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Column Leaching Study of Six Pesticides, Nitrate, and Chloride through Four Wisconsin Soils

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ABSTRACT

The leaching of pesticides to groundwater from agricultural practices has been of increasing concern in Wisconsin as well as throughout the United States. Differences in chemical solubility, adsorptive characteristics, volatility, and degradability as well as soil properties that effect water movement, biological activity and chemical retention all effect the amount of a pesticide that will leach to groundwater. This project was designed to determine the relative leaching that could be expected for a group of commonly used pesticides on four soil types representing a range of soil properties common to Wisconsin agriculture. The soils studied included two sandy outwash soils (Sparta and Plainfield sands), one silt loam over sand (Antigo), and one sandy loam (Burkart). The pesticides in this study included Aldicarb, Oxymyl, Carbofuran, Carbaryl, Atrazine, and Alachlor. In addition, ammonium nitrate and potassium chloride were added to compare the pesticide leaching to nitrate and chloride movement. Two rates of chemical addition were used representing the normal range of chemical applications for each pesticide.

Results showed more rapid leaching of pesticides, nitrate, and chloride through the sandy Sparta and Plainfield soils. Only small amounts of pesticides were recovered in the leachate from the Antigo of Burkart soils, however, only about 70 percent of the Field Moisture Capacity of these columns was collected as leachate, compared to 200 percent from the sandy soils. All soils had the equivalent of 11.6 inches of water added over a seven week leaching period. Thirty to 48 percent of the highly soluble chemicals (Aldicarb, Oxamyl, and Carbofuan) were found in the leachate from the sandy soils. Carbaryl was not found in detectable amounts in any leachate. Atrazine and Alachlor amounts in leachate from the sands were 2 percent and 0.2 percent, respectively. Aldicarb sulfoxide was the primary form of aldicarb formed and leached at about the same rate as Oxamyl and chloride. Carbofuran appeared to move slightly slower, as did nitrate.

Soil residues in the sands showed fairly complete leaching of the soluble pesticides, with Atrazine residues the highest of any pesticide in the Plainfield soil. Residues in the Antigo and Burkart soil showed relatively large amounts of Aldicarb, Carbofuran, and Atrazine remaining at the end of the seven week study. Carbaryl and Alachlor were in very low amounts, as was Oxamyl in the Burkart soil. Significant Oxamyl was found in the more acid Antigo soil.

One can conclude from this study that Aldicarb, Oxamyl, and Carbofuran are highly leachable in Wisconsin's sandy soils and that these chemicals move fairly easily to lower depths in finer textured soils. Carbaryl did not appear to move significantly in any of the soils studied. Atrazine, while moving slower than other chemicals, was found in the leachate from the sands at concentrations above current standards. Alachlor data was less conclusive. Some leaching was found to occur, but in generally small and erratic amounts.

INTRODUCTION

The impact of pesticides (insecticides and herbicides) on the environment has been a national concern since the 1960's. During that time, most of the attention was on the effects of the pesticides on the ecosystem. Within the past fifteen years, the contamination of our groundwater resources has gained increasing amounts of attention. Approximately one-half of the total population of the United States and 95 percent of the rural households depend on groundwater for their drinking water supply (Cast, 1985). Within the state of Wisconsin, approximately two-thirds of the drinking water is supplied by groundwater, which accounts for about 27 percent of the state's total groundwater use (UWEX, 1983). The remaining groundwater extracted is used for industrial, commercial, and agricultural purposes. With the widespread use of pesticides over the soils of the recharge areas for these groundwater aquifers, the attention and concerns directed at the use of these chemicals is warranted.

There are numerous pathways for pesticides to come in contact with the groundwater. These pathways can be categorized as either point sources or non-point sources (USEPA, 1986). A point source is a definable location where the transport of pesticides to the groundwater can be delineated. Accidental spills and leaks at manufacturing facilities or at other establishments where bulk pesticides are stored and handled would be considered point sources.

A non-point source is much more difficult (if not impossible) to delineate as the pesticides are used over a large area. A typical intended use of the pesticides in this manner would be weed and insect control for agricultural purposes.

Point sources, although they can have an extremely detrimental effect on groundwater, are easier than non-point sources to regulate, contain, and clean up due to their definable and limited presence (USEPA, 1986). Non-point sources, which can and do occur through the intended and legal uses of pesticides, are a much more difficult problem to correct.

It was previously thought that pesticides applied to soils would either degrade rapidly or be absorbed onto soil particles and eventually break down to harmless by-products (USEPA, 1986; Kelley, et al, 1986). These theories have been proven incorrect in the past fifteen years by the numerous reports documenting the occurrence of pesticides in groundwater (Cohen et al, 1984; Cohen et al, 1986; USEPA, 1986; Holden, 1986, Nielsen et al, 1987). The United States Environmental Protection Agency's (USEPA) Office of Groundwater Protection compiled a list of pesticides found in groundwater due to normal land application in 1985 (USEPA, 1986). The list included 17 different pesticides found in 23 different states. It is assumed that this list will continue to increase as analytical detection limits for pesticides in water decrease, methodologies and instrumentation for detection increase, and as monitoring efforts continue to expand.

Midwestern states, like Wisconsin, Iowa, and Minnesota have been ahead of the national average for the investigation and monitoring of pesticides in groundwater (Kelley et al, 1986; Gunsolus, 1987; Postle and LeMaster, 1987). Results from these increased efforts have resulted in more documented pesticides detections in groundwater for these states than for those included in the 1985 USEPA list.

The state of Wisconsin, prompted by the growing concerns of pesticides and other chemical contaminants within its groundwater, signed into law Wisconsin Act 410. This bill established the mechanisms by which state enforcement standards could be set for known and potential groundwater pollutants. It also established a state groundwater monitoring program (Holden, 1986). At present, there are 30 standards established for pesticides.

The establishment of standards alone will not resolve the issue of pesticides in groundwater. Although these standards are indicators of problems, they are not solutions. Widespread monitoring for pesticide contamination is expensive, and the clean-up of any detected problems are very difficult (USEPA, 1986; Carsel et al, 1985). Clean-up of pesticide contaminated water is hindered by both cost and technology.

It should also be noted that detections of pesticides in groundwater either below or above groundwater standards indicate that groundwater has already been affected. Based on this information, additional monitoring and/or investigation would be required to determine the extent of the groundwater contamination problem. In order to prevent pesticide migration to groundwater, an understanding of the processes that cause pesticide migrations needs to be evaluated and understood.

Numerous studies, both column and field have been conducted to evaluate the factors effecting pesticide movement in soil. Various factors such as climatic factors (Friesen 1965, Gary and Weierich 1968, Jury and Valintine 1986), application factors (Letey and Farmer 1974), soil factors (Helling 1971, Felsot and Wilson 1980, McCall et al., 1980 and White et al., 1986) and pesticide characteristic (Felsot, 1984 and Gary and Weierich, 1968) have all been evaluated. This studies are targeted at one factor of the leaching equations and are using specific conditions to a given set of data.

In order to determine a pesticides leachability through the root zone, a research study was initiated in 1987 to investigate pesticide leaching under a uniform set of conditions. The conditions were not meant to represent actual field conditions for any given year. The data generated is interpreted as the capacity for a pesticide to leach through the root zone for the given soil types.

Objectives

The objective of this research was to compare the leachability of six pesticides (oxamyl, aldicarb, carbofuran, carbaryl, atrazine and alachlor) and two inorganic tracers (potassium chloride and ammonium nitrate) through the root zone (upper 1-meter) of four soils commonly used for agriculture in Wisconsin under uniform conditions. The pesticides were chosen to cover the range of expected mobility and to include compounds of current concern, due to their detection in groundwater (atrazine and aldicarb). The inorganic tracers were selected based on their current use as fertilizer in Wisconsin agriculture. The soil types were chosen to represent the range of soil conditions present within the state. The soil types used were the Plainfield, Sparta, Burkart and Antigo. The Plainfield and Sparta are considered sandy soils and the Burkart and Antigo soil are more clayey.

To achieve this objective a leaching study had to designed to eliminate or at least minimize field anomalies such as macro pore transport, presence of cobbles, below average rain fall, erosion, plant uptake, and naturally occurring zones of preferential flow (fingering). The reason these anomalies were controlled or at least attempted to be controlled is that during a column leaching study the occurrence of any anomalies would greatly skew the leaching results.

It is understood that these things do exist within actual field conditions, but there influences (decrease or increase) on leaching are buffered by the total size of the leaching environment. A 6-inch I.D. soil column represents 2.25×10^{-6} acres and the data generated from this is extrapolated to field dimensions, therefore, the effects of any of these or other field anomalies would be greatly exaggerated.

By conducting a column leaching study under uniform conditions the results could be used for strict comparison purposes, without the occurrence outlier data points.

MATERIALS AND METHODS

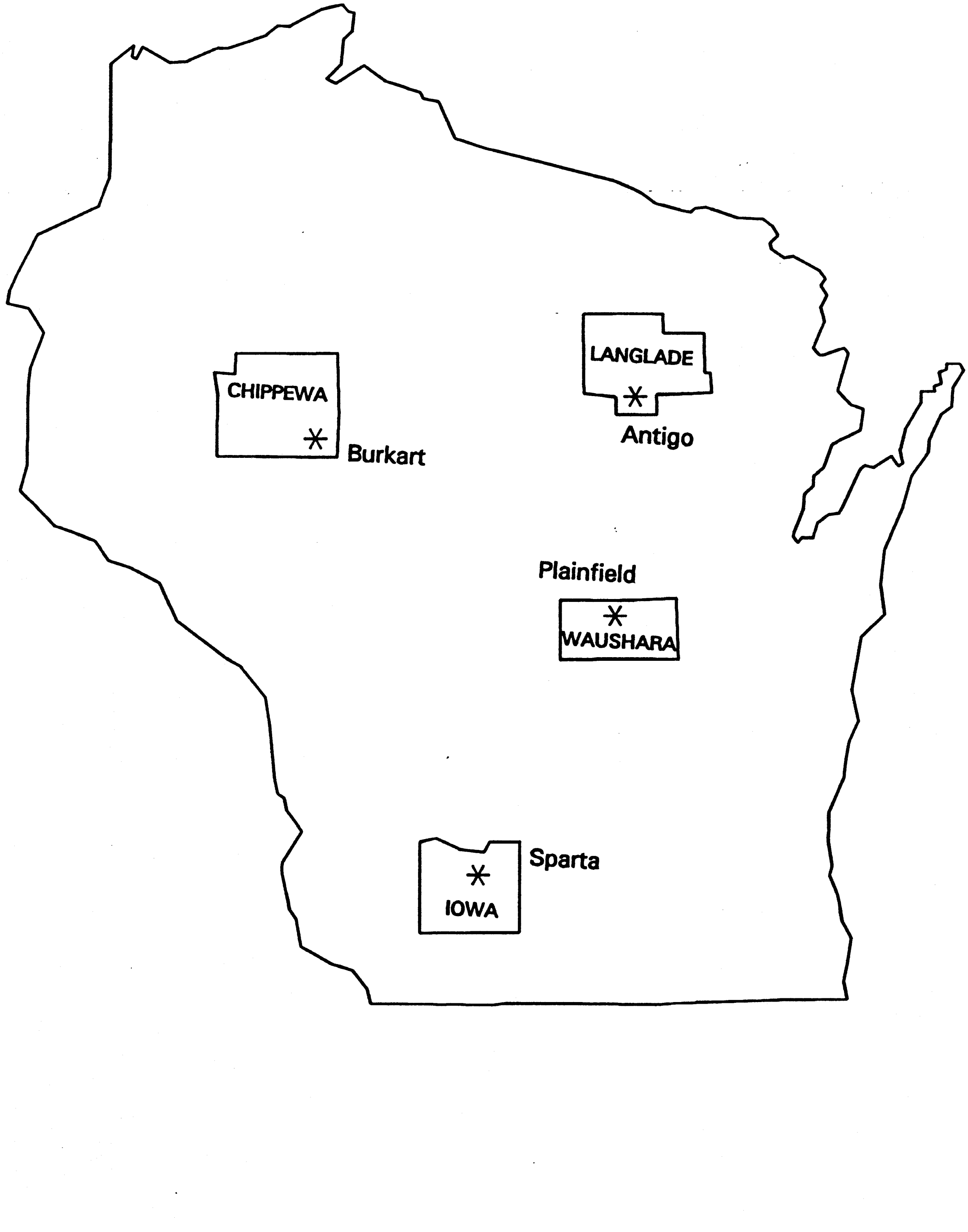
Column Leachate Study

The leachate study consisted of 16 columns which were prepared using the procedures listed in the Soil Collection and Column Set-up sections of this document. Four columns were each packed with Antigo silt loam, Burkart, Sparta, and Plainfield sand soils. The columns were placed on two column stands (8 columns on each stand) and labeled 1 through 16.

Soil Collection and Column Set-up

The soils used for column set studies were collected from the areas shown in Figure 1. Each location was chosen based on information obtained from county agents or owners stating that there had been no pesticide application within five years prior to the date of sampling. A more detailed description of the soil types and locations of sampling is contained within the Soil Description section of this document.

Soil used within the columns was collected by first digging a soil pit. The approximate soil pit dimensions were four feet in length by three feet in width by four feet in depth. The soil horizons were determined from a pit wall to a depth of one meter. The determination of horizons was based on texture, structure, and color. The width of each horizon within the one-meter depth interval (study depth) was used to estimate a soil volume for


CHIPPEWA
Burkart
LANGLADE
Antigo
Plainfield
WAUSHARA
Sparta
IOWA

collection. The volume was determined based on the amount of soil needed to fill ten (10) six-inch diameter, one-meter-in-length soil columns.

The soil was collected using shovels to dig into the soil pit wall and excavate each horizon. The soil for each horizon was transferred to a five-gallon bucket lined with a clean plastic trash bag. To prevent the mixing of soil horizons, the soil was removed from the top of the excavation to the bottom.

The five-gallon buckets and the plastic bags used for liners were labeled with the soil type, horizon type, and collection date. Upon completion of the soil collection, the soil pit was back-filled and the vegetation (if any) was replaced.

The soil collected was then transported back to the laboratory where each bucket was air dried. Next, the soil was double-bagged within plastic garbage bags, replaced in the five-gallon buckets, and stored in a dry place until needed.

Soils Descriptions

The four soils sampled for use in the column study were Burkart, Plainfield, Antigo, and Sparta. A brief description of the soil, their legal descriptions, and the horizons delineated and sampled are as follows:

Burkart

The Burkart series is a Typic hapludoll soil. It is a somewhat excessively or excessively drained soil formed in loamy deposits overlaying sand and gravel on outwash plains. Permeability is moderately rapid and rapid. This soil is used

to ? or

mostly for croplands.

The soil sampled was taken from Chippewa County, just east of the county farm where the Agriculture Department has a sampling well. The legal description of the county farm is T.29N-R8.W-Sec 33,Sec 28-N1/2. The soil was taken from land east of the farm that is owned by NSP. The legal description for this is N1/4 S1/2 R.8W T.29N Sec 34.

The horizons were as follows:

Ap	0-7"	0-18 cm
A12	7-10"	18-25 cm
B2t	10-19"	25-48 cm
IIC1	19-29"	48-74 cm
IIC2	29-40"	74-100 cm

<u>Plainfield</u>

The Plainfield series is a mixed, mesic Typic udipsamments. These soils typically have a brown, loamy sand Ap horizon; dark yellow-brown sand B horizons; and strongly acid, yellow-brown and strong brown sand C horizon. Permeability is rapid, and available water capacity is low.

The sampling site was the farm of Steve Corneli in Waushara County. The legal description of the sampling site is SW1/4 SE1/4 R.8E T.20N Sec 33.

The horizons were as follows:

Ap	0-8"	0-20 cm
B2	8-14"	20-36 cm

B3	14-19"	36-48 cm
C1	19-31"	48-79 cm
C2	31-40"	79-100 cm

Antigo

The Antigo series consists of well-drained soils moderately deep to sand or gravelly sand. These soils formed in silty deposits and the underlying sand or gravelly sand and typically are on outwash plains. It is a fine-silty over sandy or sandy-skeletal, mixed Typic Glossoboralfs. Permeability is moderate in the solum and rapid or very rapid in the substratum.

The soil samples were taken from Langlade County at the municipal airport. The legal description is NW 1/4 SW1/4 R.10E T.31N Sec 22.

The soil horizons were as follows:

Ap	0-10"	0-25 cm
E	10-18"	25-46 cm
Bt1	18-28"	46-71 cm
2Bt	28-35"	75-89 cm
3C	35-40"	89-100 cm

Sparta

The Sparta series is an excessively drained soil formed in sandy material on uplands, stream terraces, and outwash plains. The Sparta series is a sandy, mixed, mesic Entic Hapludolls. Permeability in these soils is rapid.

The soil samples were taken from Hartung Brothers Farms in Iowa County. The legal description is NE1/4 SW1/4 R.4E T8N Sec 11.

The horizons sampled were as follows:

Ap	0-10"	0-25 cm
Ac	10-22"	25-56 cm
C	22-40"	56-100 cm

Column Construction

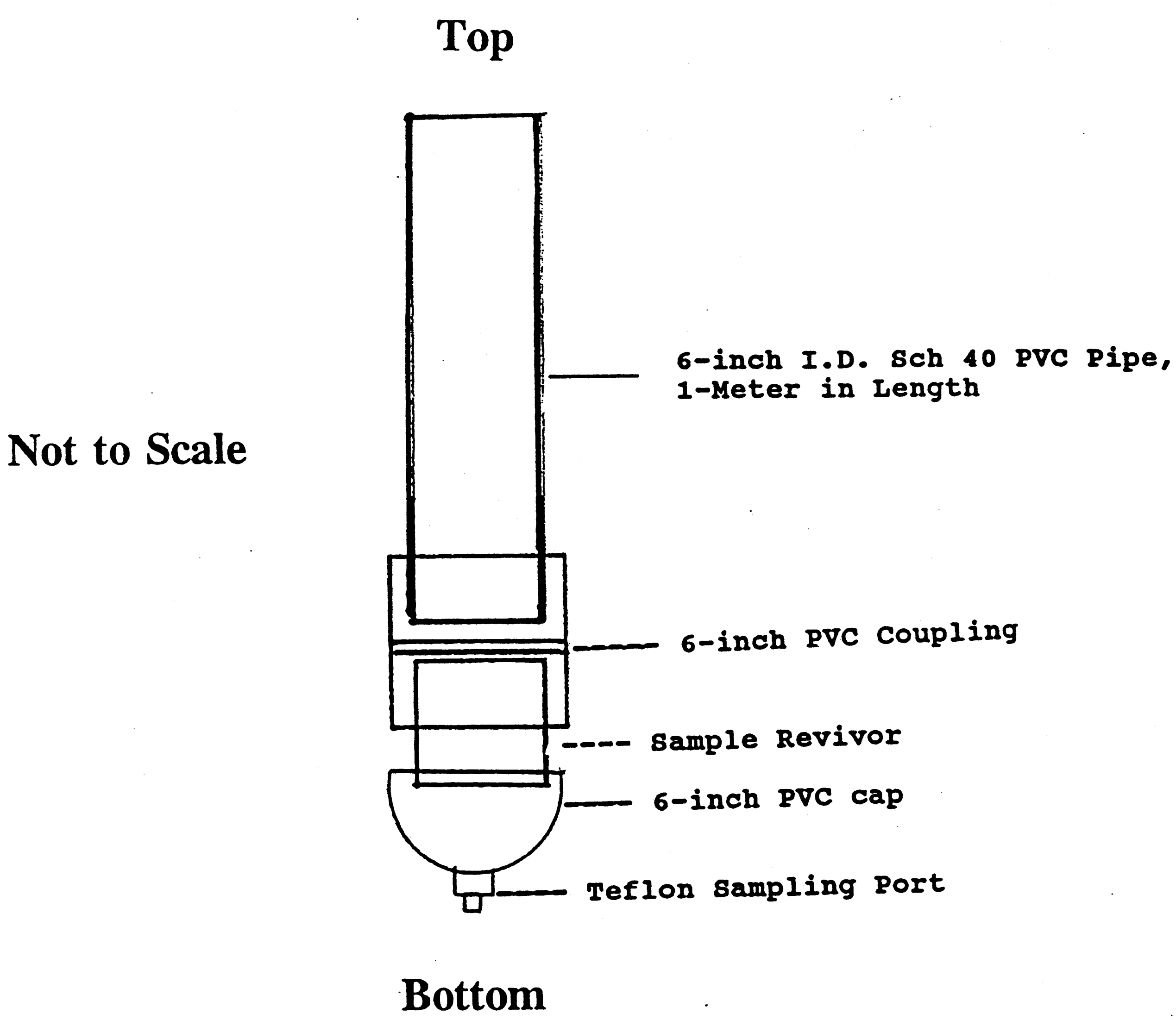
Soil columns used for the leachate studies were constructed of schedule 40 PVC, plexi-glass, stainless steel, and teflon. A completed column is shown in Figure 2. All parts used within the construction of the columns were scrubbed with a soap (Alconox) solution and then triple rinsed with distilled water.

The main body of the column consisted of a 1.1 meter in length, 6-inch diameter, schedule 40 PVC pipe. These pieces were cut from ten-foot sections of PVC pipe. Any edges left from the cutting of the column to proper length were sanded down to smooth, level surfaces. A schedule 40 PVC six-inch diameter couple (Figure 2) was attached to the top and bottom of the main body. The bottom coupling was used to connect the main body to the sample reservoir, and the top coupling was used to add height to the column. The additional height was needed since the soil was packed to the top of the main body.

The sample reservoir consisted of a six- to nine-inch long section of six-inch diameter, schedule 40 PVC. One end of the reservoir was inserted into the six-inch coupling. The other was sealed with a six-inch schedule 40 PVC cap. A hole was drilled

Figure 2

Soil Column Construction Diagram



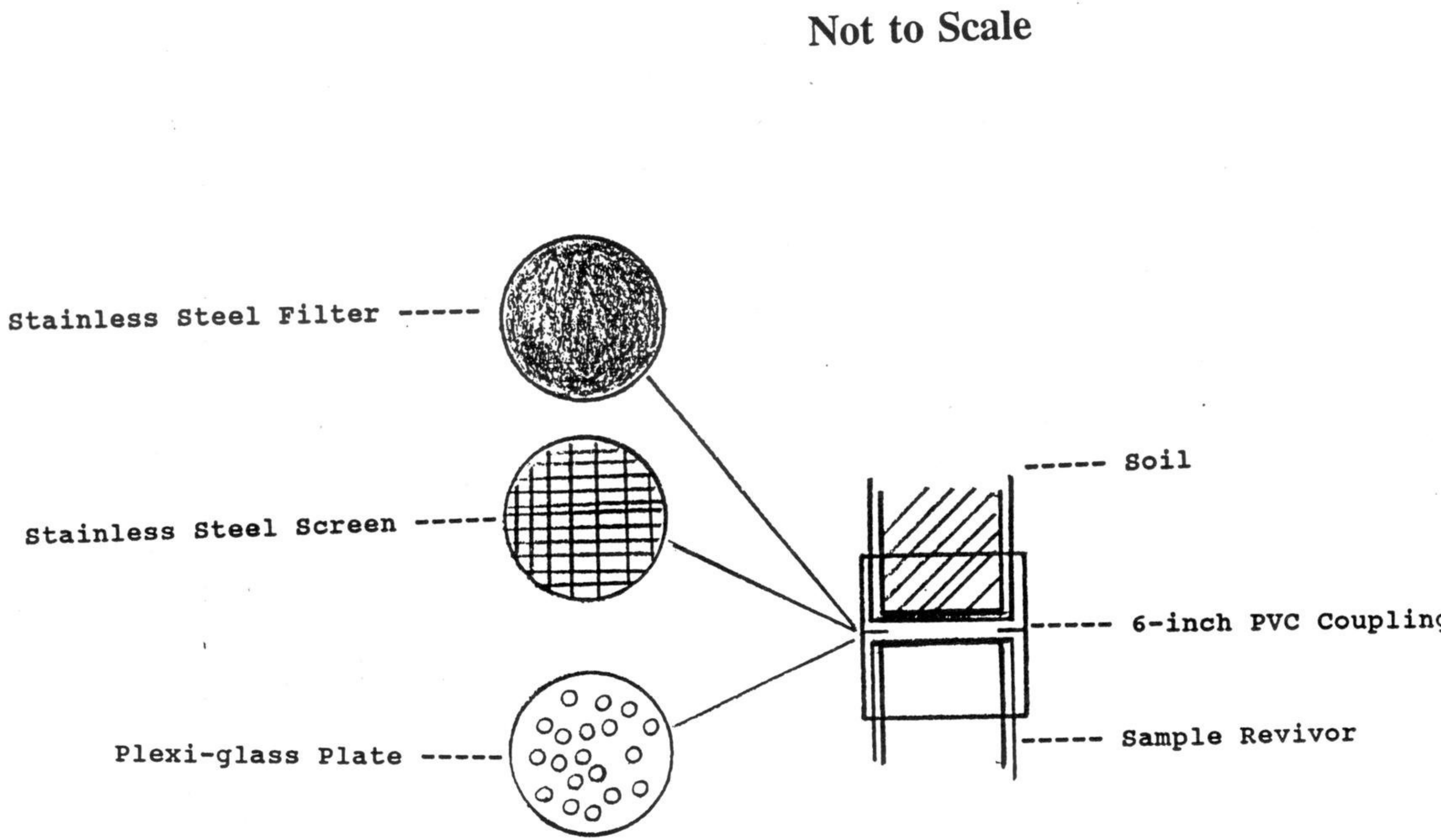
through the center of the PVC cap. The drilled hole was tapped and a teflon sampling port was threaded into the opening (Figure 2). Teflon tape was used to prevent leaks from the sides of the sampling port. The inside of the cap was sanded to prevent the pooling of liquid sample. The caps were tested with distilled water to ensure that minimal pooling of water occurred.

The soil was held within the column by placing a stainless steel filter disc, stainless steel screen, and a plexi-glass plate (with holes drilled through it) between the bottom of the main body and the coupling (Figure 3). The stainless steel filter discs (Figure 3) were approximately 1/16-inch in width, 6.5 inches in diameter and had a pore space of five microns. This pore space would allow for water to pass through the filter but would prevent the passage of the finer soil particles. The stainless steel screen was placed between the filter disc and the plexi-glass plate (Figure 3). This was done to prevent the filter disc from forming a seal with the plexi-glass plate, which could have allowed preferential flow of leachate through the filter disc in the areas of the filter disc which were over one of the 1/8-inch holes in the plexi-glass plate. The plexi-glass plate (Figure 3) was used to support the stainless steel filter and the weight of the soil within the soil column. The plexi-glass plate consisted of a 6.5-inch diameter, 1/4-inch thick plate with a series of 1/8-inch holes through the horizontal surface to allow leachate water to pass through.

The plexi-glass plate was placed on the lip on the inside of

Figure 3

Soil Column Coupling Connection Diagram



the schedule 40 PVC coupling (Figure 3). A stainless steel screen and filter disc were placed on top of the plexi-glass plate. The main body was then inserted until it was flush with the filter disc.

The seams of the completed column were sealed with a silicone base caulk which was allowed to dry for 48 hours after application. The column was then washed again with an Alconox solution and triple rinsed with distilled water. The column outlet port (Figure 2) was the plugged and the column was filled with distilled water to test for leaks. If leaks were detected, the column was emptied and re-caulked. The cleaning and testing process was then repeated until no leaks were detected. Once the column was leak free, it was placed on paper towels and allowed to air dry for 48 hours.

Column Packing Procedures

A completed column was prepared for packing by placing the column in an upright position on a piece of foam insulation. The sample port was protected by inserting it into a hole which was cut in the foam insulation. The column was then strapped to a work bench in the upright position using elastic cords.

Soil was prepared for insertion into the column by first sieving all the individual horizons of a soil type through a six-millimeter screen to remove rocks, roots, and any other debris within the soil. The soil was then poured through a riffle sampler and transferred back to the five-gallon buckets with new liners.

A sub-sample of each horizon was collected for background physical and chemical analysis.

Columns were packed by transferring the appropriate volume of soil for each horizon from the 5-gallon buckets to each column. Soil was transferred by placing the soil on a piece of cloth with strings attached to the corners. The soil was lowered to the bottom of the column and removed from the cloth. Transferring the soil in this manner prevented the soil form sorting by particle size, which would have occurred had the soil been poured from the top of the column. The column was tapped periodically with a rubber mallet to allow the soil the settle. A meter stick was used to ensure that the correct depth of each horizon was obtained. Upon completion of the packing of the soil, the top of the column was covered with aluminum foil, and the column was placed in the column stand.

Column Preparation for Chemical Application

The soil columns were re-hydrated to field moisture capacity (FMC) prior to the application of the inorganics and pesticides. FMC is defined as the amount of water held in a soil by capillary action after gravitational water has percolated downward and drained away; expressed as the ratio of the water retained to the weight of dry soil. The columns were first saturated using distilled water. This was completed by adding water from the bottom of the column using a gravity feed. The gravity feed consisted of a container held at a height equal to the top of the columns, with tubing connected to the sample port. The suspended container served as a water reservoir and was used to feed water to the column. Distilled water was added until water rose above the top of the soil within the column. The column was then allowed to equilibrate for seven to ten days. Each column was monitored daily and more distilled water was added when the water level dropped below the surface of the soil. Saturation of the columns using this procedure limited the possibility of dry zones within the soil columns and prevented the entrapment of air bubbles within the soil.

Once the columns had reached equilibrium, the sample ports were opened and the water was allowed to drain. No vacuum was applied during this process and the columns drained to FMC.

Any variations from the above procedure for either Column Set I or II were noted within their respective set-up sections.

Column Set-up

The bottom one-third (33 cm) of each column was wrapped in Tygon tubing in order to create a temperature gradient similar to that which would be found in the natural environment. The gradient was created by running cold water through the interconnected tubing on the 16 columns. The tubing was set up so that water coming directly from the source would only have to cool two soil columns. This prevented the water from warming and thus having various columns at different temperatures. The entire stand was also insulated using both fiberglass and foam board insulation material.

No temperature probes were used for this study. The temperature gradient was assumed to be present based on a preliminary study in which probes were inserted into the columns.

Once the column set-up was completed, a three-foot bubble level was used to ensure that all the columns were vertically level.

A sample collection container consisting of a two-liter glass flask fitted with 2-hole neoprene stoppers was connected to the sample discharge port of each column. One hole of the stopper was used to connect the container to the column discharge port with a piece of teflon tubing. The other hole was used to connect the vacuum hose.

The sample containers for each individual column were held in a galvanized tub underneath the stand. The tubs were filled with ice to cool the leachate coming off the columns to approximately 4 degrees Celsius. The melted ice water was drained daily and the ice replenished.

A vacuum system was attached to the columns to prevent water from pooling on the filter discs. The vacuum was operated for three minutes every other day. The vacuum source was from the College of Natural Resources building vacuum and was controlled using a water column. The vacuum at the water column was directed to four smaller water columns, one for each soil type. Four tubes were connected between the smaller water column and the sample containers. The vacuum tubing was connected to each sample container through a hole within the neoprene stopper. The length of tubing associated with each sample container was the same to prevent preferential flow from the vacuum. The vacuum was drawn at the sample port of each column.

Problems with the vacuum system were recorded in a log book.

Once the proper volume was determined for the water column to maintain a 30 kPA vacuum, the level was marked on the water columns. This level was checked weekly and the water volume adjusted as needed.

Chemical Application

Prior to the chemical application, each column was brought to FMC using the procedure listed in the Column Preparation for Chemical Application section of this document. The upper two- to four inches of soil in each column were mixed with a clean stainless steel spatula to produce a rough surface for chemical application. This was done to simulate field conditions.

The chemical compounds applied for this column study set were atrazine, alachlor, oxamyl aldicarb, carbofuran, carbaryl, potassium chloride (KCL), and ammonia nitrate (NH_4NO_3). The amounts of the individual compounds applied to each column are listed in Table 1.

All pesticides applied were laboratory grade neat standards, which were brought into solution with methanol. The standard were obtained from the USEPA. A pre-determined volume of the methanol solution, containing the pesticide, was transferred to 150 ml volumetric containing organic free water. The volume transferred was calculated to contain the designated mass (Table 1) of the pesticide.

why methanol. This is not used in the field.

The potassium chloride and ammonia nitrate used were reagent grade chemical standards. The standards were obtained from the chemical stock room of the Environmental Task Force Laboratory.

Table 1: Column Leachate Study Chemical Treatment Applications

COLUMN NUMBER	SOIL TYPE	PREVIOUS CHEMICAL TREATMENTS	CURRENT CHEMICAL TREATMENTS	
1	BURKART	NONE	**"High Concentrations"**	
			Atrazine	2.52 mg
			Alachlor	3.72 mg
			Aldicarb	3.16 mg
			Oxamyl	3.91 mg
			Carbofuran	3.15 mg
			Carbaryl	3.30 mg
			KCl	621 mg
			NH4NO3	621 mg
2	BURKART	NONE	**"High Concentrations"**	
			Atrazine	2.52 mg
			Alachlor	3.72 mg
			Aldicarb	3.16 mg
			Oxamyl	3.91 mg
			Carbofuran	3.15 mg
			Carbaryl	3.30 mg
			KCl	621 mg
			NH4NO3	621 mg
3	SPARTA	NONE	**"High Concentrations"**	
			Atrazine	2.52 mg
			Alachlor	3.72 mg
			Aldicarb	3.16 mg
			Oxamyl	3.91 mg
			Carbofuran	3.15 mg
			Carbaryl	4.60 mg
			KCl	621 mg
			NH4NO3	621 mg
4	SPARTA	NONE	**"High Concentrations"**	
			Atrazine	2.52 mg
			Alachlor	3.72 mg
			Aldicarb	3.16 mg
			Oxamyl	3.91 mg
			Carbofuran	3.15 mg
			Carbaryl	4.60 mg
			KCl	621 mg
			NH4NO3	621 mg
5	BURKART	NONE	**"Low Concentrations"**	
			Atrazine	1.78 mg
			Alachlor	1.86 mg
			Aldicarb	1.14 mg
			Oxamyl	1.20 mg
			Carbofuran	1.10 mg
			Carbaryl	1.84 mg
			KCl	621 mg
			NH4NO3	621 mg

Table 1: Column Leachate Study Chemical Treatment Applications

COLUMN NUMBER	SOIL TYPE	PREVIOUS CHEMICAL TREATMENTS	CURRENT CHEMICAL TREATMENTS
6	BURKART	NONE	**"Low Concentrations"** Atrazine 1.78 mg Alachlor 1.86 mg Aldicarb 1.14 mg Oxamyl 1.20 mg Carbofuran 1.10 mg Carbaryl 1.84 mg KCl 621 mg NH4NO3 621 mg
7	SPARTA	NONE	**"Low Concentrations"** Atrazine 1.78 mg Alachlor 1.86 mg Aldicarb 1.14 mg Oxamyl 1.20 mg Carbofuran 1.10 mg Carbaryl 1.84 mg KCl 621 mg NH4NO3 621 mg
8	SPARTA	NONE	**"Low Concentrations"** Atrazine 1.78 mg Alachlor 1.86 mg Aldicarb 1.14 mg Oxamyl 1.20 mg Carbofuran 1.10 mg Carbaryl 1.84 mg KCl 621 mg NH4NO3 621 mg
9	ANTIGO	NONE	Atrazine 2.52 mg Alachlor 3.72 mg Aldicarb 3.16 mg Oxamyl 3.91 mg Carbofuran 3.15 mg KCl 621 mg NH4NO3 621 mg
10	ANTIGO	KCL, NH4NO3 615 mg Alachlor (high), farm grade, 7.15 mg Previous leachate study	**"Low Concentrations"** Atrazine 1.78 mg Aldicarb 1.14 mg Oxamyl 1.20 mg Carbofuran 1.10 mg Carbaryl 1.84 mg
11	PLAINFIELD	KCL, NH4NO3 615 mg Atrazine (high), farm grade, 3.79 mg Previous leachate study	**"Low Concentrations"** Alachlor 1.86 mg Aldicarb 1.14 mg Oxamyl 1.20 mg Carbofuran 1.10 mg Carbaryl 1.84 mg

Same as "High" concent. columns.

Table 1: Column Leachate Study Chemical Treatment Applications

COLUMN NUMBER	SOIL TYPE	PREVIOUS CHEMICAL TREATMENTS	CURRENT CHEMICAL TREATMENTS
12	PLAINFIELD	Blank for Previous Study	**"High Concentrations"** Atrazine 2.52 mg Alachlor 3.72 mg Aldicarb 3.16 mg Oxamyl 3.91 mg Carbofuran 3.15 mg Carbaryl 4.60 mg KCl 621 mg NH4NO3 621 mg
13	ANTIGO	Blank for Previous Study	**"High Concentrations"** Atrazine 2.52 mg Alachlor 3.72 mg Aldicarb 3.16 mg Oxamyl 3.91 mg Carbofuran 3.15 mg Carbaryl 4.60 mg KCl 621 mg NH4NO3 621 mg
14	ANTIGO	KCL, NH4NO3 615 mg Atrazine (high), farm grade, 3.79 mg Previous leachate study	**"Low Concentrations"** Alachlor 1.86 mg Aldicarb 1.14 mg Oxamyl 1.20 mg Carbofuran 1.10 mg Carbaryl 1.84 mg
15	PLAINFIELD	KCL, NH4NO3 615 mg Alachlor (high), farm grade, 7.15 mg Previous leachate study	**"Low Concentrations"** Atrazine 1.78 mg Aldicarb 1.14 mg Oxamyl 1.20 mg Carbofuran 1.10 mg Carbaryl 1.84 mg
16	PLAINFIELD	NONE	**"High Concentrations"** Atrazine 2.52 mg Alachlor 3.72 mg Aldicarb 3.16 mg Oxamyl 3.91 mg Carbofuran 3.15 mg Carbaryl 4.60 mg KCl 621 mg NH4NO3 621 mg

mg = milligram
KCl = potassium chloride
NH4NO3 = ammonia nitrate

Application rates for pesticides were obtained from the application instructions provided by the manufacturers (Attachment 1). The high and low level rates were chosen to represent the range at which these chemicals are typically used. It should be noted that the manufacturer's instructions determine application amounts based on both the soil type and the type of pest control needed. The high and low application rates were chosen without consideration to these items.

Inorganic (KCl and NH_4NO_3) application rates were the same for all columns. A rate of 300 pounds per acre was used. This rate was determined to be an average application rate for fertilizers, used on agricultural cropland from conversations with University personnel.

The values obtained for pesticides and inorganics were based on a volume or mass per acre application rate. The applicable application rate for the area of the soil columns was determined by the calculation of a conversion factor which represented the ratio of the column surface area to the surface area of an acre. Each six-inch diameter column represented 2.25×10^{-6} acres. Therefore, the application rate given per acre multiplied by 2.25×10^{-6} equalled the proportional application rate for the column.

The inorganic compounds (KCl and NH_4NO_3) required that 613 mg be added to each column to represent a 300 pound per acre application rate. The compounds were prepared for application by dissolving 25.4 grams in two liters of distilled water. This solution allowed for the application of 635 mg by using 50 ml aliquots of the prepared solution for each column.

Prior to the chemical application, each column was brought to FMC using the procedure listed in the Column Preparation for Chemical Application section of this document. The upper two- to four inches of soil in each column was mixed with a clean stainless steel spatula to produce a rough surface for chemical application. This was done to simulate field conditions.

Chemical applications were completed by pouring the prepared solutions uniformly over the surface area of the soil column. The container which stored the chemical was rinsed once with distilled water. The rinsate was applied to the column. A total of 400 ml of liquid was added to each column. The order of chemical addition was the inorganic (KCl and NH_4NO_3) solution followed by the pesticide mixture. The treatments applied to each column are listed in Table 1.

A four-inch layer of clean, well-sorted sand was then applied to each column. The purpose of the sand was to disperse the simulated rain water.

Column Water Application

Distilled water was applied to the soil columns to facilitate soil leaching. No attempt was made to alter the chemistry of the distilled water to simulate that of rain water. The water was applied by pouring over the surface of the sand layer and allowed to infiltrate. During application, the water was not allowed to pool on the sand layer. A total of 5,200 mls of water was applied to each column. This total does include the 400 mls added during the initial chemical application. This volume represented approximately 21 inches of water applied to the column or 1.75 inches per application.

The 4,800 mls of water added equated out to approximately 800 mls per week over six weeks of the leachate study. These amounts were required to assure an adequate volume of leachate for analysis.

Inorganic Analytical Methodology

Inorganic water analyses were completed by the University of Wisconsin - Stevens Point Environmental Task Force Laboratory (ETF) using standard techniques. Nitrogen and chloride analyses were performed using the Technicon Autoanalyzer. Analyses were performed using ETF standard operating procedures. Ammonium analyses were also conducted using the Technicon Autoanalyzer. Samples were prepared for analysis using a Total Kjeldahl digestion.

