California Department of Food and Agriculture
Environmental Monitoring and Pest Management
1220 N Street, Room A-149
Sacramento, CA 95814
March 21, 1988

PROTOCOL TO DETERMINE THE ENVIRONMENTAL FATE OF AMITROLE

I. INTRODUCTION

Amitrole (3-amino-1,2,4-triazole) is a pesticide on the Governor's List of chemicals known to the State to cause cancer or reproductive toxicity pursuant to Proposition 65, the Safe Drinking Water and Toxic Enforcement Act. The Environmental Hazards Assessment Program (EHAP) of CDFA will undertake this study to provide environmental fate information for typical amitrole use at different California locations. Additionally, procedures used during design and execution of this study will be assessed for their appropriateness in performing future Safe Use Determinations which may be requested under Proposition 65.

Technical amitrole is an off-white, coarse powder at room temperature with a vapor pressure of less than 1×10^{-5} mbar at 20^{o}C and a solubility of 280 g/l at 25^{o}C in water. Product formulations include wettable powders, dusts, and liquid concentrates containing from 1 to 90 percent active ingredient. Amitrole acts as a chlorophyll synthesis and enzymatic process inhibitor. It is absorbed by leaf tissues and root systems of plants and translocated in both phloem and xylem. The use of amitrole in control of annual and perennial grasses, broadleaf weeds, and certain aquatic weeds in marshes and drainage ditches has been restricted by the EPA since 1986 to non-cropland areas only. Areas which allow the use of amitrole include: highway shoulders, rights-of-way, railroads, fencerows, industrial areas, parking lots, embankments, ditchbanks and drainage canal banks. Application methods include backpack sprayers, other hand-held sprayers, and truck-mounted spray rigs for large areas.

Amitrole is applied year-round in California with the most frequent applications taking place from March to June. The average application rate is between 2 and 4 pounds active ingredient in 100-150 gallons of water per acre.

References to the dissipation of amitrole in soils and water in the literature provide conflicting information on its longevity. Less than 1 to greater than 56-day half-lives have been reported in non-sterile aerobic soils (Day, Jordan and Hendrixson, 1961; Burschel and Freed, 1959) . Although one study reported soil chemical processess (oxidative in nature) as a major breakdown pathway (Kaufman et al., 1967), other studies support microbial action as the most important degradation pathway (Riepma, 1962). Degradation has been found to be associated with temperature, pH, moisture and clay content in one soil study (Ercegovich and Frear, 1964). Amitrole has been reported as stable (half-life greater than 40 days) (Reinert and Rodgers, 1987) and non-persistent (Heckman, 1981) in water, although no data were presented. Photolysis, hydrolysis and volatilization are not expected to be significant fate processes (Kaufman et al., 1967).

II. OBJECTIVES

The objectives of this study are:

1. To quantify the concentration of amitrole found in soil, vegetation, air and water samples following a typical treatment for weed control in two different types of settings:

   Type A. Level surfaces with low potential for significant run-off problems. These sites include rights-of-way, highway shoulders, fencelines, and industrial areas.

   Type B. Sloping surfaces with high potential for run-off problems. These sites include ditchbanks, irrigation canal banks, or any type of steep embankment which could allow the formation of runoff.

2. To quantify concentration rates in runoff created by simulated rainfall events within Type B sites.

3. To characterize groundwater contamination potential by collecting soil cores at sites of historical amitrole usage.

4. To assess the effectiveness of EHAP's generic Proposition 65 protocol for Safe Use Determination.

III. PERSONNEL

This study will be conducted by EHAP personnel under the overall supervision of Randy Segawa. Other key personnel include:

Project Leader: Bonnie Turner
Senior Staff Scientist: Lisa Ross
Study Design/Data Analysis: Margaret Bisbiglia
Field Sampling: Debra Denton/John Sitts
Lab Liaison/Quality Control: Nancy Miller
Agency and Public Contact: Madeline Ames

IV. STUDY PLAN/EXPERIMENTAL DESIGN

The following study plan is to be used as a preliminary estimate of number of samples collected and sites to be treated during the project. Numbers may vary slightly due to enviromental or administrative factors beyond our control.

