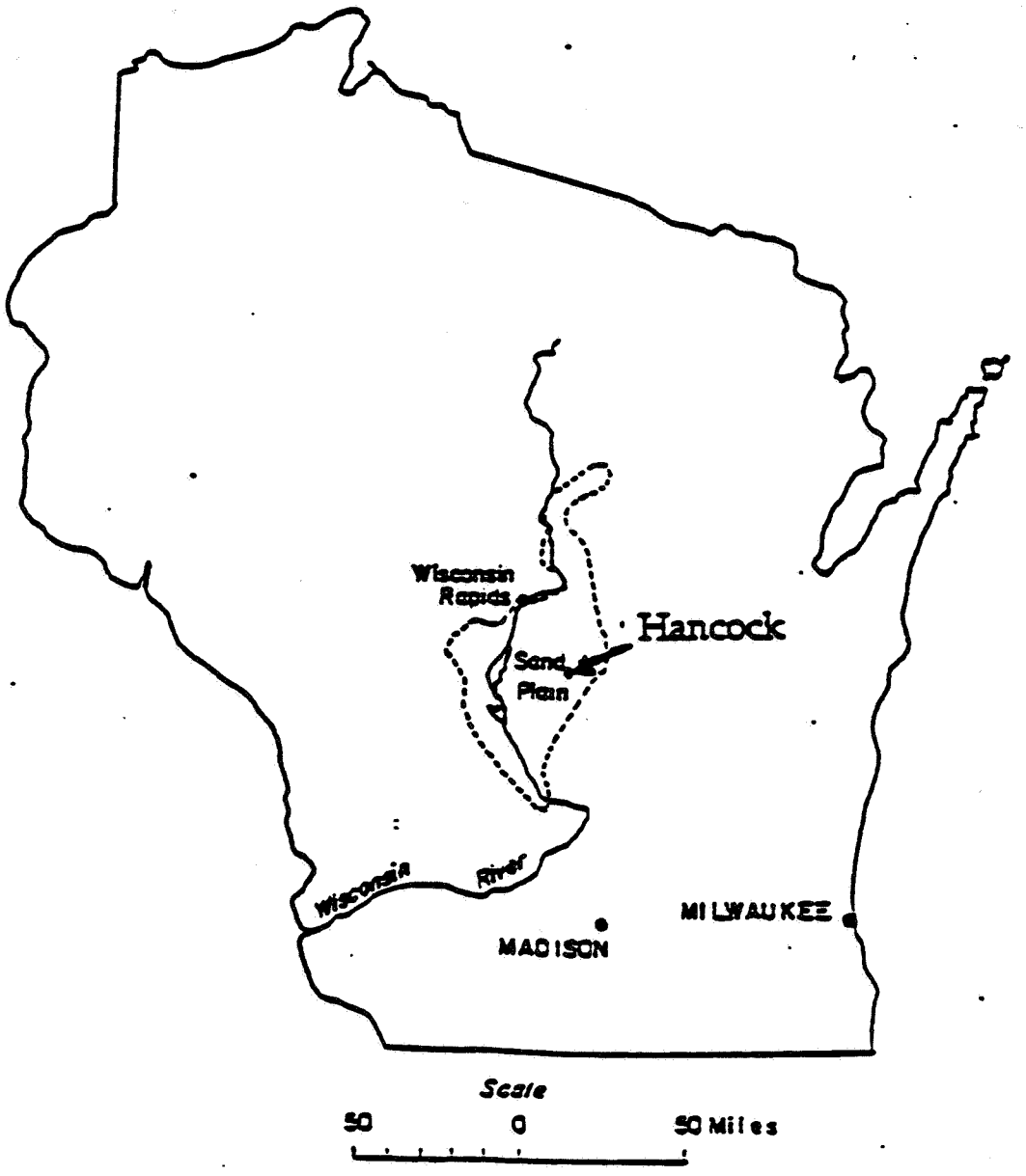
Date	Interval in Months	C1				C2				C3				C4			
		L1	L2	L3	L5	L1	L2	L3	L5	L1	L2	L3	L5	L1	L2	L3	L5
22 June	0.5	•	•	•	--	•	•	•	--	•	•	•	--	•	•	•	--
06 July	1.0	•	•	•	--	•	•	•	--	•	•	•	--	•	•	•	--
14 July	1.2	•	<1	•	--	•	<1	#	--	•	•	•	--	•	•	•	--
20 July	1.4	#	<1	•	--	<1	<1	<1	--	•	4	•	--	•	15	7	--
25 July	1.5	<1	#	#	--	•	#	<1	--	•	#	•	--	•	20	16	--
29 July	1.7	<1	<1	•	•	•	#	<1	•	•	#	•	9	•	•	#	•
02 Aug	1.8	•	3	•	#	•	#	<1	•	•	#	•	16	•	•	10	4
05 Aug	1.9	<1	#	•	3	•	#	<1	<1	•	#	•	13	•	•	#	6
10 Aug	2.0	<1	1	•	4	•	<2	<1	<1	•	•	•	•	•	•	•	•