Conductivity, pH, total alkalinity, calcium hardness, and chemical oxygen demand were completed following methods outlined in Standard Methods for the Examination of Water and Wastewater (APHA et al, 1983).

Pesticide Analytical Methodology

Atrazine and Alachlor Method

Atrazine and alachlor were analyzed by EPA Method 507. This method is a gas chromatographic (GC) method using a nitrogen and phosphorus detector (NPD).

Leachate samples were collected for analysis in one-liter amber glass containers with teflon-lined screw caps. No sample preservatives were added. Samples were refrigerated at 4^0C until ready for extraction. (Note: EPA Method 507 recommends the use of mercuric chloride as a preservative. It was not used due to its toxicity and handling requirements.)

Leachate samples were prepared for analysis by extraction using either a liquid to liquid or solid phase extraction method. Solid phase extractions were only used on samples in which emulsion made liquid to liquid extractions impractical.

Liquid to liquid extractions were performed per EPA 507 methodology using methylene chloride.

Surrogates were not used during the leachate study because it was not known if the carbamates would cause interferences.

Solid phase extractions were performed using Empore™ (C8, 47 mm) Extraction disks. The method used was provided by the vendor and is included in Attachment 2. Iso-octane was substituted for ethyl acetate in the method.

The final solvent for both the liquid to liquid extractions and the solid phase extractions was iso-octane. The final volume was dependent upon the original sample volume.

Triphenylphosphate (TPP) was added to the final volume of sample. Enough TPP was added to give a final concentration of approximately 1.34 mg/L. TPP volumes were recorded in the project notebook. TPP was added as an internal standard.

An internal standard is a pure compound which is added to a sample extract in a known amount and used to calibrate concentration measurements of other analytes that are target compounds. The internal standard is known not to be within the samples being analyzed prior to its addition.

Samples were prepared for analyses by transferring approximately 1 ml of the final volume to a 1.5 ml sample jar with an open top screw cap and a teflon-lined septum. Samples were placed in a numbered slot on the automatic sampler sample tray. Sample order was recorded on the injection log form.

Samples were analyzed by the injection of a 2-ul aliquot into the GC. Sample analytes were separated prior to the nitrogen and phosphorus detector using a 30m x 0.25 I.D. DB-5 bonded fused column with a 0.25 um film thickness.

Calibration standards and QA/QC samples were run in accordance with the recommendations contained in the method.

Sample results were obtained from the system integrator. The integrator is an electronic device which measures and records the signal output from the detector. The integrator can also be programmed (using the calibration standards) to report results in ppb. The integrator used is Hewlett-Packard HP3396A.

Sample results could also be calculated by transferring the integrator data files to a computer spreadsheet. The sample responses were manipulated within the spreadsheet to calculate sample concentrations.

Concentrations were calculated using either the integrator or the computer spreadsheet (Lotus or Excel).

Sample results from either the integrator or the computer spreadsheet were obtained using relative responses to the internal standards. This was completed by calculating a relative response factor for each analyte. Relative response refers to the analyte's response to the internal standard.

The relative responses of three calibration standards are plotted versus concentration. A best fit curve is drawn with the data points.

Relative responses from the unknown samples are compared to the curve and concentration values are obtained. These values represent the concentrations contained within the final volume of extractant. These values are converted to the concentration contained within the original sample by multiplying by the extraction ratio.

<u>Carbamates Analytical Methodology</u>

Carbamates were analyzed using EPA, Method 531.1 (EPA/600/4-85/054). This method is a high performance liquid chromatography (HPLC) method which uses a post column derivation and a fluorescence detector.

Leachate samples were collected for analysis in 40 ml glass vials with teflon-lined screw top lids. Samples were preserved with 2.5M monochloroacetic acid to a pH of less than 3. Samples were stored at 4^{0}C until ready for analysis.

Sample preparation consisted of filtering and transferring approximately 4 mL of the preserved leachate to a 5-mL sample vial with an open top screw cap and a teflon-line septum. Samples were filtered with a 0.45 um filter. The sample vials were then placed in the autosampler tray and the order of analysis was recorded on a sample injection log form.

A 540 uL sample was injected into the reverse-phase C^{18} 150 mm x 46 m I.D. packed column. Analyte separation is achieved using gradient elution chromatography. After elution from the column, the analytes are hydrolyzed with 0.05N sodium hydroxide (or potassium hydroxide) at $95^{0}C$. The methylamine formed during hydrolysis is reacted with a o-phenaldehyde and 2-mercaptoethanol to form a highly fluorescent derivate which is detected by the fluorescence detector.

Sample responses are measured on the HP3396A integrator. Concentrations are calculated using external calibration standard methods.

External calibration calculations are performed by comparing sample analyte responses to the calibration curve contained within the integrator. The calibration curve is programmed within the integrator from the measured responses to three known concentration standards. The integrator produces a best-fit linear curve. Since no extraction involving the concentration of the samples was performed, the integrator reads the results in ppb within the sample.

Soil Core Volumes (FMC)

The volume of water which each soil column held at field moisture capacity was determined at the end of each column set study. After being allowed to drain for approximately seven days, the soil columns were stored upright in a freezer until time of processing.

Soil columns were processed by taking the frozen column and cutting/breaking the PVC casing to expose the soil. Care was taken so that no PVC cuttings or pieces were mixed with the soil.

The exposed soil was sectioned into six intervals. The top five intervals (0-75 cm) were 15 cm in width. The width of the bottom interval (sixth) varied from 18 to 25 cm. The sixth interval consisted of all the remaining soil behind the fifth interval or the 75 cm mark.

Each section or interval of soil was placed in a pre-weighed container and weighed on a triple-arm balance. These weights were recorded in the project notes. The containers were covered with brown paper and placed in the soil air-drying ovens. The temperature of the ovens was maintained at 70^0F.

The sections were allowed to dry for ten to twenty days. Each section pan was mixed every two- to three days to assure all the soil was being air-dried.

Once a section was determined to be air-dried, the container was again weighed. This weight was also recorded in the project notes. The percent moisture for each section was calculated using the following equation:

$$\text{Percent moisture } (\% M_I) = \frac{[\text{Initial weight (g)} - \text{Air-dried weight (g)}]}{\text{Initial weight (g)}} \times 100$$

A sub-sample of each air-dried interval was collected in a pre-dried (at 104^0F), pre-weighed aluminum pan and dried for 24 hours at 104^0F. The pan was then placed in a desiccator and allowed to cool to room temperature. The dish was then weighed again. Percent moisture was again calculated using the following calculation:

$$\text{Percent moisture } (\%\ M_2) = \frac{[\text{Initial weight (g)} - \text{Oven-dried weight (g)}]}{\text{Initial weight (g)}} \times 100$$

The air-dried percent moisture and the oven-dried percent moisture were added to total percent moisture (% M). The initial wet weight of soil was then multiplied by the total percent moisture to determine grams (g) of water. Grams (g) of water was converted to mL using the density of water at standard temperature and pressure (1 g = 1 mL). The water volumes for each section were totaled to give the total volume of water contained within each soil column at field moisture capacity.

Pesticide and Soil - General Characteristics

A total of six pesticides were used for the Column Set II leaching study. The pesticides, their class, other names, and known metabolites are listed in Table 2.

The chemical characteristics which affect leachability are shown in Table 3. Those characteristics which are in direct relation to soil properties are listed by soil type where possible. Aldicarb was detected regularly in three forms (Aldicarb, Aldicarb sulfone, and Aldicarb sulfoxide) and is therefore listed in each form on the table. If values were found for the metabolites, these were also listed.

The physical properties of the four soil types tested (Antigo, Burkart, Plainfield, and Sparta) are listed in Table 4. These values were measured in laboratory experiments.

Table 2: Pesticide General Information for Compounds used in the Column Leaching Study

Compound	Class	Other Names	Action	Degradation Products
Oxamyl	Carbamate	Vydate	Insecticide, Acaricide and Nematicide	
Aldicarb	Carbamate	Temik	Systemic Insecticide, Acaricide and Nematicide	Aldicarb Sulfone, Aldicarb Sulfoxide
Carbofuran	Carbamate	Furan, Curaterr, Yaltox	Broad Spectrum Insecticide, Nematicide and Miticide	3-Hydroxy-Carbofuran, 3-Keyto-7-Phenol, 3-Hydroxy-7-Phenol, 7-Phenol
Carbaryl	Carbamate	Sevin, Ravyon, Tercyl, Tricarnam	Broad Spectrum Insecticide	1-Naphthol
Atrazine	Triazine	AAtrex	Herbicide	Deethylatrazine, Diesopropylatrazine
Alachlor	Triazine	Lasso, Alanex	Herbicide	2-Chloro-2'-6'-diethylacetanilide

TABLE 3
Pesticide Water Solubility and Koc Data

	Oxamyl	Aldicarb Sulfone	Aldicarb Sulfoxide	Aldicarb	Carbofuran	Carbaryl	Atrazine	Alachlor
Solubility (mg/L) (Temp. 20-25 C)	2.80E+05	8,000	333,000	6000	700	40	33	220
Koc (b)	0.003	NK	NK	70	40	22	64	18
Vapor Pressure (mm Hg @ 25 C)	NK	0.00005	0.00007	0.0001	0.00002	0.002	0.000001	NK

NK = not known at time of print
(b)Jury et al, 1984; Rao et al, 1985; and Wilkerson et al, 1984.

Table 4: Physical and Chemical Characteristics of Soils used for Column Study

Soil Type	Horizion (depth - inches)	cm	Organic Matter (%)	Particle Size (%) Sand	Silt	Clay	pH	Conductivity (cm\min)
Antigo	Ap (0-10)	0-25	2.15	87	2	11	5.69	0.0031
	E (10-18)	25-46	0.403	72	2	24	4.82	0.0039
	Bt1 (18-28)	46-71	0.224	70	5	25	4.83	0.00014
	2Bt (28-35)	75-89	0.206	70	5	25	4.62	0.014
	2C (35-40)	89-100	0.138	81	1	19	4.67	Not tested
Burkart	Ap (0-7)	0-18	1.36	80	2	18	5.7	0.154
	A12 (7-10)	18-25	0.79	74	21	5	4.91	0.046
	B2t (10-19)	25-48	0.37	67	21	12	4.81	0.158
	IIC1 (19-29)	48-74	0.19	85	8	7	4.87	0.124
	IIC2 (29-60)	74-100	0.04	90	3	7	4.67	0.832
Plainfield	Ap (0-8)	0-20	1.03	94	1	5	5.65	0.554
	B2 (8-14)	20-36	0.172	94	1	5	7.15	0.559
	B3 (14-19)	36-48	0.138	90	2	8	7.1	0.857
	C1 (19-31)	48-79	0.086	95	1	4	6.83	0.712
	C2 (31-40)	79-100	0.034	97	1	2	6.84	1.77
Sparta	Ap (0-10)	0-25	0.47	95	2	3	6	0.705
	Ac (10-22)	25-56	0.12	95	3	2	4.8	0.96
	C (22-40)	56-100	0.03	95	2	3	6.8	1.1

RESULTS

Leachate and soil (if applicable) chemical results for pesticides, nitrates, and chlorides are presented by soil type. Soil moisture results from the termination of the leaching study are shown in Table 5. The weekly leachate volumes and recoveries are listed in Table 6. This table represents the percentage of water added that was recovered from the previous week's application.

Table 7 lists the amount of leachate recovered relative to the water holding capacity (FMC pore volume) of the column. The FMC pore volume represents the volume of water in the column at Field Moisture Capacity (FMC) as shown in Table 5. The total percent of this FMC pore volume leached is represented by the percent recovery shown in Week 7 of this table. These data indicate that for Sparta and Plainfield soil, the volume of leachate collected was about 200 percent of the FMC pore volume, while for Antigo and Burkart soil, it was only 60 to 80 percent. This is due to the texture differences and the fact that the same water volumes were added to each column.

Pesticide leaching data for this column run is displayed in Table 8. This table also lists the percent recoveries of the pesticide compounds that occurred in the leachate relative to the amount added to the soil.

Inorganic leaching data is recorded in Table 9. This table lists both ppm concentrations and mass of compound. Leachate data for nitrate+nitrite-N and chlorides is shown graphically in

Table 5: Percent Moisture for 16 Columns used in Leachate Study
(Page 1 of 3)

Column Soil type	Depth Interval (cm)	Percent Moisture from Air-Dried Weight	Percent Moisture from Air-Dried Weight	Total Percent Moisture	Average
1	0-15	21	0.80	22.17	20%
Burkart	15-30	19	0.70	20.13	
	30-45	19	0.37	18.92	
	45-60	19	0.86	20.35	
	60-75	20	0.37	20.83	
	75-96	17	0.75	17.72	
2	0-15	21	0.70	21.71	20%
Burkart	15-30	19	0.49	19.58	
	30-45	18	0.33	18.52	
	45-60	20	0.40	20.27	
	60-75	21	0.38	20.99	
	75-94	17	0.36	17.36	
3	0-15	7	0.31	6.97	7%
Sparta	15-30	7	0.30	7.17	
	30-45	6	0.29	6.59	
	45-60	6	0.17	6.13	
	60-75	4	0.20	4.67	
	75-100	10	0.37	10.75	
4	0-15	7	0.36	7.51	7%
Sparta	15-30	7	0.43	7.36	
	30-45	7	0.27	6.85	
	45-60	7	0.20	6.84	
	60-75	5	0.06	5.21	
	75-100	11	0.07	10.83	
5	0-15	19	2.43	21.74	20%
Burkart	15-30	19	0.58	19.41	
	30-45	18	0.43	18.29	
	45-60	19	0.35	19.74	
	60-75	20	0.45	20.77	
	75-96	17	0.52	17.59	
6	0-15	20	0.63	21.05	20%
Burkart	15-30	19	0.56	19.44	
	30-45	18	0.38	18.78	
	45-60	20	0.41	20.23	
	60-75	21	0.35	21.56	
	75-94	18	0.31	18.48	

Table 5: Percent Moisture for 16 Columns used in Leachate Study

Column Soil type	Depth Interval (cm)	Percent Moisture from Air-Dried Weight	Percent Moisture from Air-Dried Weight	Total Percent Moisture	Average
7 Sparta	0-15	7	0.21	7.18	7%
	15-30	8	0.21	7.90	
	30-45	7	0.20	7.48	
	45-60	7	0.13	7.03	
	60-75	5	0.04	4.84	
	75-100	10	0.10	9.82	
8 Sparta	0-15	7	0.31	7.22	7%
	15-30	7	0.32	7.78	
	30-45	7	0.24	6.86	
	45-60	6	0.24	6.55	
	60-75	3	0.06	2.98	
	75-102	10	0.61	10.54	
9 Antigo	0-15	26	3.04	28.97	26%
	15-30	22	-1.79	20.38	
	30-45	24	2.73	26.74	
	45-60	25	1.97	27.44	
	60-75	23	4.74	27.86	
	75-96	19	5.24	24.68	
10 Antigo	0-15	26	1.38	27.54	26%
	15-30	24	2.02	26.07	
	30-45	23	1.79	25.24	
	45-60	24	2.12	25.82	
	60-75	25	1.63	26.29	
	75-95	21	2.24	23.15	
11 Plainfield	0-15	8	0.34	8.25	7%
	15-30	7	0.22	6.75	
	30-45	5	0.19	5.64	
	45-60	5	0.19	5.49	
	60-75	6	0.20	6.66	
	75-94	9		9.29	
12 Plainfield	0-15	8	0.36	8.57	7%
	15-30	6	0.27	6.74	
	30-45	6	0.18	5.73	
	45-60	6	0.72	6.33	
	60-75	6	0.14	5.84	
	75-94	9	0.08	9.27	

Table 5: Percent Moisture for 16 Columns used in Leachate Study
(Page 3 of 3)

Column Soil type	Depth Interval (cm)	Percent Moisture from Air-Dried Weight	Percent Moisture from Air-Dried Weight	Total Percent Moisture	Average
13	0-15	26	1.17	27.65	26%
Antigo	15-30	25	1.21	26.23	
	30-45	24	1.71	25.30	
	45-60	25	1.52	26.72	
	60-75	24	1.57	25.57	
	75-97	21	1.30	22.79	
14	0-15	22	1.14	22.81	21%
Antigo	15-30	20	1.36	21.70	
	30-45	19	2.30	21.32	
	45-60	19	2.89	22.09	
	60-75	19	2.36	21.74	
	75-95	16	3.10	19.02	
15	0-15	5	0.49	5.49	7%
Plainfield	15-30	7	0.39	7.39	
	30-45	8	0.22	8.22	
	45-60	5	0.19	5.19	
	60-75	5	0.16	5.16	
	75-93	11	0.15	11.15	
16	0-15	6	0.29	6.72	7%
Plainfield	15-30	7	0.20	7.05	
	30-45	7	0.08	6.93	
	45-60	6	0.09	5.73	
	60-75	5	0.12	5.01	
	75-99	10	0.12	10.26	

Table 6: Weekly Leachate Volumes Collected and Percent Recoveries Related to Water Added

Column	Soil Type	Week* 2 Amount Collected (ml)	2 Recovery	3 Amount Collected (ml)	3 Recovery	4 Amount Collected (ml)	4 Recovery	5 Amount Collected (ml)	5 Recovery	6 Amount Collected (ml)	6 Recovery	7 Amount Collected (ml)	7 Recovery	Totals Amount Collected (ml)	Totals Recovery
1	Burkart	760	95%	649	81%	680	85%	703	88%	406	51%	750	94%	3948	82%
2	Burkart	720	90%	732	92%	1487	186%	745	93%	1028	129%	712	89%	5424	113%
3	Sparta	1070	134%	350	44%	1000	125%	738	92%	720	90%	705	88%	4583	95%
4	Sparta	1024	128%	350	44%	987	123%	684	86%	743	93%	698	87%	4486	93%
5	Burkart	697	87%	652	82%	900	113%	666	83%	688	86%	743	93%	4346	91%
6	Burkart	692	87%	702	88%	767	96%	741	93%	756	95%	720	90%	4378	91%
7	Sparta	929	116%	403	50%	990	124%	702	88%	716	90%	763	95%	4503	94%
8	Sparta	1121	140%	410	51%	935	117%	698	87%	735	92%	723	90%	4622	96%
9	Antigo	630	79%	670	84%	680	85%	672	84%	681	85%	680	85%	4013	84%
10	Antigo	766	96%	670	84%	690	86%	735	92%	730	91%	688	86%	4279	89%
11	Plainfield	717	90%	330	41%	950	119%	608	76%	818	102%	740	93%	4163	87%
12	Plainfield	799	100%	325	41%	890	111%	616	77%	778	97%	743	93%	4151	86%
13	Antigo	755	94%	650	81%	705	88%	706	88%	687	86%	691	86%	4194	87%
14	Antigo	856	107%	700	88%	750	94%	677	85%	716	90%	673	84%	4372	91%
15	Plainfield	712	89%	428	54%	940	118%	681	85%	793	99%	785	98%	4339	90%
16	Plainfield	809	101%	350	44%	940	118%	579	72%	833	104%	710	89%	4221	88%

* Week 1 leachate data is consider residual for the re-wetting process

Table 7: **Soil Column Water Volumes at Field Moisture Capacity (FMC) and the Accumulative Percent Recovery of the FMC Leached**

Column Number	Soil Type	FMC Pore Volume	Week 1*	2*	3*	4*	5*	6*	7*
1	Burkart	6118	4%	16%	27%	38%	49%	56%	68%
2	Burkart	6051	8%	20%	32%	56%	69%	86%	98%
3	Sparta	2278	23%	69%	84%	128%	160%	191%	221%
4	Sparta	2484	15%	56%	70%	110%	137%	167%	195%
5	Burkart	6030	5%	16%	27%	42%	53%	64%	77%
6	Burkart	6073	9%	20%	32%	44%	56%	69%	81%
7	Sparta	2395	33%	72%	88%	129%	158%	188%	220%
8	Sparta	2297	33%	81%	99%	139%	168%	200%	231%
9	Antigo	7438	8%	17%	26%	35%	44%	53%	62%
10	Antigo	7217	5%	15%	25%	34%	44%	54%	64%
11	Plainfield	2040	16%	51%	67%	114%	143%	183%	219%
12	Plainfield	2035	15%	54%	70%	113%	143%	181%	217%
13	Antigo	7312	3%	13%	22%	32%	41%	51%	60%
14	Antigo	5916	6%	21%	33%	45%	57%	69%	80%
15	Plainfield	2354	13%	43%	62%	102%	131%	164%	198%
16	Plainfield	2339	35%	69%	84%	124%	149%	184%	214%

* Volume of water added = 0.800 Liters

Table 8 : Mass of Pesticide Collected in Leachate for 16 Columns Over a 7-week Leaching Period

COLUMN No. (SOIL TYPE)	SET No.	LEACHATE VOLUME	MASS OF COMPOUNDS LEACHED (% OF TOTAL APPLIED) (TOTAL APPLIED) A-Sulfx ug	A-sulfn ug	Ald ug	Total Ald ug	Percent Rec	OXAMYL ug	Percent Rec	3-H-Car ug	Carbo ug	Total Carbo	Percent Rec	Carba ug	Percent Rec	Atraz ug	Percent Rec	Alach ug	Percent Rec
1 (BURKART)	1	234	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	760	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.02	**0.0%**	0.58	**0.0%**
	3	649	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.03	**0.0%**	0.63	**0.0%**
	4	680	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	5	703	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	6	406	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.06	**0.0%**	ND	**0.0%**
	7	750	12.68	ND	ND	12.68	**0.4%**	ND	**0.0%**	ND	18.75	18.75	**0.5%**	ND	**0.0%**	0.28	**0.0%**	ND	**0.0%**
	TOTAL	4182	12.68	0.00	0.00	12.68	**0.4%**	0.00	**0.0%**	0.00	18.75	18.75	**0.5%**	0.00	**0.0%**	0.40	**0.0%**	1.22	**0.0%**
2 (BURKART)	1	478	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	720	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.02	**0.0%**	0.51	**0.0%**
	3	732	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.02	**0.0%**	0.67	**0.0%**
	4	1487	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	5	745	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.05	**0.0%**	ND	**0.0%**
	6	1028	ND	ND	LS	ND	**0.0%**	ND	**0.0%**	LS	LS	LS	**0.0%**	LS	**0.0%**	0.46	**0.0%**	ND	**0.0%**
	7	712	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	TOTAL	5902	0.00	0.00	0.00	0.00	**0.0%**	0.00	**0.0%**	0.00	0.00	0.00	**0.0%**	0.00	**0.0%**	0.54	**0.0%**	1.18	**0.0%**
3 (SPARTA)	1	525	ND	ND	ND	0.00	**0.0%**	ND	**0.0%**	ND	ND	0.00	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	1070	ND	ND	ND	0.00	**0.0%**	ND	**0.0%**	ND	ND	0.00	**0.0%**	ND	**0.0%**	0.03	**0.0%**	0.63	**0.0%**
	3	350	ND	ND	ND	0.00	**0.0%**	ND	**0.0%**	ND	ND	0.00	**0.0%**	ND	**0.0%**	0.01	**0.0%**	0.34	**0.0%**
	4	1000	412.00	57.00	ND	469.00	**14.8%**	595.00	**15.2%**	ND	75.50	75.50	**2.4%**	ND	**0.0%**	11.40	**0.5%**	ND	**0.0%**
	5	738	562.36	122.51	ND	684.86	**21.7%**	805.16	**20.6%**	ND	402.95	402.95	**12.8%**	ND	**0.0%**	12.40	**0.0%**	1.50	**0.0%**
	6	720	73.44	15.84	107.28	196.56	**6.2%**	107.28	**2.7%**	ND	40.32	40.32	**1.3%**	ND	**0.0%**	17.21	**0.7%**	3.30	**0.1%**
	7	705	34.90	13.82	ND	48.72	**1.5%**	60.91	**1.6%**	ND	108.57	108.57	**3.4%**	ND	**0.0%**	7.83	**0.3%**	ND	**0.0%**
	TOTAL	5108	1082.69	209.17	107.28	1399.14	**44.3%**	1568.35	**40.1%**	0.00	627.34	627.34	**19.9%**	0.00	**0.0%**	48.87	**1.4%**	5.77	**0.2%**
4 (SPARTA)	1	387	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	1024	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.09	**0.0%**	0.64	**0.0%**
	3	350	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.01	**0.0%**	0.28	**0.0%**
	4	987	291.17	21.22	ND	312.39	**9.9%**	393.81	**10.1%**	ND	43.82	43.82	**1.4%**	ND	**0.0%**	1.25	**0.0%**	ND	**0.0%**
	5	684	303.01	24.30	7.93	335.25	**10.6%**	362.52	**9.3%**	ND	473.33	473.33	**15.0%**	ND	**0.0%**	12.11	**0.5%**	0.86	**0.0%**
	6	743	276.02	50.26	31.91	358.20	**11.3%**	455.09	**11.6%**	ND	626.35	626.35	**19.9%**	ND	**0.0%**	18.43	**0.7%**	4.43	**0.1%**
	7	698	59.75	23.87	24.99	108.61	**3.4%**	112.38	**2.9%**	ND	280.60	280.60	**8.9%**	ND	**0.0%**	9.79	**0.4%**	5.14	**0.1%**
	TOTAL	4873	929.95	119.66	64.83	1114.44	**35.3%**	1323.80	**33.9%**	0.00	1424.10	1424.10	**45.2%**	0.00	**0.0%**	41.68	**1.7%**	11.35	**0.3%**

A-Sulfx = aldicarb sulfoxide, A-Sulfn = aldicarb sulfone, Ald = aldicarb, 3-H-Car = 3-hydroxy-carbofuran, Carbo = carbofuran, Carba = Carbaryl, Atraz = atrazine, Alach = alachlor
ND = not detected
ug = m[illegible]ram

BTOTS.XLS

Table 8 : Mass of Pesticide Collected in Leachate for 16 Columns Over a 7-week Leaching Period

COLUMN No. (SOIL TYPE)	SET No.	LEACHATE VOLUME	MASS OF COMPOUNDS LEACHED (% OF TOTAL APPLIED) (TOTAL APPLIED)																
			A-Sulfx ug	A-sulfn ug	Ald ug	Total Ald ug	Percent Rec	OXAMYL ug	Percent Rec	3-H-Car ug	Carbo ug	Total Carbo	Percent Rec	Carba ug	Percent Rec	Atraz ug	Percent Rec	Alach ug	Percent Rec
5 (BURKART)	1	275	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	697	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.01	**0.0%**	0.44	**0.0%**
	3	652	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.03	**0.0%**	0.57	**0.0%**
	4	900	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.03	**0.0%**	0.06	**0.0%**
	5	666	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.16	**0.0%**	ND	**0.0%**
	6	668	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.14	**0.0%**	ND	**0.0%**
	7	743	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.34	**0.0%**	ND	**0.0%**
	TOTAL	4601	0.00	0.00	0.00	0.00	**0.0%**	0.00	**0.0%**	0.00	0.00	0.00	**0.0%**	0.00	**0.0%**	0.70	**0.0%**	1.07	**0.1%**
6 (BURKART)	1	519	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	692	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.02	**0.0%**	0.48	**0.0%**
	3	702	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.03	**0.0%**	0.59	**0.0%**
	4	767	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.01	**0.0%**	ND	**0.0%**
	5	741	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	6	756	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.24	**0.0%**	ND	**0.0%**
	7	720	3.46	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.18	**0.0%**	ND	**0.0%**
	TOTAL	4897	3.46	0.00	0.00	0.00	**0.0%**	0.00	**0.0%**	0.00	0.00	0.00	**0.0%**	0.00	**0.0%**	0.48	**0.0%**	1.07	**0.1%**
7 (SPARTA)	1	788	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.23	**0.0%**	0.28	**0.0%**
	2	929	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.12	**0.0%**	ND	**0.0%**
	3	403	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.01	**0.0%**	0.32	**0.0%**
	4	990	57.42	5.94	ND	63.36	**5.6%**	103.46	**8.6%**	ND	ND	ND	**0.0%**	ND	**0.0%**	2.02	**0.1%**	ND	**0.0%**
	5	702	148.12	37.28	3.04	188.44	**16.5%**	256.93	**21.4%**	ND	154.44	154.44	**14.0%**	ND	**0.0%**	19.73	**1.1%**	2.11	**0.1%**
	6	716	42.17	20.33	5.86	68.36	**6.0%**	127.45	**10.6%**	0.90	153.22	154.13	**14.0%**	ND	**0.0%**	10.31	**0.6%**	3.76	**0.2%**
	7	763	6.34	4.87	3.16	14.37	**1.3%**	23.88	**2.0%**	0.82	64.70	65.53	**6.0%**	ND	**0.0%**	10.00	**0.6%**	4.90	**0.3%**
	TOTAL	5291	254.05	68.42	12.06	334.53	**29.3%**	511.72	**42.6%**	1.73	372.37	374.09	**34.0%**	0.00	**0.0%**	42.41	**2.4%**	11.36	**0.6%**
8 (SPARTA)	1	773	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.12	**0.0%**	ND	**0.0%**
	2	1121	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.30	**0.0%**	ND	**0.0%**
	3	410	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.01	**0.0%**	0.28	**0.0%**
	4	935	169.24	15.43	ND	184.66	**16.2%**	366.52	**30.5%**	ND	1.96	1.96	**0.2%**	ND	**0.0%**	0.96	**0.1%**	ND	**0.0%**
	5	689	200.15	43.75	1.27	245.18	**21.5%**	374.47	**31.2%**	ND	177.07	177.07	**16.1%**	ND	**0.0%**	6.41	**0.4%**	0.62	**0.0%**
	6	735	43.29	16.68	6.36	66.33	**5.8%**	147.00	**12.3%**	ND	202.86	202.86	**18.4%**	ND	**0.0%**	10.44	**0.6%**	3.56	**0.2%**
	7	723	7.30	5.66	3.33	16.30	**1.4%**	26.90	**2.2%**	ND	119.30	119.30	**10.8%**	ND	**0.0%**	5.74	**0.3%**	3.15	**0.2%**
	TOTAL	5386	419.98	81.52	10.96	512.47	**45.0%**	914.89	**76.2%**	0.00	501.19	501.19	**45.6%**	0.00	**0.0%**	23.97	**1.3%**	7.61	**0.4%**

A-Sulfx = aldicarb sulfoxide, A-Sulfn = aldicarb sulfone, Ald = aldicarb, 3-H-Car = 3-hydroxy-carbofuran, Carbo = carbofuran, Carba = Carbaryl, Atraz = atrazine, Alach = alachlor
ND = not detected
ug = microgram

COLUMN No. (SOIL TYPE)	SET No.	LEACHATE VOLUME	MASS OF COMPOUNDS LEACHED (% OF TOTAL APPLIED) (TOTAL APPLIED) A-Sulfx ug	A-sulfn ug	Ald ug	Total Ald ug	Percent Rec	OXAMYL ug	Percent Rec	3-H-Car ug	Carbo ug	Total Carbo	Percent Rec	Carba ug	Percent Rec	Atraz ug	Percent Rec	Alach ug	Percent Rec
9 (ANTIGO)	1	2600	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	N/A		0.20	**0.0%**	ND	**0.0%**
	2	630	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	N/A		ND	**0.0%**	ND	**0.0%**
	3	670	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	N/A		0.01	**0.0%**	0.45	**0.0%**
	4	680	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	N/A		ND	**0.0%**	0.05	**0.0%**
	5	672	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	N/A		0.02	**0.0%**	ND	**0.0%**
	6	681	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	N/A		0.52	**0.0%**	ND	**0.0%**
	7	680	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	N/A		0.02	**0.0%**	ND	**0.0%**
	TOTAL	6613	0.00	0.00	0.00	0.00	**0.0%**	0.00	**0.0%**	0.00	0.00	0.00	**0.0%**	0.00		0.77	**0.0%**	0.49	**0.0%**
10 (ANTIGO)	1	335	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	766	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.05	**0.0%**	ND	**0.0%**
	3	670	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.29	**0.0%**	8.24	**0.1%**
	4	690	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.02	**0.0%**	0.07	**0.0%**
	5	735	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	0.12	**0.0%**	0.06	**0.0%**
	6	730	0.25	1.53	ND	1.78	**0.2%**	ND	**0.0%**	ND	3.43	3.43	**0.3%**	ND	**0.0%**	0.37	**0.0%**	ND	**0.0%**
	7	688	3.44	0.28	ND	3.72	**0.3%**	9.70	**0.8%**	ND	6.05	6.05	**0.6%**	ND	**0.0%**	0.62	**0.0%**	0.10	**0.0%**
	TOTAL	4614	3.69	1.81	0.00	5.50	**0.5%**	9.70	**0.8%**	0.00	9.49	9.49	**0.9%**	0.00	**0.0%**	1.46	**0.1%**	8.47	**0.1%**
11 (PLAINFIELD)	1	338	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	717	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	3	330	6.83	ND	1.06	7.89	**0.7%**	14.42	**1.2%**	ND	5.51	5.51	**0.5%**	ND	**0.0%**	0.09	**0.0%**	0.31	**0.0%**
	4	950	193.80	15.58	4.37	213.75	**18.8%**	313.50	**26.1%**	ND	220.40	220.40	**20.0%**	ND	**0.0%**	13.47	**0.4%**	0.54	**0.0%**
	5	608	118.56	29.24	ND	147.80	**13.0%**	192.74	**16.1%**	ND	127.68	127.68	**11.6%**	ND	**0.0%**	6.63	**0.2%**	0.54	**0.0%**
	6	818	70.76	34.36	ND	105.11	**9.2%**	130.06	**10.8%**	ND	93.25	93.25	**8.5%**	ND	**0.0%**	10.39	**0.3%**	0.88	**0.0%**
	7	740	12.73	12.88	ND	25.60	**2.2%**	30.93	**2.6%**	ND	38.85	38.85	**3.5%**	ND	**0.0%**	5.87	**0.1%**	0.35	**0.0%**
	TOTAL	4501	402.68	92.06	5.43	500.16	**43.9%**	681.65	**56.8%**	0.00	485.69	485.69	**44.2%**	0.00	**0.0%**	36.44	**1.0%**	2.62	**0.1%**
12 (PLAINFIELD)	1	310	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	2	799	ND	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	ND	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**	ND	**0.0%**
	3	325	5.36	ND	4.03	9.39	**0.3%**	9.75	**0.2%**	ND	2.76	2.76	**0.1%**	ND	**0.0%**	0.15	**0.0%**	0.26	**0.0%**
	4	890	189.57	22.07	14.51	226.15	**7.2%**	295.48	**7.6%**	ND	97.90	97.90	**3.1%**	ND	**0.0%**	63.99	**2.5%**	0.17	**0.0%**
	5	616	126.28	32.65	ND	158.93	**5.0%**	155.85	**4.0%**	ND	47.43	47.43	**1.5%**	ND	**0.0%**	14.35	**0.6%**	0.04	**0.0%**
	6	778	217.06	106.59	9.65	333.30	**10.5%**	293.31	**7.5%**	2.88	988.84	991.72	**31.5%**	ND	**0.0%**	31.42	**1.2%**	1.34	**0.0%**
	7	743	42.57	24.96	8.02	75.56	**2.4%**	52.68	**1.3%**	ND	377.44	377.44	**12.0%**	ND	**0.0%**	17.31	**0.7%**	ND	**0.0%**
	TOTAL	4461	580.85	186.27	36.21	803.33	**25.4%**	807.06	**20.6%**	2.88	1514.38	1517.26	**48.2%**	0.00	**0.0%**	127.22	**5.0%**	1.81	**0.0%**

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ND = not detected
ug = m[illegible]gram

Table 8 : Mass of Pesticide Collected in Leachate for 16 Columns Over a 7-week Leaching Period

COLUMN No. (SOIL TYPE)	SET No.	LEACHATE VOLUME	MASS OF COMPOUNDS LEACHED (% OF TOTAL APPLIED) (TOTAL APPLIED) A-Sulfx ug	A-sulfn ug	Ald ug	Total Ald ug	Percent Rec	OXAMYL ug	Percent Rec	3-H-Car ug	Carbo ug	Total Carbo	Percent Rec	Carba ug	Percent Rec	Atraz ug	Percent Rec	Alach ug	Percent Rec
13 (ANTIGO)	1	202	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	2	755	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	3	650	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	0.01	0.0%	0.59	0.0%
	4	705	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	5	706	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	0.04	0.0%	ND	0.0%
	6	687	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	1.70	0.1%	ND	0.0%
	7	691	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	0.18	0.0%	ND	0.0%
	TOTAL	4396	0.00	0.00	0.00	0.00	0.0%	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.0%	1.93	0.1%	0.59	0.0%
14 (ANTIGO)	1	384	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	2	856	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	3	700	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	0.01	0.0%	0.53	0.0%
	4	750	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	5	677	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	0.02	0.0%	0.05	0.0%
	6	716	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	0.37	0.0%	ND	0.0%
	7	673	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	TOTAL	4756	0.00	0.00	0.00	0.00	0.0%	0.00	0.0%	0.00	0.00	0.00	0.0%	0.00	0.0%	0.40	0.0%	0.57	0.0%
15 (PLAINFIELD)	1	311	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	2	712	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	3	428	4.67	ND	ND	4.67	0.4%	8.56	0.7%	ND	0.81	0.81	0.1%	ND	0.0%	0.05	0.0%	0.34	0.0%
	4	940	186.12	22.56	3.67	212.35	18.6%	315.84	26.3%	ND	121.26	121.26	11.0%	ND	0.0%	0.05	0.0%	ND	0.0%
	5	681	91.94	29.21	ND	121.15	10.6%	179.10	14.9%	ND	93.30	93.30	8.5%	ND	0.0%	10.56	0.6%	ND	0.0%
	6	793	35.76	19.43	ND	55.19	4.8%	71.45	6.0%	ND	38.62	38.62	3.5%	ND	0.0%	5.69	0.3%	ND	0.0%
	7	785	LS	LS	LS	0.00	N/A	LS	N/A	LS	LS	N/A	N/A	LS	N/A	15.54	0.9%	ND	0.0%
	TOTAL	4650	318.48	71.20	3.67	393.35	34.5%	574.95	47.9%	0.00	253.99	253.99	23.1%	0.00	0.0%	31.89	1.8%	0.34	0.0%
16 (PLAINFIELD)	1	822	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	ND	0.0%
	2	809	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	0.20	0.0%	0.20	0.0%
	3	350	ND	ND	ND	ND	0.0%	ND	0.0%	ND	ND	ND	0.0%	ND	0.0%	ND	0.0%	0.28	0.0%
	4	940	266.96	23.22	21.53	311.70	9.9%	523.58	13.4%	ND	286.70	286.70	9.1%	ND	0.0%	2.50	0.0%	0.24	0.0%
	5	579	220.02	88.59	14.76	323.37	10.2%	402.41	10.3%	ND	442.36	442.36	14.0%	ND	0.0%	24.03	1.0%	0.89	0.0%
	6	833	186.59	56.06	9.83	252.48	8.0%	385.68	9.9%	ND	390.68	390.68	12.4%	ND	0.0%	7.08	0.3%	ND	0.0%
	7	710	21.51	9.59	5.15	36.25	1.1%	28.54	0.7%	ND	112.54	112.54	3.6%	ND	0.0%	38.98	1.5%	ND	0.0%
	TOTAL	5043	695.09	177.45	51.27	923.80	29.2%	1340.21	34.3%	0.00	1232.27	1232.27	39.1%	0.00	0.0%	72.79	2.8%	1.61	0.0%

A-Sulfx = aldicarb sulfoxide, A-Sulfn = aldicarb sulfone, Ald = aldicarb, 3-H-Car = 3-hydroxy-carbofuran, Carbo = carbofuran, Carba = Carbaryl, Atraz = atrazine, Alach = alachlor
ND = not detected
ug = microgram

CRBTOTS.XLS

Table 9: Inorganic Parameters (Concentrations and Mass) for Leachate Collected from 16 Soil Columns Over a 7-week Leaching Period