After an initial survey of the 17 highest-use counties (based on 1986 Pesticide Use Data Base information), Monterey, Solano and Merced counties were selected for further investigation as possible sites for the study. Following site visits to each county, two counties were selected from which four study sites will be chosen after consideration of surface slope, soil type, ease of access, crew and spray rig availability, and other factors.

Media and No. of Samples: The following table presents the potential number of samples for each medium to be collected during the study period.

Table 1. Number of Sampling Intervals, Samples and Sites for Amitrole Study at Four Experimental Sites.

Sample Medium	No. of Samples per Site per Sampling Interval (days post trmt) -1	0	+1	+2	+4	+8	+16	No. of Sites	Total No. Samples
Kimbies		8	0	0	0	0	0	4	32
Surface Soil*	4	8	8	8	8	8	8	4	208
Runoff	0	4	4	4	4	4	4	2	48
Air	2	5+5	5	5				4	88
Vegetation	2	6	6	3	3	3	3	4	104
Samples per Interval:	8	36	23	20	15	15	33	2-4	
							Total Exper. Site Samples:		480

*Subsurface soil samples to be collected at historical usage sites concurrently with experimental site sampling:

2 counties x 4 sites x 9 samples each site = 72

STUDY: 552

Treatments: The total number of treatments will be categorized as follows:

Sandy Soil:

Type A Site - 1 treatment (soil,air,veg samples)

Type B Site - 1 treatment (soil,runoff,air,veg samples)

Clay/Organic Soil:

Type A Site - 1 treatment

Type B Site - 1 treatment

Pesticide Applications: Amitrole will be applied in wettable powder form (Amizol) at a rate of 4 lbs active ingredient mixed in 100 gallons of water per acre treated. This rate represents the average high application rate according to our survey. Spray equipment and crews will be supplied locally by county personnel. For vegetation, air and soil sampling areas within both site types (A and B), roadside applications will be made over an area approximately 4 m wide by 25 m long. In addition, an area approximately 4 m wide by 36 m long will be treated with amitrole at the above rates at Type B sites only. This area will be used solely for artificial rainfall treatments (see attached diagrams for site descriptions).

<u>Sampling Intervals:</u> After background sampling is completed, samples will be collected on Day 0, 1, 2, 4, 8, and 16 for soil, runoff, and vegetation. Air samples will be collected during treatment, 1-hr post treatment, and on days 1 and 2 after treatment. Subsurface samples will be collected in each county at a time to be determined after consultation with county personnel.

Additional measurements of the following parameters will be made either during field sampling or in the lab:

Soil:	wet weight, percent moisture, pH, texture analysis, percent organic matter, bulk density
Runoff:	temperature and pH of sample
Air sampling:	maximum temperature during sampling period, barometric pressure, humidity, wind direction and speed, sampler position, sampling period length, sample air volume
Vegetation:	wet weight, dry weight, height, density, viability estimate

<u>Statistical Methods:</u> Both linear and nonlinear regression techniques will be employed in the analysis of this nested 2 x 2 factorial repeated measures design. The following sources of variation will be considered for the linear model describing the soil and vegetation samples (Anderson and McLean, 1974):

Source of Variation[1]	Degrees of Freedom
Plot	P-1
Replication (Plot)	P(R-1)
Soil Type	SO-1
Slope Type	SL-1
Time	T-1
Soil x Time	(SO-1)(T-1)
Slope x Time	(SL-1)(T-1)
Soil x Slope	(SO-1)(SL-1)
Soil x Slope x Time	(SO-1)(SL-1)(T-1)
Residual	By subtraction
Corrected Total	(PxRxSOxSLxT)-1

All analyses will be carried out using Type III Sums of Squares from the General Linear Model procedure in the SAS system. Contrasts will be used to explore linear and quadratic trends, if any, over time. Covariance matrices will be examined to determine if Huynh-Feldt (H-F) conditions are met, and if not, appropriate downward adjustments to degrees of freedom will be made (Milliken and Johnson, 1984). Air analyses will be conducted by linear analyses only. Vegetation analyses will be incorporated into the overall mass balance analyses.