NOTES:
- • Lysimeter dry; No sample collected.
- # Not analyzed due to insufficient volume (≤ 5 ml).
- Lysimeters labelled L5 were installed on 25 July 1988

C1 Cluster in subplot 1
C2 Cluster in subplot 2
C3 Cluster in subplot 3
C4 Cluster in subplot 4

L1 Lysimeter set at 1 m depth
L2 Lysimeter set at 2 m depth
L3 Lysimeter set at 3 m depth
L5 Lysimeter set at 1.5 m (5 ft) depth

Figure 1. Location of Hancock in the Central Sand Plain of Wisconsin



Plot W-2. Site Selected for the Small Scale Prospective Study With Acifluorfen-Sodium.

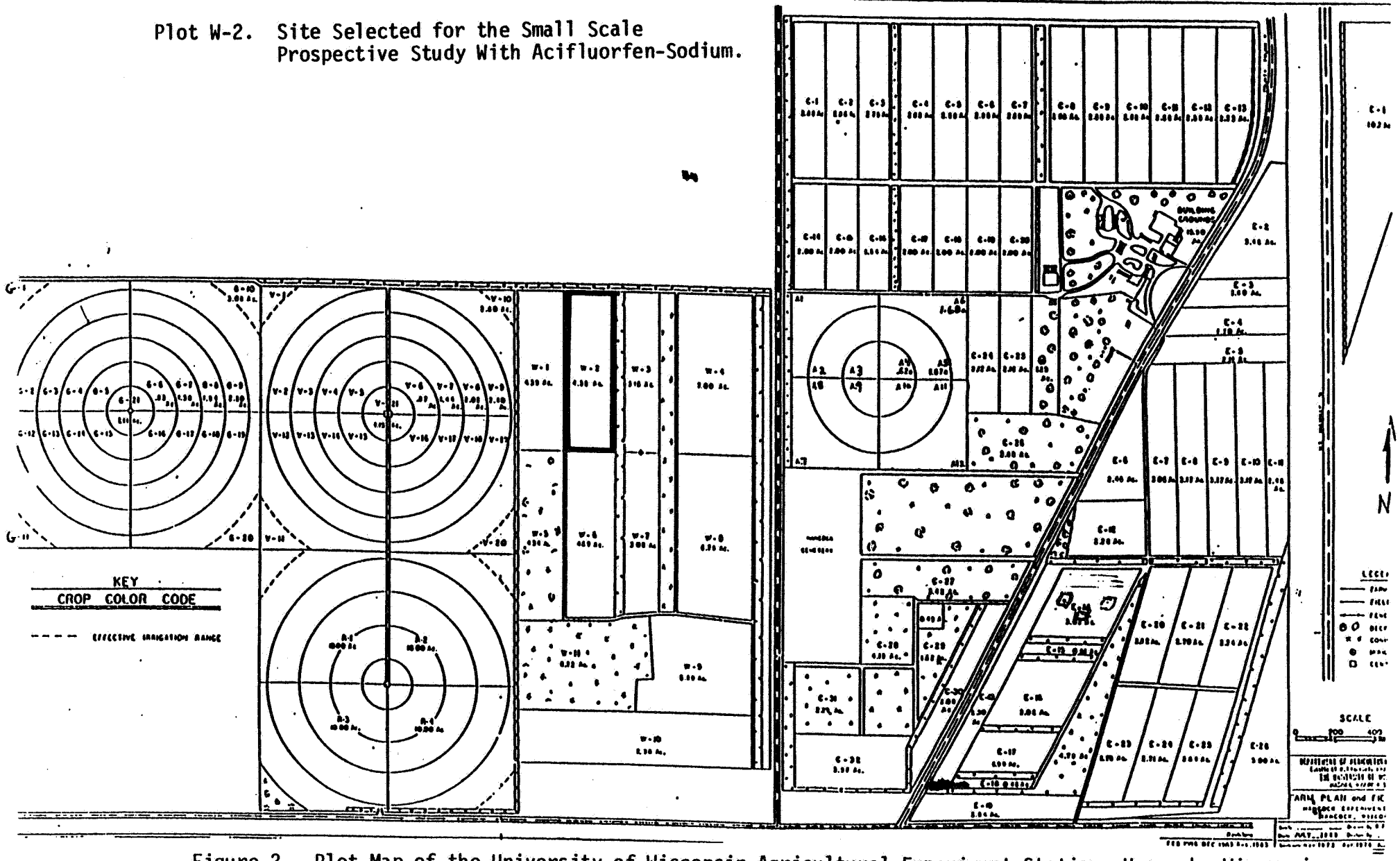


Figure 2. Plot Map of the University of Wisconsin Agricultural Experiment Station, Hancock, Wisconsin.