COLUMN No.	SOIL TYPE	SET No.	NO2-N03 ppm	NH4 ppm	Cl ppm	NO2-NO3 mg	NH4 mg	Cl mg	pH	COND UMHOS	LEACHATE VOLUME
1	BURKART	1	ND		9	0.0	0.00	2	6.99	74.8	234
		2	ND	0.02	ND	0.0	0.02	0	6.78	98.0	760
		3	ND	0.08	2	0.0	0.05	1	6.86	114.0	649
		4	ND	0.05	1	0.0	0.03	1	6.81	126.0	680
		5	ND	0.02	10	0.0	0.01	7	6.45	130.0	703
		6	0.2	ND	19	0.2	0.00	8	6.93	161.0	406
		7	4.0	0.27	73	3.0	0.20	55	7.05	252.0	750
2	BURKART	1	ND	0.02	9	0.0	0.01	4	6.8	86.3	478
		2	ND	ND	5	0.0	0.00	4	6.79	156.0	720
		3	ND	0.05	9	0.0	0.04	7	6.91	168.0	732
		4	ND	0.05	2	0.0	0.07	3	6.44	98.3	1487
		5	5.0	0.15	9	3.7	0.11	7	6.66	198.0	745
		6	15.5	0.10	9	11.0	0.10	9	6.66	238.0	1028
		7	6.0	0.02	8	4.3	0.01	6	6.69	307.0	712
3	SPARTA	1	1.5	0.35	10	0.8	0.18	5	5.93	95.7	525
		2	NS	0.20	NS	0.0	0.21	0	5.51	119.0	1070
		3	40.0	0.15	1	14.0	0.05	0	5.52	370.0	350
		4	37.2	ND	103	37.2	0.00	103	5.04	770.0	1000
		5	16.5	0.05	170	12.2	0.04	125	5.79	723.0	738
		6	65.0	0.50	45	45.8	0.36	32	5.54	694.0	720
		7	51.0	0.54	9	36.0	0.38	6	5.82	366.0	705
4	SPARTA	1	23.0	0.15	10	8.9	0.06	4	6.16	208.0	387
		2	18.5	0.05	ND	18.9	0.05	0	5.35	193.0	1024
		3	24.0	0.05	1	8.4	0.02	0	5.75	228.0	350
		4	26.0	ND	86	25.7	0.00	85	5.39	596.0	987
		5	21.5	0.02	215	14.7	0.01	147	5.66	919.0	684
		6	72.0	1.15	52	50.3	0.85	39	5.72	762.0	743
		7	64.0	0.80	94	44.7	0.56	66	5.71	482.0	698
5	BURKART	1	ND	0.08	3	0.0	0.02	1	7.19	86.5	275
		2	0.2	0.15	3	0.1	0.10	2	6.73	157.0	697
		3	ND	0.05	11	0.0	0.03	7	6.5	189.0	652
		4	0.2	0.18	7	0.2	0.16	6	6.55	177.0	900
		5	ND	NS	16	0.0	0.00	11	7.21	245.0	666
		6	ND	0.20	57	0.0	0.14	39	7.23	366.0	688
		7	7.0	0.56	68	5.2	0.42	51	6.91	401.0	743
6	BURKART	1	ND	0.08	1	0.0	0.04	1	6.9	56.4	519
		2	ND	0.05	ND	0.0	0.03	0	6.55	112.0	692
		3	ND	0.08	2	0.0	0.06	1	6.59	117.0	702
		4	0.2	0.05	1	0.2	0.04	1	6.54	134.0	767
		5	ND	NS	5	0.0	0.00	4	7.04	145.0	741
		6	4.2	ND	34	3.0	0.00	26	7.03	232.0	756
		7	19.0	0.19	7	13.7	0.14	5	6.28	333.0	720

NO2-NO3 = nitrite-nitrate, NH4 = ammonia, Cl = chloride
COND = conductance
ND = not detected
ppm = mg/L or parts per million

INFINC2.XLS

Table 9: Inorganic Parameters (Concentrations and Mass) for Leachate Collected from 16 Soil Columns Over a 7-week Leaching Period

COLUMN No.	SOIL TYPE	SET No.	NO2-N03 ppm	NH4 ppm	Cl ppm	NO2-NO3 mg	NH4 mg	Cl mg	pH	COND UMHOS	LEACHATE VOLUME
7	SPARTA	1	15.2	0.8	ND	12	0.63	0	6.15	167	788
		2	17.0	0.25	ND	15.8	0.23	0	5.72	193.0	929
		3	22.0	0.10	ND	8.9	0.04	0	5.72	222.0	403
		4	27.0	ND	115	26.7	0.00	114	5.65	737.0	990
		5	49.5	0.08	155	34.7	0.06	109	5.85	934.0	702
		6	85.0	0.80	50	60.9	0.57	36	5.48	850.0	716
		7	55.0	0.35	7	42.0	0.27	5	5.59	390.0	763
8	SPARTA	1	34.5	0.80	4	26.7	0.62	3	5.41	304.0	773
		2	NS	0.30	NS	0.0	0.34	0	5.13	222.0	1121
		3	22.0	0.10	ND	9.0	0.04	0	5.48	218.0	410
		4	26.5	ND	90	24.8	0.00	84	5.38	710.0	935
		5	45.0	0.05	185	31.4	0.03	129	5.4	1012.0	698
		6	85.0	0.40	48	62.5	0.29	35	5.18	877.0	735
		7	71.0	0.28	18	51.3	0.20	13	5.39	470.0	723
9	ANTIGO	1	1.0	0.05	1	2.6	0.13	3	6.08	6.7	2600
		2	0.2	ND	1	0.1	0.00	1	6.42	18.0	630
		3	ND	0.05	1	0.0	0.03	1	6.51	21.5	670
		4	0.5	ND	2	0.3	0.00	1	6.58	24.0	680
		5	0.2	ND	3	0.1	0.00	2	6.23	34.5	672
		6	1.5	0.05	11	1.0	0.03	7	5.92	58.0	681
		7	6.0	0.17	23	4.1	0.12	16	5.56	96.2	680
10	ANTIGO	1	42.2	0.28	45	14.1	0.09	15	5.11	483.0	335
		2	47.5	0.20	42	36.4	0.15	32	4.63	540.0	766
		3	65.0	0.25	50	43.6	0.17	34	4.71	672.0	670
		4	138.0	0.22	42	95.2	0.15	29	4.54	645.0	690
		5	110.0	0.32	35	80.9	0.24	26	4.47	686.0	735
		6	110.0	0.25	29	80.3	0.18	21	4.57	608.0	730
		7	71.0	0.26	2	48.8	0.18	1	4.8	543.0	688
11	PLAINFIELD	1	17.5	0.08	3	5.9	0.03	1	7.07	213.0	338
		2	22.0	0.05	1	15.8	0.04	1	6.96	253.0	717
		3	23.0	0.02	21	7.6	0.01	7	7.08	264.0	330
		4	1.8	ND	2	1.7	0.00	2	6.83	102.0	950
		5	0.5	0.08	1	0.3	0.05	1	6.99	86.4	608
		6	4.0	0.02	6	3.3	0.02	5	7.01	96.0	818
		7	11.5	0.04	4	8.5	0.03	3	6.76	114.0	740
12	PLAINFIELD	1	21.5	0.02	ND	6.7	0.01	0	6.98	237.0	310
		2	27.0	ND	2	21.6	0.00	2	7.04	326.0	799
		3	31.0	0.12	30	10.1	0.04	10	6.51	470.0	325
		4	2.8	ND	145	2.5	0.00	129	6.6	611.0	890
		5	47.5	0.02	140	29.3	0.01	86	6.62	883.0	616
		6	175.0	0.05	35	136.2	0.04	27	6.54	821.0	778
		7	52.5	0.02	1	39.0	0.01	1	6.59	394.0	743

NO2-NO3 = nitrite-nitrate, NH4 = ammonia, Cl = chloride
COND = conductance
ND = not detected
ppm = mg/L or parts per million

Table 9: Inorganic Parameters (Concentrations and Mass) for Leachate Collected from 16 Soil Columns Over a 7-week Leaching Period

COLUMN No.	SOIL TYPE	SET No.	NO2-N03 ppm	NH4 ppm	Cl ppm	NO2-NO3 mg	NH4 mg	Cl mg	pH	COND UMHOS	LEACHATE VOLUME
13	ANTIGO	1	22.0	0.18	6	4.4	0.04	1	6.19	197.0	202
		2	22.0	0.20	6	16.6	0.15	5	5.44	209.0	755
		3	28.5	0.20	5	18.5	0.13	3	5.2	243.0	650
		4	26.8	0.15	4	18.9	0.11	3	5.19	236.0	705
		5	32.2	0.18	1	22.7	0.13	1	4.96	284.0	706
		6	32.8	0.20	12	22.5	0.14	8	4.8	304.0	687
		7	31.8	0.23	19	22.0	0.16	13	5.06	286.0	691
14	ANTIGO	1	26.5	0.15	34	10.2	0.06	13	5.59	309.0	384
		2	36.2	0.18	37	31.0	0.15	32	4.95	433.0	856
		3	49.5	0.25	44	34.7	0.18	31	4.97	516.0	700
		4	105.0	0.25	37	78.8	0.19	28	4.6	571.0	750
		5	140.0	0.28	38	94.8	0.19	26	4.56	737.0	677
		6	150.0	NS	42	107.4	0.00	30	4.45	701.0	716
		7	74.0	0.35	29	49.8	0.24	20	4.73	596.0	673
15	PLAINFIELD	1	18.0	0.05	5	5.6	0.02	2	6.95	204.0	311
		2	23.5	ND	1	16.7	0.00	1	6.97	260.0	712
		3	31.2	ND	1	13.4	0.00	0	6.88	319.0	428
		4	0.5	ND	2	0.5	0.00	2	6.75	99.2	940
		5	2.8	ND	ND	1.9	0.00	0	6.9	100.0	681
		6	135.0	ND	42	107.1	0.00	33	6.81	127.0	793
		7	12.8	ND	1	10.0	0.00	1	6.76	131.0	785
16	PLAINFIELD	1	3.5	ND	3	2.9	0.00	2	6.48	64.3	822
		2	3.2	ND	2	2.6	0.00	2	6.37	74.5	809
		3	11.5	0.02	2	4.0	0.01	1	6.27	139.0	350
		4	2.5	ND	103	2.4	0.00	97	5.96	413.0	940
		5	9.0	0.08	235	5.2	0.05	136	6.01	839.0	579
		6	ND	0.85	5	0.0	0.71	4	5.9	703.0	833
		7	59.0	1.10	2	41.9	0.78	1	6	434.0	710

NO2-NO3 = nitrite-nitrate, NH4 = ammonia, Cl = chloride
COND = conductance
ND = not detected
ppm = mg/L or parts per million

Figures 4 and 5. No inorganic data is listed for Columns 10, 11, 14, and 15. These columns were used in a preliminary study and the inorganic leachate results are a continuation of that study. These results will be covered later in the Discussion Section.

Residual pesticide in soil data for Columns 1, 2, 5, 6, 9, 10, 13, and 15 are listed in Table 10. The soil from the remaining columns was not analyzed.

Burkart

Columns numbered 1, 2, 5, and 6 were packed with Burkart soil. Columns 1 and 2 were treated with "high" pesticide levels, while Columns 5 and 6 were treated with "low" levels of the respective pesticides. All four were treated with the standard amount of inorganic tracers. Application rates for these columns are listed in Table 1 (Page 7).

The percent leachate recovered, based on the volume of water previously added is listed in Table 6 (Page 37). The total average recoveries from the Burkart columns were as follows:

- Column 1 82%
- Column 2 113%
- Column 5 91%
- Column 6 92%

Taking into account the effects of evaporation, which were not measured, the average recoveries should have been less than 100 percent. It is believed that the reason Column 2 is greater than 100 percent is because it was at a moisture content greater than FMC at the start of the leaching study. The reason for this is not

Table 10: Pesticide Residuals by Depth in Selected Column Soils at end of 7-week Leaching Period
Page 1 of 2

Column ID	Depth CM	Soil Type	Total Weight (mg)	COMPOUNDS A-Sulfx ug	A-Sulfn ug	Ald ug	Total Ald ug	Percent Rec	Oxamyl ug	Percent Rec	3-H-Car ug	Carbo ug	Carbo Total ug	Percent Rec	Carba ug	Percent Rec	Atraz ug	Percent Rec	Alach ug	Percent Rec
1	0-15	BURKART	3207	3.85	0.96	6.41	11.23	0.4%	0.32	0.01%	1.60	41.05	42.66	1.4%	15.39	0.5%	N/A		N/A	
	15-30		3040	2.13	2.43	11.55	16.11	0.5%	ND	0.00%	0.91	110.05	110.97	3.5%	1.82	0.1%	N/A		N/A	
	30-45		3186	22.94	7.65	7.01	37.59	1.2%	0.32	0.01%	1.27	103.53	104.81	3.3%	1.91	0.1%	N/A		N/A	
	45-60		3392	156.01	34.59	4.75	195.35	6.2%	1.70	0.04%	0.68	91.23	91.91	2.9%	ND	0.0%	N/A		N/A	
	60-75		3243	349.23	52.85	0.97	403.06	12.8%	1.95	0.05%	ND	44.42	44.42	1.4%	ND	0.0%	N/A		N/A	
	75-96		4039	25.45	6.06	0.40	31.91	1.0%	ND	0.00%	0.40	30.70	31.10	1.0%	ND	0.0%	N/A		N/A	
			TOTALS	559.60	104.55	31.10	695.25	22.0%	4.28	0.11%	4.87	420.99	425.86	13.5%	19.13	0.6%	N/A	N/A	N/A	N/A
2	0-15	BURKART	3964	10.31	3.57	11.89	25.77	0.8%	3.96	0.10%	1.59	57.09	58.67	1.9%	149.85	4.5%	N/A		N/A	
	15-30		4108	ND	2.88	33.27	36.15	1.1%	2.05	0.00%	1.23	182.80	184.03	5.8%	0.82	0.0%	N/A		N/A	
	30-45		4469	ND	0.89	11.62	12.51	0.4%	0.45	0.01%	0.45	98.32	98.77	3.1%	ND	0.0%	N/A		N/A	
	45-60		4578	ND	ND	5.95	5.95	0.2%	ND	0.00%	ND	87.45	87.45	2.8%	ND	0.0%	N/A		N/A	
	60-75		4519	ND	0.45	1.36	1.81	0.1%	ND	0.00%	ND	65.53	65.53	2.1%	ND	0.0%	N/A		N/A	
	75-94		5453	ND	ND	ND	0.00	0.0%	ND	0.00%	ND	13.63	13.63	0.4%	ND	0.0%	N/A		N/A	
			TOTALS	10.31	7.79	64.09	82.19	2.6%	6.47	0.11%	3.27	504.81	508.08	16.1%	150.67	4.6%	N/A	N/A	N/A	N/A
5	0-15	BURKART	3985	5.18	1.99	19.13	26.30	2.3%	0.40	0.03%	2.39	153.82	156.21	14.2%	136.69	7.4%	207.22	11.6%	402.49	21.6%
	15-30		4267	14.93	10.24	11.52	36.69	3.2%	0.43	0.04%	0.85	139.52	140.38	12.8%	20.05	1.1%	ND	0.0%	ND	0.0%
	30-45		4509	21.19	14.88	5.41	41.49	3.6%	0.45	0.04%	0.45	70.34	70.80	6.4%	4.51	0.2%	ND	0.0%	ND	0.0%
	45-60		4717	61.79	35.37	2.36	99.52	8.7%	0.47	0.04%	0.47	63.67	64.15	5.8%	ND	0.0%	ND	0.0%	ND	0.0%
	60-75		4229	32.99	17.34	0.85	51.17	4.5%	ND	0.00%	0.42	36.80	37.22	3.4%	ND	0.0%	ND	0.0%	ND	0.0%
	75-93		5245	ND	0.52	ND	0.52	0.0%	ND	0.00%	ND	21.51	21.51	2.0%	ND	0.0%	ND	0.0%	ND	0.0%
			TOTALS	136.08	80.35	39.26	255.70	22.4%	1.75	0.15%	4.59	485.66	490.25	44.6%	161.25	8.8%	207.22	11.6%	402.49	21.6%
6	0-15	BURKART	3308	3.31	1.32	11.25	15.88	1.4%	0.33	0.03%	1.65	84.01	85.67	7.8%	154.13	8.4%	284.12	16.0%	150.49	8.1%
	15-30		3702	6.29	3.70	7.40	17.40	1.5%	0.74	0.06%	0.74	80.71	81.45	7.4%	4.44	0.2%	ND	0.0%	ND	0.0%
	30-45		4108	18.90	7.81	6.57	33.27	2.9%	1.64	0.14%	1.64	79.28	80.93	7.4%	1.64	0.1%	ND	0.0%	ND	0.0%
	45-60		3580	68.38	15.39	2.51	86.28	7.6%	4.65	0.39%	0.36	43.68	44.03	4.0%	ND	0.0%	ND	0.0%	ND	0.0%
	60-75		3704	122.59	23.70	0.37	146.67	12.9%	1.48	0.12%	0.37	10.00	10.37	0.9%	ND	0.0%	ND	0.0%	ND	0.0%
	75-94		6340	16.48	4.44	ND	20.92	1.8%	ND	0.00%	ND	8.24	8.24	0.7%	ND	0.0%	ND	0.0%	ND	0.0%
			TOTALS	235.95	56.37	28.10	320.42	28.1%	8.85	0.74%	4.77	305.92	310.69	28.2%	160.22	8.7%	284.12	16.0%	150.49	8.1%

A-Sulfx = aldicarb sulfoxide, A-sulfn = aldicarb sulfone, Ald = aldicarb, 3-H-Carb = 3-hydroxy-carbofuran, Carb = carbaryl, Atraz = atrazine, Alach = alachlor
ND = not detected
N/A = no[illegible]zed

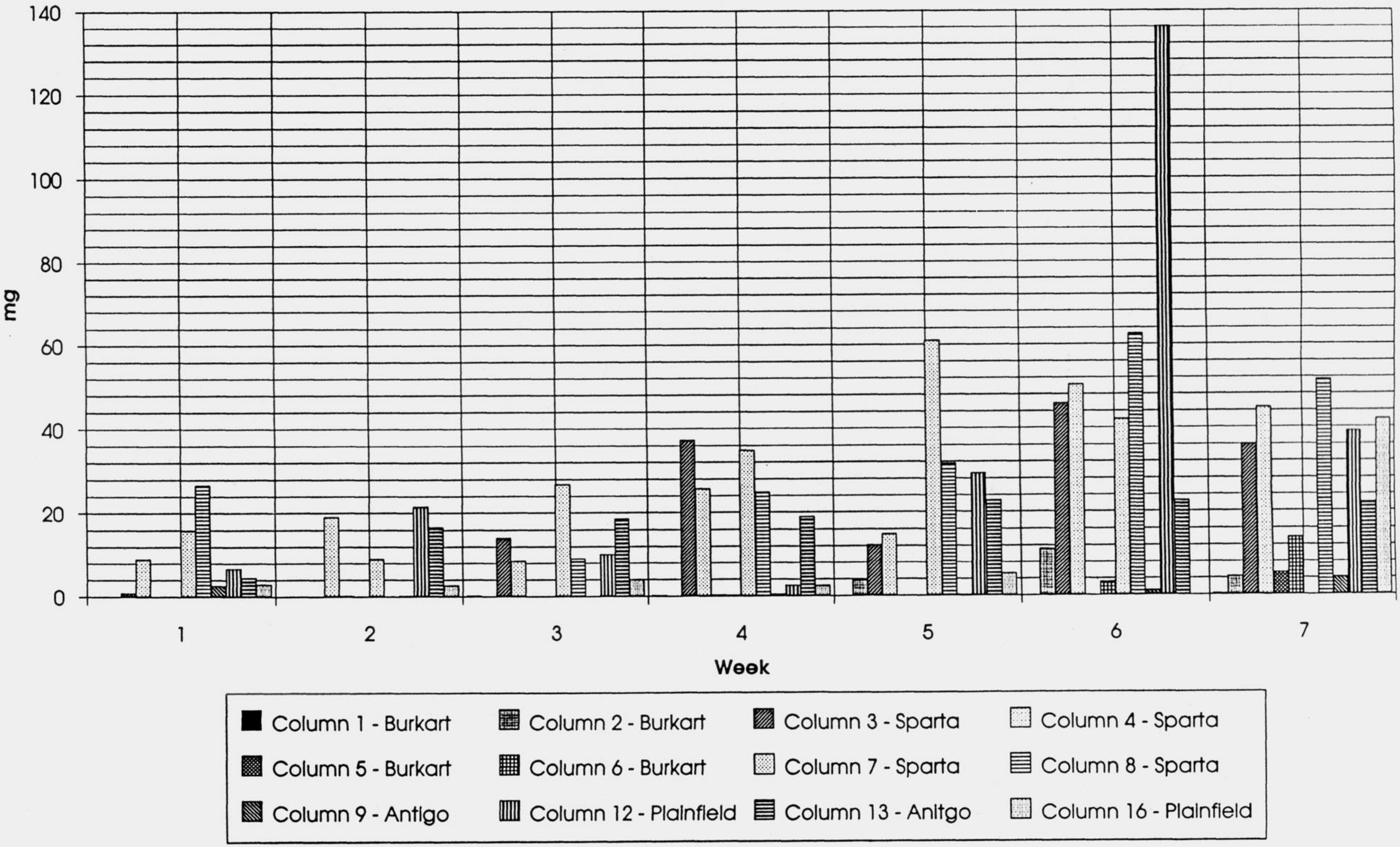
Table 10: Pesticide Residuals by Depth in Selected Column Soils at end of 7-week Leaching Period

Column ID	Depth CM	Soil Type	Total Weight (mg)	COMPOUNDS A-Sulfx ug	A-Sulfn ug	Ald ug	Total Ald ug	Percent Rec	Oxamyl ug	Percent Rec	3-H-Car ug	Carbo ug	Carbo Total ug	Percent Rec	Carba ug	Percent Rec	Atraz ug	Percent Rec	Alach ug	Percent Rec
9	0-15	ANTIGO	3639	6.19	11.28	56.40	73.87	2.3%	3.64	0.09%	4.73	372.26	376.99	12.0%	N/A		123.36	4.9%	ND	0.0%
	15-30		4276	15.82	26.51	23.94	66.27	2.1%	5.56	0.14%	1.71	125.71	127.42	4.0%	N/A		ND	0.0%	ND	0.0%
	30-45		4196	83.92	40.28	9.23	133.43	4.2%	57.48	1.47%	0.84	92.31	93.15	3.0%	N/A		ND	0.0%	ND	0.0%
	45-60		4729	256.32	78.03	1.89	336.24	10.6%	224.63	5.75%	2.84	367.93	370.76	11.8%	N/A		ND	0.0%	ND	0.0%
	60-75		4229	81.61	13.11	0.42	95.14	3.0%	33.83	0.87%	1.27	121.78	123.05	3.9%	N/A		ND	0.0%	ND	0.0%
	75-95.5		6143	ND	ND	ND	0.00	0.0%	0.61	0.02%	ND	1.23	1.23	0.0%	N/A		ND	0.0%	ND	0.0%
			TOTALS	443.86	169.21	91.89	704.96	22.3%	325.76	8.33%	11.39	1081.22	1092.60	34.7%	N/A	N/A	123.36	4.9%	0.00	0.0%
10	0-15	ANTIGO	3504	2.45	3.50	11.56	17.52	1.5%	4.91	0.41%	1.40	54.32	55.72	5.1%	69.73	3.8%	281.39	15.8%	ND	0.0%
	15-30		4386	95.62	98.69	7.90	202.20	17.7%	35.53	2.96%	0.44	55.27	55.70	5.1%	6.14	0.3%	ND	0.0%	ND	0.0%
	30-45		4455	89.10	80.19	5.35	174.64	15.3%	50.34	4.20%	0.45	28.07	28.51	2.6%	13.37	0.7%	ND	0.0%	ND	0.0%
	45-60		4306	118.42	31.86	3.44	153.73	13.5%	155.02	12.92%	0.86	100.33	101.19	9.2%	8.61	0.5%	130.47	7.3%	110.24	0.1%
	60-75		4445	17.78	4.89	0.44	23.11	2.0%	34.22	2.85%	ND	25.33	25.33	2.3%	3.11	0.2%	ND	0.0%	ND	0.0%
	75-94.5		6039	16.31	2.42	0.60	19.33	1.7%	27.78	2.32%	ND	19.33	19.33	1.8%	1.21	0.1%	ND	0.0%	ND	0.0%
			TOTALS	339.68	221.56	29.30	590.53	51.8%	307.80	25.65%	3.15	282.64	285.79	26.0%	102.17	5.6%	411.87	23.1%	110.24	0.1%
13	0-15	ANTIGO	3504	5.61	8.06	28.73	42.40	1.3%	7.01	0.18%	2.80	124.05	126.85	4.0%	122.65	2.7%	317.13	12.6%	ND	0.0%
	15-30		4386	103.95	105.71	48.25	257.91	8.2%	65.79	1.68%	5.26	190.36	195.62	6.2%	25.44	0.6%	130.71	5.2%	ND	0.0%
	30-45		4455	515.91	301.62	47.67	865.20	27.4%	223.20	5.71%	3.56	290.92	294.49	9.3%	17.82	0.4%	73.51	2.9%	ND	0.0%
	45-60		4306	295.83	131.77	8.18	435.78	13.8%	221.76	5.67%	2.15	242.43	244.59	7.8%	16.79	0.4%	ND	0.0%	ND	0.0%
	60-75		4445	108.00	27.11	0.89	136.00	4.3%	136.00	3.48%	1.33	152.01	153.34	4.9%	1.33	0.0%	ND	0.0%	ND	0.0%
	75-94.5		6039	ND	2.42	ND	2.42	0.1%	ND	0.00%	ND	4.83	4.83	0.2%	ND	0.0%	ND	0.0%	ND	0.0%
			TOTALS	1029.30	576.68	133.72	1739.70	55.1%	653.77	16.72%	15.12	1004.60	1019.72	32.4%	184.04	4.0%	521.35	20.7%	0.00	0.0%
15	0-15	PLAINFIELD	3504	0.35	0.35	1.40	2.10	0.2%	0.35	0.03%	0.35	3.15	3.50	0.3%	6.66	0.4%	85.85	4.8%	55.72	0.1%
	15-30		4386	ND	ND	ND	0.00	0.0%	0.44	0.04%	ND	2.19	2.19	0.2%	0.88	0.0%	54.39	3.1%	ND	0.0%
	30-45		4455	ND	ND	0.45	0.45	0.0%	ND	0.00%	ND	1.78	1.78	0.2%	0.45	0.0%	23.17	1.3%	ND	0.0%
	45-60		4306	ND	0.43	0.43	0.86	0.1%	0.43	0.04%	ND	1.72	1.72	0.2%	ND	0.0%	19.81	1.1%	ND	0.0%
	60-75		4445	ND	ND	ND	0.00	0.0%	ND	0.00%	ND	1.78	1.78	0.2%	ND	0.0%	ND	0.0%	ND	0.0%
	75-94.5		6039	1.81	4.23	ND	6.04	0.5%	3.62	0.30%	ND	10.27	10.27	0.9%	ND	0.0%	25.37	1.4%	ND	0.0%
			TOTALS	2.16	5.01	2.28	9.45	0.8%	4.84	0.40%	0.35	20.90	21.25	1.9%	7.98	0.4%	208.58	11.7%	55.72	0.1%

A-Sulfx = aldicarb sulfoxide, A-sulfn = aldicarb sulfone, Ald = aldicarb, 3-H-Carb = 3-hydroxy-carbofuran, Carb = carbaryl, Atraz = atrazine, Alach = alachlor
ND = not detected
N/A = not analyzed

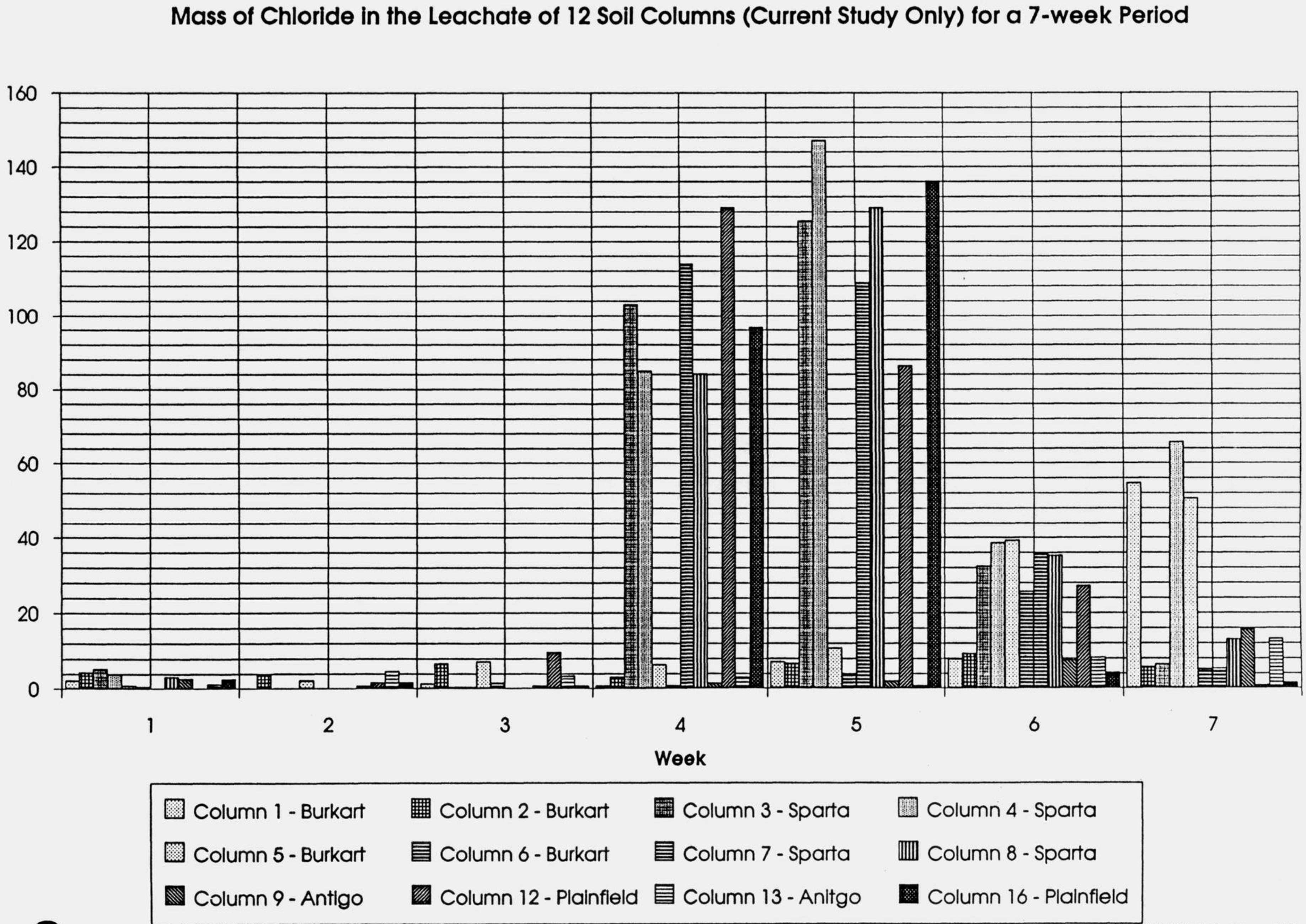
Figure 4

Mass of Nitrate Detected in the Leachate of 12 Soil Columns (Current Study Only) for a 7-week Period



INFINC2.XLS Chart 1

Figure 5



INFINC2.XLS Chart 2

known, but may be due to the packing of the column. Although each column was packed in the same manner, this column may have experienced clogging at the filter disk or may have been a tighter pack.

Table 7 (Page 38) lists the ratio of leachate recovered to the pore volume of the column based on the measured FMC for the column. The values for the percent of the column pore volume leached for the Burkart soils were as follows:

- Column 1 68%
- Column 2 98%
- Column 5 77%
- Column 6 81%

The extra volume noted in Column 2 is believed to be leftover water from the re-wetting process. All of these values are less than 100 percent, meaning the volume of water leached did not exceed the amount of water held in the soil prior to additions of the pesticide and subsequent water additions.

Only Column 1 had any of the pesticides applied detected in the leachate. Two pesticides were detected in the leachate from this column - aldicarb sulfoxide (aldicarb metabolite) and carbofuran. These compounds were detected in the Week 7 leachate sample at 12.68 ug/L and 18.75 ug/L, total concentration, respectively (Table 8). These amounts represent only 0.40% of the total aldicarb applied and 0.48% of the total carbofuran applied. Small amounts of atrazine were also detected at about 0.02% of the total applied. The atrazine values are within the error of the analytical method and therefore suspect.

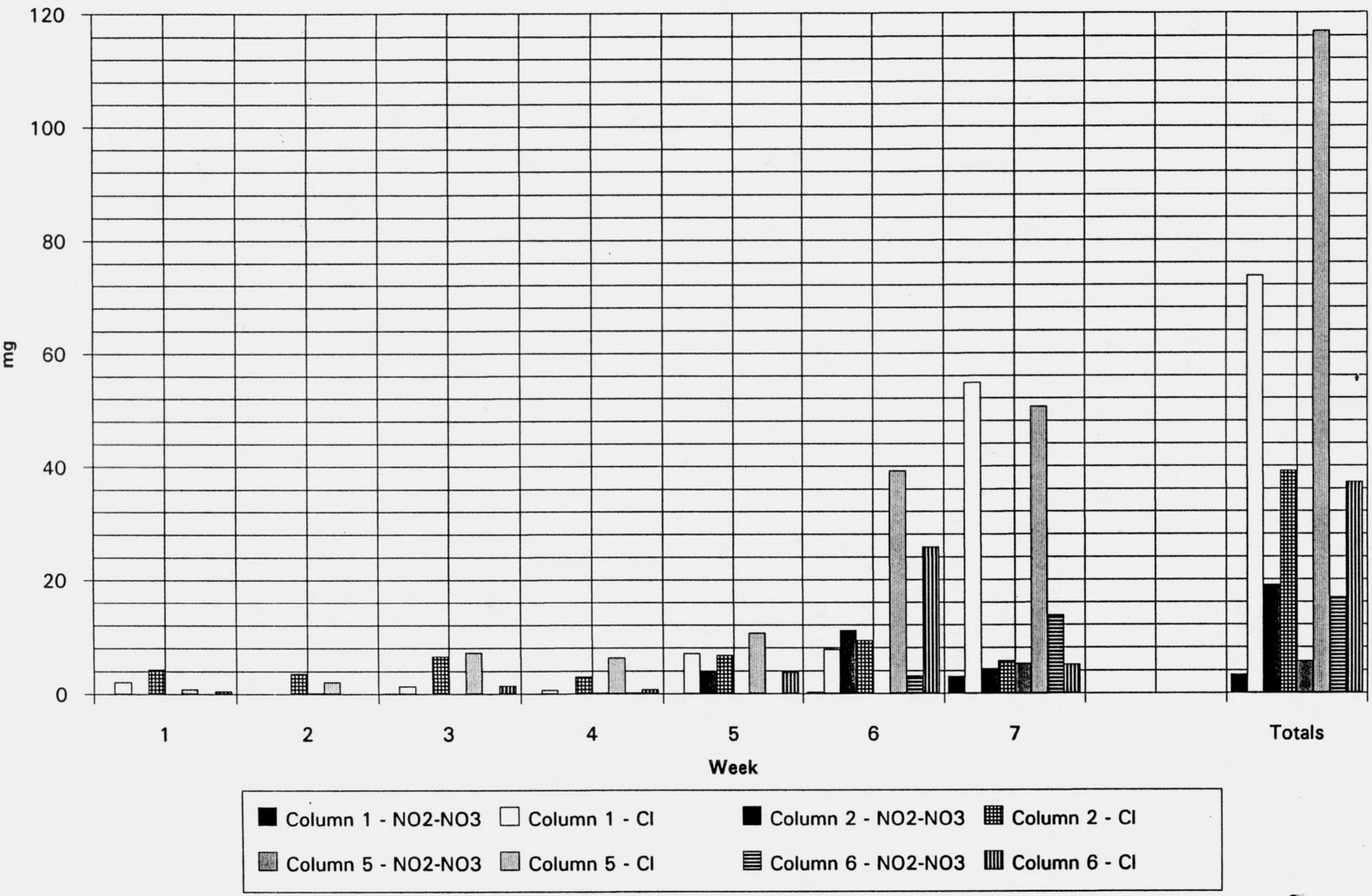
No oxamyl was detected, which would be expected if carbofuran had leached from the column. The reason that oxamyl had not broken through the column is not known.

Inorganic leachate results (Table 9) indicate that some retardation of the organics by the soil had occurred in the Burkart soil. This was determined based on the observation that in three of the columns (1, 5, and 6), breakthrough of the chloride tracer had occurred by Week 5, and that nitrate-nitrite breakthrough was starting to occur at Week 7 (Figure 6). These results confirm that solubility is not the only factor in determining pesticide or nitrate leaching rates.

The inorganic tracer results from Column 2 were sporadic and did not follow the same pattern as the other three. It also should be noted that in each of the other three columns (1, 5, and 6), chloride was detected two weeks prior to nitrate-nitrite.

Figure 6

Mass of Nitrate and Chloride Detected in Leachate from 4-Burkart Soil Columns for a 7-week Period



INFINC2.XLS Chart 3

Soil Residues

The soil from the Burkart columns, at the end of the leaching runs, was analyzed for both pesticides and the inorganic compounds that were applied. Table 11 lists the amount of chemicals at each depth and the percent recovery of each pesticide applied. The mass of pesticides and inorganics detected within the soil for Columns 1, 2, 5, and 6 are shown graphically in Figures 7, 8, 9, and 10.

Review of the results indicated that total aldicarb was recovered at levels between 22% and 28% for Columns 1, 5, and 6. Total aldicarb recovery from Column 2 was only 2.88%, which is substantially lower than the other three. The majority of aldicarb recovered for Columns 1, 5, and 6 was in the form of aldicarb sulfoxide. Figures 7, 9, and 10 show that over 50% of the total aldicarb recovered in the soil was between the 45 - 75 cm depths.

Oxamyl results show very little recovery from the soil. This compound also was not detected within the leachate.

Total carbofuran was recovered at rates between 13% and 44% (Table 11). Over 97% of the total carbofuran recovered was in the form of the parent compound. The distribution of total carbofuran in the soil (Figures 7, 8, 9, and 10) varied with the rate of application. The columns with "high" rates of application (Columns 1 and 2) contained the majority of total carbofuran between 15 - 60 cm. The "low" application rate columns (Columns 5 and 6) contained the majority of total carbofuran between 0 - 45 cm.