The nature of the degradation of amitrole under each soil and slope type combination will be explored using nonlinear regression analyses

1. The overall residual term will serve as the error term for all factors in the model excluding the test for plot differences which will use the replication (plot) as the error term.

with a first order decay model of the functional form $f(t) = B_o e^{-B, t} + e$. Hypothesis testing concerning parameters which arise from these nonlinear models will be compared using a weighted analysis of variance model (Milliken and Debruin, 1978) with the weights being derived from the asymptotic covariance matrices from models fit to individual populations.

Subsurface soil sampling results will be described graphically, plotting amitrole concentration versus depth.

V. SAMPLING METHODS

Soil: Surface soil samples will be collected using 6 cm diameter metal soil corers inserted to a depth of approximately 4 cm. Each sample will be a composite of 3 subcores selected randomly within the site. Soil samples will be frozen until analysis.

To determine the potential for groundwater contamination, subsurface soil samples will be collected at 4 sites with a known history of amitrole use. At each site, one core will be drilled to a depth of ten feet using a truck-mounted drill rig fitted with a split barrel sampler. Samples will be collected at the following depths below surface: 6, 12, 20, 32, 46, 60, 80, 100 and 120 inches. Nine samples per core will be kept frozen until analysis. The corings will take place during mid-April while sampling at the experimental sites is ongoing.

Runoff: After treatment at intervals listed in Table 1, artificial rainfall will be applied to the surface slope (Type B sites only) at a known rate. When sufficient water has been applied to a randomly selected sample plot within a treatment site (see attached diagram) to generate runoff at the bottom of the slope, the runoff will be collected by a piece of curved PVC sheeting (similar to gutter pipe). The sheeting will run the length of the sample plot (1.5 m). Runoff will be poured from the sheeting into a 1-liter glass sample jar. Any additional runoff will be bottled separately to be used for backup analysis or storage life QC analysis. Four sample plots will be "watered" at each sampling interval. At subsequent intervals, new plots will be selected from areas of the treatment site which have not been previously wetted. This will give us an estimate of amitrole concentrations in runoff occurring over time post treatment. All water samples will be refrigerated until analysis.

Air: Two background air samples will be collected at each site prior to amitrole treatment. To determine air concentrations during treatment and immediately afterward, when gas phase or mists are most likely, 3 impinger samplers will be placed downwind within 10 m of the treatment area during the treatment period and for a 1-hour post treatment period. To determine any additional off-target movement of amitrol, 2 impinger samplers will be positioned downwind < 30 m from treatment site for the same sampling periods. At +1 and +2 days post treatment, sampling will be repeated at the same locations. Air samples will be kept refrigerated until analysis.

Vegetation: Six samples will be collected from each Type A and B site at Day 0 and Day +1 and analyzed for total residues (3 samples each) and dislodgeable residues (3 samples each). On successive days, 3 samples from each site will be analyzed for total residues only. Each vegetation sample will consist of 3 subsamples collected randomly. Each subsample will consist of at least 3 whole plants (or > 30 g) cut at ground level and placed in glass containers with as little disturbance as possible. Samples will be kept frozen or refrigerated until analysis. Additional plant material will be collected per unit area and weighed. This material will be used to relate amitrole residues to the entire site on a square meter basis.

VI. CHEMISTRY METHODS/QUALITY CONTROL

Analytical method development is ongoing at present and will include using a spectrophotometric/colorimetric method at an adsorption at 520 nm. Soil will be analyzed for amitrole and percent moisture with results reported in ppb on a dry weight basis. Water will be analyzed for amitrole with results reported in ppb. Vegetation will be analyzed for total amitrole with results reported in ppb. Dislodgable residues from vegetation will be reported in ug/sample. Air will be analyzed for amitrole with results reported in ug.