Figure 3. Plot Map, Small Scale Prospective Study

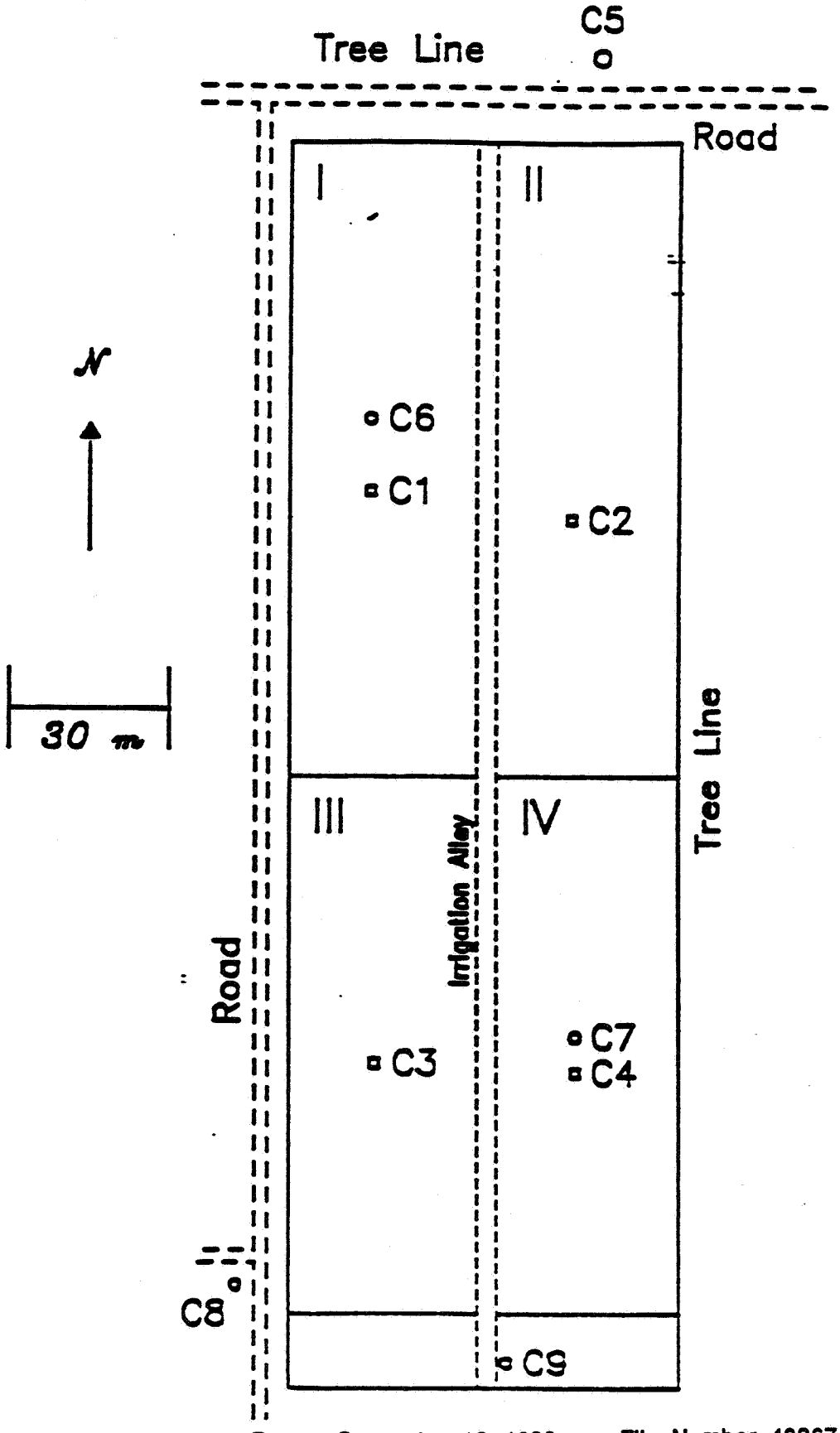