Carbaryl recoveries for Columns 1, 2, 5, and 6 were between 0.59% and 8.77% (Table 11). The distribution of carbaryl in

Table 11: Burkart Soil Column Pesticide Residue Recoveries by Depth Intervals

Page 1 of 2

Compounds	Column 1 Depths (cm) 0-15	15-30	30-45	45-60	60-75	75-96	Totals	Column 2 Depths (cm) 0-15	15-30	30-45	45-60	60-75	75-94	Totals
Aldicarb Sulfoxide	0.12%	0.07%	0.73%	4.93%	11.05%	0.81%	**17.71%**	0.33%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.33%**
Aldicarb Sulfone	0.03%	0.08%	0.24%	1.20%	1.60%	0.19%	**3.34%**	0.11%	0.09%	0.03%	0.00%	0.01%	0.00%	**0.24%**
Aldicarb	0.21%	0.36%	0.22%	0.05%	0.10%	0.01%	**0.95%**	0.38%	1.32%	0.37%	0.19%	0.05%	0.00%	**2.31%**
Total Aldicarb	0.36%	0.51%	1.19%	6.18%	12.75%	1.01%	**22.00%**	0.82%	1.41%	0.40%	0.19%	0.06%	0.00%	**2.88%**
Oxamyl	0.01%	0.00%	0.01%	0.04%	0.05%	0.00%	**0.11%**	0.10%	0.00%	0.01%	0.00%	0.00%	0.00%	**0.11%**
3-Hydroxy-Carbofuran	0.03%	0.03%	0.04%	0.02%	0.00%	0.02%	**0.14%**	0.05%	0.04%	0.02%	0.00%	0.00%	0.00%	**0.11%**
Carbofuran	1.32%	3.49%	3.29%	2.90%	1.41%	0.97%	**13.38%**	1.81%	5.80%	3.12%	2.78%	2.08%	0.43%	**16.02%**
Total Carbofuran	1.35%	3.52%	3.33%	2.92%	1.41%	0.99%	**13.52%**	1.86%	5.84%	3.14%	2.78%	2.08%	0.43%	**16.13%**
Carbaryl	0.47%	0.06%	0.06%	0.00%	0.00%	0.00%	**0.59%**	4.54%	0.02%	0.00%	0.00%	0.00%	0.00%	**4.56%**
Atrazine	N/A	N/A	N/A	N/A	N/A	N/A	**0.00%**	N/A	N/A	N/A	N/A	N/A	N/A	**0.00%**
Alachlor	N/A	N/A	N/A	N/A	N/A	N/A	**0.00%**	N/A	N/A	N/A	N/A	N/A	N/A	**0.00%**

N/A = not analyzed

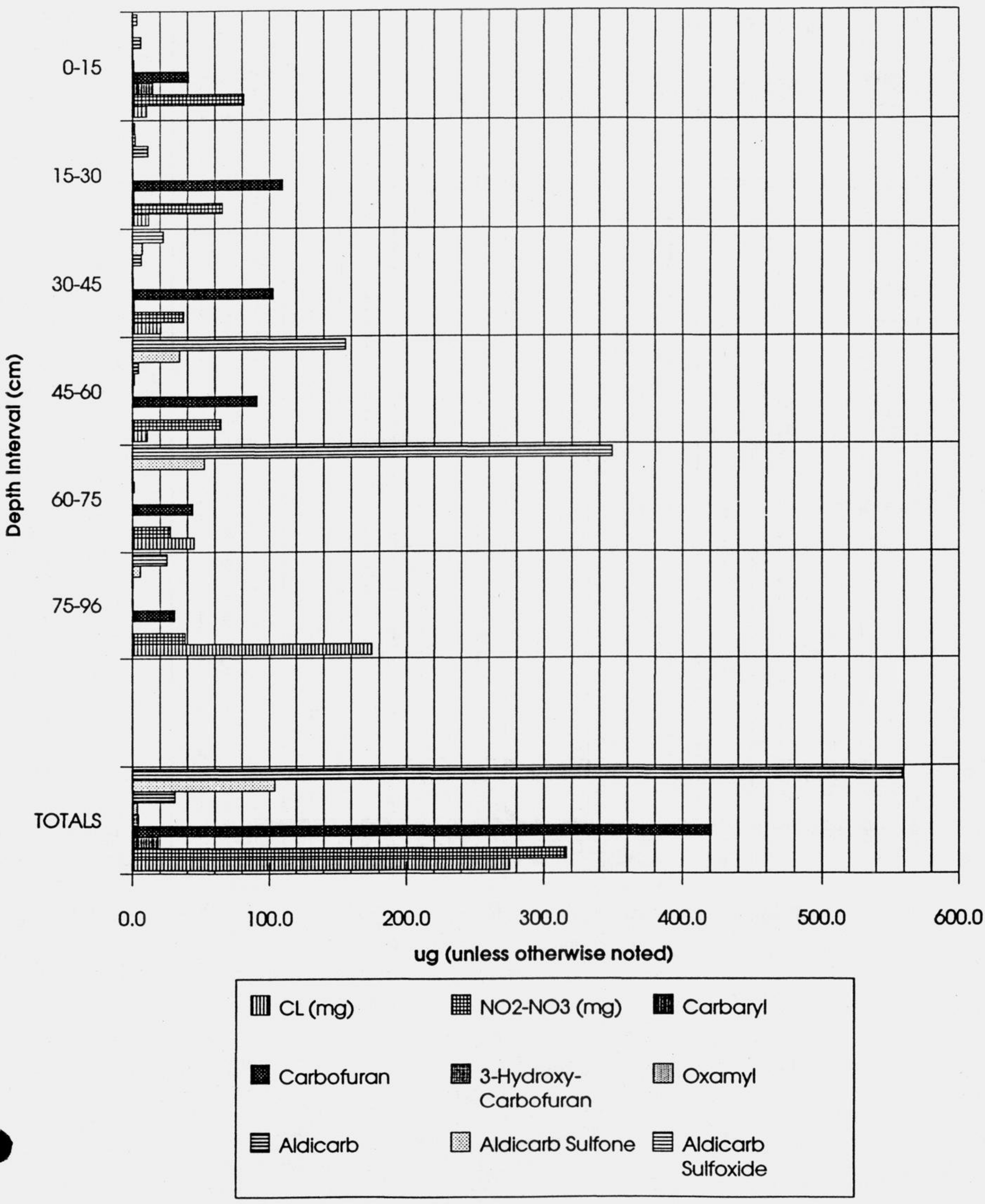
Table 11: Burkart Soil Column Pesticide Residue Recoveries by Depth Intervals

	Column 5 Depths (cm)							Column 6 Depths (cm)						
Compounds	0-15	15-30	30-45	45-60	60-75	75-93	**Totals**	0-15	15-30	30-45	45-60	60-75	75-94	**Totals**
Aldicarb Sulfoxide	0.45%	1.31%	1.86%	5.42%	2.89%	0.00%	**11.93%**	0.29%	0.55%	1.66%	6.00%	10.75%	1.45%	**20.70%**
Aldicarb Sulfone	0.17%	0.90%	1.31%	3.10%	1.52%	0.05%	**7.05%**	0.12%	0.32%	0.69%	1.35%	2.08%	0.39%	**4.95%**
Aldicarb	1.69%	1.01%	0.47%	0.21%	0.08%	0.00%	**3.46%**	0.98%	0.66%	0.57%	0.22%	0.04%	0.00%	**2.47%**
Total Aldicarb	2.31%	3.22%	3.64%	8.73%	4.49%	0.05%	**22.44%**	1.39%	1.53%	2.92%	7.57%	12.87%	1.84%	**28.12%**
Oxamyl	0.03%	0.04%	0.04%	0.04%	0.00%	0.00%	**0.15%**	0.03%	0.06%	0.14%	0.39%	0.12%	0.00%	**0.74%**
3-Hydroxy-Carbofuran	0.22%	0.08%	0.05%	0.00%	0.00%	0.00%	**0.35%**	0.39%	0.06%	0.15%	0.03%	0.03%	0.00%	**0.66%**
Carbofuran	13.98%	12.68%	6.39%	5.79%	3.34%	1.96%	**44.14%**	7.40%	7.34%	7.21%	3.97%	0.91%	0.75%	**27.58%**
Total Carbofuran	14.20%	12.76%	6.44%	5.83%	3.38%	1.96%	**44.57%**	7.79%	7.40%	7.36%	4.00%	0.94%	0.75%	**28.24%**
Carbaryl	7.43%	1.09%	0.25%	0.00%	0.00%	0.00%	**8.77%**	8.38%	0.24%	0.09%	0.00%	0.00%	0.00%	**8.71%**
Atrazine	11.64%	0.00%	0.00%	0.00%	0.00%	0.00%	**11.64%**	11.64%	0.00%	0.00%	0.00%	0.00%	0.00%	**11.64%**
Alachlor	21.64%	0.00%	0.00%	0.00%	0.00%	0.00%	**21.64%**	8.09%	0.00%	0.00%	0.00%	0.00%	0.00%	**8.09%**

N/A = not analyzed

Figure 7

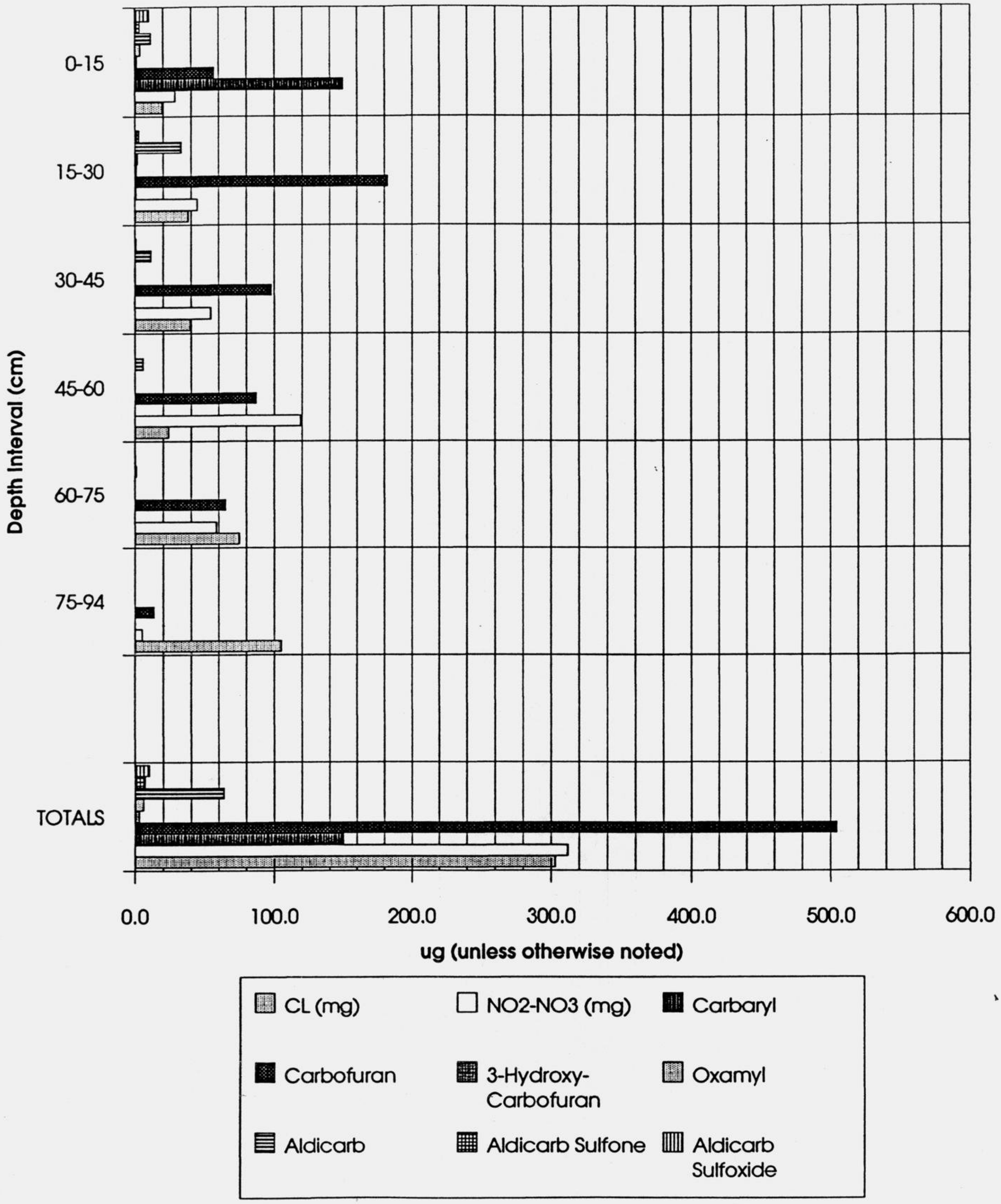
Mass of Pesticide, Nitrate, and Chloride Residuals by Depth for Burkart Soil Column 1 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 2

Figure 8

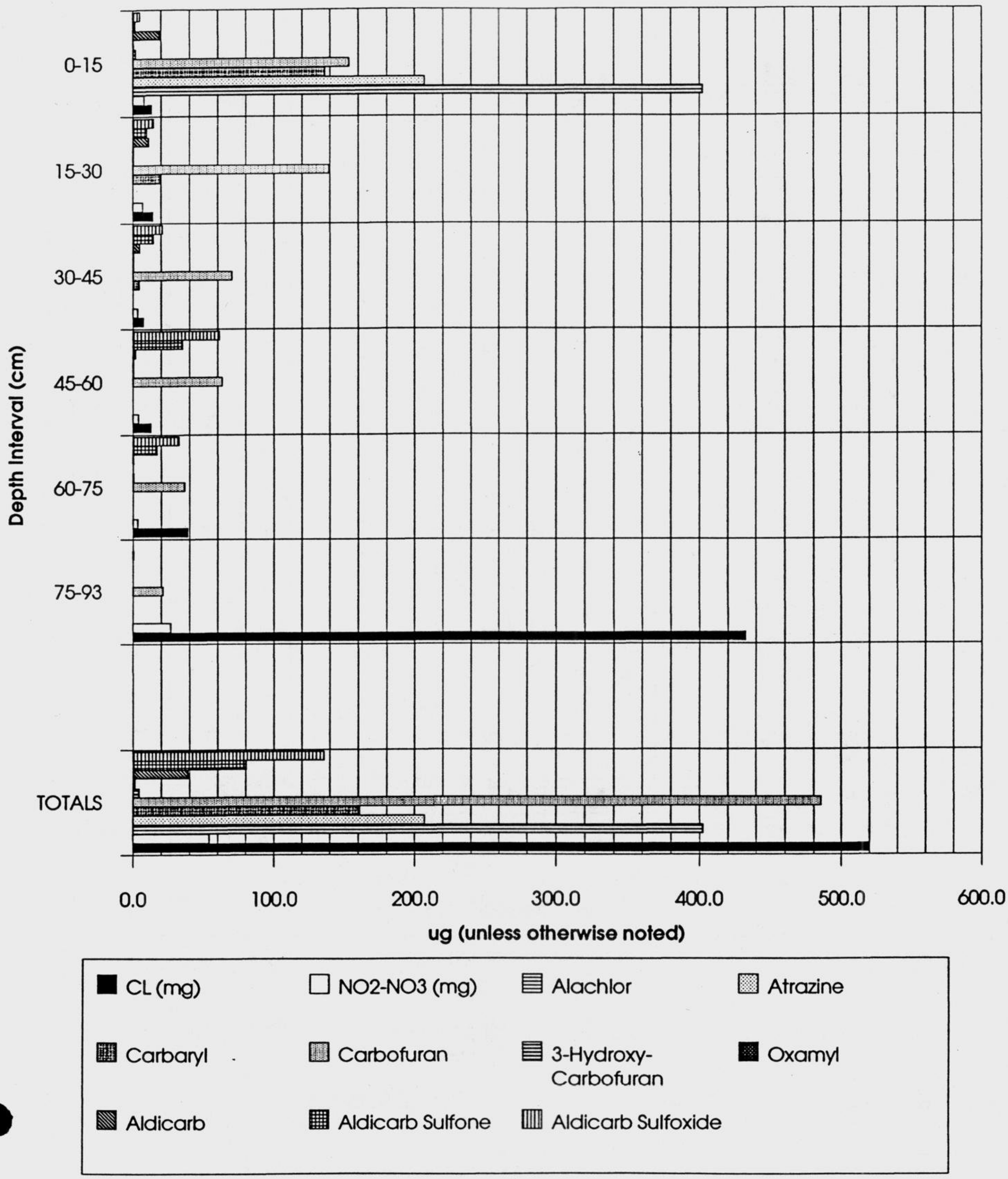
Mass of Pesticide, Nitrate, and Chloride Residuals by Depth for Burkart Soil Column 2 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 3

Figure 9

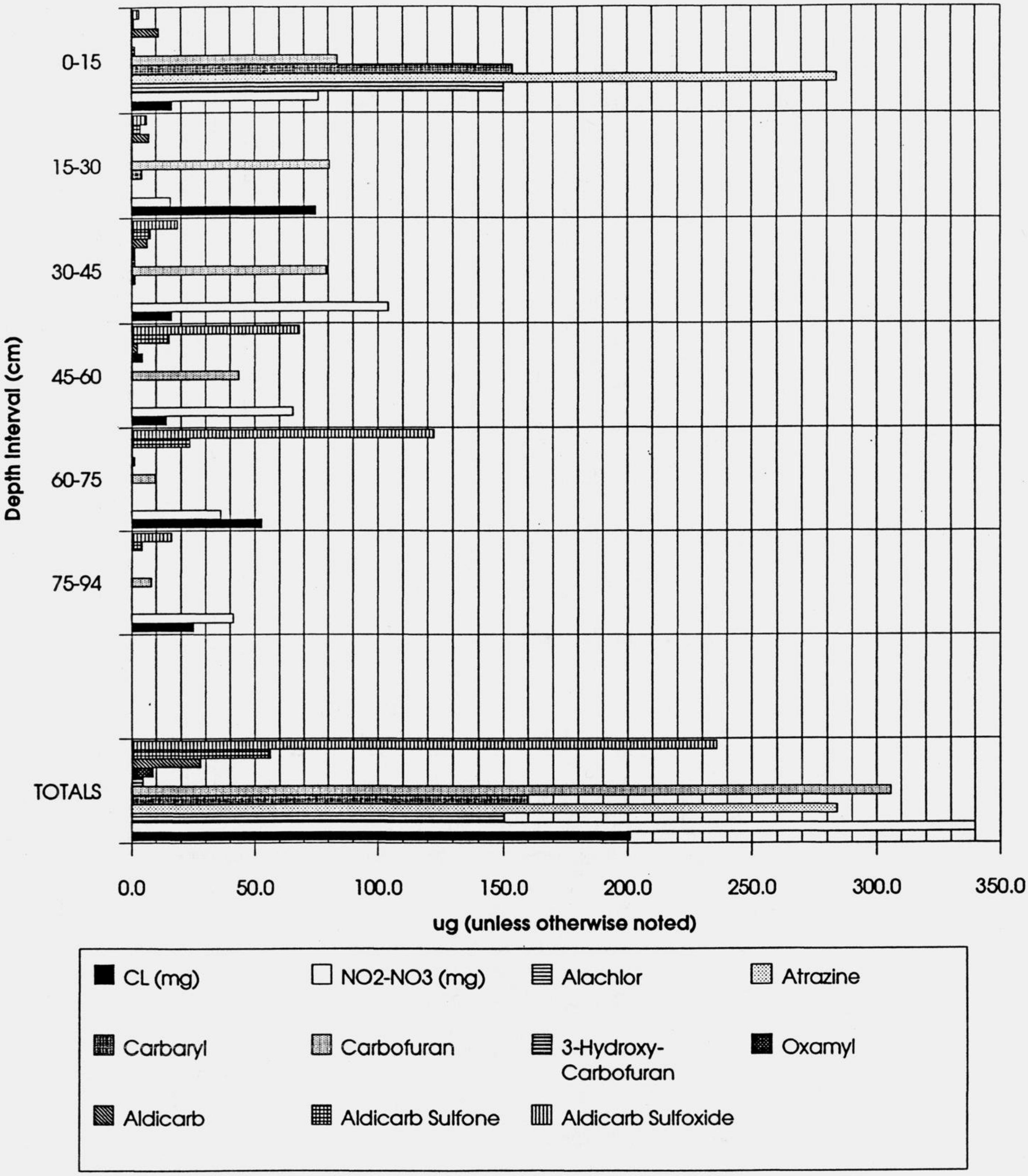
Mass of Pesticide, Nitrate, and Chloride Residuals by Depth for Burkart Soil Column 5 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 4

Figure 10

Mass of Pesticide, Nitrate, and Chloride Residuals by Depth for Burkart Soil Column 6 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 5

the soil columns indicates this compound did not leach beyond the first 30 cm of the soil column.

The triazine, atrazine and alachlor, were only analyzed on soil from Columns 5 and 6. Both columns had an atrazine recovery of 11.64% (Table 11). All of the atrazine detected was in the first 15 cm of soil (Figures 9 and 10).

Alachlor recoveries were 8.09% and 21.64% (Table 11). As with atrazine, all of the alachlor detected was limited to the upper 15 cm of soil (Figures 9 and 10). These data suggest that both atrazine and alachlor and carbaryl were much more tightly held than aldicarb or carbofuron. Longer leaching periods or higher leaching volumes would be needed to determine the extent of leaching that would occur in this soil.

<u>**Sparta**</u>

Columns numbered 3, 4, 7, and 8 were packed with Sparta soil. Columns 3 and 4 were treated with the "high" levels while Columns 7 and 8 were treated with the "low" levels of the pesticides studied. All four of the columns were treated with the standard amounts of inorganic tracers. Application amounts for these columns are listed in Table 1 (Page 7) and correspond to rates normally used in agricultural practice.

The percent leachate recovered, based on the volume of water added, is listed in Table 6 (Page 37). The total average recoveries of water added from the Sparta columns were as follows:

- Column 3 96%
- Column 4 93%

- Column 7 94%
- Column 8 96%

Table 7 (Page 38) displays the ratio of leachate recovered to the field capacity pore volume of the column. The values for the percent of the FMC that leached through the Sparta columns were as follows:

- Column 3 221%
- Column 4 195%
- Column 7 220%
- Column 8 231%

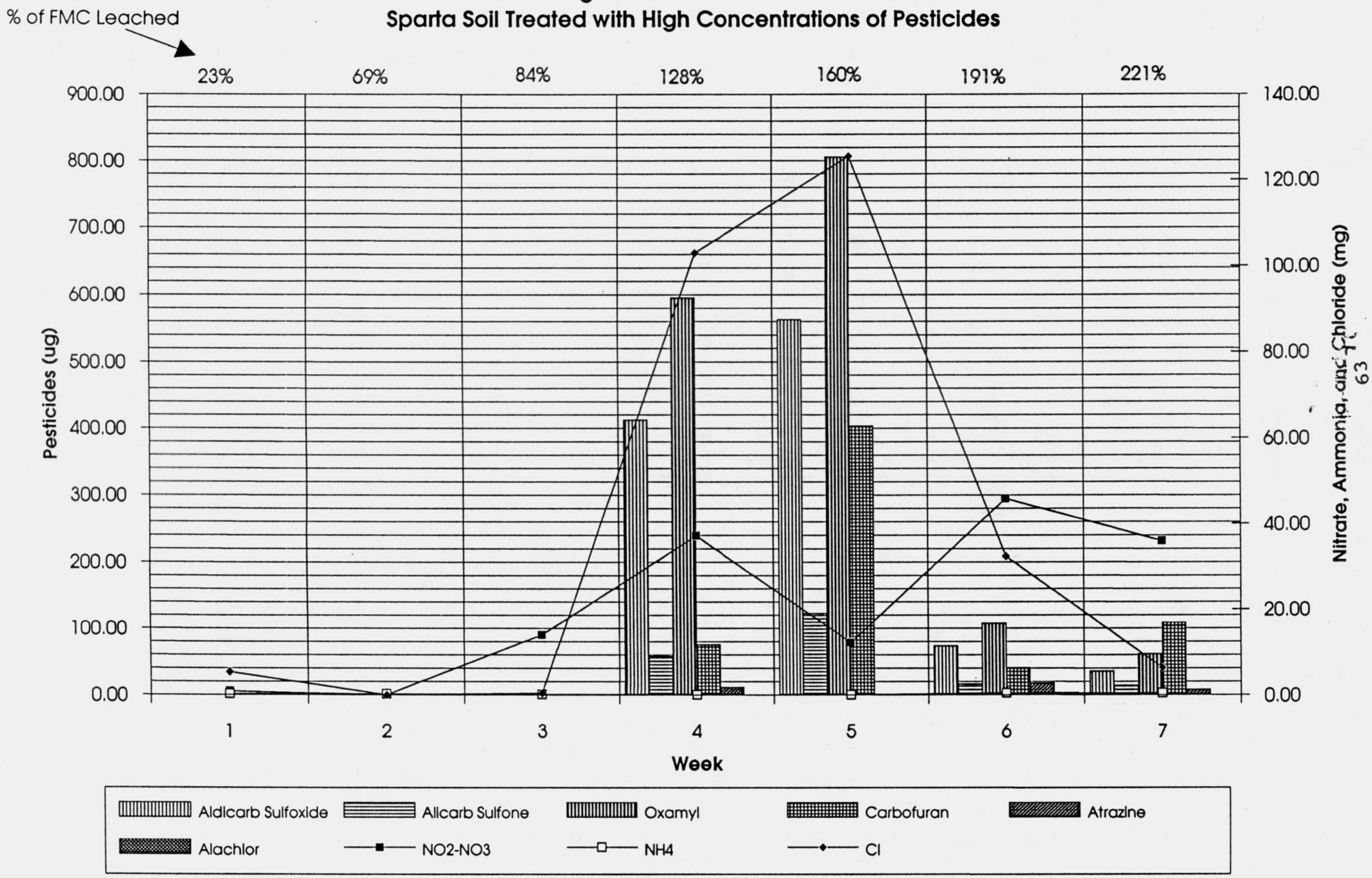
Pesticides were detected in the leachate of each of the Sparta columns (Table 8, Page 39). The inorganic tracers, nitrate-nitrite and chloride were also detected from the leachate of each of this set of columns (Table 9, Page 43).

The mass of pesticide and inorganic tracers in leachate are shown graphically for Columns 3, 4, 7, and 8 in Figures 11, 12, 13, and 14, respectively. Percent recoveries of pesticides are also shown graphically for Columns 3, 4, 7, and 8 in Figures 15, 16, 17, and 18. Table 12 lists the week of column breakthrough, concentration range, and percent recoveries for each compound detected in leachate from each column.

Aldicarb, oxamyl, total carbofuran, alachlor, and atrazine were detected in leachate from all Sparta columns, whereas carbaryl was not detected.

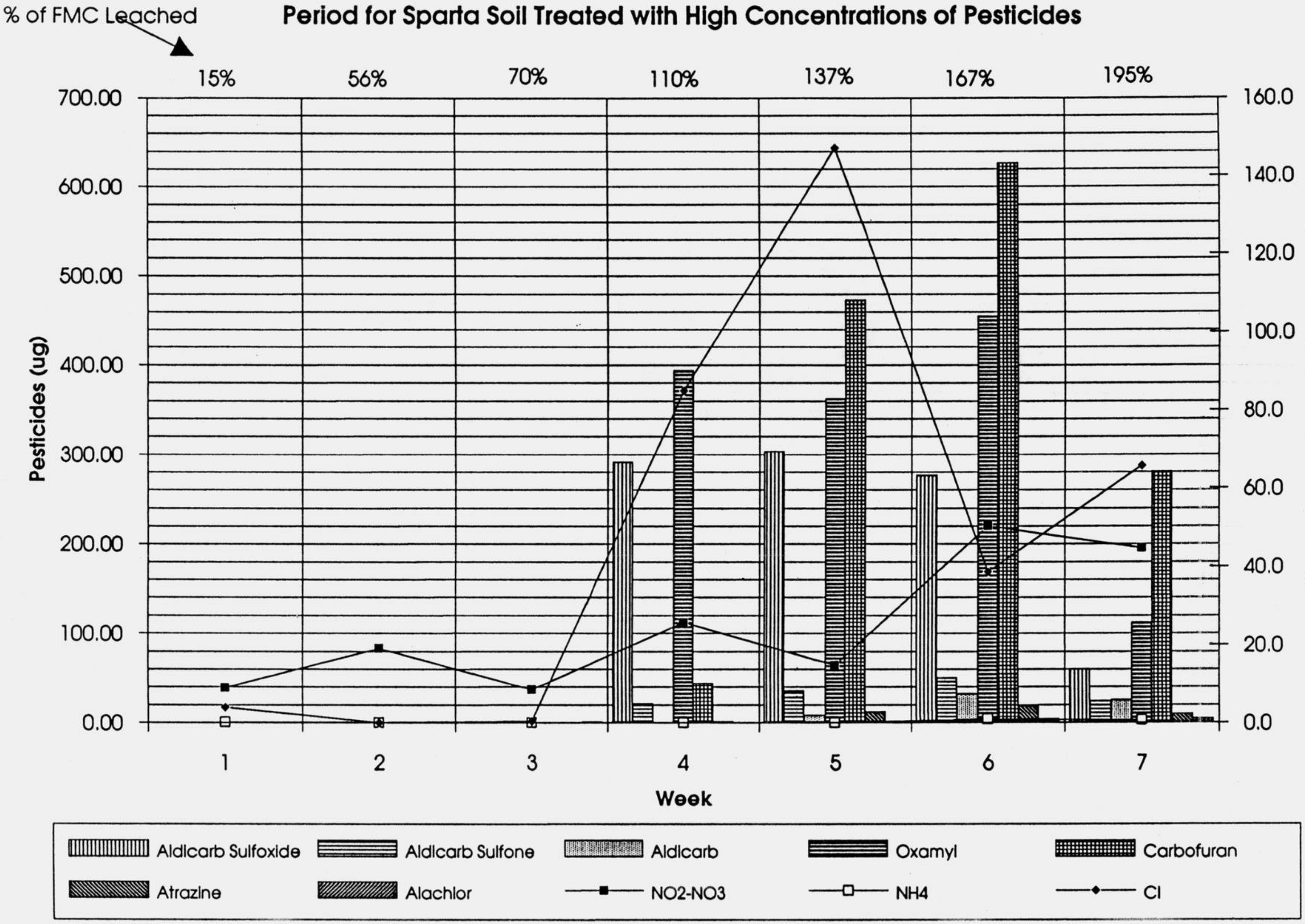
The atrazine and alachlor detects were minor compared to the carbamate data. Less than two percent of the atrazine and less

Figure 11
Column 3 - Mass of Pesticide and Inorganic Tracers Detected in Leachate from 7-week Period for Sparta Soil Treated with High Concentrations of Pesticides



63

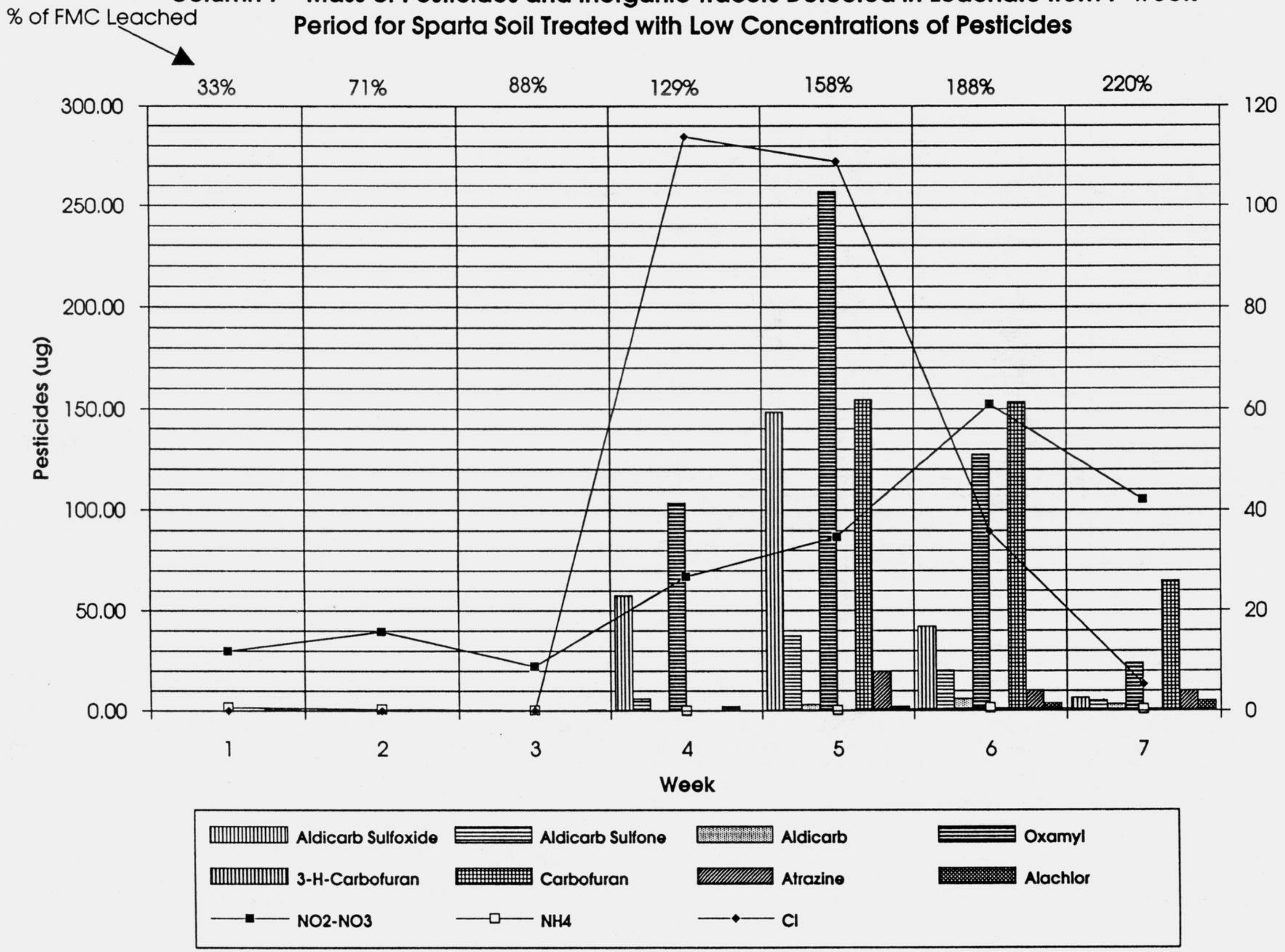
Figure 12
Column 4 - Mass of Pesticides and Inorganic Tracers Detected in Leachate from 7-week Period for Sparta Soil Treated with High Concentrations of Pesticides



64

Figure 13

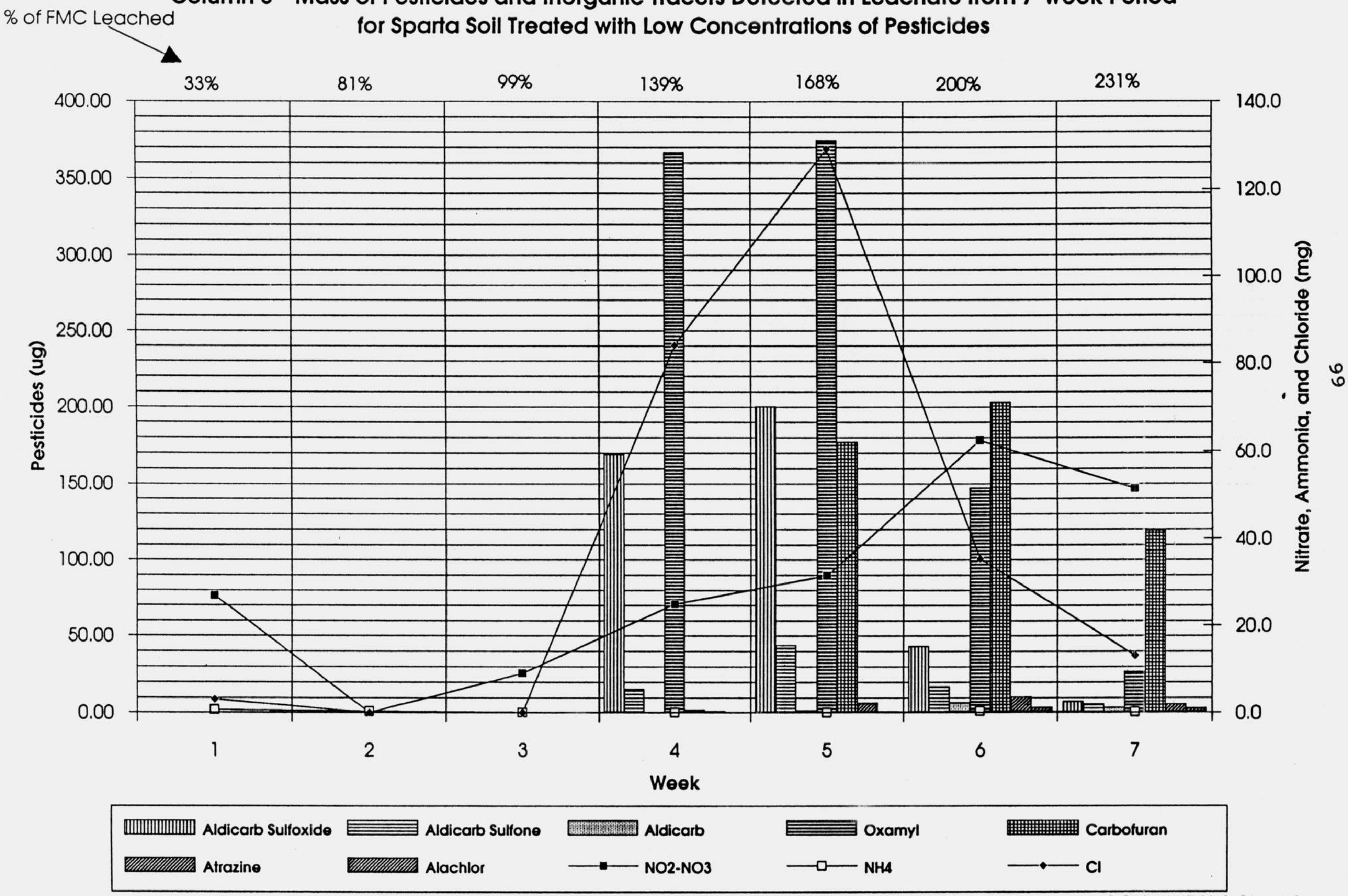
Column 7 - Mass of Pesticides and Inorganic Tracers Detected in Leachate from 7-week Period for Sparta Soil Treated with Low Concentrations of Pesticides



COLUMN7.X Chart 2

Figure 14

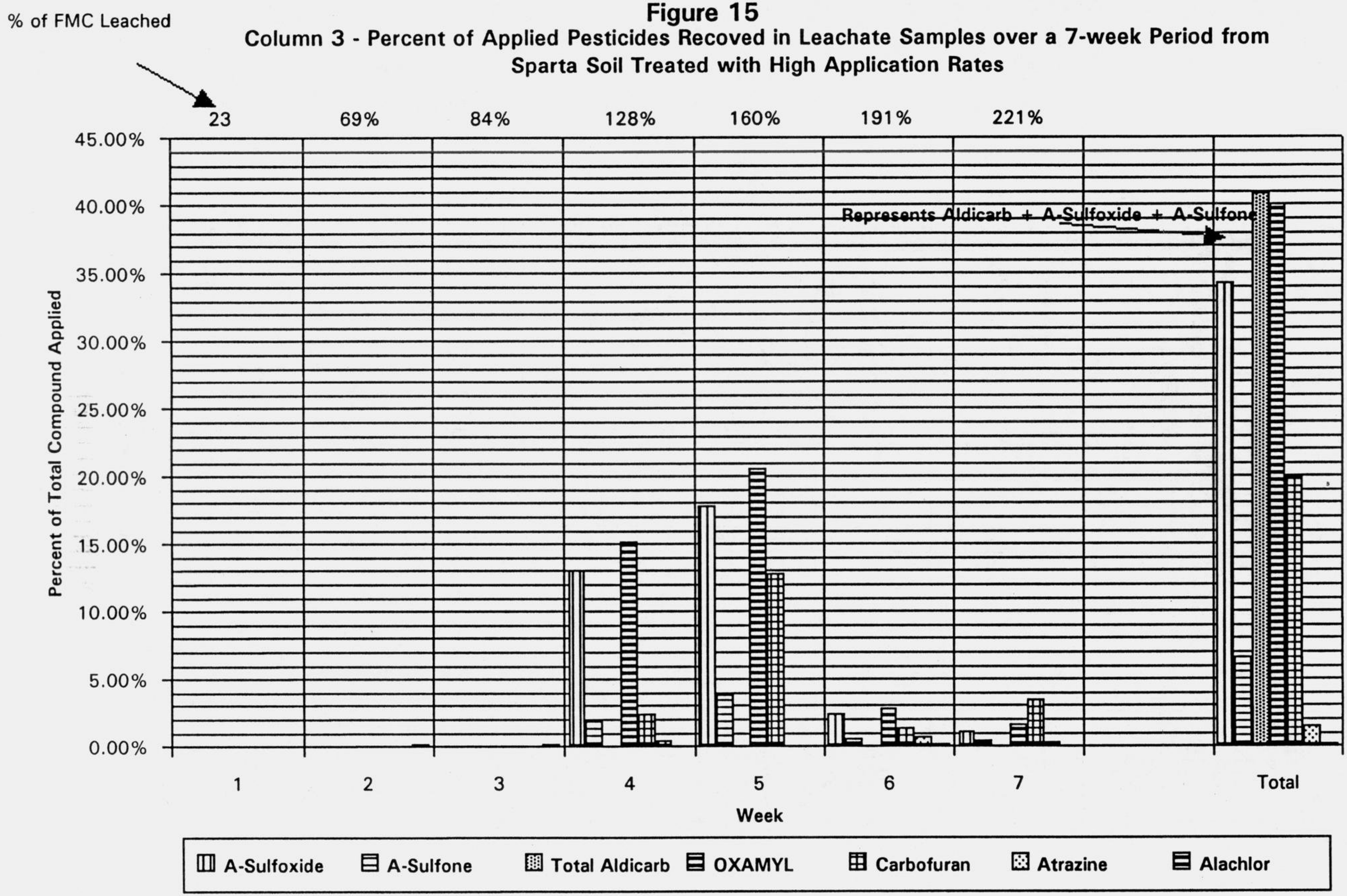
Column 8 - Mass of Pesticides and Inorganic Tracers Detected in Leachate from 7-week Period for Sparta Soil Treated with Low Concentrations of Pesticides