Method Validation: Five replicate samples will be spiked with amitrole at each of 3 concentrations for each media (soil, water, vegetation, air). Additional analyses will be done if chemical analytical problems arise.

Continuing Quality Control: One solvent blank, 1 matrix spike sample and 3 replicate injections for 1 positive sample will be analyzed with each set of samples. Ten percent of the samples collected will be split between and analyzed by two different laboratories.

VII. TIMETABLE

Field site selection:	February 23 - March 10.
Sampling Preparation:	March 1 - March 30
Sampling Period:	March 28 - May 15
Chemical Analysis:	April 3 - August 30
Physical Analyses (Fresno):	May 1 - July 30
Statistical Analysis:	September 1 - October 15
Report Preparation:	October 1 - October 30
Final Report Draft:	November 1

VIII. BUDGET

Personnel Expenses:	$25,000
Operating Expenses:	85,000
Total Costs:	$110,000

IX. REFERENCES

Burschel, P. and V. H. Freed. 1959. The Decomposition of Herbicides in Soil. Weeds. No. 7, pp. 157-161.

Day, B. E., L. S. Jordan, and R. T. Hendrixson. 1961. The Decomposition of Amitrole in California Soils. Weeds. No. 9, pp. 443-456.

Ercegovich, C. and E. Frear. 1964. The Fate of 3-Amino-1,2,4-triazole in Soils. J. Agric. and Food Chem. Vol. 12, No. 1, Jan-Feb. pp. 26-29.

Heckman, C., 1981. Long-Term Effects of Intensive Pesticide Applications on the Aquatic Community in Orchard Drainage Ditches near Hamburg, Germany. Archives of Environmental Contamination and Toxicology. Vol. 10, pp. 393-426.

Kaufman, D. D., J. R. Plimmer, P. C. Kearney, J. Blake, and F. S. Guardia. 1967. Chemical Versus Microbial Decomposition of Amitrole in Soil. Weed Science. Vol. 16, No. 2, pp. 266-272.

Riepma, P., 1962. Preliminary Observations on the Breakdown of 3-Amino-1,2,4-Triazole in Soil. Weed Res. 2, pp. 41-50.

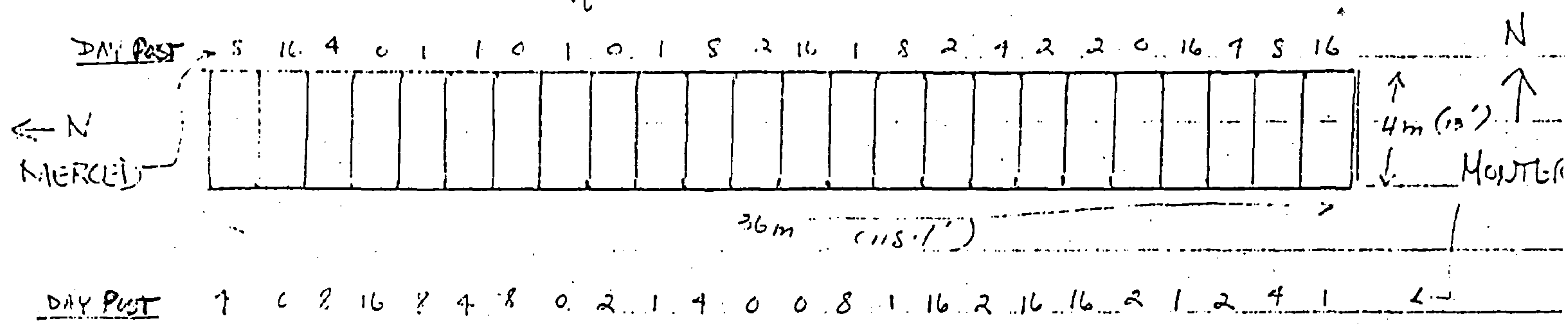
Milliken, G.A., and Johnson, D.E. 1984. Analysis of Messy Data Volume I: Designed Experiments. Belmont, California: Lifetime Learning Publications.