Figure 4. Schematic of a Suction Lysimeter

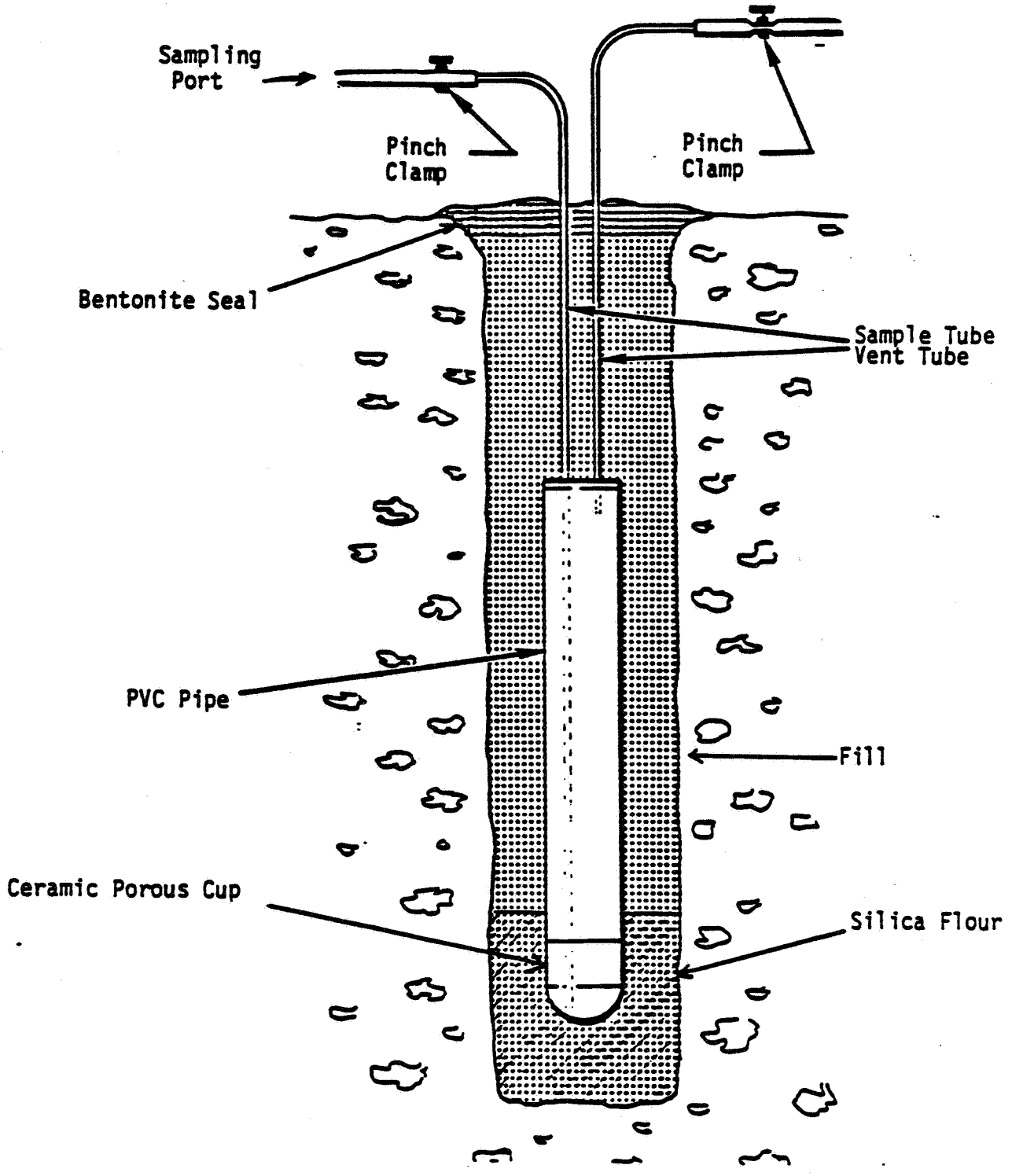
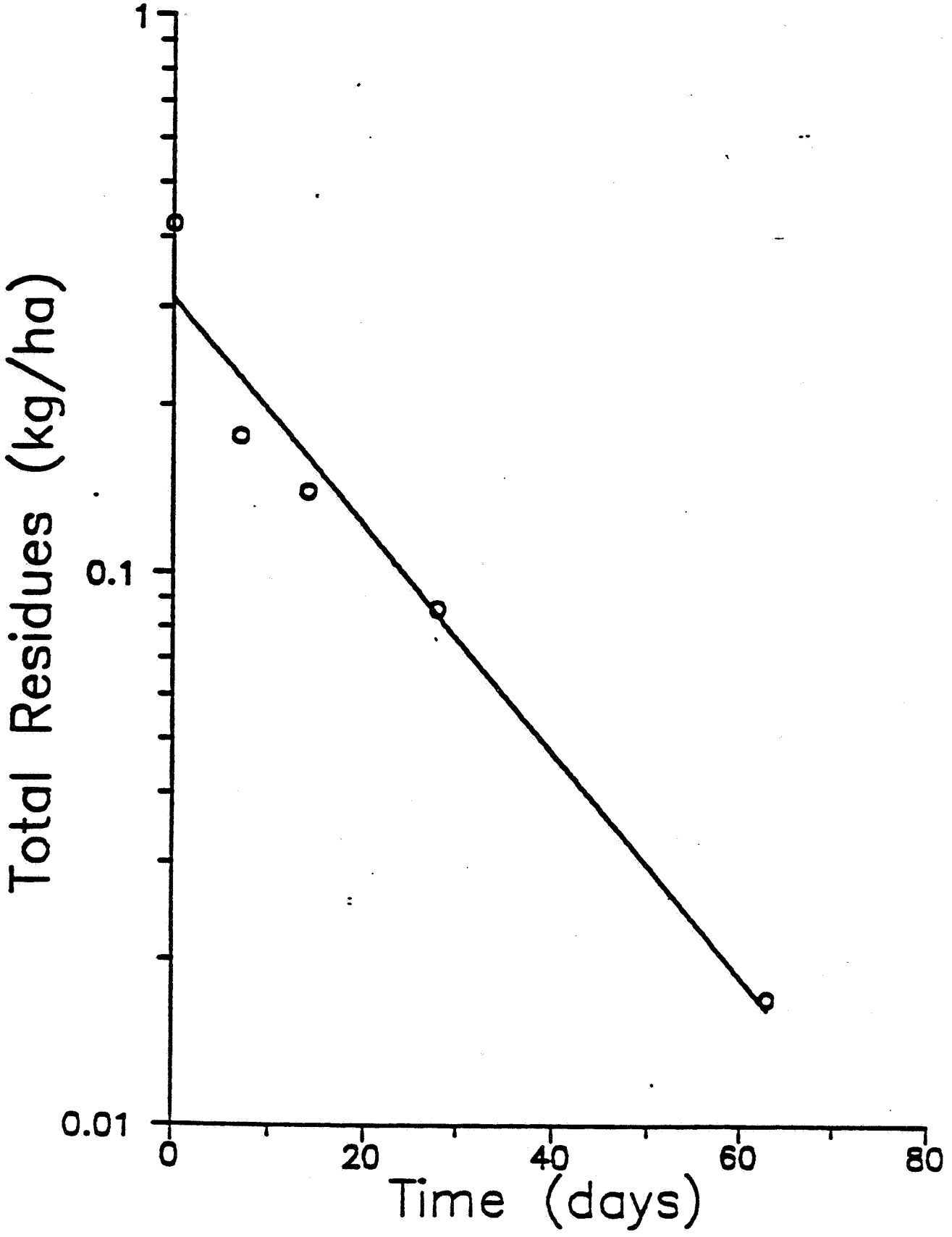