COLUMN7.XLS Chart 3

Figure 15

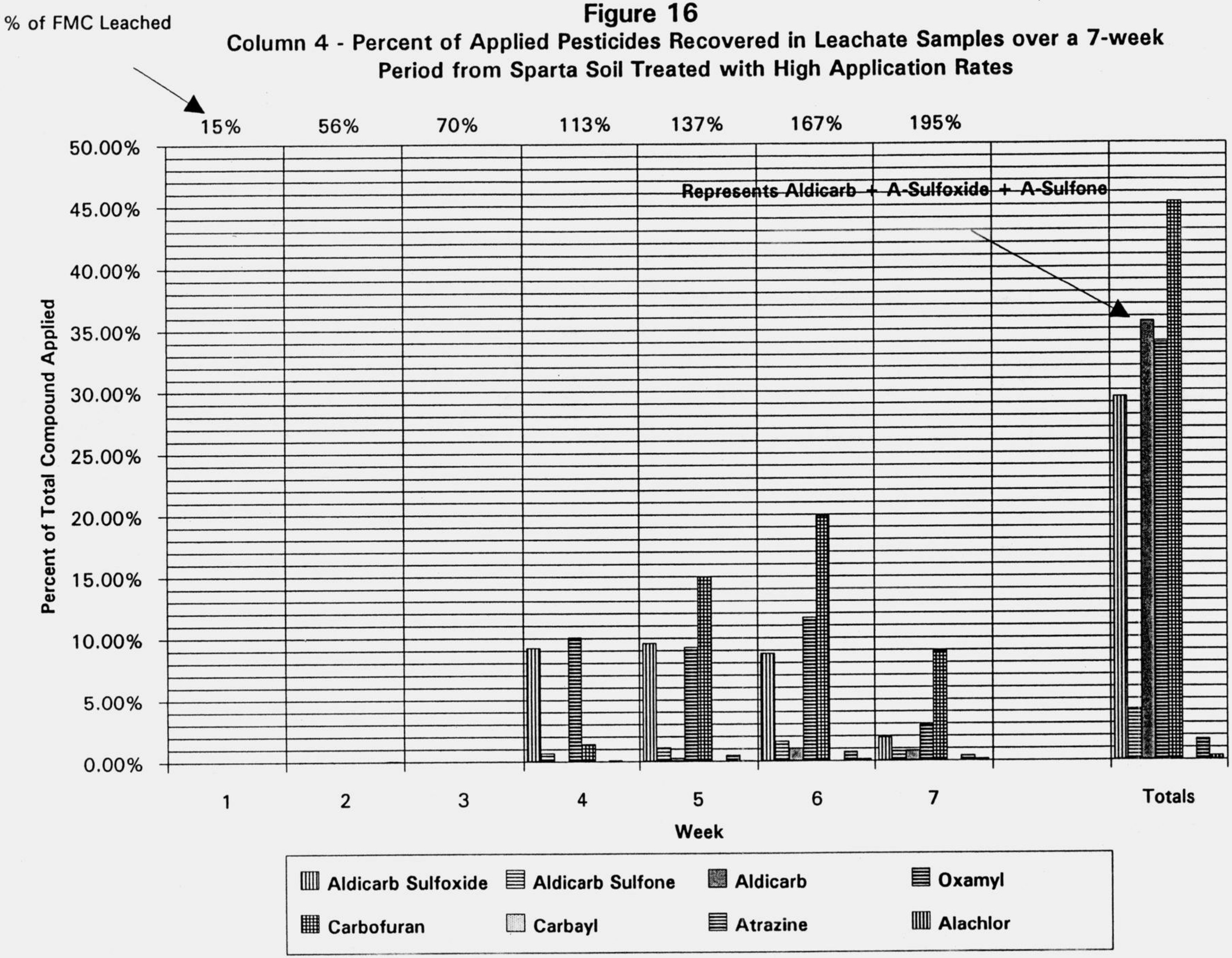
Column 3 - Percent of Applied Pesticides Recoved in Leachate Samples over a 7-week Period from Sparta Soil Treated with High Application Rates



COLUMN3.XLS Chart 4

Figure 16

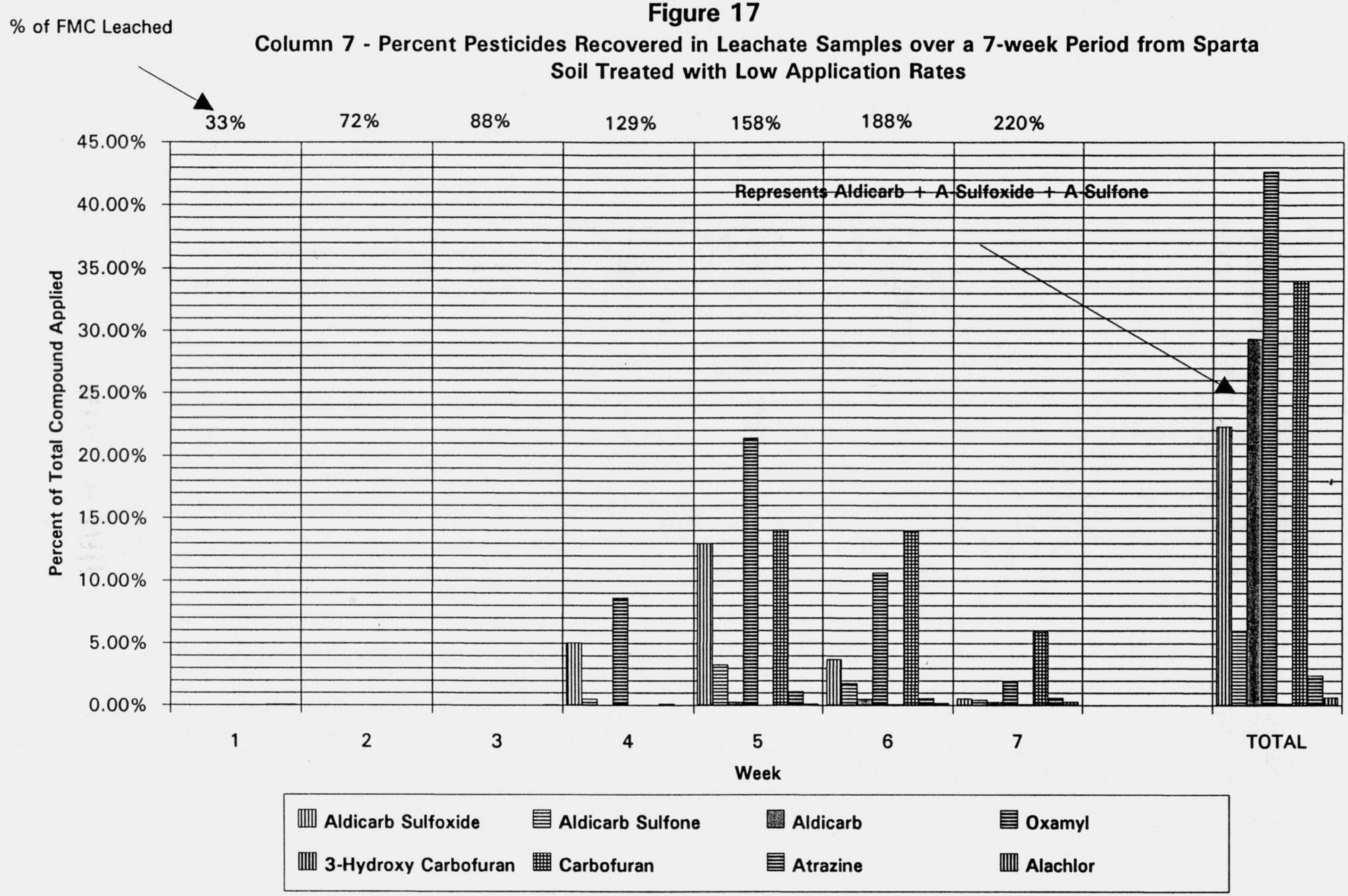
Column 4 - Percent of Applied Pesticides Recovered in Leachate Samples over a 7-week Period from Sparta Soil Treated with High Application Rates



COLUMN4.XLS Chart 2

Figure 17

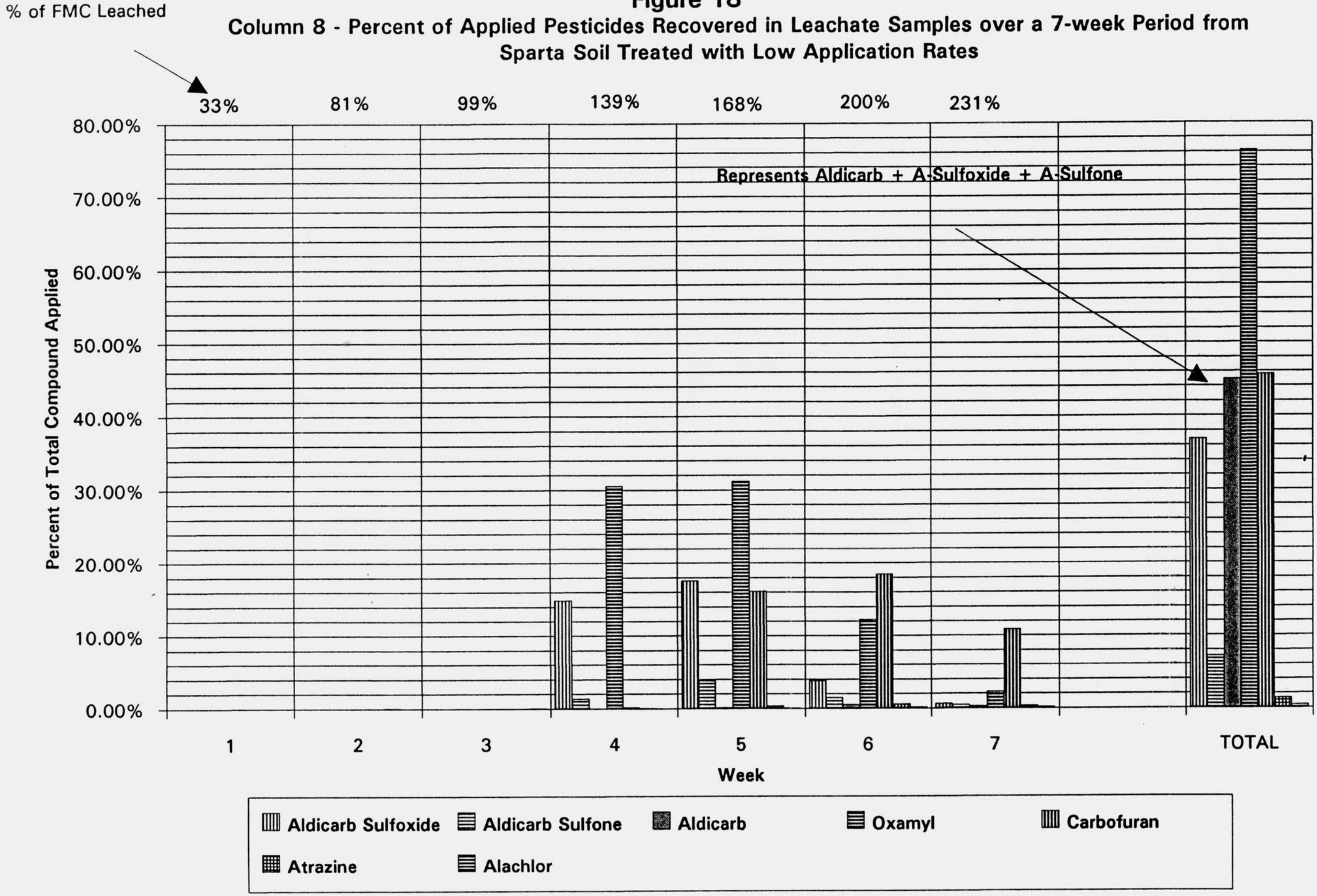
Column 7 - Percent Pesticides Recovered in Leachate Samples over a 7-week Period from Sparta Soil Treated with Low Application Rates



COLUMN7.XLS [illegible]art 1

Figure 18

Column 8 - Percent of Applied Pesticides Recovered in Leachate Samples over a 7-week Period from Sparta Soil Treated with Low Application Rates



COLUMN7.XLS Chart 4

Table 12: Summary of Pesticide, Nitrate, and Chloride Leaching Results for 4-Sparta Soil Columns

	Column 3 (High Concentration)			Column 4 (High Concentration)			Column 7 (Low Concentration)			Column 8 (Low Concentration)		
	Week of Break Through	Maximum Concentration ug/L + (Week) Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery
Aldicarb Sulfoxide	4	762 (5)	34.0%	4	443 (5)	29.0%	4	211 (5)	22.0%	4	291 (5)	38.0%
Aldicarb Sulfone	4	166 (5)	7.0%	4	68 (6)	4.0%	4	53 (5)	6.0%	4	64 (5)	7.0%
Aldicarb	6	146 (6)	3.0%	5	43 (6)	2.0%	5	8.2 (6)	1.0%	5	8.7 (6)	0.0%
Total Aldicarb	—	—	44.0%	—	—	35.0%	—		29.0%	—		45.0%
Oxamyl	4	1091 (5)	40.0%	4	530 (5)	34.0%	4	366 (5)	43.0%	4	544 (5)	76.0%
3-Hydroxy-Carbofuran	ND		0.0%	ND		0.0%	5	1.3 (6)	0.0%	ND		0.0%
Carbofuran	4	546 (5)	20.0%	4	957 (6)	45.0%	5	220 (5)	34.0%	4	276 (6)	46.0%
Total Carbofuran	—	—	20.0%	—	—	45.0%	—		34.0%	—		46.0%
Carbaryl	ND		0.0%	ND		0.0%	ND		0.0%	ND		0.0%
Atrazine	4	24 (6)	1.4%	4	25 (6)	1.7%	4	28 (5)	2.4%	5	14 (6)	1.3%
Alachlor	6	4.6 (6)	0.2%	5	7.4 (7)	0.3%	5	6.4 (7)	0.6%	6	4.8 (6)	0.4%
Nitrate-Nitrite	3	65 (6)	NC	UK	72 (6)	NC	UK	85 (6)	NC	UK	35 (6)	NC
Chloride	4	170 (5)	NC	4	215 (5)	NC	4	155 (5)	NC	4	185 (5)	NC

ND = not detected
---- = not analyzed
NC = not calulated
UK = unknown

Table 12: Summary of Pesticide, Nitrate, and Chloride Leaching Results for 4-Sparta Soil Columns

	Column 3 (High Concentration)			Column 4 (High Concentration)			Column 7 (Low Concentration)			Column 8 (Low Concentration)		
	Week of Break Through	Maximum Concentration ug/L + (Week) Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery
Aldicarb Sulfoxide	4	762 (5)	34.0%	4	443 (5)	29.0%	4	211 (5)	22.0%	4	291 (5)	38.0%
Aldicarb Sulfone	4	166 (5)	7.0%	4	68 (6)	4.0%	4	53 (5)	6.0%	4	64 (5)	7.0%
Aldicarb	6	146 (6)	3.0%	5	43 (6)	2.0%	5	8.2 (6)	1.0%	5	8.7 (6)	0.0%
Total Aldicarb	—	—	44.0%	—	—	35.0%	—		29.0%	—		45.0%
Oxamyl	4	1091 (5)	40.0%	4	530 (5)	34.0%	4	366 (5)	43.0%	4	544 (5)	76.0%
3-Hydroxy-Carbofuran	ND		0.0%	ND		0.0%	5	1.3 (6)	0.0%	ND		0.0%
Carbofuran	4	546 (5)	20.0%	4	957 (6)	45.0%	5	220 (5)	34.0%	4	276 (6)	46.0%
Total Carbofuran	—	—	20.0%	—	—	45.0%	—		34.0%	—		46.0%
Carbaryl	ND		0.0%	ND		0.0%	ND		0.0%	ND		0.0%
Atrazine	4	24 (6)	1.4%	4	25 (6)	1.7%	4	28 (5)	2.4%	5	14 (6)	1.3%
Alachlor	6	4.6 (6)	0.2%	5	7.4 (7)	0.3%	5	6.4 (7)	0.6%	6	4.8 (6)	0.4%
Nitrate-Nitrite	3	65 (6)	NC	UK	72 (6)	NC	UK	85 (6)	NC	UK	35 (6)	NC
Chloride	4	170 (5)	NC	4	215 (5)	NC	4	155 (5)	NC	4	185 (5)	NC

ND = not detected
— = not analyzed
NC = not calulated
UK = unknown

than one percent of the alachlor applied was recovered for any of the four columns, compared to 25% to 45% for aldicarb; 34% to 76% for oxamyl; and 20% to 45% for carbofuran.

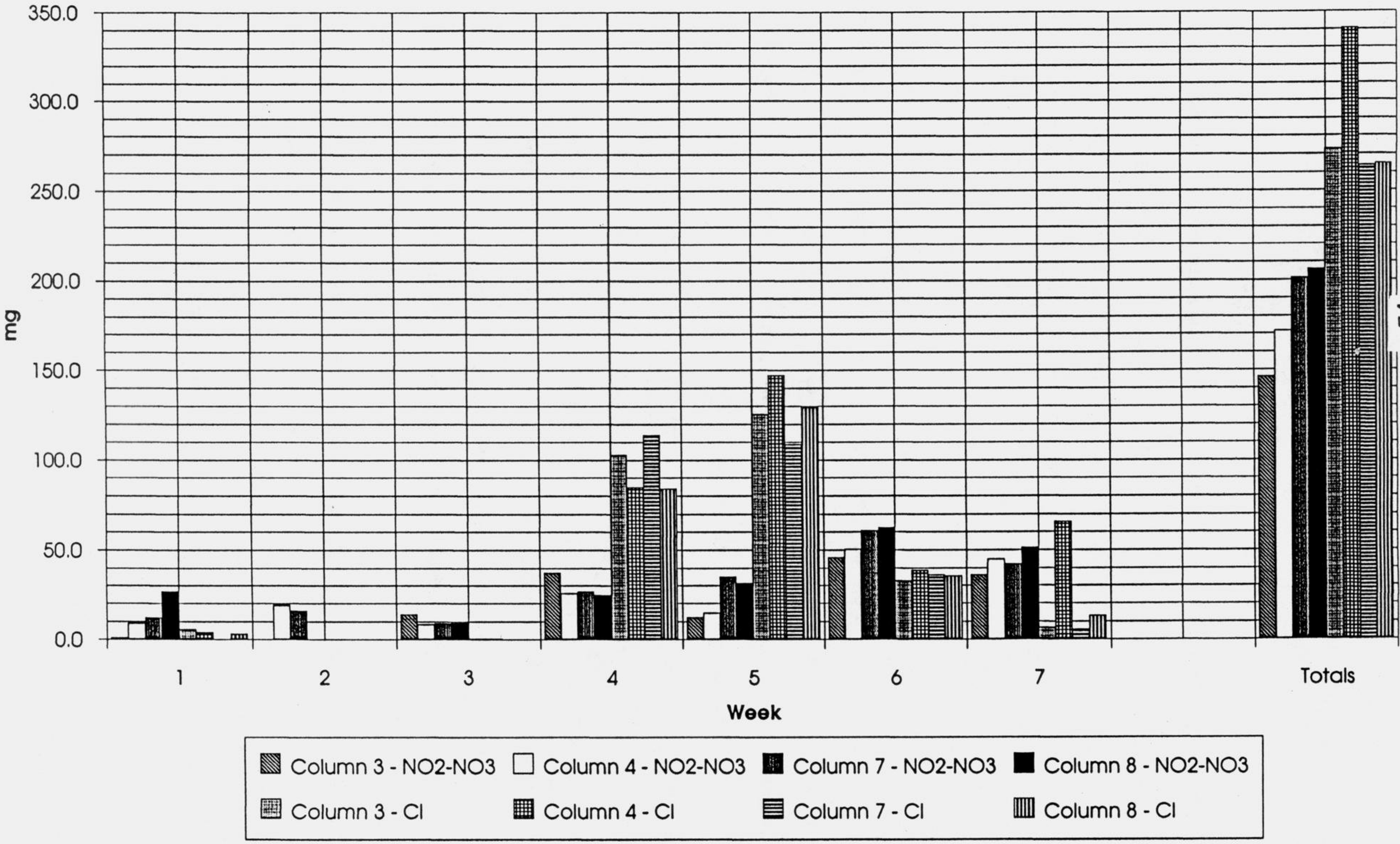
For the carbamate compounds, total aldicarb, oxamyl, and carbofuran were each detected within the column leachate samples by Week 4. Percent recoveries for total aldicarb ranged from 29% to 45% (Table 12). At least 75% of the total aldicarb detected was in the form of aldicarb sulfoxide. The metabolite aldicarb sulfone was the second most predominant component of total aldicarb detected. The parent product, aldicarb, was detected in each of the four columns but at much lower concentrations and was not detected until Weeks 5 and 6, indicating it is less mobile than its metabolites. Oxamyl had percent recoveries from 34% to 76% (Table 12), and carbofuran recoveries ranged from 20% to 46% (Table 12). Carbaryl was not detected within any of the leachate samples from the Sparta soil.

Both inorganic tracers (nitrite-nitrate and chloride) were detected from the leachate of each of the Sparta columns (Figure 19). Chloride was first detected in the Week 4 leachate sample of each of the four columns (Table 12). Nitrite-Nitrate data was more sporadic. It was detected in all samples analyzed from this group (Figure 19). Initial detects may be from residuals in the soil which was present prior to soil collection. The nitrite+nitrate-N data did not follow the same leaching pattern as chloride, but appeared to be retarded by about one week compared to chloride (Figure 19). Chloride and the pesticides aldicarb and oxamyl leached at about the same rate, through this soil while atrazine, alachlor and carbofuran showed up in leachate one week later. This indicates slightly slower movement of these chemicals, which appear to move at rates similar to nitrate.

Soil samples were not analyzed for this soil set.

Figure 19

Mass of Nitrate and Chloride Detected in Leachate from 4-Sparta Soil Columns for a 7-week Period



INFINC2.X Chart 4

Antigo

Columns 9, 10, 13, and 14 were packed with Antigo soil. Columns 9 and 13 were treated with "high" levels, while columns 10 and 14 were treated with "low" levels of the pesticides. Application rates for these columns are listed in Table 1 (Page 7). In addition to these chemical additions, columns 10, 13, and 14 (Table 1) were used in a preliminary column study in which column 10 had an application of potassium chloride, ammonium nitrate, and a farm grade alachlor. Column 14 had an application of potassium chloride, ammonium nitrate, and a farm grade atrazine. Column 13 was used as a blank in the previous study with no chemicals applied. These columns were leached for a total of 11 weeks and had a total of 10,200 mls of water applied (5,000 mL of water were from a previous study, and 5,200 mL were from the current study).

The percent leachate recovered, based on the volume of water added, is listed in Table 6 (Page 37). The total average water recoveries from the Antigo columns were as follows:

- Column 9 84%
- Column 10 89%
- Column 13 87%
- Column 14 91%

Table 7 (Page 38) lists the ratio of leachate recovered to the pore volume of the column. The values for the percent of the column pore volume leached for the Antigo soils were as follows:

- Column 9 62%

- Column 10 64% (140%)
- Column 13 60%
- Column 14 80% (174%)

The percentages shown in parentheses represent the total pore volume (FMC) leached from both the previous study and the current study for columns which had chemicals previously applied.

Pesticide leachate data for the Antigo columns is listed in Table 8. No carbamate pesticides were detected in the leachate of Columns 9, 13, and 14. Only a suspect amount (analytical detection limit) of atrazine and alachlor was detected in Columns 9, 10, 13, and 14. If these values were true, other faster leaching compounds, such as oxamyl, should also be present unless these chemical were present in the soil from previous field applications. Column 10, which was treated with "low" amounts of pesticides, had low detects of aldicarb sulfoxide, aldicarb sulfone, oxamyl, carbofuran, alachlor, and atrazine occurring mostly during Week 6. A small amount of alachlor (previously applied) was detected in the leachate from Week 3.

Inorganic results, for comparison to pesticide leaching, are limited to Columns 9 and 13 for the current study. The remaining two columns from the Antigo set (Columns 10 and 14) had potassium chloride and ammonium nitrate applied as part of a preliminary leaching study. However, inorganic results for these columns are included in Table 9 (Page 43). Table 13 shows the inorganic leachate data for both the previous study and the current study. These results are indicators of the future potential for the Antigo soil to leach, but are not related to the current pesticide data.

Results for Columns 9 and 13 are shown in Figure 20. Leachate from Column 9 contained increased concentrations of nitrite+nitrate-N and chloride by Week 6, indicating breakthrough. Column 13 results for nitrite-nitrate were not as definitive as elevated levels were detected in all samples, but did seem to increase more at the later end of the leaching study. Chloride results showed breakthrough at Week 6.

The inorganic data from Columns 10 and 14 for both the previous study and the current study is shown graphically in Figures 21 (Column 10) and 22 (Column 14). Both of these sets of data show a more rapid breakthrough of chloride compared to nitrate for these soil columns.

The soil from Antigo Columns 9, 10, and 13 were analyzed for both pesticides and inorganic compounds at the end of the leaching study. Table 14 lists the depth and percent recovery of each pesticide applied. The mass of pesticides and inorganics detected within the soil for Columns 9, 10, and 13 are shown graphically in Figures 23, 24, and 25.

Review of the results indicated that residual total aldicarb was present within each of the three columns analyzed at 22.31% to 55.08% of the total applied (Table 14). Aldicarb sulfoxide was the

Table 13: Mass of Nitate and Chloride Detected in leachate from Anitgo Soil Columns 10 and 14, which were Leached in a Previous Study and the Current Study

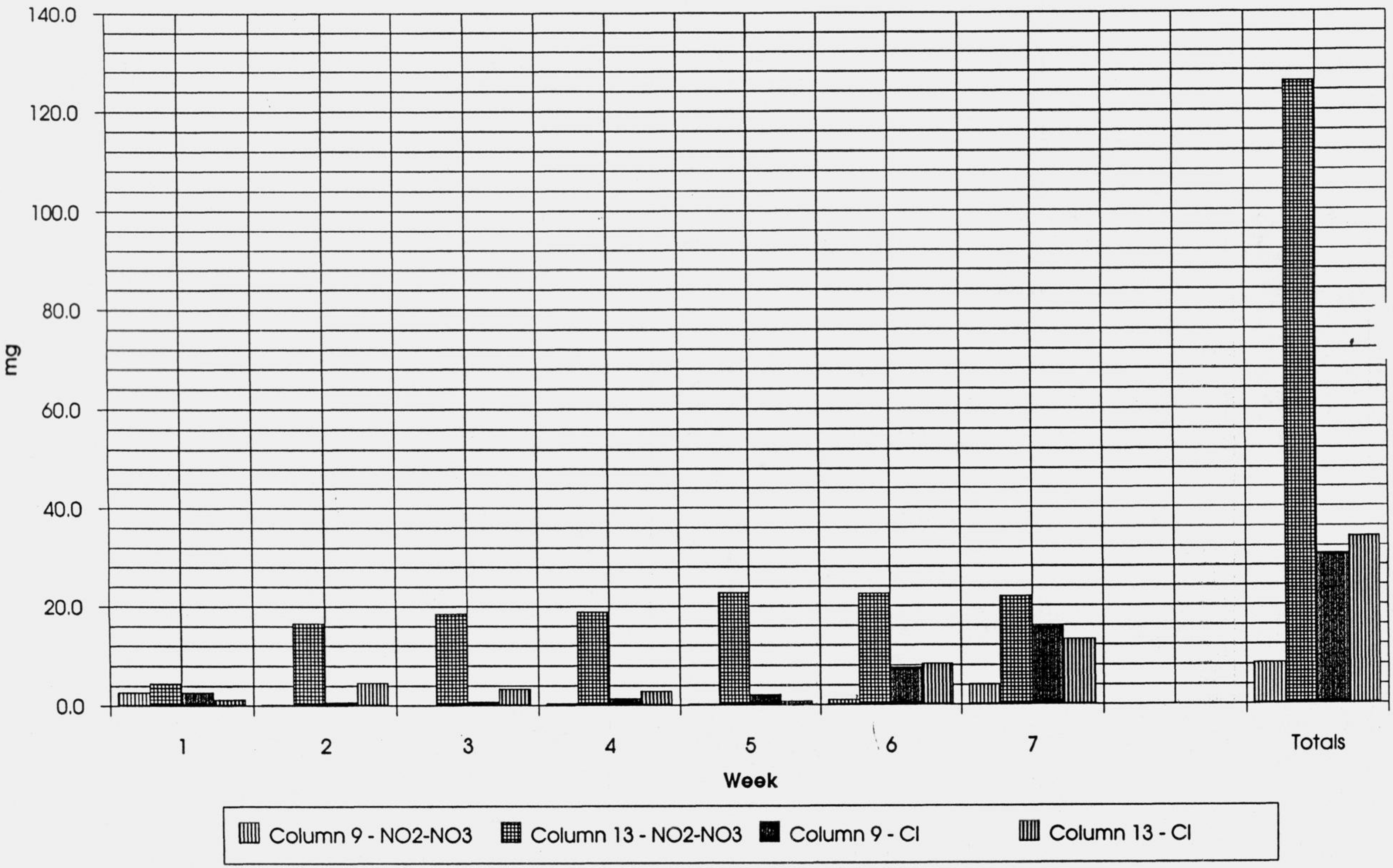
		WEEKS	NH4 (mg)	NO2-NO3 (mg)	Cl (mg)	LEACHATE (mls)	pH	Conductance (umhos)
Column 10	Previous Study	0					6.08	17
		1	0.04	0	2	950	6.99	43
		2						
		3	0.03	0	4	905	5.71	68
		4					5.4	45
		5	0.07	0	5	820	6.15	48
		6	0.06	1	6	470	5.5	65
		7	0.08	2	10	350	5.73	110
		8	0.04	3	16	435	5.12	170
		9	0.08	5	28	420		
		10	0.09	6	38	420	4.89	293
		11	0.14	16	42	760	4.71	376
	Current Study	12	0.09	14	15	335	5.11	483
		13	0.15	36	32	766	4.63	540
		14	0.17	44	34	670	4.71	672
		15	0.15	95	29	690	4.54	645
		16	0.24	81	26	735	4.47	686
		17	0.18	80	21	730	4.57	608
		18	0.18	49	1	688	4.8	543
	TOTALS		**1.79**	**432**	**309.3**	**10,144**		
Column 14	Previous Study	0					6.16	12
		1	0.04	0	1	1110	6.99	34
		2						
		3	0.09	0	3	805	6.16	33
		4					5.4	40
		5	0.09	0	5	795	5.84	46
		6	0.08	0	5	500	5.57	55
		7	0.12	1	8	300	6.09	88
		8	0.12	2	12	450	4.95	117
		9	0.15	3	17	425	5.32	151
		10	0.12	6	32	405	5.07	273
		11	0.12	16	41	770	4.84	374
	Current Study	12	0.06	10	13	384	5.59	309
		13	0.15	31	32	856	4.95	433
		14	0.18	35	31	700	4.97	516
		15	0.19	79	28	750	4.6	571
		16	0.19	95	26	677	4.56	737
		17	0.00	107	30	716	4.45	701
		18	0.24	50	20	673	4.73	596
	TOTALS		**1.92**	**434**	**302.1**	**10,316**		

NH4 = ammonia
NO2-NO3 = nitrite-nitare
Cl = chloride

INANT104.XLS

Figure 20

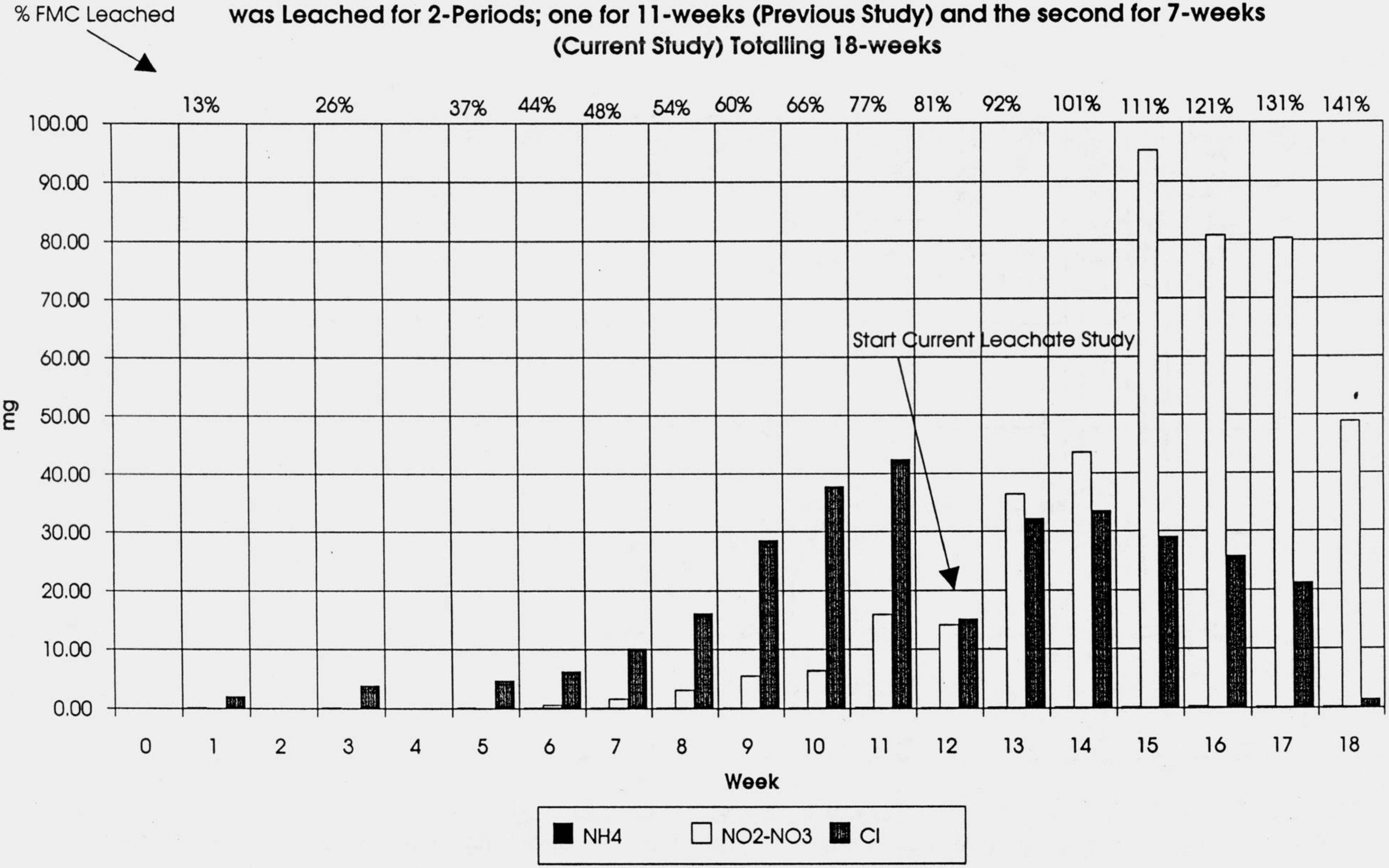
Mass of Nitrate and Chloride Detected in Leachate from 2-Antigo Soil Columns (Current Study Only)



INFINC2.XLS Chart 5

Figure 21

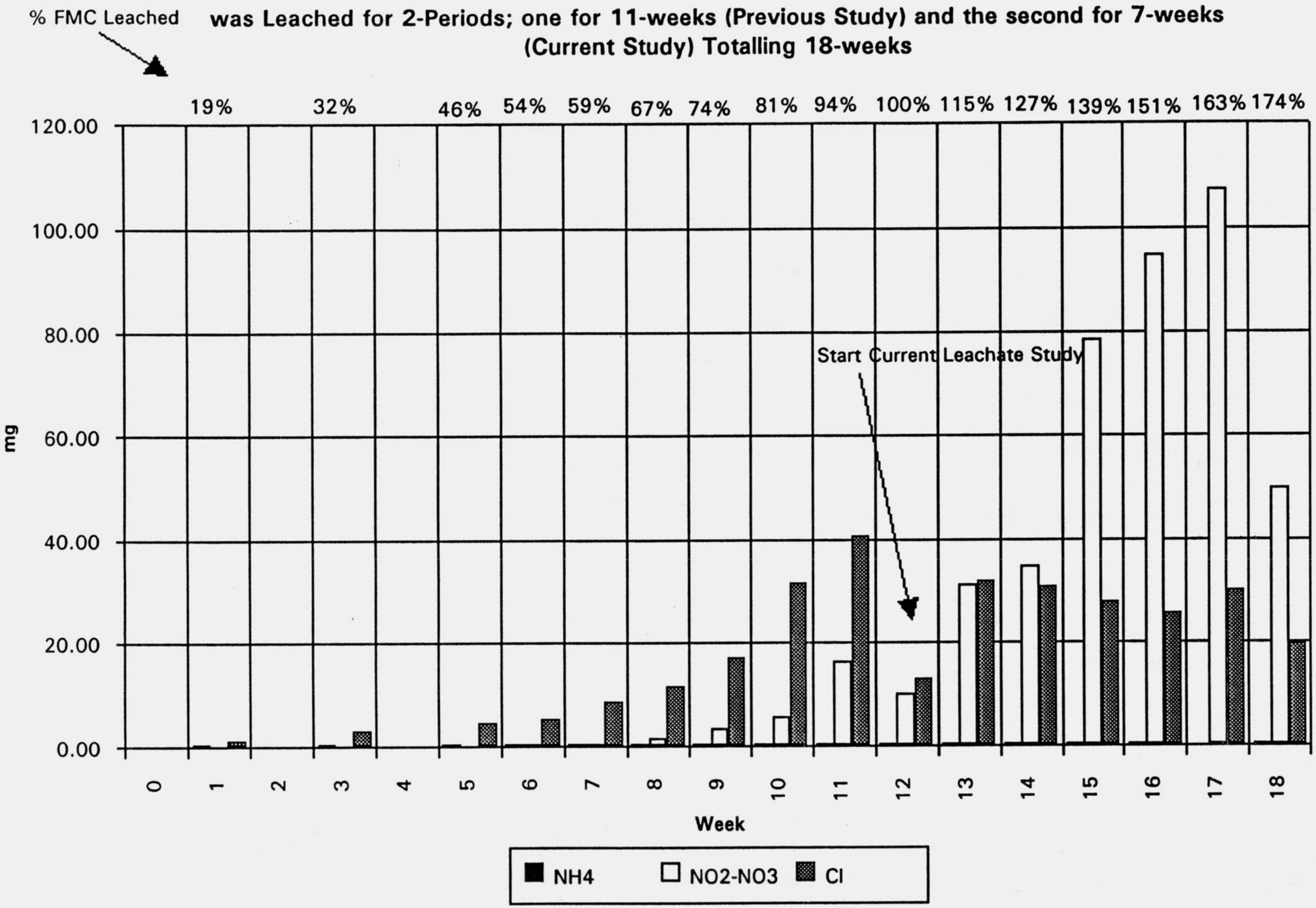
Mass of Nitrate and Chloride Detected in Leachate Samples from Antigo Soil Column 10, which was Leached for 2-Periods; one for 11-weeks (Previous Study) and the second for 7-weeks (Current Study) Totalling 18-weeks



INAN 04.XLS Chart 2

Figure 22

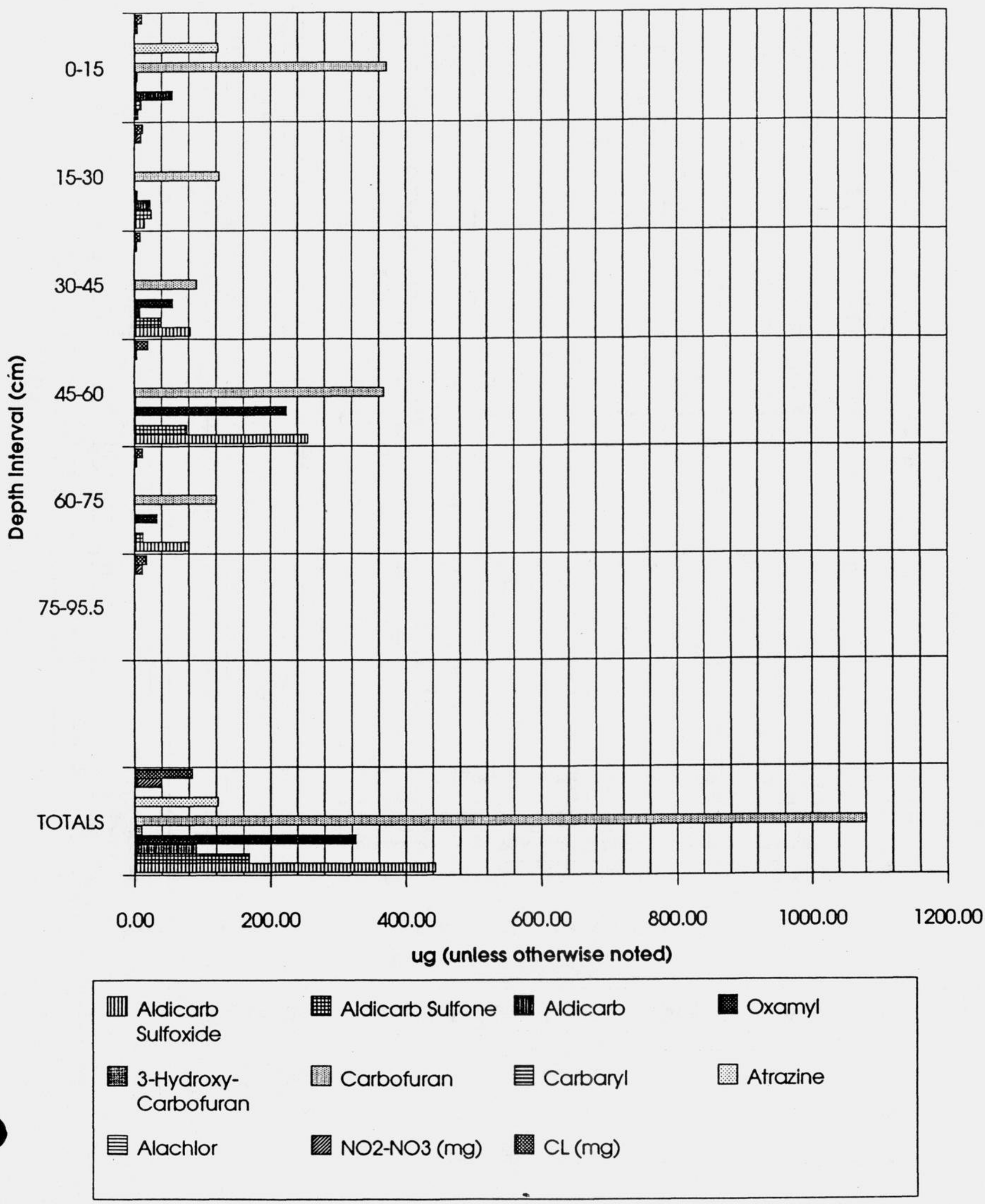
Mass of Nitrate and Chloride Detected in Leachate Samples from Antigo Soil Column 14, which was Leached for 2-Periods; one for 11-weeks (Previous Study) and the second for 7-weeks (Current Study) Totalling 18-weeks