Anderson, V.L. and McLean, R.A. 1974. Design of Experiments: A Realistic Approach. New York: Marcel Dekker, Inc.

Milliken, G.A., and Debruin, R.L. (1978). A Procedure to Test Hypotheses for Nonlinear Models. Communications of Statistics: Theory and Methods, X, X- X.

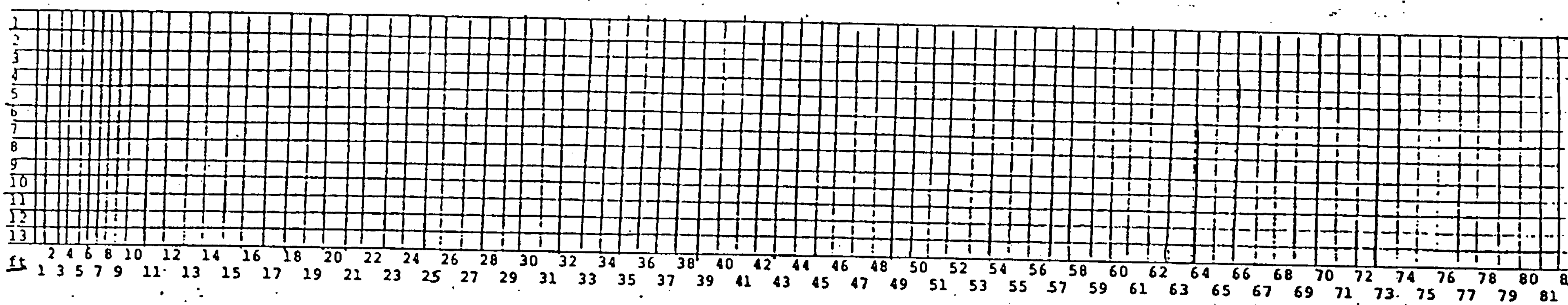
Type B Sites Only

Runoff Plots – Random Treatments



Type A and B ' Tes

SOIL AND VEGETATION SAMPLING:



Random sampling grid
for soil/veg subsamples.

Nelo
2/29/88

PROP 65 AMITROLE PROTOCOL

I. INTRODUCTION

Amitrole (3-amino-1,2,4-triazole, CAS 61-82-5) is one of several pesticides on the Governor's List for Prop 65 regulation. The literature provides conflicting information regarding its fate in soil and water with no information available on air concentrations. The Environmental Hazard Assessment Program (EHAP) of CDFA has undertaken this study to provide environmental fate information for typical amitrole usage patterns among several California soil types. Additionally, the procedures used during the design and execution of this study will be assessed for their appropriateness in performing future Safe Use Determinations as requested under Prop 65.

Technical amitrole is an off-white, coarse powder at room temperature with a vapor pressure of less than 1 x 10^{-5}mbar at 20^{o}C and a solubility of 280 g/l at 25^{o}C in water. Product formulations include wettable powders, dusts, and liquid concentrates containing from 1 to 90 percent active ingredient. Amitrole acts as a chlorophyll synthesis and enzymic process inhibitor. It is absorbed by leaf tissues and root systems of plants and translocated in both phloem and xylem. The use of amitrole in control of annual and perennial grasses, broadleaf weeds, and certain aquatic weeds in marshes and drainage ditches has been restricted by the EPA since 1986 to non-cropland areas only. Areas which allow the use of amitrole include: highway shoulders, rights-of-way, railroads, fencerows, industrial areas, parking lots, embankments, ditchbanks and drainage canal banks. Application methods include backpack sprayers, other handheld sprayers, and truck-mounted spray rigs for large areas.