Figure 5. Soil Dissipation Kinetics



SUMMARY OF ACIFLUORFEN-SODIUM RESIDUES IN GROUNDWATER MONITORING WELLS (µg/L)#

Interval	C5			C6			C7			C8			C9		
in Months	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3	W1	W2	W3
pre	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1	<1	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1
2	*	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1	*	<1	<1
3	*	<1	<1	*	<1	<1	*	<1	<1	*	3	<1	*	<1	<1
4	<1	<1	<1	*	1.6	<1	*	<1	<1	*	<1	<1	*	1.5	<1
4.5	<1	<1	<1	3	1	<1	*	<1	<1	*	<1	<1	*	<1	<1
5	<1	<1	<1	(2)	1	<1	*	<1	<1	*	<1	<1	*	(19)	<1

\# Individual Analyses
* Well was Dry

Notes:

C5 Cluster upgradient and north of field.
C6 Cluster in northwest subplot in field.
C7 Cluster in southeast subplot in field.
C8 Cluster downgradient and southwest of field.
C9 Cluster downgradient and south of field.
W1 Well with screen placed approximately 0.3 m (1 ft) below water table◊.
W2 Well with screen placed approximately 1.5 m (5 ft) below water table◊.
W3 Well with screen placed approximately 3.0 m (10 ft) below water table◊.
◊ Water table on April 19,1988.