INANT104.XLS Chart 3

Figure 23

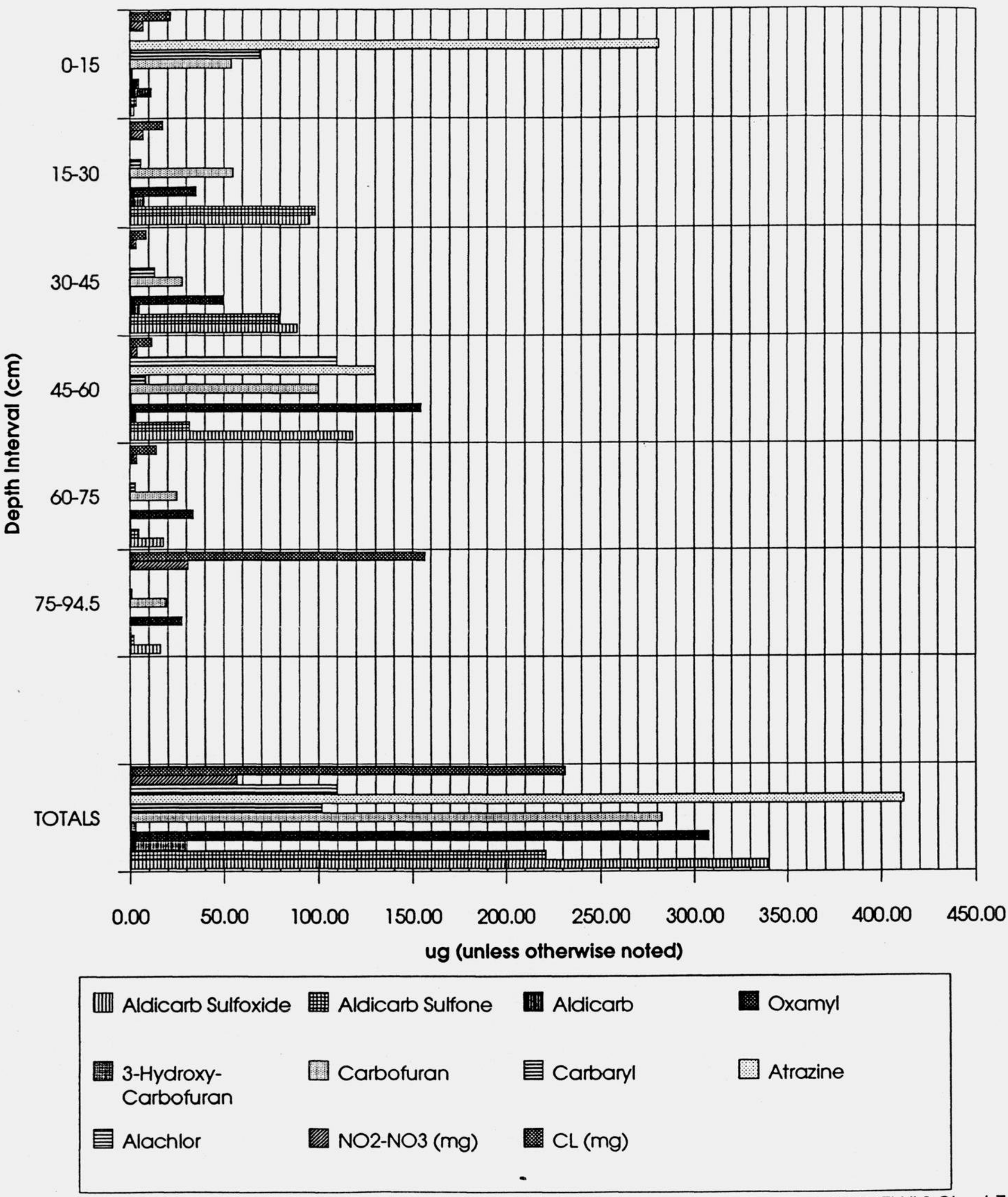
Mass of Pesticide, Nitrate, and Chloride Residuals by Depth for Antigo Soil Column 9 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 6

Figure 24

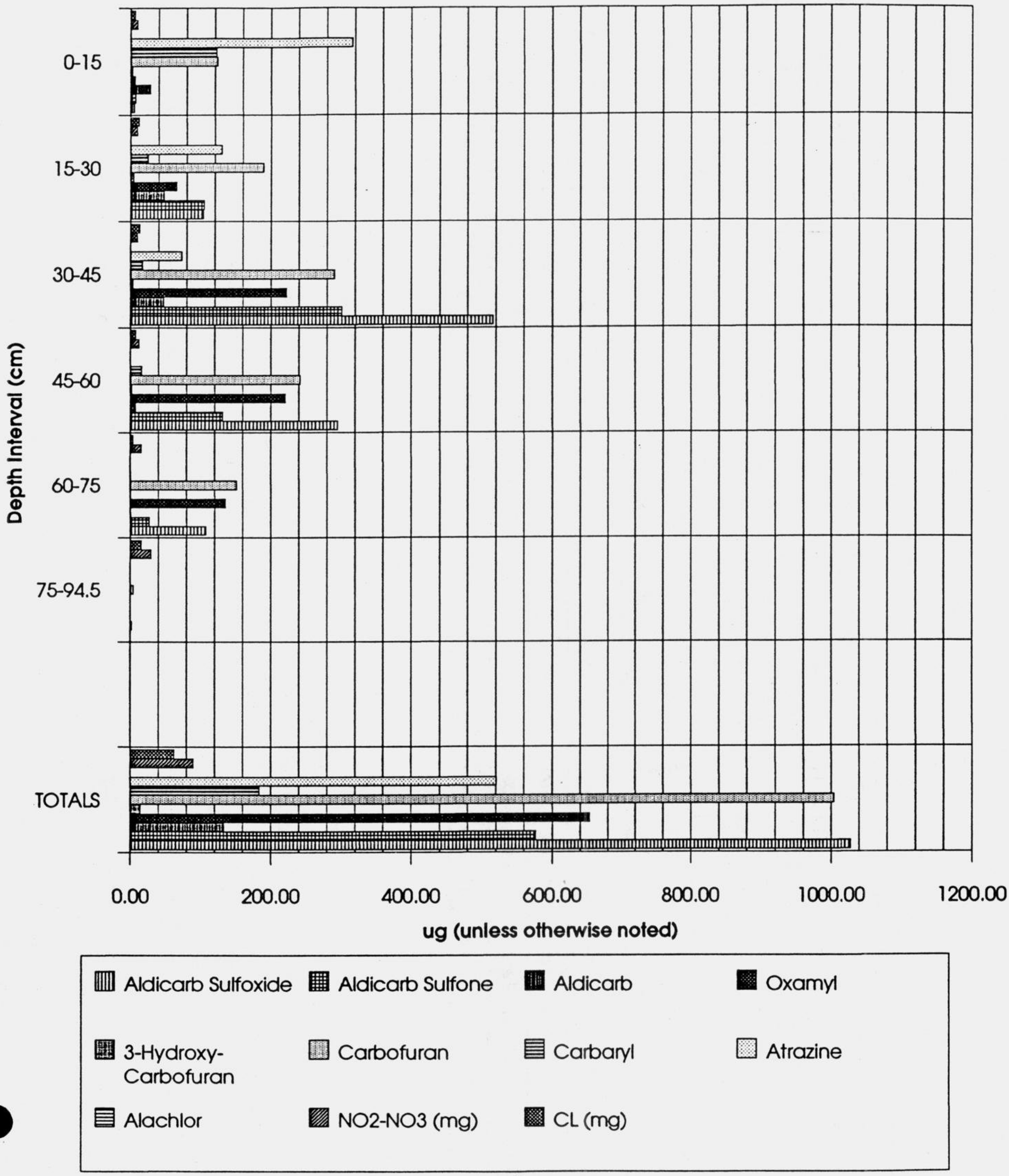
Mass of Pesticide, Nitrate, and Chloride Residuals by Depth for Antigo Soil Column 10 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 7

Figure 25

Mass of Pesticides, Nitrate, and Chloride Residuals by Depth for Antigo Soil Column 13 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 8

Table 14: Antigo Soil Column Pesticide Residue Recoveries by Depth Interval

	Column 9 Depths (cm)							Column 10 Depths (cm)							Column 13 Depths (cm)						
Compounds	0-15	15-30	30-45	45-60	60-75	75-96	Totals	0-15	15-30	30-45	45-60	60-75	75-94	Totals	0-15	15-30	30-45	45-60	60-75	75-93	Totals
Aldicarb Sulfoxide	0.20%	0.50%	2.65%	8.09%	2.58%	0.00%	**14.02%**	0.22%	8.39%	7.82%	10.39%	1.56%	1.43%	**29.81%**	0.18%	3.29%	16.33%	9.36%	3.42%	0.00%	**32.58%**
Aldicarb Sulfone	0.36%	0.84%	1.27%	2.46%	0.41%	0.00%	**5.34%**	0.31%	8.66%	7.03%	2.80%	0.43%	0.21%	**19.44%**	0.26%	3.35%	9.54%	4.17%	0.86%	0.08%	**18.26%**
Aldicarb	1.78%	0.76%	0.30%	0.09%	0.02%	0.00%	**2.95%**	1.01%	0.69%	0.47%	0.30%	0.04%	0.05%	**2.56%**	0.91%	1.53%	1.51%	0.26%	0.03%	0.00%	**4.24%**
Total Aldicarb	2.34%	2.10%	4.22%	10.64%	3.01%	0.00%	**22.31%**	1.54%	17.74%	15.32%	13.49%	2.03%	1.69%	**51.81%**	1.35%	8.17%	27.38%	13.79%	4.31%	0.08%	**55.08%**
Oxamyl	0.09%	0.14%	1.47%	5.75%	0.87%	0.02%	**8.34%**	0.41%	2.96%	4.20%	12.92%	2.85%	2.32%	**25.66%**	0.18%	1.68%	5.71%	5.67%	3.48%	0.00%	**16.72%**
3-Hydroxy-Carbofuran	0.15%	0.05%	0.03%	0.09%	0.04%	0.00%	**0.36%**	0.13%	0.04%	0.04%	0.08%	0.00%	0.00%	**0.29%**	0.09%	0.17%	0.11%	0.07%	0.04%	0.00%	**0.48%**
Carbofuran	11.82%	3.99%	2.93%	11.68%	3.87%	0.00%	**34.29%**	4.94%	5.02%	2.55%	9.12%	2.30%	1.76%	**25.69%**	3.94%	6.04%	9.24%	7.70%	4.83%	0.15%	**31.90%**
Total Carbofuran	11.97%	4.04%	2.96%	11.77%	3.91%	0.00%	**34.65%**	5.07%	5.06%	2.59%	9.20%	2.30%	1.76%	**25.98%**	4.03%	6.21%	9.35%	7.77%	4.87%	0.15%	**32.38%**
Carbaryl	N/A	N/A	N/A	N/A	N/A	N/A	N/A **0.00%**	3.79%	0.33%	0.73%	0.47%	0.17%	0.07%	**5.56%**	2.67%	0.55%	0.39%	0.37%	0.03%	0.00%	**4.01%**
Atrazine'	4.90%	0.00%	0.00%	0.00%	0.00%	0.00%	**4.90%**	15.81%	0.00%	0.00%	7.33%	0.00%	0.00%	**23.14%**	12.58%	5.19%	2.92%	0.00%	0.00%	0.00%	**20.69%**
Alachlor	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**	0.00%	0.00%	0.00%	1.54%	0.00%	0.00%	**1.54%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	**0.00%**

most predominate chemical form present, followed by aldicarb sulfone and then aldicarb. The 45-65 cm interval contained the highest percentages of total aldicarb. Figures 23, 24, and 25 show graphically the distribution of total aldicarb in Columns 9, 10, and 13, respectively. The higher residue in this soil compared to the Burkart may be due to the lower pH which will retard the degredation rate of this chemical.

Oxamyl was present within the three soil columns between 8.34% and 25.66% of the total applied (Table 14). The highest percentages were detected in the 30-60 cm depth interval. The distribution of oxamyl within the soil columns was similar to the total aldicarb distributions (Figures 23, 24, and 25).

Residual total carbofuran was detected at 25.98% to 34.65% of the total applied (Table 14). The carbofuran metabolite 3-hydroxy-carbofuran was detected in each of the three columns, but in low concentrations. The distribution of total carbofuran within the soil is similar to total aldicarb and oxamyl. The greatest concentrations were found in intervals 0-15 cm and 45-60 cm for Column 9, interval 45-60 cm for Column 10, and interval 30-45 cm for Column 13. Higher percentages retained in the 0-30 cm depth illustrates carbofuran's slightly higher absorption capacity compared to oxamyl and aldicarb.

Carbaryl was detected in small quantities in the soil from Column 10 and Column 13 (Table 14). Due to a shortage of the compound during application, it was not applied to Column 9. The amount of carbaryl detected in Column 10 soil represents 5.56% of the total mass applied. The carbaryl detected from Column 13 soil represents 4.01% of the total applied. Approximately 65% of the total detected was within the 0-15 cm interval for both columns. Amounts detected in any of the deeper intervals represented less than one percent of the total applied. This indicates that the chemical either broke down, volatilized, or was not detectable by the methods used. Minimal leaching of this chemical appears to occur in this or other soils used in this study.

Atrazine recoveries were 4.90%, 23.14% and 20.69% for Columns 9, 10, and 13, respectively (Table 14). The reason for the lower recovery from Column 9 is not known. The result for atrazine do correspond to the results from aldicarb and oxamyl in that the recoveries for those compounds from this column were also considerably lower than Columns 10 and 13. Carbofuan recovery from Column 9, however, was slightly higher than the other two columns. The majority of the atrazine recovered from the three columns was detected in the 0-15 cm interval, however, significant amounts were found at 45-60 cm in Column 10 and down to 45 cm in Column 13.

Soils in each column were not analyzed to composition, Need some possible answer

Alachlor was not detected in Columns 9 and 13. Only a small amount, less than 2%, was detected in Column 10. The higher amount in this column corresponds to leaching data and may be due to application of this chemical for the previous column study. The lack of residual alachlor would suggest this chemical has either degraded, volatized, or been converted to metabolites not detected by this method.

Plainfield

Columns numbered 11, 12, 15, and 16 were packed with Plainfield soil. Columns 12 and 16 were treated with the "high" levels while Columns 11 and 15 were treated with the "low" levels of the pesticides studied. Columns 11, 12 and 15 were used in the preliminary column leaching study in which Column 11 had potassium chloride, ammonium nitrate, and a farm grade atrazine applied. Column 15 had potassium chloride, ammonium nitrate, and a farm grade alachlor applied. Column 12 was used as a blank and had no chemicals applied. These columns (11, 12 and 15) were leached for a total of 11 weeks and had a total of 10,200 mls of water applied (5000 mls from previous study and 5,200 from current study). Chemical application amounts for these columns for the present and previous studies are listed in Table 1 (Page 7).

The percent leachate recovered, based on the volume of water added, is listed in Table 6 (Page 37). The total average recoveries from the Sparta columns were as follows:

- Column 11 87%
- Column 12 86%
- Column 15 90%
- Column 16 88%

Table 7 (Page 38) lists the ratio of leachate recovered to the FMC pore volume of the column. The values for the percent of the column FMC pore volume leached for the Plainfield columns were as follows:

- Column 11 219% (453%)
- Column 12 217%

- Column 15 198% (439%)
- Column 16 214%

The percentages shown in parentheses represent the total pore volume (FMC) leached from both the preliminary study and the current study for columns which had chemicals previously applied.

Pesticides were detected in the leachate of each of the Plainfield columns (Table 8, Page 39). Inorganic tracers nitrate-nitrite and chloride were also detected in the leachate from each of these columns (Table 9, Page 43).

The amount of pesticides and inorganic tracers found in leachate are shown graphically for Columns 11, 12, 15, and 16 in Figures 26, 27, 28, and 29, respectively. Percent recoveries of pesticides are also shown graphically for Columns 11, 12, 15, and 16 in Figures 30, 31, 32, and 33. Table 15 denotes the week of column breakthrough, concentration range, and percent recoveries for each compound detected in each column.

In leachate from all Plainfield columns, total aldicarb, oxamyl, total carbofuran, alachlor, and atrazine were detected. Carbaryl was not detected. The alachlor detects were minor and within the detection limits of the analytical method. The totals amount of alachlor detected was less than 0.2% of the added amount for all columns.

Atrazine recoveries ranged from 1% to 5% of the totals applied (Table 15). Breakthrough of atrazine occurred at Weeks 4, 3, 5, and 4 for Columns 11, 12, 15, and 16, respectively. The maximum concentrations were detected at Week 4 for Columns 11 and 12, and

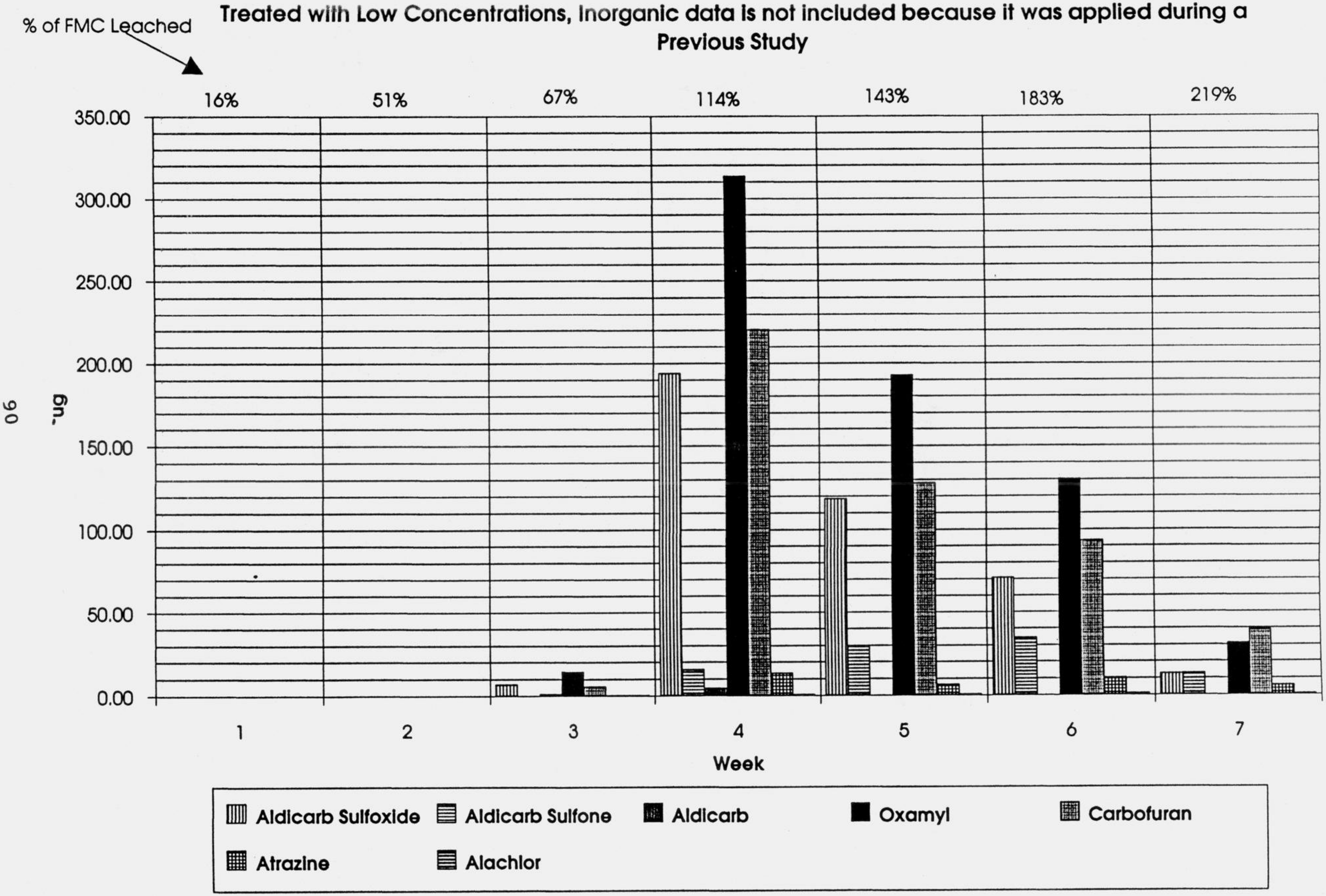
Table 15: Summary of Pesticide, Nitrate, and Chloride Leaching Results for 4-Plainfield Soil Columns

	Column 11 (Low Concentration)			Column 12 (High Concentration)			Column 15 (Low Concentration)			Column 16 (High Concentration)		
	Week of Break Through	Maximum Concentration ug/L + (Week) Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery	Week of Break Through	Maximum Concentration (ug/L) + Week Detected	Percent Recovery
Aldicarb Sulfoxide	3	204 (4)	35.3%	3	279 (5)	18.4%	3	198 (4)	27.9%	4	380 (5)	22.0%
Aldicarb Sulfone	4	48 (5)	8.1%	4	137 (6)	5.9%	4	42.9 (5)	6.2%	4	153 (5)	5.6%
Aldicarb	3	4.6 (4)	0.5%	3	16.3 (4)	1.1%	4	3.9 (4)	0.4%	4	25.5 (5)	1.6%
Total Aldicarb	----	----	43.9%	----	----	25.4%	----		34.5%	----		29.2%
Oxamyl	3	330 (4)	56.8%	3	377 (6)	20.6%	3	336 (4)	47.9%	4	695 (5)	34.3%
3-Hydroxy-Carbofuran	ND		0.0%	6	3.7 (6)	0.1%	ND		0.0%	ND		0.0%
Carbofuran	3	232 (4)	44.2%	3	1271 (6)	48.1%	3	137 (5)	23.1%	4	764 (5)	39.1%
Total Carbofuran	----	----	44.2%	----	----	48.2%	----		23.1%	----		39.1%
Carbaryl	ND		0.0%	ND		0.0%	ND		0.0%	ND		0.0%
Atrazine	4	14.2 (4)	1.0%	3	71.9 (4)	5.0%	5	19.8 (7)	1.8%	4	54.9 (7)	2.8%
Alachlor	4	1.1 (6)	0.1%	3	1.7 (6)	0.0%	ND		0.0%	ND		0.0%
Nitrate-Nitrite	N/A	N/A	N/A	UK	175 (6)	NC	N/A	N/A	N/A	UK	41.9 (6)	NC
Chloride	N/A	N/A	N/A	3	145 (4)	NC	N/A	N/A	N/A	4	136 (5)	NC

ND = not detected
---- = not analyzed
NC = not calculated
UK = unknown

Figure 26

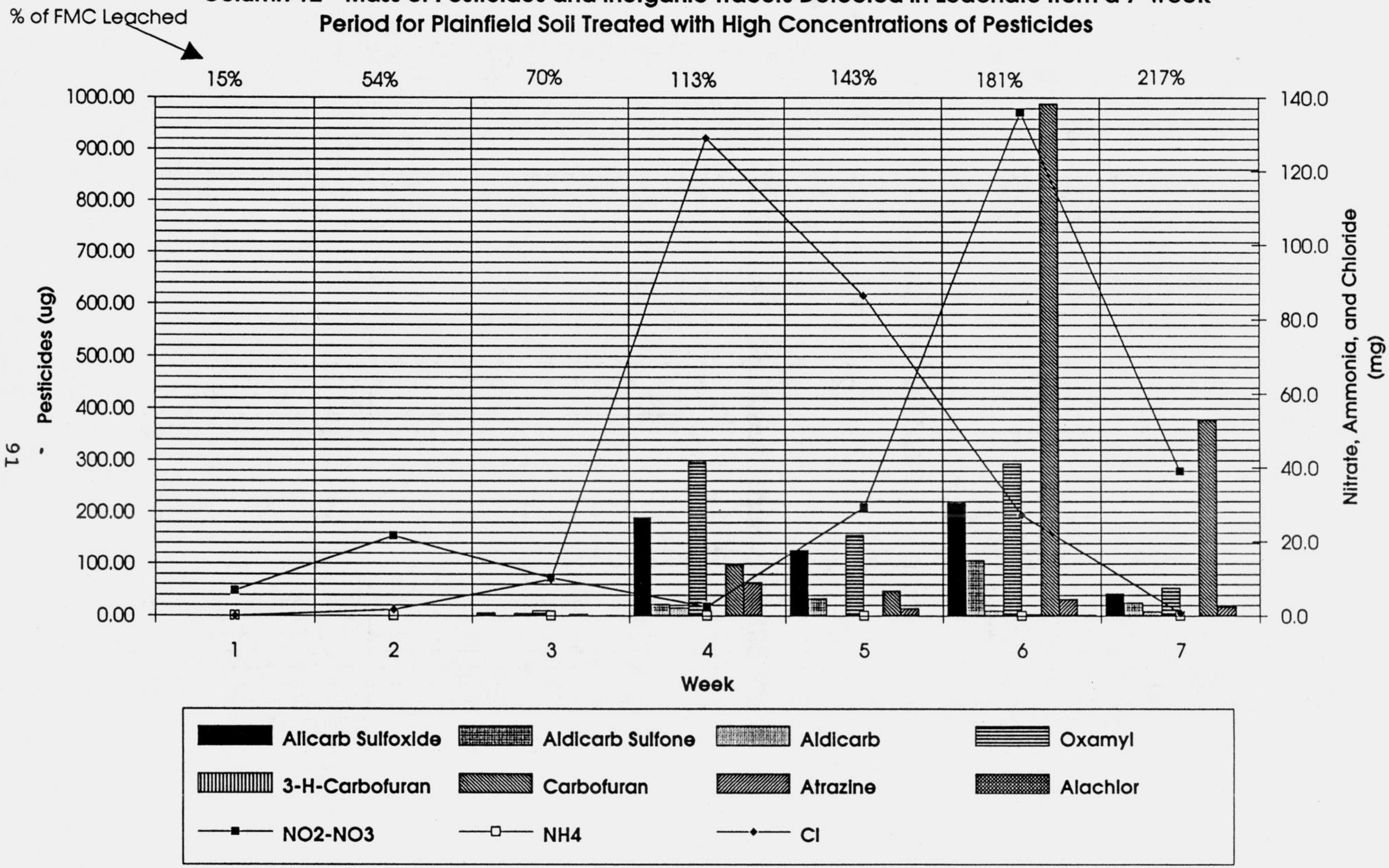
Column 11 - Mass of Pesticides Detected in Leachate from a 7-week Period for Plainfield Soil Treated with Low Concentrations, Inorganic data is not included because it was applied during a Previous Study



COL 12.XLS Chart 1

Figure 27

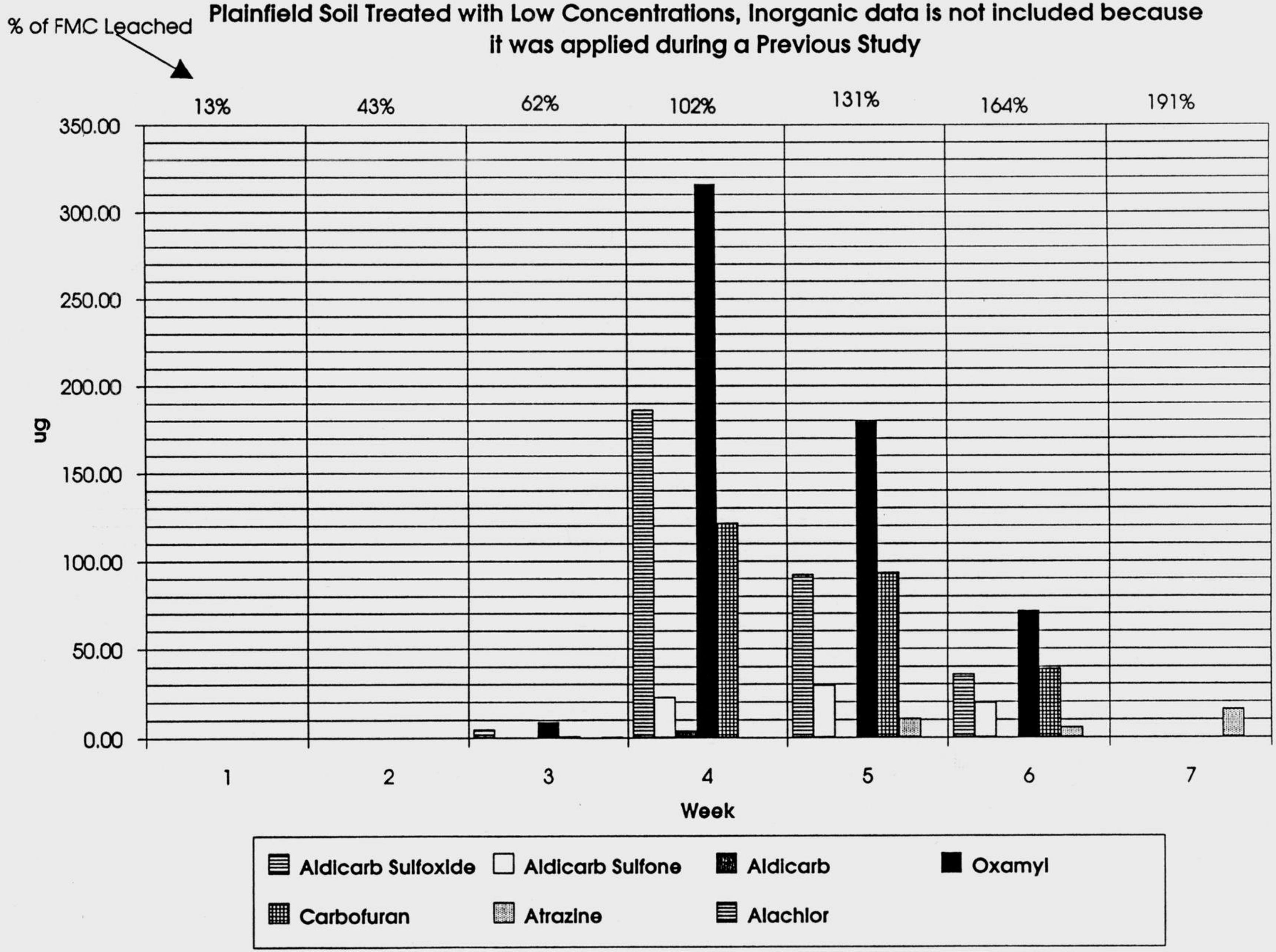
Column 12 - Mass of Pesticides and Inorganic Tracers Detected in Leachate from a 7-week Period for Plainfield Soil Treated with High Concentrations of Pesticides



COL1112.XLS Chart 4

Figure 28

Column 15 - Mass of Pesticides Detected in Leachate from a 7-week Period for Plainfield Soil Treated with Low Concentrations, Inorganic data is not included because it was applied during a Previous Study

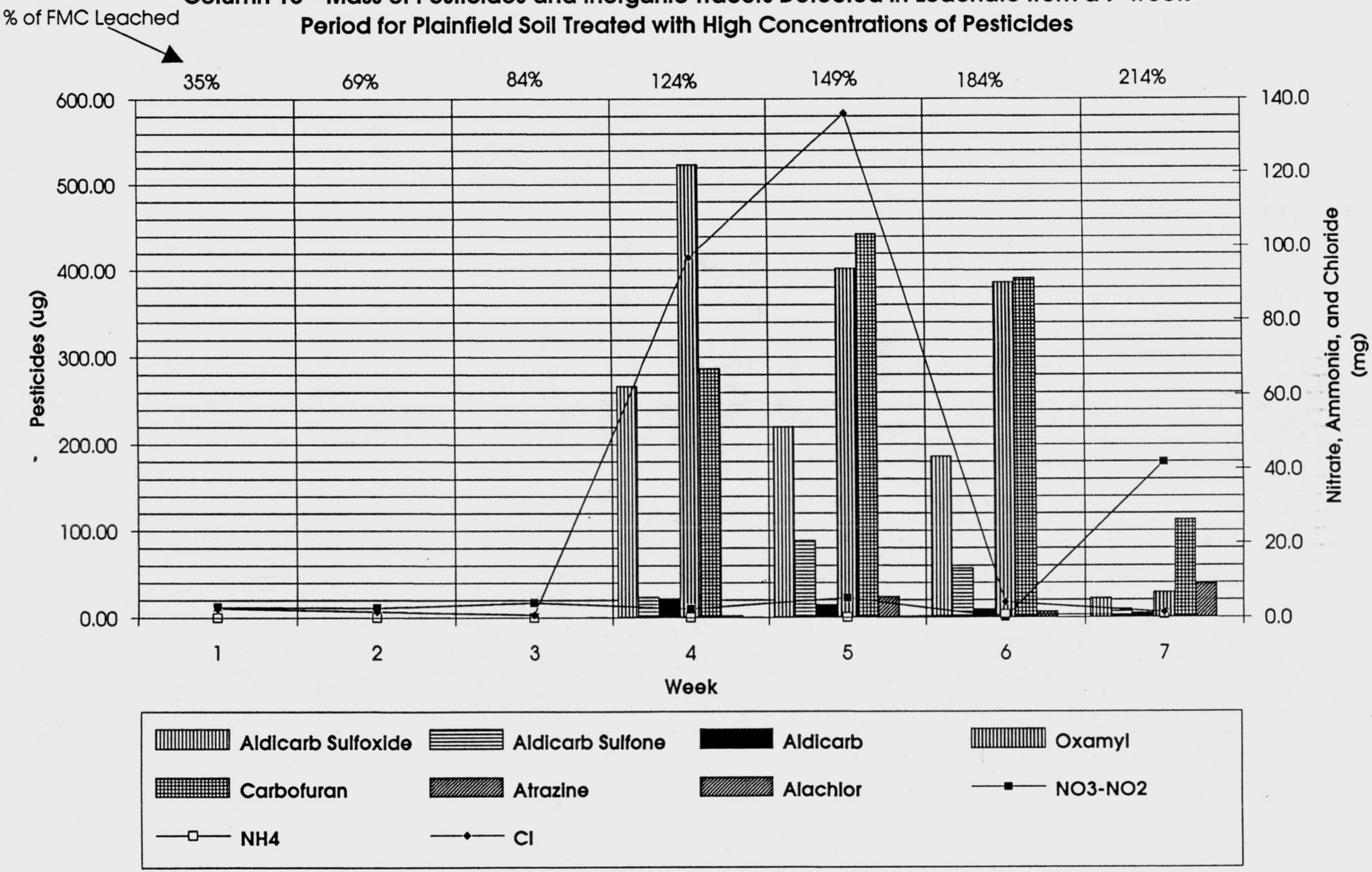


92

COL[illegible]16.XLS Chart 3

Figure 29

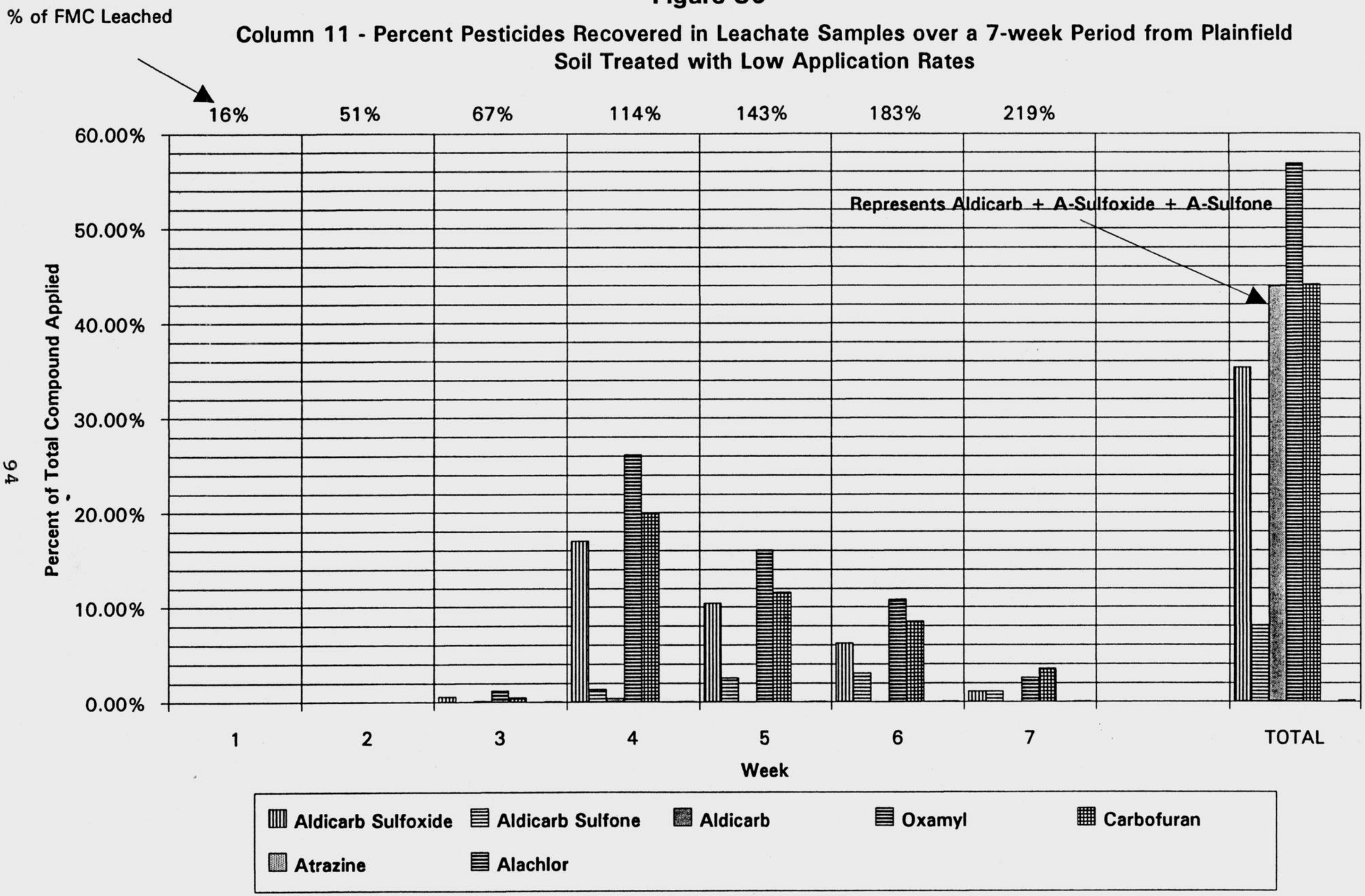
Column 16 - Mass of Pesticides and Inorganic Tracers Detected in Leachate from a 7-week Period for Plainfield Soil Treated with High Concentrations of Pesticides