Amitrol is applied year-round in California wih the most frequent applications taking place during March to June. The average application rate is between 2 and 4 pounds active ingredient in 100-150 gallons of water per acre.

References to the dissipation of amitrole in soils and water in the literature provide conflicting information on its longevity. Less than 1 to greater than 56-day half-lives have been reported in non-sterile aerobic soils. Although one study reported chemical processess (oxidative in nature) as a major breakdown factor, most studies support microbial action as the most important degradation pathway. Amitrol has been reported as both stable and non-persistent in water. Photolysis, hydrolysis and volatilization are not expected to be significant fate processes. Degradation has been found to be associated with temperature, moisture and clay content in some studies but not others.

II. OBJECTIVES

The objectives of this study are:

1. To quantify the concentration of amitrole found in soil, vegetation, air and water samples following a typical treatment for weed control in two different types of settings:

   Type A. Level surfaces with low potential for serious run-off problems. These sites include rights-of-way, highway shoulders, fencelines, industrial areas. (vegetation, air, and soil samples)

   Type B. Sloping surfaces with high potential for run-off problems. These sites include ditchbanks, irrigation canal banks, or any type of steep embankment which could allow the formation of runoff. (vegetation, air, soil and water samples)

2. To characterize soil dissipation rates over a 15-day period as a function of certain soil properties including but not limited to: organic content, soil type (texture analysis), and pH.

3. To quantify concentration rates in runoff (water and sediment fractions) created by simulated rainfall events within the Type B sites.

4. To determine concentrations in air and vegetation for a limited period of time after treatment which would represent the most likley period for health concerns.

5. To characterize groundwater contamination potential by collecting 10-ft deep soil cores at Type B sites and other sites of historical amitrole usage.

6. To assess the effectiveness of EHAP's generic protocol for SUD in implementing this study.

III. PERSONNEL

This study will be conducted by EHAP personnel under the overall supervision of Randy Segawa, Sr. EHS. Other key personnel include:

Project Leader: Bonnie Turner

Senior Staff Scientist: John Troiano/Lisa Ross

Study Design/Data Analysis: Margaret Bisbiglia

Field Sampling: Bonnie Turner

Lab Liaison/Quality Control: Nancy Miller

Agency and Public Contact: Madeline Ames

IV. STUDY PLAN/EXPERIMENTAL DESIGN

The following study plan is to be used as a preliminary estimate of the number of potential samples collected and sites to be treated during the project. The numbers may vary slightly due to various environ or administrative factors beyond our control.

After an initial survey of the 17 highest-use counties (based on 1 Pesticide Use Data Base information), Monterey, Solano and Merced counties were selected for further investigation as possible sites the study. Following site visits to each county, the choice of 4 study sites will be made after consideration of surface slope, soil type, ease of access, crew and spray rig availability, and other factors.

Media and No. of Samples: The following table presents the potentia number of samples for each medium to be collected during the study period.

Table 1. Number of Sampling Intervals, Samples and Treatments for Amitrol Study.

Sample	Sampling Interval (days post trmt)							No. of	Total No.
Medium	-1	0	+1	+2	+4	+8	+16	Treatments	Samples
Surface Soil	4	8	8	8	8	8	8	4	208
Subsurf Soil							18	4	72
Runoff	0	4	4	4	4	4	4	2	48
Air	2	5+5	5	5				4	88
Vegetation	2	6	6	3	3	3	3	4	104
Samples per Interval:	8	32	27	24	19	19	33	2-4	
								TOTAL:	520

Treatments: The total number of treatments will be categorized as follows:

Sandy Soil:

Type A Site - 1 treatment (soil,air,veg)

Type B Site - 1 treatment (soil,runoff,air,veg)

Clay/Organic Soil:

Type A Site - 1 treatment

Type B Site - 1 treatment

Pesticide Applications: Amitrole will be applied in wettable powder form (Amizol) at a rate of 4 lbs mixed in 100 gallons of water per acre treated. This rate represents the average high application rate according to our survey. Spray equipment and crews will be supplied locally by county personnel. At Type A sites, roadside applications will be made over an area approximately 8 ft wide by 1/4 mile long (1/4 acre). At Type B sites, a sloping bank of a dry irrigation canal or drainage ditch will be treated. The total area will be determined by site availability but will not exceed 1/4 acre.