SUMMARY OF ACIFLUORFEN-SODIUM RESIDUES IN
GROUNDWATER MONITORING WELLS (µg/L)#
AT 4.5 MONTHS AFTER APPLICATION

CLUSTER	WELL 1	WELL 2	WELL 3	APPROXIMATE LOCATION OF CLUSTER
5	<1	<1	<1	Upgradient and 15 m north of field.
6	3	1	<1	In field near center of northwest subplot.
7	*	<1	<1	In field near center of southeast subplot.
8	*	<1	<1	Downgradient and 10 m west of southwest corner of field.
9	*	<1	<1	Downgradient and 10 m south of southeast subplot.
10	<1	<1	<1	One m outside the western edge of the northwest subplot of field.
11	<1	<1	Δ	In field near center of northeast subplot.
12	<1	<1	<1	One m outside the western edge at midlength of field.
13	<1	<1	<1	In field, 30 m from western edge along midlength.
14	3	<1	<1	In field, 15 m from eastern edge along midlength.
15	10	<1	<1	Out of field, 1 m from the western edge of the southwest subplot.
16	<1	11	<1	In field, 30 m from western edge of southwest subplot.
17	3	<1	<1	Out of field, 1 m from the western edge of the southwest subplot.
18	18	1	<1	In field, 30 m from western edge of the southwest subplot.
19	5	<1	<1	In field 15 m from eastern edge of southeast subplot.
20	<1	<1	<1	Downgradient and 40 m west of southwest corner of field.
21	<1	2	<1	Downgradient and 10 m south of the southwest subplot.
22	<1	<1	<1	Downgradient and 40 m west, 30 m south of the southwest subplot.
23	1	<1	<1	Downgradient and 10 m west, 30 m south of the southwest subplot.
24	<1	2	Δ	Downgradient and 30 m south of the southwest subplot.
25	<1	<1	Δ	Downgradient and 30 m south of the southeast subplot.

Well 1 Well with screen placed approximately 0.3 m (1 ft) below water table.
Well 2 Well with screen placed approximately 1.5 m (5 ft) below water table.
Well 3 Well with screen placed approximately 3.0 m (10 ft) below water table.
Clusters 6 through 9 were installed on April 19,1988.
Clusters 10 through 25 were installed on October 24 - 26, 1988.
* Well Dry
Δ Broken Well Casing

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SUMMARY OF ACIFLUORFEN-SODIUM RESIDUES IN
GROUNDWATER MONITORING WELLS (µg/L)#
AT 5 MONTHS AFTER APPLICATION

CLUSTER	WELL 1	WELL 2	WELL 3	APPROXIMATE LOCATION OF CLUSTER
5	<1	<1	<1	Upgradient and 15 m north of field.
6	2	1	<1	In field near center of northwest subplot.
7	*	<1	<1	In field near center of southeast subplot.
8	*	<1	<1	Downgradient and 10 m west of southwest corner of field.
9	*	19	<1	Downgradient and 10 m south of southeast subplot.
10	<1	<1	<1	One m outside the western edge of the northwest subplot of field.
11	14	<1	Δ	In field near center of northeast subplot.
12	1	<1	<1	One m outside the western edge at midlength of field.
13	3	<1	<1	In field, 30 m from western edge along midlength.
14	4	<1	<1	In field, 15 m from eastern edge along midlength.
15	15	<1	<1	Out of field, 1 m from the western edge of the southwest subplot.
16	8	<1	<1	In field, 30 m from western edge of southwest subplot.
17	3	<1	<1	Out of field, 1 m from the western edge of the southwest subplot.
18	23	<1	<1	In field, 30 m from western edge of the southwest subplot.
19	7	<1	<1	In field 15 m from eastern edge of southeast subplot.
20	<1	<1	<1	Downgradient and 40 m west of southwest corner of field.
21	6	<1	<1	Downgradient and 10 m south of the southwest subplot.
22	<1	<1	<1	Downgradient and 40 m west, 30 m south of the southwest subplot.
23	<1	<1	<1	Downgradient and 10 m west, 30 m south of the southwest subplot.
24	<1	<1	Δ	Downgradient and 30 m south of the southwest subplot.
25	<1	<1	Δ	Downgradient and 30 m south of the southeast subplot.

Well 1 Well with screen placed approximately 0.3 m (1 ft) below water table.
Well 2 Well with screen placed approximately 1.5 m (5 ft) below water table.
Well 3 Well with screen placed approximately 3.0 m (10 ft) below water table.
Clusters 6 through 9 were installed on April 19,1988.
Clusters 10 through 25 were installed on October 24 - 26, 1988.
* Well Dry
Δ Broken Well Casing

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