COL1516.XLS Chart 1

Figure 30

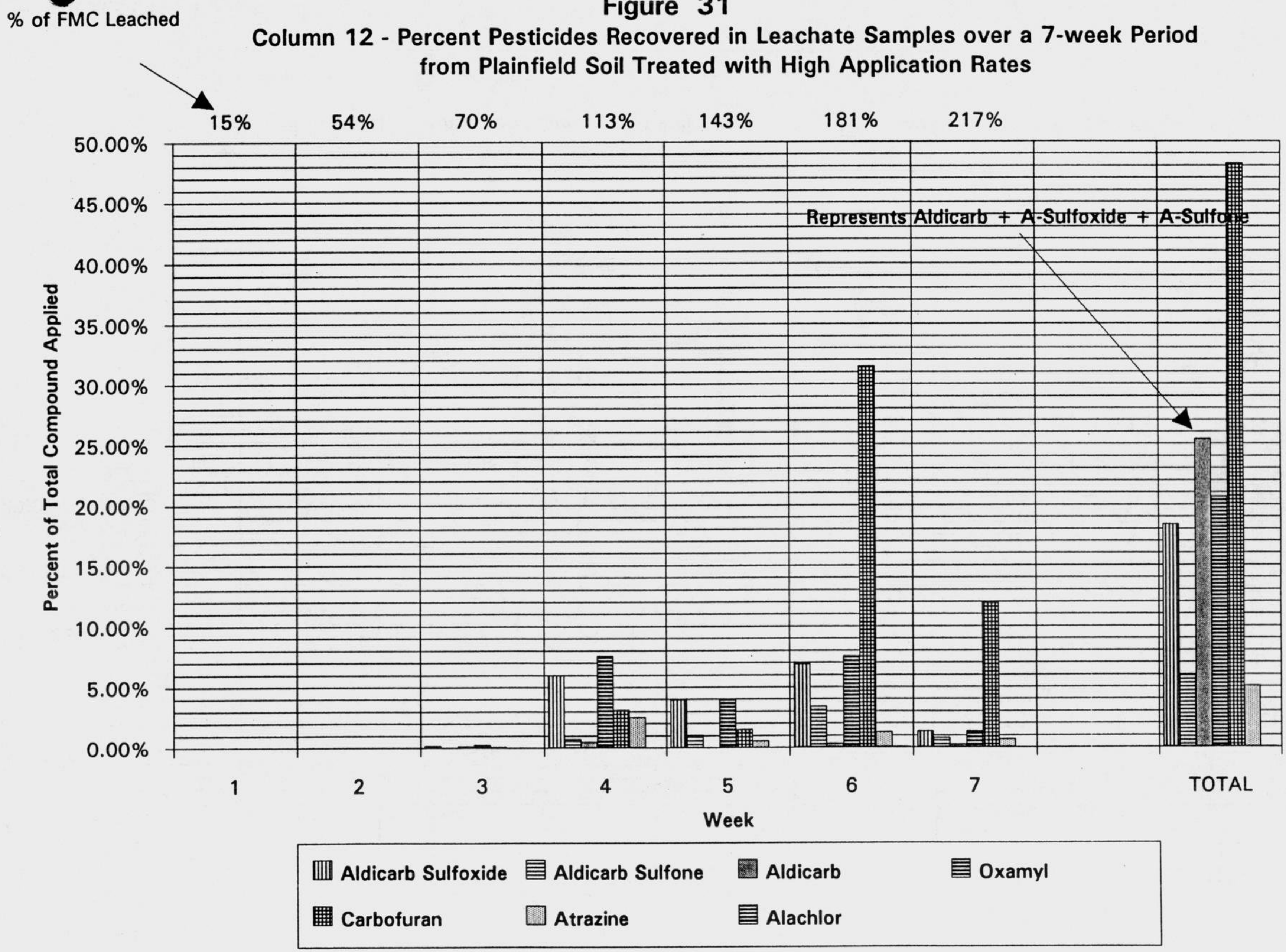
Column 11 - Percent Pesticides Recovered in Leachate Samples over a 7-week Period from Plainfield Soil Treated with Low Application Rates



COL1112.XLS Chart 2

Figure 31

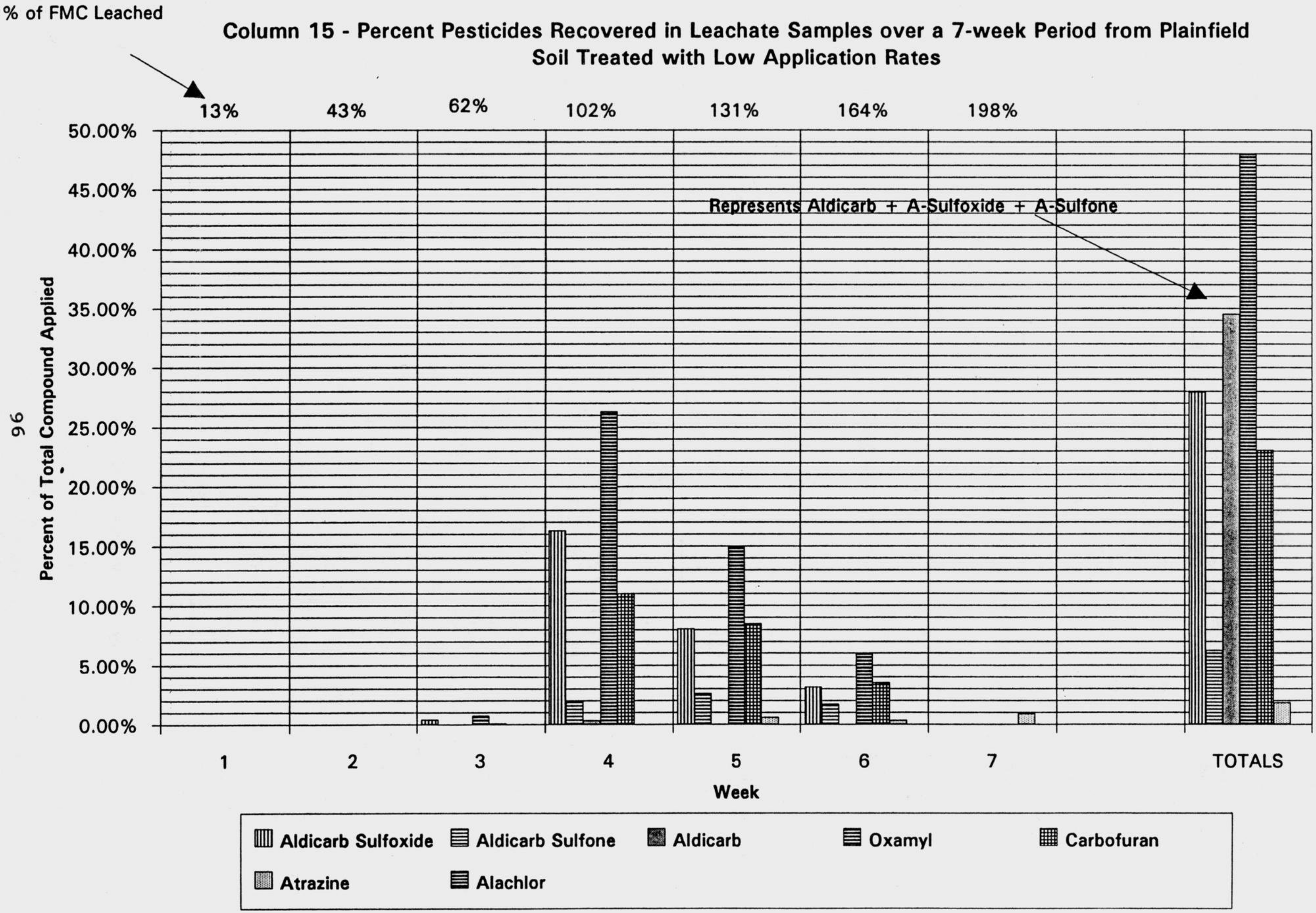
Column 12 - Percent Pesticides Recovered in Leachate Samples over a 7-week Period from Plainfield Soil Treated with High Application Rates



COL1112.XLS Chart 3

Figure 32

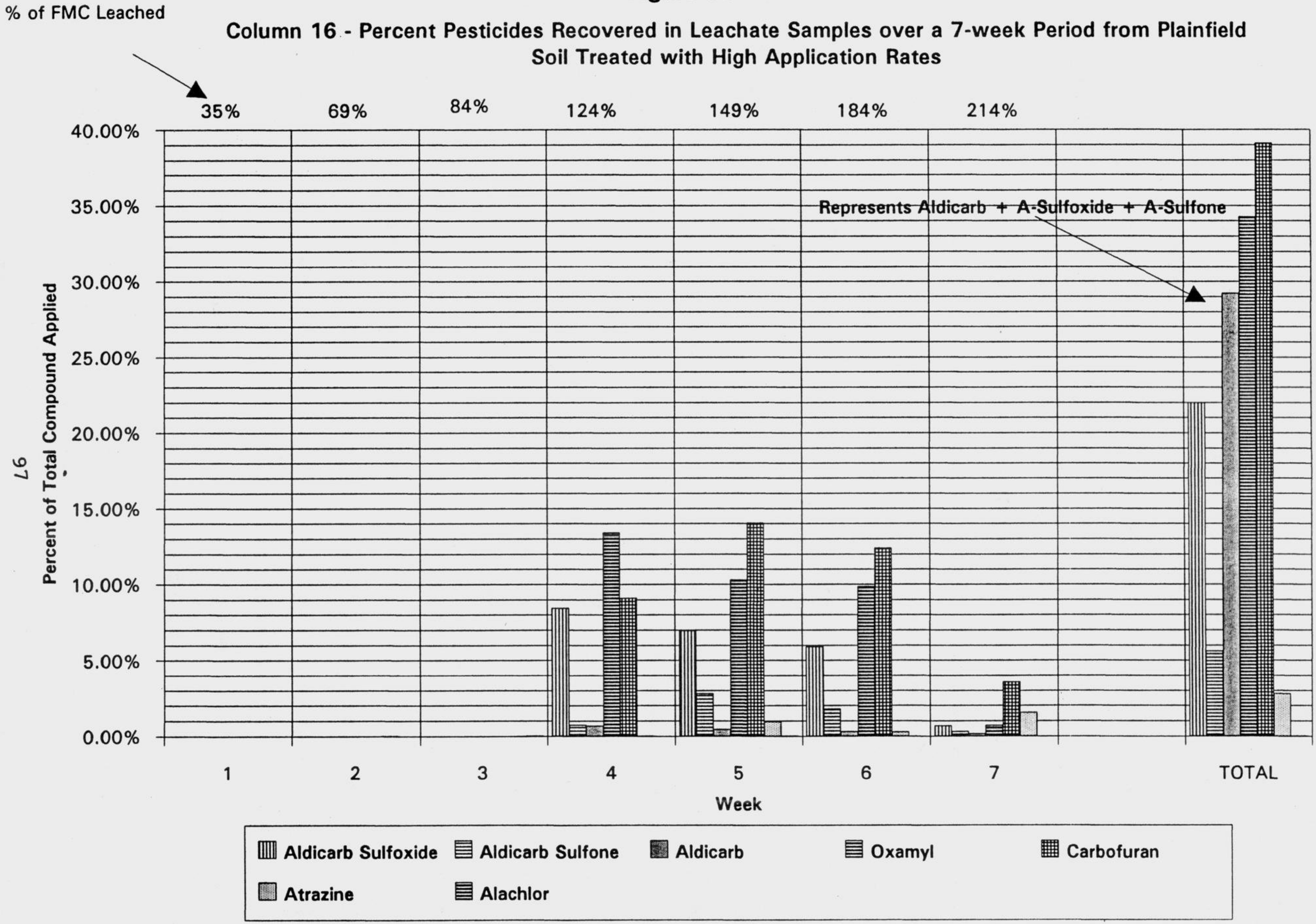
Column 15 - Percent Pesticides Recovered in Leachate Samples over a 7-week Period from Plainfield Soil Treated with Low Application Rates



COL1516.XLS Chart 4

Figure 33

Column 16 - Percent Pesticides Recovered in Leachate Samples over a 7-week Period from Plainfield Soil Treated with High Application Rates



COL1516.XLS Chart 2

at Week 7 for Columns 15 and 16 (Figures 26, 27, 28 and 29).

Total aldicarb recoveries ranged from 25.4% to 43.9% of the total applied (Table 15). Greater percent recoveries were recorded at the low treatment levels. The metabolite aldicarb sulfoxide was the most predominant compound at approximately 70% of the total aldicarb detected. It was first detected at Week 3 for Columns 11, 12, and 15 (Table 15), and at Week 4 for Column 16. The highest concentration detected for this compound was at Week 4 for "low treatment" columns (Columns 11 and 15). The high detect for the "high treatment" columns (12 and 16) was at Week 5 (Figures 26, 27, 28, and 29). The second most predominant compound of total aldicarb detected was the metabolite aldicarb sulfone at approximately 17% of the total aldicarb detected. This compound was first detected at Week 4 for all columns. The highest detections noted were at Week 5 for Columns 11, 15, and 16, and at Week 6 for Column 12. The parent compound, aldicarb, represented the remaining portion of the total aldicarb detected. The highest levels detected were from Week 4 for Columns 11, 12, and 15; and at Week 5 for Column 16.

Oxamyl recoveries range from 20.6% to 56.8% of the total applied (Table 15). Higher recoveries were recorded for "low treatment" Column 11 (56.8%) and Column 15 (47.9%) than for "high treatment" Column 12 (20.6%) and Column 16 (34.3%). Oxamyl was first detected at Week 3 for Columns 11, 12, and 15, and at Week 4 for Column 16. The highest concentrations of oxamyl were detected at Week 4 for the low application rate Columns 11 and 15; at Week

5 for Column 16; and at Week 6 for Column 12 (Figures 26, 27, 28, and 29).

Total carbofuran recoveries ranged from 23.1% to 48.2% of the total applied (Table 15). All of the total carbofuran detected in Columns 11, 15, and 16 was in the form of the parent compound, carbofuran. Column 12 had a minimal amount of the metabolite 3-hydroxy-carbofuran (0.1%) detected (Table 15). The highest levels were detected at Week 4 for Column 11, Week 5 for Columns 15 and 16, and Week 6 for Column 12.

Both inorganic tracers, nitrate+nitrite-N and chloride were detected in Columns 12 and 16 (inorganics were applied in the current study). Columns 11 and 15 had the inorganics applied during a previous study. Leachate results for the previous study and the current study are shown in Table 16. Nitrate+nitrite-N results from the current study for Column 12 shows most nitrate to leach during Week 4 with concentrations very low by Week 7. Column 16 results are more sporadic (Figure 34). Chloride data showed breakthrough at Week 3 for Column 12 and at Week 4 for Column 16 (Table 15). The highest detection of chloride was from Week 4 for Column 12 and Week 5 for Column 16, as shown in Figure 34.

The inorganic data from Columns 11 and 15 for both the previous study and the current study is shown graphically in Figure 35 (Column 11) and Figure 36 (Column 15). These data indicate a trend similar to that found for the other soils, showing chloride to be leached more quickly than nitrate the somewhat bimodal and inorganic residues at the end of the study.

The soil from Column 15 was analyzed for pesticide residues at the end of the study (Table 10). Results indicate the presence of small quantities of the total applied amounts for total aldicarb (0.8%), oxamyl (0.4%), total carbofuran (1.9%), carbaryl (0.4%), and alachlor (0.8%). Atrazine levels in the soil represented 11.7% of the total applied. Distribution of the pesticides in the soil column is shown in Figure 37.

The pesticide residue data suggest that most of the highly soluble and mobile pesticides have been leached out of this soil by the end of the 7 week leaching study. The highest residuals of aldacarb, oxamyl, and carbofuran occur at the 75-95 cm depth in the column, while the highest residue of carbaryl, atrazine, and alachlor occurred near the top of the column.

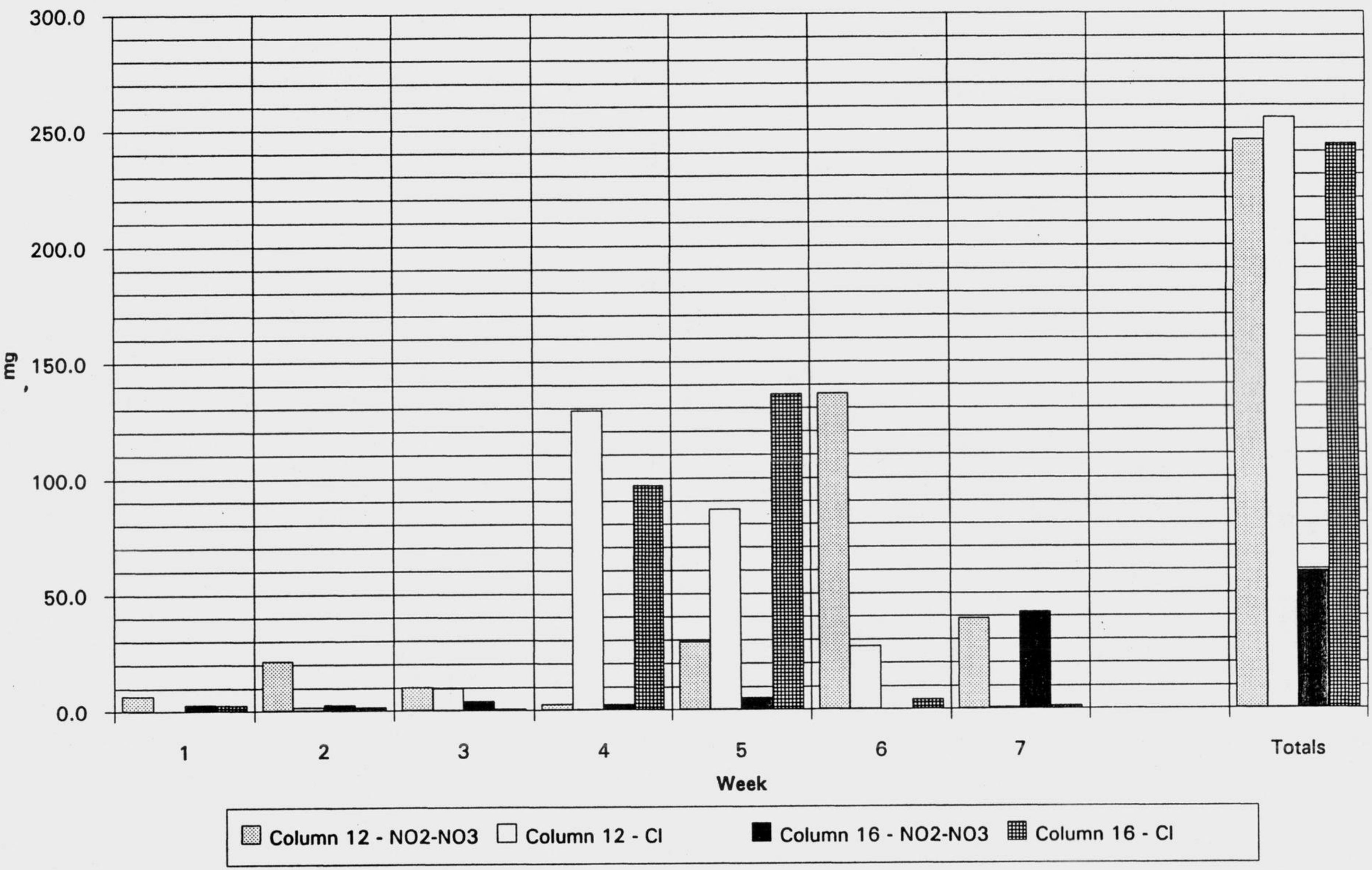
Table 16: Mass of Nitrate and Chloride Detected in Leachate form Plainfield Soil Columns 11 and 15, which were Leached in a Previous Study and the Current Study

		WEEKS	NH4 (mg)	NO2-NO3 (mg)	Cl (mg)	LEACHATE (milliliters)	pH	Conductance (umhos)
Column 11	Previous Study	0					6.7	64
		1	0.15	19	1	810	7.81	225
		2						
		3	0.29	68	112	920	6.33	985
		4					5.86	1558
		5	0.30	22	139	515	5.98	1669
		6	0.18	24	69	265	5.72	1069
		7	0.08	48	25	365	5.8	1199
		8	0.09	74	5	405	4.9	1399
		9	0.02	43	2	360	5.94	961
		10	0.04	18	1	375	6.15	428
		11	0.02	37	0	735	6.43	220
	Current Study	12	0.03	6	1	338	7.07	213.
		13	0.04	16	1	717	6.96	253.
		14	0.01	8	7	330	7.08	264.
		15	0.00	2	2	950	6.83	102.
		16	0.05	0	1	608	6.99	86.
		17	0.02	3	5	818	7.01	96
		18	0.03	9	3	740	6.76	114
	TOTALS		**1.33**	**397**	**371.0**	**9,251**		
Column 15	Previous Study	0					6.68	47
		1	0.31	11	2	1570	7.5	137
		2						
		3	0.32	20	139	855	6.19	1370
		4					5.82	1967
		5	0.18	102	123	595	6.01	1957
		6	0.08	62	39	365	5.94	1543
		7	0.12	58	12	360	5.92	1302
		8	0.06	36	3	420	5.04	850
		9	0.00	14	1	380	6.03	366
		10	0.04	8	1	390	6.35	257
		11	0.00	13	1	745	6.49	227
	Current Study	12	0.02	6	2	311	6.95	204.
		13	0.00	17	1	712	6.97	260
		14	0.00	13	0	428	6.88	319
		15	0.00	0	2	940	6.75	99.
		16	0.00	2	0	681	6.9	100.
		17	0.00	107	33	793	6.81	127.
		18	0.00	10	1	785	6.76	131
	TOTALS		**1.13**	**478**	**358.2**	**10,330**		

NH4 = Ammonia
NO2-NO3 = Nitrite-Nitrate
Cl = Chloride
mg = Milligram

Figure 34

Mass of Nitrate and Chloride Detected in Leachate from 2-Plainfield Soil Columns (Current Study Only)

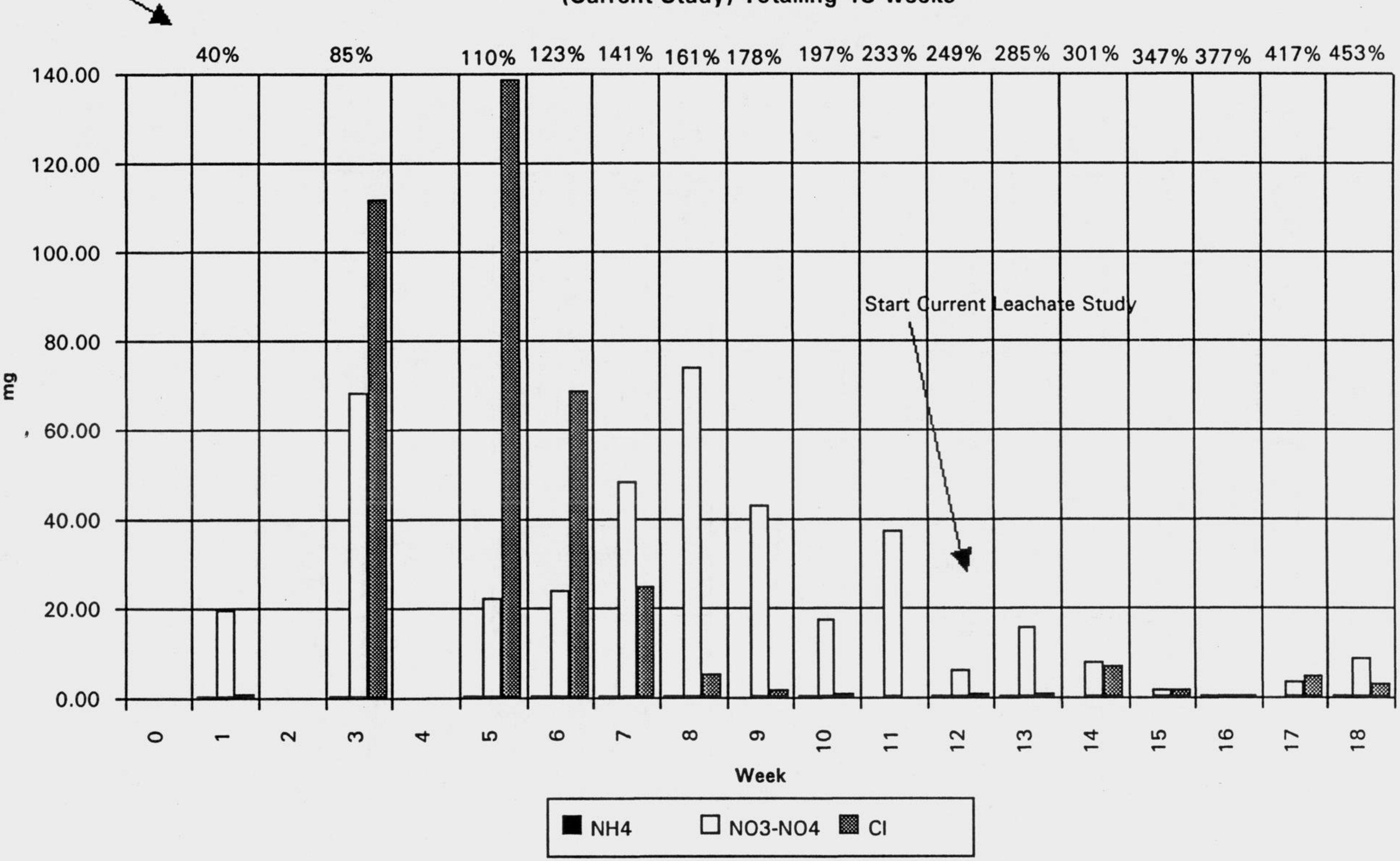


INFINC2.XLS Chart 6

Figure 35

Mass of Nitrate and Chloride Detected in Leachate Samples from Plainfield Soil Column 11, which was Leached for 2-Periods; one for 11-weeks (Previous Study) and the second for 7-weeks (Current Study) Totalling 18-weeks

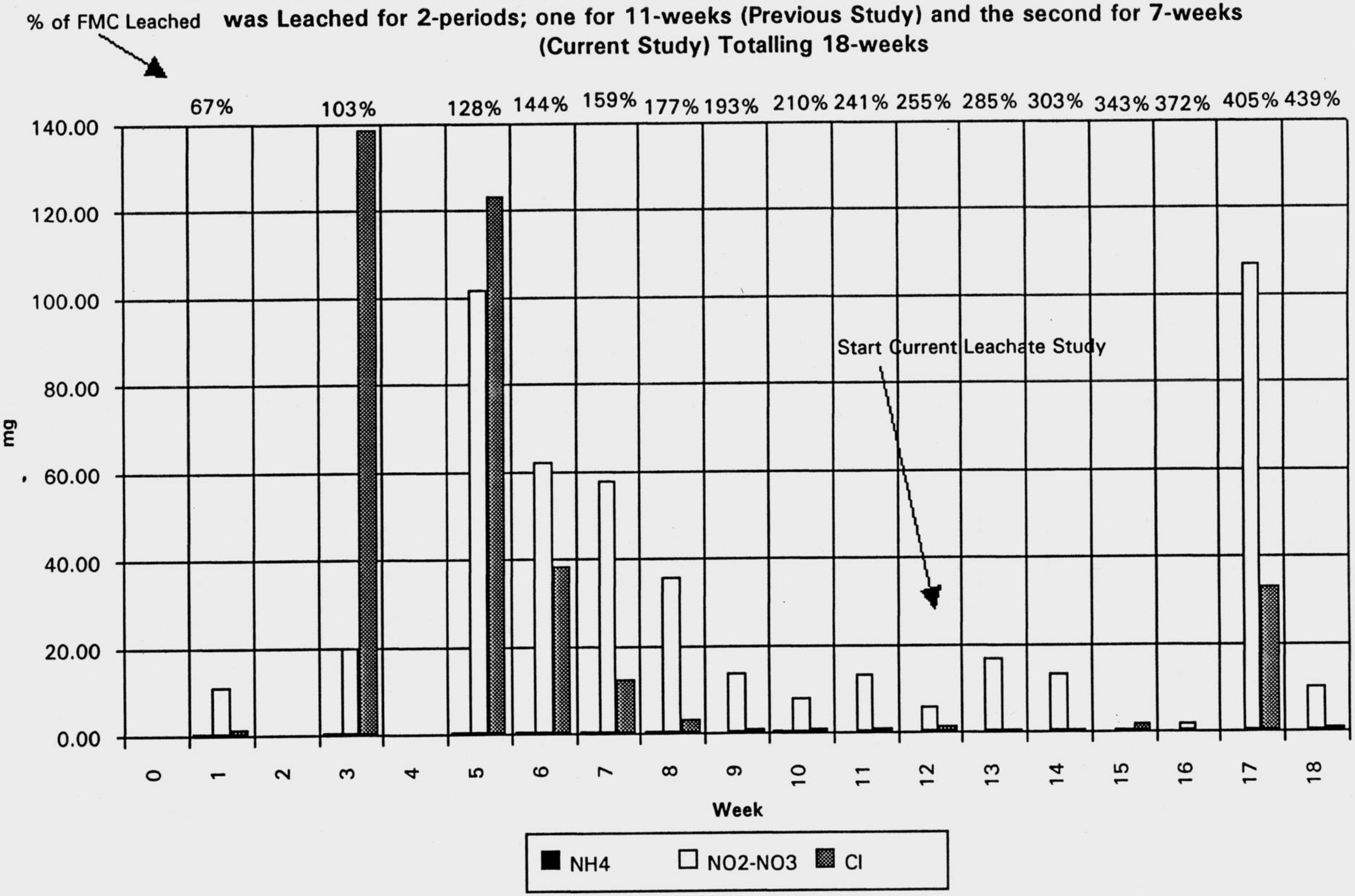
% FMC Leached



PLNIN156.XLS Chart 3

Figure 36

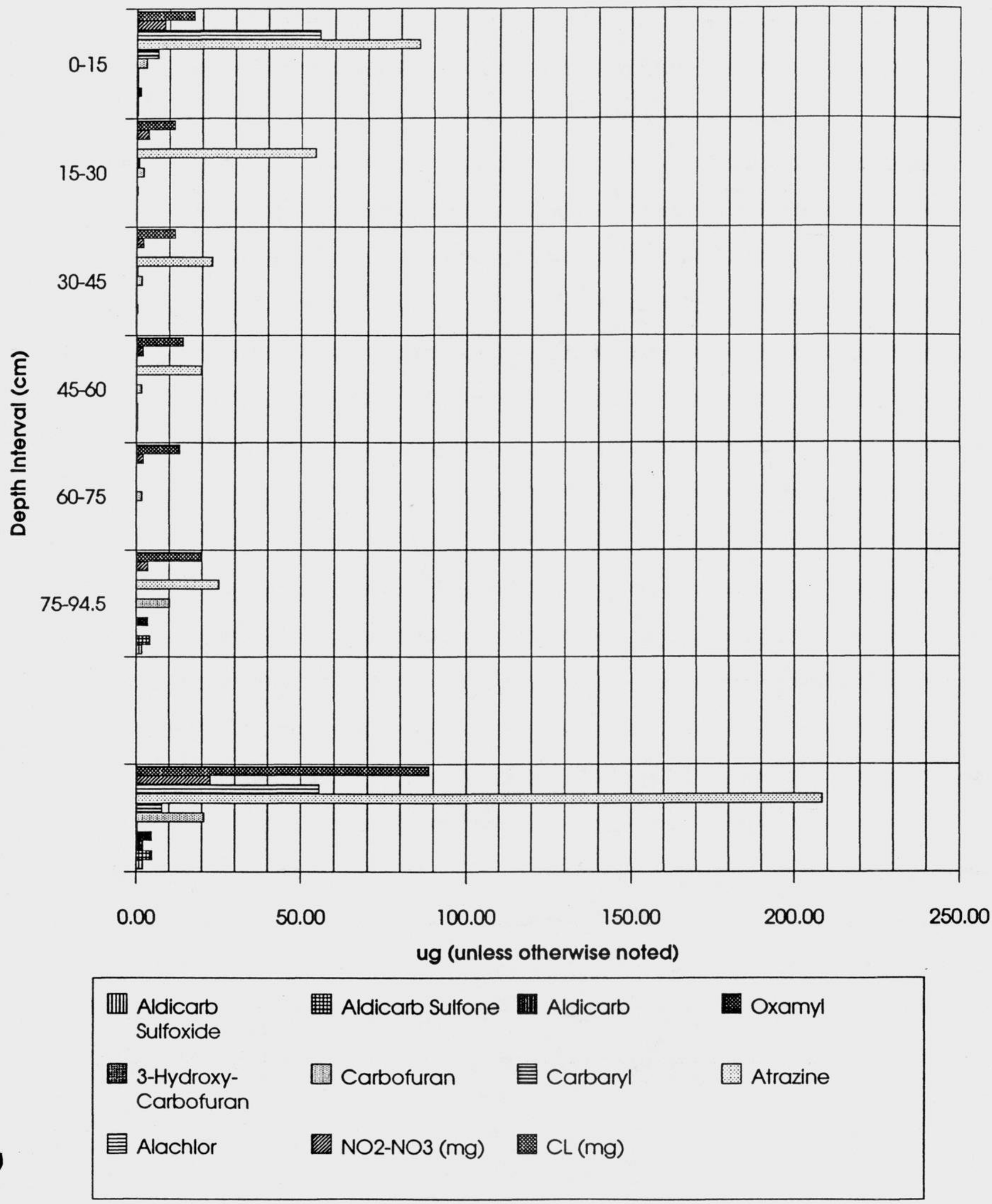
Mass of Nitrate and Chloride Detected in Leachate Samples from Plainfield Soil Column 15, which was Leached for 2-periods; one for 11-weeks (Previous Study) and the second for 7-weeks (Current Study) Totalling 18-weeks



PLNIN156.XLS Chart 4

Figure 37

Mass of Pesticides, Nitrate, and Chloride Residuals for Plainfield Soil Column 15 at end of 7-week Leaching Period



CS2SOLTI.XLS Chart 9

DISCUSSION

Many investigations into the factors contributing to pesticide leaching have been completed (Carsel et al., 1985) which have illustrated that the migration of pesticides within the root zone is a dynamic process with many interacting factors. Factors such as the chemical solubility in water, sorptive properties, pesticide formulation, soil persistence, soil properties, climatic conditions, crop type and cropping practices all effect chemical movement. Since the objective of this study was to establish a base comparison of various pesticides on various soil type, as many of these factors were eliminated as possible. Observation of the effects of the remaining factors on pesticide leaching are discussed within this section.

Leachate Volumes

The weekly leachate volumes collected and percent recoveries listed in Table 6 indicate that water loss by evaporation had occurred during the column study. The percent recoveries listed are probably higher than what had actually occurred due to the apparent excess water collected during different weeks of the study. The more permeable soils, Sparta and Plainfield had excess water over that applied collected in weeks 2, and 4. Percent recoveries during those weeks were higher than the recoveries observed during other weeks. The excess water from week 2 can be attributed to water held in the columns beyond its FMC levels at the beginning of the study probably form the initial saturation of the columns.

The less permeable soils, Burkart and Antigo, were more consistent, with the exceptions of the anomalies detected in week 4 and 6 for Burkart Column 2. It is suspected that since the more permeable soils (Sparta and Plainfield) were above FMC at the start of the study that the less permeable (Antigo and Burkart) were also be above FMC, but due to their lower permeability and higher water holding capacity they would be expected to release the excess water at a slower rate and would therefore, take longer to reach FMC. The higher FMC of these soils would also tend to buffer differences between columns.

The water loss from the columns is believed to be due to evaporation, either through the top of the column or through the vacuum. The column system is otherwise closed (i.e. sample containers or stoppered). It is suspected that the majority of the evaporation occurred from the top of the column since the vacuum was only run periodically.

The cumulative leachate volumes related to FMC listed in Table 7 showed good correlation between the soil types, with the exception of Antigo column 14 which was approximately 20% less than the other three antigo columns.

The total leachate collected from the Burkart soil sets represents about two-thirds of the calculated FMC. This is a factor of the pore size of this soil type and its ability to hold water. The same is true for the Antigo soil which also showed about two-thirds the calculated FMC being collected as leachate. These low volumes should result in minimal leaching of chemicals from these columns since most pesticide movement is associated with water movement (Bailey and White, 1970).

The more permeable, larger pored soils, showed that approximately two times the calculated FMC was leached through the soil columns. Therefore, for the Sparta and Plainfield soils, the columns were actually flushed with the added water. An increase in the movement of water through the soil column will increase the extent of leaching (Friesen, 1965)

If the Antigo and Burkart columns were leached with a proportional volume of water relative to FMC, the leaching results between these and the sandy soils may have shown more similarities. If you use the inorganic nitrate and chloride data as an indicator, remembering that they are not subject to the degradation or volitization that organics are, evidence that leaching similarities between the soil types receiving equivalent FMC pore volumes can be seen in Figures 21 and 22. As stated previously, the inorganics from these two columns were subject to additional leaching that amounted to approximately one and one-half times the FMC. Comparison of this data to the leaching results of the Sparta (Figure 11, 12, 13, and 14) and Plainfield (Figures 27 and 29) shows more similar results than what was observed between the different soil types receiving equal volumes of water. It is believed that results under these conditions would still show significant difference between the soil types due to other factors influencing chemical movement. Compounds with lower adsorptive capacities would likely been detected more often than chemicals with strong adsorptive characteristics.

Chemical Properties

In past studies of the effects of chemical properties on leaching results it was determined that solubility is the most important factor (Felsot, 1984; Gray and Weierich, 1968)

This conclusion is supported by the data collected in this study based on the similarities of the oxamyl, total aldicarb and total carbofuran results from the Sparta and Plainfield soils. Based on chromatographic separation of these compounds during reverse phase column HPLC analysis, it would be expected that oxamyl, aldicarb sulfoxide, and aldicarb sulfone would leach much faster than carbofuran. It would also indicate that carbaryl, a much less soluble compound (Table 3), would also leach based on its weak adsorptive capacity. Carbaryl has similar adsorptive capacities to carbofuran based on HPLC column retention times but is more than an order of magnitude less soluble. Carbofuran was detected in leachate from all four Sparta and Plainfield columns and in one Antigo and one Burkart column, but no carbaryl was detected in any leachate samples (Table 8).

Atrazine, however, has a water solubility similar to carbaryl and was detected at levels greater than detection limits in all Sparta and Plainfield columns (Table 8). The levels detected were however, noticeably less than the more soluble compounds.

Alachlor has a solubility approximately 5-times that of atrazine (Table 3), but was detected at lower levels. It appears that other processes, absorption, degradation and/or volatilization, are limiting the detections for this compound.

Table 17 summarizes the average pesticide recoveries for both leachate samples and soil samples.

Table 17. Pesticide leaching summary. Percent pesticide recovered in leachate or remaining in soil columns for four soil types and six pesticides over a seven week leaching study.

	Antigo		Burkart		Plainfield		Sparta	
	Leachate	Soil	Leachate	Soil	Leachate	Soil	Leachate	Soil
Aldicarb	0.1	43	0.1	19	33.3	0.8	37	N/A
Oxamyl	0.2	17	ND	0.3	40	0.4	48	N/A
Carbofuran	0.2	31	0.1	25	38.6	2	36	N/A
Carbaryl	ND	5	ND	5.7	ND	0.4	ND	N/A
Atrazine	<0.1	17	<0.1	14	3.0	12	1.7	N/A
Alachlor	0.2	<0.1	<0.1	15	<0.1	0.9	<0.1	N/A

N/A = not analyzed
ND = not detected

The difference in the carbaryl and atrazine data may be related to adsorption/desorption processes. These processes are also believed to be important in determining chemical leachability (Jury, 1986) The K_{oc} (measure of adsorptive capacity) for atrazine is higher (less absorptive) than carbaryl (Table 3). The K_{oc} for alachlor indicates it is more suspectable to adsorptive processes than carbaryl.

The effects of chemical absorptive properties is obvious in the leaching data collected for this study. The timing and amount of leaching observed for the readily leachable pesticides oxamyl and aldicarb sulfoxide compared to the more adsorptive pesticides carbofuran, aldicarb, atrazine, and alachlor. This shows the effect of chemical adsorption properties on leaching.

In each Sparta and Plainfield column, oxamyl and aldicarb sulfoxide (sulfoxide) were first detected in the same week and the maximum concentrations detected also occurred during the same week. It can therefore be assumed that within the sandy soil types these two compounds are similar leachers. Aldicarb sulfone (sulfone) generally followed the same leaching pattern with the exceptions of Columns 4, 11 and 12. It is suspected that these differences are due more to the degradation process of aldicarb to its metabolites than the adsorptive process. Since the breakthrough of these chemical occurs rapidly with the sandy soils (3 or 4 weeks), the degradation from sulfoxide to sulfone may not have occurred yet. The degradation of aldicarb to sulfoxide occurs readily because the sulfoxide has a lower partition coefficient allowing for the dissolved concentration to increase until most of the conversion is complete. The degradation of sulfoxide to sulfone follows a first-order decay curve and is slower (Mullins, 1993).

In Columns 4,8,12, and 15 carbofuran (Tables 12 and 15) was first detected during the same week as oxamyl and sulfoxide, but the maximum concentrations were observed in a later sample (1-week later). In Column 7 carbofuran was detected one week later than oxamyl and sulfoxide. This initial detection for this column also represented the maximum concentration detected, indicating a form of slug movement through this column. This slightly delayed movement of carbofuran is believed to be related to the effects of absorption.

Both aldicarb initial detection and its maximum detection followed that of oxamyl and sulfoxide by one week for Columns 3, 4, 7, and 8 (Sparta soil) The data from the Plainfield columns showed that only column 15 followed this trend.