Sampling Intervals: After background sampling is completed, samples will be collected on Day 0, 1, 2, 4, 8, and 16 for soil, runoff, and vegetation. Air samples will be collected during treatment, 1-hr post treatment, and on days 1 and 2 after treatment.

Additional measurements of the following parameters will be made either during field sampling or in the lab:

Soil:	wet weight, percent moisture, pH, texture analysis, percent organic matter
Runoff:	temperature and pH of sample
Air sampling:	maximum temperature during sampling period, barometric pressure, humidity, wind direction and speed, sampler position, sampling period length, sample air volume
Vegetation:	wet weight, dry weight, height, viability estimate

Statistical Methods:

Both linear and nonlinear regression techniques will be employed in the analysis of this nested 2 x 2 factorial repeated measures design. The following sources of variation will be considered for the linear model describing the soil and vegetation samples:

Source of Variation	Degrees of Freedom
Plot	P-1
Replication (Plot)	P(r-1)
Soil Type	SO-1
Slope Type	SL-1
Time	T-1
Soil x Time	(SO-1)(T-1)
Slope x Time	(SL-1)(T-1)
Soil x Slope	(SO-1)(SL-1)
Soil x Slope x Time	(SO-1)(SL-1)(T-1)
Residual	By subtraction
Corrected Total	(PxRxSxOxSLxT)-1

All analyses will be carried out using Type III Sums of Squares from the General Linear Model procedure in the SAS system. Contrasts will be used to explore linear and quadratic trends, if any, over time. Covariance matrices will be examined to determine if Huynh-Feldt (H-F) conditions are met, and if not, appropriate downward adjustments to degrees of freedom will be made. Air analyses will be conducted by a linear analyses only.

The nature of the degradation of amitrole under each soil and slope type combination will be explored using nonlinear regression analyses with a first order decay model of the functional form $f(t) = B_o e^{-B_1 t} + e$ being investigated. Hypothesis testing concerning parameters which arise from these nonlinear models will be compared using a weighted analysis of variance model with the weights being derived from the asymptotic covariance matrices from models fit to individual populations. The residual sums of squares will be obtained by pooling.

Following standard statistical practice, results will be declared statistically significant if the P value is less than or equal to .05. Results will be declared marginally significant if the corresponding P value is less than or equal to .10 but greater than .05 ($.05 < P \leq .10$).

V. SAMPLING METHODS

Soil: Surface soil samples will be collected using 6 cm diameter metal soil corers inserted to a depth of approximately 4 cm. Each sample will be a composite of 3 subcores selected randomly within the site. At Type B sites, samples will be collected from previously unwetted areas of the treatment site only. (See runoff sampling methods.) Soil samples will be frozen until analysis.

Subsurface soil samples will be collected using a truck-mounted drill rig fitted with a split barrel sampler. At each site, two cores will be drilled to a depth of ten feet. Samples will be collected at the following depths below surface: 6, 12, 20, 32, 46, 60, 80, 100 and 120 inches. Nine samples per core will be kept frozen until analysis. The corings will take place at the bottom of the 2 Type B site slopes (where a known amount of simulated rainfall has been applied over the 16-day period) and at two additional historical usage sites determined by county personnel interviews. No corings will be taken at the Type A sites (due to dry condition).

<u>Runoff:</u> After treatment at intervals listed in Table 1, artificial rainfall will be applied to the surface slope (Type B sites only) at a known rate (gpm). When sufficient water has been applied to a randomly selected sample plot (area=slope ht x 1.5 m length) to generate runoff at the bottom of the slope, the runoff will be collected by a piece of curved metal sheeting (similar to gutter pipe). The sheeting will run the entire length of the sample plot. Runoff will be poured from the sheeting into a 1-liter glass sample jar. A portion of each sample will be bottled separately for storage life QC tests. If sufficient sediment is collected within the runoff sample to warrant a separate

analysis, the runoff will be filtered and filtrate and sediment analyzed separately. Otherwise, only water samples will be analyzed. Four sample plots will be "watered" at each sampling interval. At subsequent intervals, new plots will be selected from areas of the treatment site which have not been previously wetted. This will give us an estimate of amitrol concentrations in runoff occurring over time post treatment. All water samples will be refrigerated until analysis.

Air: Two background air samples will be collected at each site prior to amitrole treatment. To determine air concentrations during treatment and immediately afterward, when gas phase or mists are most likely, 3 hi-vol samplers will be placed within the treatment area during the treatment period and for a 1-hour post treatment period. To determine off-target movement of amitrol, 2 hi-vol samplers will be positioned downwind < 10 m away from treatment site for the same sampling periods. XAD resin in glass jars placed at 3-5 ft above ground will be used to capture particulate and volatilized amitrol. At +1 and +2 days post treatment, sampling will be repeated at the same locations. Air samples will be kept frozen until analysis.

Vegetation: Samples will be collected from Type A and B sites at intervals noted in Table 1 and analyzed for total residues. Type B site vegetation samples will be collected from previously unwetted areas (see runoff samples) only. Each vegetation sample will consist of 3 subsamples collected randomly. Each subsample will consist of at least 3 whole plants (or > 30 g) cut at ground level and placed in glass containers with as little disturbance as possible. Samples will be kept frozen until analysis. Additional plant material will be collected for wet and dry weight measurements. This material will be used to relate amitrole residues to the entire site on a square meter basis.

VI> CHEMISTRY METHODS/QUALITY CONTROL

Analytical method development is ongoing at present and will include using a spectrophotometric/colorimetric method at an adsorption at 520 nm. Soil will be analyzed for aminotriazole and percent moisture with results reported in ppm on a dry weight basis. Water will be analyzed for aminotriazole with results reported in ppb. Vegetation will be analyzed for total aminotriazole with results reported in ug/sample. Air will be analyzed for aminotriazole with results reported in ug.

Method Validation: Five replicate spiked samples at each of 3 concentrations will be analyzed for each media (soil, water, vegetation, air).

Continuing Quality Control: One solvent blank, 1 matrix spike sample and 3 replicate injections for 1 positive sample will be analyzed with each set of samples. Ten percent of the samples collected will be split between and analyzed by two different laboratories.

VII. TIMETABLE

Field site selection:	February 23 - March 10.
Sampling Preparation:	March 1 - March 30
Sampling Period:	April 1 - May 1
Chemical Analysis:	April 10 - August 30
Physical Analyses:	May 1 - July 30
Data Analysis:	September 1 - October 15
Report Preparation:	October 1 - October 30
Final Report:	November 1

VIII. BUDGET

Field Personnel Requirements/Costs - Tens of Dollars
Travel Costs (Per Diem) - Hundreds of Dollars
Vehicular Requirements/Costs - Thousands of Dollars
Materials and Services - Millions of Dollars
Chemistry/QC Costs - Billions of Dollars

IX. REFERENCES

Milliken, G.A., and Johnson, D.E. 1984. Analysis of Messy Data Volume I: Designed Experiments. Belmont, California: Lifetime Learning Publications.

Anderson, V.L. and McLean, R.A. 1974. Design of Experiments: A Realistic Approach. New York: Marcel Dekker, Inc.

Milliken, G.A., and Debruin, R.L. (1978). A Procedure to Test Hypotheses for Nonlinear Models. Communications of Statistics: Theory and Methods, X, X- X.