Atrazine was first detected during the same week as oxamyl and sulfoxide in Sparta Columns 3 and 4, and Plainfield Column 16, but the maximum detections were a week or more later. Atrazine was detected after oxamyl and aldicarb sulfoxide in Columns 8 and 15.

In columns with detections of alachlor, it was detected after oxamyl and sulfoxide.

These data indicate that if solubility were the only factor effecting leachability, all pesticides would have been detected at the same time and would of followed similar distributions and only concentrations would have varied. In other words leachate results would be the same as water movement and no retardation would occur.

Soil Effects

Soil properties and conditions affecting pesticide leaching include: Texture (%sand, silt, and clay), structure, bulk density, moisture content, organic matter content, pH, cation-exchange capacity, and microogranisum population and types. These properties act in combination to influence water movement, pesticide absorption and desorption and degredation.

The effects of soil properties on the pesticide leachate data collected were not that distinguishable, with the exception of texture. Texture in directly related to the previous discussion of leachate volumes.

It is assumed that if this study were to have been extended the effects of other soil properties would have had a more noticeable effect on pesticide leaching results. The less permeable soils would have leached at a slower rate which would have allowed for the greater separation of the pesticides applied due to adsorption/desorptive processes. Degredation rate differences between soils may also have showed up. Antigo soil from Columns 10 and 14 actually show a more distinct separation of chloride from nitrate than the current column study. This illustrates that soil properties also effect leaching, but it appears that the properties of the chemical is the more dominant force for the conditions present within this soil column study.

Leaching differences were observed for the sandy soils compared to the Antigo and Burkart, with apparently larger total degredation occurring in the heavier soils where total chemical residues were lower at the end of the study.

Application Amounts

Both a "High Concentration" and a "Low Concentration" amount of pesticides were applied to soil columns for each soil type. The "High Concentration" amounts represent the upper end of the recommended application rates by the manufacturer. This value was selected without consideration of the soil type referred to in the instructions. The "Low Concentration" is the lower end of the application rates. A table is included in Attachment 1 with the manufacturers instructions, which show the pounds per acre used.

No consistent trends differentiating the "low" from the "high" applications were noted. Inconsistencies were noted in percent recoveries of columns of similar soil types, are assume to be related to other processes (i.e. column packing procedures, etc...). Although, based on this study the application rate, within the range of the instructions, does not increase leaching percentages, it does increase concentrations. The mass of compounds detected in the leachate samples and within soil residue were consistently higher for the higher application rates.

<u>Residual Soil</u>

Burkart soil data (Table 11) indicates that for Columns 1, 5, and 6 the majority of total aldicarb applied had migrated through the upper 45 cm of soil. For these columns, the total percentage found between 45 and 75 cm ranged between 13 and 21 percent. Based on the soil characteristics of the lower horizon of the Burkart soil, it could be assumed that the continuation of the water application would have caused breakthrough for that compound (Table 4). It also appears that carbofuran would be a continued leaching threat.

Oxamyl was not detected in any significant quantities and carbaryl, atrazine, and alachlor residues were limited to the upper horizons and would be of minimal threat to further migration.

The Antigo pesticide residual data Table 14 shows the potential for breakthrough of fatal aldicarb, oxamyl, and carbofuran. A 7.33 percent detection in the 45-60 cm horizon is the result of the longer/8 week leaching. These values at this depth is a threat for breakthrough.

The reason for the much higher recoveries of oxamyl compared to the Burkart soil is not known, however, there are significant pH differences between these soils that could export chemical or biological breakdown.

The results from the soil indicates that under the environmental conditions used, and pesticides compound determine to be leachable would also migrate through the heavier soils used for this project.

CONCLUSIONS

Based on the data generated and presented within this document, the following conclusions can be drawn:

1. The addition of 11.6 inches of water to 4 soil types resulted in significant pesticide leaching from the sandy Plainfield and Sparta soils and minimal leaching from the Antigo silt loam and Burkart sandy loams columns. The primary reason for the difference was the water holding capacity of the soils which created the 11.6 inches for the pine textured soils and was about half the 11.6 inches for the sandy soils.

2. There was no significant difference between the leaching results observed between the Plainfield and Sparta soils.

3. The pesticide retention time within the soil was relative to the water solubility and adsorption characteristics of the chemical.

4. Under similar conditions, chloride leached at a slightly faster rate than nitrate.

5. The pesticides Aldicarb, Oxamyl, and Carbofuran appear to be the greatest threat to leaching.

6. Carbaryl and Alachlor showed minimal migration.

7. Atrazine shows similar leaching patterns as the highly soluble pesticides but leached at a lower percentage of the amount applied and moved slightly slower than the highly soluble pesticides.

8. Within the range of manufacturers recommendations, increasing the application rate of pesticides does not influence the rate of leaching, but does increase the concentrations leached. ?

No discussion of Organic matter content. Seems this has been an area of focus for other research.

No discussion of soil properties and possible reasons for differences. Page 112 dismisses the effects.

APPENDIX I

Sevin® brand 4F

UNION CARBIDE

Carbaryl Insecticide

For Agricultural Or Commercial Use Only

KEEP OUT OF REACH OF CHILDREN
CAUTION

ACTIVE INGREDIENTS:
Carbaryl (1-naphthyl N-methylcarbamate) . . . . 43% by Wt.

INERT INGREDIENTS: . . . . 57% by Wt.
(Contains 4 pounds Carbaryl per Gallon)

E.P.A. Reg. No. 264-349

E.P.A. Est. No. 264-MO-01

IN CASE OF EMERGENCY—TELEPHONE DAY OR NIGHT (UCC HELP) 800-822-4357

PRECAUTIONARY STATEMENTS

CAUTION

HAZARDS TO HUMANS AND DOMESTIC ANIMALS
MAY BE HARMFUL IF SWALLOWED. Avoid breathing spray mist. Do not take internally. Avoid contact with eyes, skin or clothing. Wear regular long-sleeved work clothing. Change to clean clothing daily. Wash hands and face before eating. Wash thoroughly after handling.

ANTIDOTE STATEMENT
ATROPINE SULFATE IS HIGHLY EFFECTIVE AS AN ANTIDOTE. See NOTE TO PHYSICIAN below.

STATEMENT OF PRACTICAL TREATMENT

GENERAL
Contact a physician immediately in all cases of suspected poisoning. Transport to a physician or hospital immediately and SHOW A COPY OF THIS LABEL TO THE PHYSICIAN.

IF SWALLOWED: Never give anything by mouth to an unconscious or convulsing person. If conscious and not convulsing, drink 1 to 2 glasses of water and induce vomiting by touching the back of the throat with finger.

IF IN EYES: Flush eyes with plenty of water. Get medical attention if irritation persists.

IF ON SKIN: Wash thoroughly with soap and water.

IF INHALED: Move from contaminated atmosphere and call a physician.

NOTE TO PHYSICIAN
Carbaryl is a carbamate insecticide, which is a chloinesterase inhibitor. Overexposure to this substance may cause toxic signs and symptoms due to stimulation of the cholinergic nervous system. These effects of overexposure are spontaneously and rapidly reversible.

Specific treatment consists of parenteral atropine sulfate. Caution should be maintained to prevent overatropinization. Mild cases may be given 1 to 2 mg intramuscularly every 10 minutes until full atropinization has been achieved and repeated thereafter whenever symptoms reappear. Severe cases should be given 2 to 4 mg intravenously every 10 minutes until fully atropinized, then intramuscularly every 30 to 60 minutes to maintain the effect for at least 12 hours. Dosages for children should be appropriately reduced. Complete recovery from overexposure is to be expected within 24 hours.

Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are NOT recommended.

To aid in confirmation of a diagnosis, urine samples should be obtained within 24 hours of exposure and immediately frozen. Analyses will be arranged by Union Carbide Agricultural Products Company, Inc.

Consultation on therapy can be obtained at all hours by calling the Union Carbide emergency number 1-800-UCC-HELP.

ENVIRONMENTAL HAZARDS
This product is extremely toxic to aquatic and estuarine invertebrates. Do not apply directly to water and wetlands, except for rice use. Discharge from rice fields may kill aquatic and estaurine invertebrates. Do not contaminate water by cleaning equipment or disposal of wastes.

BEE CAUTION
This product is highly toxic to bees exposed to direct treatment or residues on blooming crops and weeds. Do not apply this product or allow it to drift to blooming crops or weeds if bees are visiting the treatment area.

DIRECTIONS FOR USE
IT IS A VIOLATION OF FEDERAL LAW TO USE THIS PRODUCT IN A MANNER INCONSISTENT WITH ITS LABELING.

GENERAL INFORMATION
SEVIN® brand 4F Carbaryl Insecticide is a suspension of microfine SEVIN carbaryl insecticide in an aqueous medium. It readily disperses in water to form a spray which may be applied by air or ground. READ THIS LABEL BEFORE USE. STRICTLY OBSERVE LABEL DIRECTIONS AND CAUTIONS, AND APPLICABLE FEDERAL AND STATE REGULATIONS.

GENERAL WORKER PROTECTION STATEMENTS
Do not apply this product in such a manner as to directly or through drift expose workers or other persons. The area treated must be vacated by unprotected persons.

Do not enter treated areas without protective clothing until sprays have dried.

Because certain states may require more restrictive reentry intervals for various crops treated with this product, consult your State Department of Agriculture for further information.

Written or oral warnings must be given to workers who are expected to be in treated area or in an area about to be treated with this product. Advise workers to stay out of fields during application and until sprays have dried. Regular long-sleeved work clothing should be worn when working in treated fields. See PRECAUTIONARY STATEMENTS, STATEMENT OF PRACTICAL TREATMENT AND NOTE TO PHYSICIAN for information on accidental exposures. When oral warnings are given, warnings shall be given in a language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written warnings must include the following information: appropriate signal word (CAUTION), area treated with SEVIN® brand 4F Carbaryl Insecticide, date of application, appropriate clothing, and re-entry interval (i.e., until sprays have dried).

Lasso®

HERBICIDE BY **Monsanto**

Emulsifiable herbicide for weed control in corn, soybeans, peanuts, dry beans, grain sorghum (milo), lima beans, red kidney beans, potatoes, sunflowers and crops listed.

Complete Directions for Use

U.S. Pat No. 3,547,620 EPA Reg. No. 524-314-AA

For use of this product in California see page 111.

1984-1 843.41-000.95/53

Read the entire label before using this product.

Use only according to label instructions.

Read "LIMIT OF WARRANTY AND LIABILITY" before buying or using. If terms are not acceptable, return at once unopened.

LIMIT OF WARRANTY AND LIABILITY

This company warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes set forth in the Complete Directions for Use label booklet ("Directions") when used in accordance with those Directions under the conditions described therein. NO OTHER EXPRESS OR IMPLIED WARRANTY OF FITNESS FOR PARTICULAR PURPOSE OR MERCHANTABILITY IS MADE. This warranty is also subject to the conditions and limitations stated herein.

Buyer and all users shall promptly notify this company of any claims whether based in contract, negligence, strict liability, other tort or otherwise.

Buyer and all users are responsible for all loss or damage from use or handling which results from conditions beyond the control of this company, including but not limited to incompatibility with products other than those set forth in the Directions, unusual weather (i. weather conditions which are outside the range considered normal at the application site and for the time period when the product is applied with the normal range being determined on the basis of the average range for the prior 40 years computed from the best available information, and ii. weather perils, including but not limited to hurricanes, tornadoes and floods) as well as weather considerations set forth in the Directions, application in any manner not explicitly set forth in the Directions, moisture conditions outside the moisture range specified in the Directions, or the presence of products other than those set forth in the Directions in or on the soil or crop.

THE EXCLUSIVE REMEDY OF THE USER OR BUYER, AND THE LIMIT OF THE LIABILITY OF THIS COMPANY OR ANY OTHER SELLER FOR ANY AND ALL LOSSES, INJURIES OR DAMAGES RESULTING FROM THE USE OR HANDLING OF THIS PRODUCT (INCLUDING CLAIMS BASED IN CONTRACT, NEGLIGENCE, STRICT LIABILITY, OTHER TORT OR OTHERWISE) SHALL BE THE PURCHASE PRICE PAID BY THE USER OR BUYER FOR THE QUANTITY OF THIS PRODUCT INVOLVED, OR, AT THE ELECTION OF THIS COMPANY OR ANY OTHER SELLER, THE REPLACEMENT OF SUCH QUANTITY OR, IF NOT ACQUIRED BY PURCHASE, REPLACEMENT OF SUCH QUANTITY. IN NO EVENT SHALL THIS COMPANY OR ANY OTHER SELLER BE LIABLE FOR ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES.

The buyer and all users are deemed to have accepted the terms of this LIMIT OF WARRANTY AND LIABILITY which may not be varied by any verbal or written agreement.

PRECAUTIONARY STATEMENTS

Hazard to Humans and Domestic Animals

Keep out of reach of children.

DANGER!

CAUSES EYE BURNS AND SKIN IRRITATION.

HARMFUL IF SWALLOWED.

MAY CAUSE ALLERGIC SKIN REACTION.

Do not get in eyes, on skin or on clothing.

Wear goggles or face shield and rubber gloves in transferring and mixing and when adjusting, repairing or cleaning equipment.

Wash thoroughly with soap and water after handling.

FIRST AID: IF IN EYES, immediately flush with plenty of water for at least 15 minutes. Call a physician.

IF ON SKIN, immediately flush with plenty of water while removing contaminated clothing. Call a physician. Wash clothing before reuse. Sensitized persons should avoid further contact and reuse of clothing.

IF SWALLOWED, induce vomiting immediately by giving two glasses of water and sticking finger down throat. Call a physician. NEVER GIVE ANYTHING BY MOUTH TO AN UNCONSCIOUS PERSON.

In case of an emergency involving this product, Call Collect, day or night, (314) 694-4000.

Environmental Hazards

Avoid direct application to any body of water. Do not contaminate water by disposal of waste or cleaning of equipment.

Physical or Chemical Hazard

COMBUSTIBLE.

Do not use or store near heat or flame.

Use only with adequate ventilation.

In case of:

FIRE, use water spray, foam, dry chemical or CO_2.

SPILL or LEAK, flush area with water spray.

Storage and Disposal

STORE ABOVE 32°F. TO KEEP PRODUCT IN SOLUTION.

STORAGE:

Below 32°F. crystals may form and settle to the bottom. If crystals form, place in a warm room and roll and/or shake the container frequently to redissolve before using. For bulk containers, see the container label for alternate storage information.

DISPOSAL:

Wastes of this pesticide may cause eye burns and skin irritation and may be dangerous. Improper disposal of excess pesticide, spray mixtures, or rinsate is a violation of Federal law. If these wastes cannot be disposed of according to label use instructions, contact your State Pesticide or Environmental Control Agency, or the Hazardous Waste representative at the nearest EPA Regional Office for guidance.

Empty container retains vapor and product residue. Observe all labeled safeguards until container is cleaned, reconditioned or destroyed.

See the individual container label for disposal information.

ACTIVE INGREDIENT:

*Alachlor	45.1%
INERT INGREDIENTS:	54.9%
	100.0%

*Contains 480 grams / litre or 4 pounds / gallon of 2-chloro-2′-6′-diethyl-N-(methoxymethyl)acetanilide.

GENERAL INFORMATION

Lasso® herbicide is recommended for control of yellow nutsedge and the annual grasses and broadleaf weeds listed in the "WEEDS CONTROLLED" section of this label. This product may be applied either as a surface application after planting or shallowly incorporated prior to planting to blend the herbicide treatment into the upper 1 to 2 inches of soil. Except for minimum or conservation tillage systems, the seedbed should be fine, firm and free of clods and trash.

®Lasso is a registered trademark of Monsanto Company.

Read and carefully observe precautionary statements and all other information appearing on the labeling of all products used in mixtures and sequential treatments.

NOTE THAT DYANAP™ PARAQUAT AND PREMERGE™ (dinoseb) HERBICIDES ARE POISONS WHICH MAY BE FATAL OR HARMFUL TO HUMANS AND DOMESTIC ANIMALS.

Do not flood irrigate following application of this product or tank mixtures. This product will not control emerged seedlings.

Do not apply when conditions favor drift.

Use of this product not consistent with this label may result in injury to persons, animals or crops, or other unintended consequences. Keep container closed to prevent spills and contamination.

Flush sprayer with clean water after use.

™Dyanap is a trademark of Uniroyal, Inc.

™Premerge is a trademark of the Dow Chemical Company.

SOIL TEXTURE

The recommended use rates of this product and the other herbicides labeled for use in tank mixtures with this product generally vary with soil texture. Unless soil texture is specifically named, rate tables throughout this label refer to only three soil texture groups: coarse, medium and fine. The following is a complete listing o corn? *potatoe

VYDATE® L

INSECTICIDE/NEMATICIDE
WATER SOLUBLE LIQUID

RESTRICTED USE PESTICIDE

For retail sale to and use only by Certified Applicators or persons under their direct supervision and only for those uses covered by the Certified Applicator's certification.

1 Gallon Contains 2 lbs. Oxamyl

ACTIVE INGREDIENT:	
Oxamyl	
Methyl *N'N'*-dimethyl-*N*-[(methylcarbamoyl)oxy]-1-thiooxamimidate	24%
INERT INGREDIENTS	76%
TOTAL	100%

EPA Reg. No. 352-372 U.S. Pats. 3,530,220 & 3,658,870

DANGER–POISON

Keep Out of Reach of Children

PELIGRO

PRECAUCION AL USUARIO: Si usted no lee ingles, no use este producto hasta que la etiqueta haya sido explicado ampliamente.

STATEMENT OF PRACTICAL TREATMENT

If swallowed: Call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. **Do not induce vomiting or give anything by mouth to an unconscious person.**

If inhaled: Remove from exposure and have patient lie down and keep quiet. If patient is not breathing, start artificial respiration immediately. **Never give anything by mouth to an unconscious person.**

In case of contact, wash skin with plenty of soap and water; for eyes, flush with water for 15 minutes and get medical attention; remove and wash contaminated clothing before re-use.

ATROPINE IS AN ANTIDOTE—SEEK MEDICAL ATTENTION AT ONCE IN ALL CASES OF SUSPECTED POISONING.

If warning symptoms appear (see **Warning Symptoms below**), get medical attention.

For medical emergencies involving this product, call toll free 1-800-441-3637.

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

DANGER—POISON

CONTAINS METHANOL. MAY BE FATAL OR CAUSE BLINDNESS IF SWALLOWED. MAY BE FATAL IF ABSORBED THROUGH SKIN OR INHALED.

Do not breathe vapors or spray mist. Do not get in eyes, on skin, or on clothing. When mixing spray, loading, applying or otherwise handling, wear protective clothing, goggles, and a mask or respirator jointly approved by the Mine Safety and Health Administration [formerly the U.S. Bureau of Mines] and by the National Institute for Occupational Safety and Health. Wear clean clothes daily. Wash thoroughly after handling, and before eating or smoking. Pilot should not assist in the mixing and loading operation.

Do not apply this product in such a manner as to directly or through drift expose workers, other persons or animals. The area being treated must be vacated by unprotected persons.

WARNING SYMPTOMS—Oxamyl poisoning produces [...] associated with anticholinesterase activity which may inclu[de] weakness, blurred vision, headache, nausea, abdominal cr[amps], discomfort in the chest, constriction of pupils, sweating, slow p[ulse], muscle tremors.

NOTE TO PHYSICIAN

TREATMENT—Atropine sulfate should be used for treat[ment]. Administer repeated doses, 1.2 to 2.0 mg. intravenously every [...] 30 minutes until full atropinization is achieved. Maintain atro[pini]zation until the patient recovers. Artificial respiration or o[xygen] may be necessary. Allow no further exposure to any cholines[terase] inhibitor until recovery is assured.

Do not use 2-PAM for exposure to VYDATE L alone. However [...] exposure to combinations of VYDATE L and organophosph[ate] insecticides, 2-PAM may be used as required to supplement atropine sulfate treatment. Do not use morphine.

ENVIRONMENTAL HAZARDS

This product is toxic to fish, birds, and other wildlife. Do not [apply] directly to water. Do not apply where runoff is likely to occur. [Do] not apply when weather conditions favor drift from areas tre[ated]. Do not contaminate water by cleaning of equipment or dispos[al of] wastes.

This product is toxic to bees exposed to direct application. [Do not] apply this product while bees are actively visiting the treatment [area]. Time applications to coincide with periods of minimum bee activ[ity].

PHYSICAL AND CHEMICAL HAZARDS

Flammable. Keep away from heat, sparks, and open flame. Ke[ep] container closed. Use with adequate ventilation.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

Du Pont VYDATE L Insecticide/Nematicide should be used in accordance with recommendations on this label or in separate Du Pont recommendations available through local dealers.

Du Pont will not be responsible for losses or damages resulting from use of this product in any manner not specifically recommended by Du Pont. User assumes all risks associated with such non-recommended use.

VYDATE L is a water soluble liquid to be diluted with water for application. Use only in commercial and farm plantings; do not use in home plantings. Do not rotate crops other than apples, [canta]loupe, celery, citrus, cotton, cucumber, eggplant, honeydew, [orna]mentals, peanuts, pears, peppers, pineapple, root crop vegetables, soybeans, summer squash, tobacco, tomatoes, watermelon and [win]ter squash within four months after the last application.

Do not use in Suffolk and Nassau Counties, Long Island, New York.

Do not enter treated areas without appropriate protective clothing until sprays have dried. Because certain states may require more restrictive reentry intervals for various crops treated with this prod[uct], consult your State Department of Agriculture for further infor[mation].

Written or oral warnings must be given to workers who are expected to be in a treated area or in an area about to be treated with [this] product. When oral warnings are given, warnings shall be given in language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written (or oral) warnings must include the following information: "DANGER—POISON. Area treated with VYDATE L on (date of application). Do not enter treated areas without appropriate protective clothing until sprays have dried. [If] warning symptoms appear, refer to Statement of Practical Treatment on front panel of VYDATE L label and seek medical attention at once."

Spray Preparation—Fill spray tank ¼ to ½ full of water. Add VYDATE L directly to tank. Mix thoroughly while adding remaining water. No further agitation is necessary.

FRUITS

APPLES

Spotted Tentiform Leafmi[ner] ...
[1]00 gals. water as follows: ...
1st Brood Leafminer—Ad...
pink (before bloom—no p...
2nd Brood Leafminer—La...
are an average of two or mo...
For best results, the applic...
water into the tissue-feedin...
European Red Mite and Tw...
Established Populations of ...
per 100 gals. water as nee...
Low Populations (Preve...
VYDATE L per 100 gal...
numbers and continue eve...
White Apple Leafhopper—...
gals. water every 10 to 14 ...
significant numbers of leaf...
Apply VYDATE L in suffi...
but not in excess of 400 ga...
NOTE: Do not apply at ...
fruit thinning may occur. ...
harvest. Do not graze live...

CITRUS

Citrus Rust Mite—Apply ...
water. Spray to run-off usin...
apply more than 2 qts. of ...
Begin applications as soon ...
continue on an as-needed ...
apply on 4- to 6-week inter...
ate to heavy pressure, ap...
infestation continues.
DO NOT MAKE MORE T...
Citrus Thrips—Apply 1 to ...
water (100 to 500 gals. per ...
early spring before bloom ...
ing. Make additional appl...
fall may be critical to prev...
recommended during mid-...
trees.
NOTE: Do not apply to ...
graze livestock in treated ...
PEARS—Use not register...
European Red Mite, Mc...
Pear Rust Mite—Apply 3 ...
100 gals. of water by grou...
...
Make application when m...
maintain control. Use lowe...
heavy infestations.
NOTE: Do not apply a...
fruit thinning may occur...
this product has been tes...
pears without russeting. I...
small scale until the possib...
Do not graze livestock in trea...
PINEAPPLE—Use not r...
Reniform And Root Knot ...
Preplant or Plant ... Tre...
per acre broadcast within ...
inches into the soil. Alt...
per acre broadcast or appl...
drip irrigation injectio...

Furadan

4F insecticide

RESTRICTED USE PESTICIDE
Due to acute oral and inhalation toxicity.
For retail sale to and application only by Certified Applicators or personnel under their direct supervision, and only for those uses covered by the Certified Applicator's certification.

FOR CONTACT AND SYSTEMIC CONTROL OF PESTS ON CERTAIN FIELD AND VEGETABLE CROPS.

FURADAN 4F insecticide is a carbamate compound designed to control alfalfa weevil larvae and lygus bugs on alfalfa, corn rootworms on field corn, European corn borer on sweet corn, sugarcane borers and various pests of potatoes, pine seedlings and small grains. It has a long residual life against alfalfa weevil and Egyptian alfalfa weevil, and can be applied earlier than other insecticides to control these larvae.

- **Contact and systemic activity**
- **Long-lasting control**
- **Economical**
- **Convenient to apply**

FURADAN—FMC trademark

RECOMMENDED USES	Alfalfa, Field corn, Sweet corn, Popcorn, Cotton, Pine seedlings, Potatoes, Small grains (wheat, oats, barley), Soybeans, Grapes (California), Strawberries (Washington and Oregon), Sugarcane, Sunflowers*, Tobacco, Ornamentals. *See label restrictions.
INGREDIENTS	ACTIVE INGREDIENT: *Carbofuran .... 44.00% INERT INGREDIENTS .... 56.00% 100.00% *2,3-Dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate. This product contains 4 lb. of carbofuran per gallon. EPA Reg. No. 279-2876-ZC-3125 U.S. Patent No. 3,474,171 FURADAN, FMC trademark
PACKAGING	1 gallon jug, 4 per case. Shipping weight 44 lbs. 2½ gallon jug, 2 per case. Shipping weight 50.63 lbs. 5 gallon jug. Shipping weight 55 lbs. 30 gallon drum. Shipping weight 312 pounds.

AAtrex®

1gal = 8pints.

4L

Herbicide

For season-long weed control in corn and sorghum

For weed control in certain other crops; in noncrop areas; and industrial sites

Active Ingredients:

Atrazine: 2-chloro-4-ethylamino-6-isopropylamino-s-triazine	40.8%
Related compounds	2.2%
Inert Ingredients:	57.0%
Total:	100.0%

2½ Gallons
U.S. Standard Measure

AAtrex 4L contains 4 lbs. active ingredients per gallon.

Shake well before using.

Use entire contents at one time.

Keep Out of Reach of Children.

Caution

See additional precautionary statements at end of label booklet.

See directions for use inside booklet.

AAtrex® trademark of CIBA-GEIGY for atrazine

EPA Reg. No. 100-497
EPA Est. 100-LA-1

Agricultural Division
CIBA-GEIGY Corporation
Greensboro, North Carolina 27419
CGA 7L38W 086

CIBA-GEIGY

DIRECTIONS FOR USE AND CONDITIONS OF SALE AND WARRANTY

IMPORTANT: Read the entire **Directions for Use** and the **Conditions of Sale and Warranty** before using this product.

Conditions of Sale and Warranty

The **Directions for Use** of this product reflect the opinion of experts based on field use and tests. The directions are believed to be reliable and should be followed carefully. However, it is impossible to eliminate all risks inherently associated with use of this product. Crop injury, ineffectiveness, or other unintended consequences may result because of such factors as weather conditions, presence of other materials, or the manner of use or application all of which are beyond the control of CIBA-GEIGY or the Seller. All such risks shall be assumed by the Buyer.

CIBA-GEIGY warrants that this product conforms to the chemical description on the label and is reasonably fit for the purposes referred to in the **Directions for Use** subject to the inherent risks referred to above. **CIBA-GEIGY makes no other express or implied warranty of Fitness or Merchantability or any other express or implied warranty. In no case shall CIBA-GEIGY or the Seller be liable for consequential, special, or indirect damages resulting from the use or handling of this product.** CIBA-GEIGY and the Seller offer this product, and the Buyer and user accept it, subject to the foregoing **Conditions of Sale and Warranty**, which may be varied only by agreement in writing signed by a duly authorized representative of CIBA-GEIGY.

DIRECTIONS FOR USE

It is a violation of federal law to use this product in a manner inconsistent with its labeling.

FAILURE TO FOLLOW THE DIRECTIONS FOR USE AND PRECAUTIONS ON THIS LABEL MAY RESULT IN POOR WEED CONTROL, CROP INJURY, OR ILLEGAL RESIDUES.

Do not apply this product in such a manner as to directly or through drift expose workers or other persons, except those knowingly involved in the application. The area being treated must be vacated by unprotected persons.

Do not enter treated areas without protective clothing until sprays have dried.

Because certain states may require more restrictive reentry intervals for various crops treated with this product, consult your State Department of Agriculture for further information.

Written or oral warnings must be given to workers who are expected to be in a treated area or in an area about to be treated with this product. Oral warnings must be given which inform workers of areas or fields that may not be entered without specific protective clothing until sprays have dried, and appropriate actions to take in case of accidental exposure as described under **Precautionary Statements** on this label. When oral warnings are given, warnings shall be given in a language customarily understood by workers. Oral warnings must be given if there is reason to believe that written warnings cannot be understood by workers. Written warnings must include the following information: "CAUTION. Area treated with AAtrex 4L on *(date of application)*. Do not enter without appropriate protective clothing until sprays have dried. In case of accidental exposure, flush eyes or skin with plenty of water. Call a physician if irritation persists. Remove and wash contaminated clothing before reuse."

General Information

This herbicide controls many annual broadleaf and grass weeds in corn, sorghum, sugarcane, pineapple, and certain other crops specified on this label. It is also effective in noncrop areas and industrial sites for control of most annual and many perennial broadleaf and grass weeds. This product may be applied before or after weeds emerge.

Following many years of continuous use of this product and chemically related products, biotypes of some of the weeds listed on this label have been reported which cannot be effectively controlled by this and related herbicides. Where this is known or suspected and weeds controlled by this product are expected to be present along with resistant biotypes, we recommend the use of this product in combinations or in sequence with other registered herbicides which are not triazines. If only resistant biotypes are expected to be present, use a registered non-triazine herbicide. Consult with your state Agricultural Extension Service for specific recommendations.

Since this product acts mainly through root absorption, its effectiveness depends on moisture to move it into the root zone. If weeds develop, a shallow cultivation or rotary hoeing will generally result in better weed control.

This product is nonflammable.

Avoid using near adjacent desirable plants or in greenhouses, or injury may occur.

To avoid spray drift, do not apply under windy conditions. Avoid spray overlap, as crop injury may result.

Where the use directions give a range of rates, use the lower rate on coarse-textured soil and soil low in organic matter; use the higher rate on fine-textured soil and soil high in organic matter.

Note: CIBA-GEIGY does not recommend applications in combination with other herbicides or oils, except as specifically described on the label or in literature published by CIBA-GEIGY.

Application Procedures

Ground application: Use conventional ground sprayers equipped with nozzles that provide accurate and uniform application. Be certain that nozzles are uniformly spaced and are the same size. Calibrate sprayer before use and recalibrate at the start of each season and when changing carriers. Unless otherwise specified, use a minimum of 10 gals. of spray mixture/A for all preplant incorporated, preplant surface, preemergence, and postemergence applications (with or without oil or surfactant) with ground equipment.

Use a pump with capacity to (1) maintain 35-40 psi at nozzles, (2) provide sufficient agitation in tank to keep mixture in suspension, and (3) to provide a minimum of 20% bypass at all times. Use centrifugal pumps which provide propeller shear action for dispersing and mixing this product. The pump should provide a minimum of 10 gals./minute/100 gal. tank size circulated through a correctly positioned sparger tube or jets.

Use screens to protect the pump and to prevent nozzles from clogging. Screens placed on the suction side of the pump should be *16-mesh or coarser.* Do not place a screen in the recirculation line. Use 50-mesh or coarser screens between the pump and boom, and where required, at the nozzles. Check nozzle manufacturer's recommendations.

For band applications, calculate amount to be applied per acre as follows:

$$\frac{\text{band width in inches}}{\text{row width in inches}} \times \text{broadcast rate per acre} = \text{amount needed per acre of field}$$

Aerial application: Use aerial application only where broadcast applications are specified. Apply in a minimum of 1 qt. of water for each quart of this product applied per acre. For postemergence treatments on corn and sorghum, apply recommended rate in a minimum of 2 gals. of water/A. Avoid applications under conditions where uniform coverage cannot be obtained or where excessive spray drift may occur.

Avoid application to humans or animals. Flagmen and loaders should avoid inhalation of spray mist and prolonged contact with skin, and should wash thoroughly before eating and at the end of each day's operation.

Application in water or liquid fertilizer: Nitrogen solution or complete liquid fertilizer may replace all or part of the water as a carrier for preemergence, preplant incorporated, or preplant surface ground application on corn and sorghum. Check the compatibility of this product with liquid fertilizer and/or nitrogen solution as shown below before use. Do not apply in nitrogen solution or complete liquid fertilizer after corn or sorghum emerges, except as noted under **Lay-by treatment** for corn, or crop injury may occur.

Compatibility Test: Since liquid fertilizers can vary, even within the same analysis, **always check compatibility with herbicide(s) each time before use.** Be especially careful when using complete suspension or fluid fertilizers as serious compatibility problems are more likely to occur. Commercial application equipment may improve compatibility in some instances. The following test assumes a spray volume of 25 gals. per acre. For other spray volumes, make appropriate changes in the ingredients. Check compatibility using this procedure:

1. Add 1 pint of fertilizer to each of 2 one-quart jars with tight lids.

CGA 130-561K

RESTRICTED USE PESTICIDE
FOR RETAIL SALE TO AND USE ONLY BY CERTIFIED APPLICATORS OR PERSONS UNDER THEIR DIRECT SUPERVISION AND ONLY FOR THOSE USES COVERED BY THE CERTIFIED APPLICATOR'S CERTIFICATION.

Temik® 15 G

*potatoes

UNION CARBIDE

Aldicarb Pesticide

For control of certain insects, mites and nematodes.

ACTIVE INGREDIENT: Aldicarb [2-methyl-2-(methylthio) propionaldehyde O-(methylcarbamoyl)oxime] 15%

INERT INGREDIENTS: 85%

EPA Reg. No. 264-330 EPA Est. No. 10352-GA-01

IN CASE OF EMERGENCY TELEPHONE COLLECT (24 HOURS A DAY) IN U.S.A. (304) 744-3487

KEEP OUT OF REACH OF CHILDREN

DANGER POISON

PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

Poisonous if swallowed. May be fatal or harmful by skin or eye contact or by breathing dust. Rapidly absorbed through skin or eyes. Do not get on skin or eyes. Do not breathe dust.

Wear long-sleeved clothing and protective gloves when handling. Wash hands and face before eating or smoking. Bathe at the end of work day, washing entire body and hair with soap and water. Change clothing daily. Wash contaminated clothing in strong washing soda solution and rinse thoroughly before reusing.

SIGNS AND SYMPTOMS OF OVEREXPOSURE:

Salivation	Muscle tremor	Nausea
Watery eyes	Difficult breathing	Vomiting
Pinpoint eye pupils	Excessive sweating	Diarrhea
Blurred vision	Abdominal cramps	Weakness
		Headache

In severe cases, convulsions, unconsciousness and respiratory failure may occur.

ANTIDOTE STATEMENT
ATROPINE SULFATE IS HIGHLY EFFECTIVE AS AN ANTIDOTE. See NOTE TO PHYSICIAN below.

STATEMENT OF PRACTICAL TREATMENT

GENERAL
Contact a physician immediately in all cases of suspected poisoning. If breathing stops, start artificial respiration, establish an airway and provide oxygen. Make certain to remove all sources of continuing contamination. Remove clothing and wash skin and hair immediately with large amounts of water. Transport the patient to a physician or hospital immediately and SHOW A COPY OF THIS LABEL TO THE PHYSICIAN.

IF SWALLOWED: Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger. Never give anything by mouth to an unconscious or convulsing person. Call a physician and follow General advice listed above.

IF IN EYES: Flush eyes with plenty of water and get medical attention.

IF ON SKIN: Wash thoroughly with soap and water.

IF INHALED: Call a physician and follow General advice listed above.

NOTE TO PHYSICIAN
TEMIK aldicarb is a methyl carbamate insecticide, which is a cholinesterase inhibitor. Overexposure to this substance may cause toxic signs and symptoms due to stimulation of the parasympathetic nervous system. These effects of overexposure are spontaneously and rapidly reversible.

Specific treatment consists of parenteral atropine sulfate. Caution should be maintained to prevent overatropinization. Mild cases may be given 1 to 2 mg intramuscularly every 10 minutes until full atropinization has been achieved and repeated thereafter whenever symptoms reappear. Severe cases should be given 2 to 4 mg intramuscularly every 10 minutes until fully atropinized, then intramuscularly every 30 to 60 minutes to maintain the effect for at least 12 hours. Dosages for children should be appropriately reduced. Complete recovery from overexposure is to be expected within 24 hours.

Narcotics and other sedatives should not be used. Further, drugs like 2-PAM (pyridine-2-aldoxime methiodide) are **NOT** recommended unless organophosphate intoxication is also suggested.

To aid in confirmation of a diagnosis, urine samples should be obtained within 24 hours of exposure and immediately frozen. Analyses will be arranged by Union Carbide Agricultural Products Company.

Consultation on therapy can be obtained at all hours by calling the Union Carbide emergency number: (304) 744-3487.

ENVIRONMENTAL HAZARDS

DECOMPOSITION AND MOVEMENT IN SOIL
This product is readily decomposed into harmless residues under most use conditions. However, a combination of sandy and acidic soil conditions, moderate to heavy irrigation and/or rainfall, use of 20 or more pounds per acre, and soil temperature below 50°F at application time, tend to reduce degradation and promote movement of residues to groundwater. If this describes your local use conditions and groundwater in your area is used for drinking, do not use this product without first contacting Union Carbide at 1 (800) 334-8577.

APPENDIX II

Extraction Of Pesticides From Ground Water

Equipment And Reagents

- Glass filtering apparatus, 47 mm
- Kudurna-Danish tube with a micro-Snyder column
- Methanol, pesticide grade
- Ethyl acetate, pesticide grade
- Water, organic-free
- Empore™ Extraction Disk, C8 phase, 47 mm

Sample Pretreatment

Add 5.0 mL methanol per 1 liter sample and mix well. Methanol is added to the sample to maintain conditioning of the C8 sorbent. *Note: Water samples are often stabilized with HCl to prevent bacterial growth. This will not affect the extraction procedure.*

Sample Extraction

Place the Empore™ Extraction Disk into the filter apparatus. Apply vacuum. Prewash disk with 10 mL ethyl acetate followed by drying under vacuum for 5 minutes. With the vacuum still on, add 10 mL of methanol sequentially followed by 10 mL of water. *Important: During the addition of the methanol and water it is essential that the disk is not allowed to dry.* This can be accomplished by regulating the vacuum.

Begin pouring the water sample into the filter apparatus reservoir. Adjust the vacuum to achieve approximately a 25 ml/min flow rate (1 liter of water should be processed in 45 min).

Important: Do not allow the disk to go dry during the sample processing.

Sample Elution

After the entire sample volume has passed through, pull air through the disk for a minimum of 5 minutes. Remove the filter holder assembly from the vacuum flask. Place the tip of the base into a large test tube inside a clean, dry vacuum flask. The test tube serves as the collection vessel. Rinse original sample bottle with 10 mL ethyl acetate and add to the filter reservoir with the vacuum off. Slowly turn on the vacuum and pull half the ethyl acetate through the disk. Turn the vacuum off and allow to stand for one minute. Turn the vacuum on and pull the remaining ethyl acetate through. Repeat with a second 10 mL aliquot of ethyl acetate.

Sample Concentration and Analysis

Transfer the combined ethyl acetate aliquots to a K-D apparatus and concentrate to a final volume of 1 mL. Add 3 mL of fresh ethyl acetate and reconcentrate to 1 mL. When cool, bring the total volume to exactly 1.0 mL with ethyl acetate. Analyze with GC/ECD/NPD.

Pesticide	Recovery at: 1 ppb/AD	10 ppb/AD	100 ppb/AD
Vernam	78.0 ± 5.1	88.2 ± 2.1	86.8 ± 2.3
Atrazine	88.0 ± 8.0	88.4 ± 2.3	86.2 ± 2.3
Diazinon	97.0 ± 4.1	92.8 ± 4.5	90.2 ± 1.6
Dyfonate	88.0 ± 3.4	92.8 ± 4.4	86.6 ± 2.4
Alachlor	97.0 ± 4.0	93.6 ± 4.5	87.9 ± 1.2
Sulprofos	115.8 ± 8.0	86.1 ± 5.3	*
Heptachlor	95.1 ± 8.0	81.0 ± 2.2	*
Aldrin	51.0 ± 7.4	55.2 ± 1.8	51.0 ± 2.2
Endosulfan	99.2 ± 4.0	101.9 ± 0.5	*
Net Average Deviation	5.8	3.1	2.0

*** Data unavailable due to solubility limitations.**

Empore™ Extraction Disks from 3M are Distributed Solely by Analytichem International and its Authorized Distributors.

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