Sh# 009001 EFGWB

DYNAMAC CORPORATION

LINDANE

Final Report

Task 1: Review and Evaluation of Individual Studies

Contract No. 68-01-6679

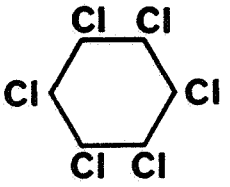
MAY 16, 1985

Submitted to:
Environmental Protection Agency
Arlington, VA 22202

Submitted by:
Dynamac Corporation
Enviro Control Division
The Dynamac Building
11140 Rockville Pike
Rockville, MD 20852

LINDANE

EXAGAMA, FORLIN, GALLOGAMA, GAMAPHEX, GAMMEX, INEXIT, ISOTOX, LINDAFOR, LINDAGRAIN, LINDALO, LINDAGRANOX, LINDAMUL, LINDAPOUDRE, LINDATERRA, NOVIGAM, SILVANOL



Gamma isomer of benzene hexachloride

Table of Contents

Study

CASE GS0315 LINDANE STUDY 1 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 05

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00103661 CONTENT CAT 01

Lichtenstein, E., K. Schulz, R. Skrentny, and Y. Tsukano. 1966. Toxicity and fate of insecticide residues in water: insecticide residues in water after direct application or by leaching of agricultural soil. Arch. Environ. Health 12(Feb): 199-212. Also In unpublished submission received Dec. 20, 1968, under 9F8785; submitted by Shell Chemical Co., Washington, DC; CDL:091349-T.

SUBST. CLASS = S.

DIRECT RVW TIME = 8 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T. Opeka DATE: Apr. 5, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSIONS:

Mobility - Leaching and Adsorption/Desorption

1. This portion of the study is scientifically valid.

2. Lindane (analytical grade, purity unspecified) was detected in the leachate from silt loam soil columns (height unspecified) eluted with >7 inches of water based on mosquito larvae bioassay and TLC tests.

3. This portion of the study does not fulfill EPA Data Requirements for Registering Pesticides because the concentration of lindane in leachate samples was not quantified, the leached soil column was not segmented and analyzed for lindane, complete soil characteristics were not specified, and the height of the soil column was not reported.

Metabolism - Aerobic Aquatic

This portion of the study is scientifically invalid because the sampling schedule was inadequate to accurately assess the degradation of the test substance. In addition, this portion of the study would not fulfill EPA Data Requirments for Registering Pesticides because the study was conducted in water only (Experiment 1), not water plus sediment as recommended; the formation and decline of degradation products was not addressed; a material balance was not determined; and the lake water, lake mud, soil, and test substance were not completely characterized.

MATERIALS AND METHODS:

Mobility - Leaching and Adsorption/Desorption

A sample of Carrington silt loam soil (soil not further characterized) was treated with lindane (analytical grade, purity and source unspecified) at 50 ppm. The lindane was applied in chloroform. Aliquots (400 g) of the treated soil were placed in each of seven glass containers (60-cm height x 7.7-cm diameter) on a previously washed 10-cm long filter of glass wool, silica sand, and gravel. Two pieces of filter paper were placed on top of each soil column to distribute elution water which was applied at one drop of water per 5 seconds. Two soil columns treated with chloroform without lindane served as controls. Two hundred and fifty milliliters of water were applied before water began eluting from the columns. Eleven 50-ml samples of leachate water were collected. The first leachate sample was discarded and the subsequent ten samples were analyzed for insecticidal lindane residues by using a mosquito bioassay. Ten third-instar larvae of Aedes aegypti were exposed directly to the leachate samples and mortality counts were conducted during a 24-hour period.

The soil columns were left undisturbed for 6 days, then leached with an additional 400 ml of water. Lindane residues were determined in the leachate samples by using a mosquito bioassay as described previously. Portions of the leachate samples were extracted with redistilled chloroform, and dried with anhydrous sodium sulfate. The extracts were spotted on silica gel TLC plates for characterization. The TLC plates were developed with methanol:hexane (1:99). Quantification of lindane residues was based on the size and intensity of the spots isolated on the TLC plates.

Similar studies were performed with lindane applied at 200 ppm.

Metabolism - Aerobic Aquatic

Experiment 1

A volume of 1,200 ml of either lake water (collected prior to insecticidal treatment from the surface, near the shore of Lake Mendota,

Madison, WI) or soil water [60-510 ppm sodium, 10-18 ppm potassium, 4-24 ppm calcium, 7-47 ppm magnesium, and traces of phosphorus; generated from 3000 ml distilled water passed through a 45 x 7.5 cm (height x diameter) column of untreated Carrington silt loam soil (not further characterized)] was treated with lindane (analytical grade, purity and source not specified) at 1 ppm in acetone. The initial concentration of acetone in water never exceeded 1% in all experiments. After mixing and plugging the flasks with cotton they were incubated at 28 ± 1 C for up to 12 months. Water treated with acetone only served as the control. Distilled water (volume not specified) was added periodically to maintain a constant volume. Water samples were taken at 1, 3, 5, 7, and 12 months after treatment. After 5 and 7 months, water samples (30 ml) were extracted with a mixture of redistilled hexane and diethyl ether (1:1), dried with anhydrous sodium sulfate, and analyzed for lindane using GLC and TLC on silica gel plates.

Experiment 2

Fifty-grams of Carrington silt loam soil (20.1% moisture, soil not further characterized) were placed into flasks and 75 ml of water (uncharacterized) were then added. The same amount of water was also added to flasks without soil. Seventy-five milliliters of lindane (analytical grade, purity and source unspecified) treated water was added to all flasks to yield a concentration of 1 ppm. Lindane was first dissolved in acetone prior to water treatment. The flasks were closed with glass stoppers and maintained at room temperature (unspecified) for 7 days. After 7 days, all of the water (119-134 ml) standing above the soil (in flasks containing soil and water) was removed and an identical amount of water was removed from the flask containing water only. Water samples were analyzed by GLC as described in Experiment 1. Soil samples were extracted with redistilled benzene and redistilled acetone (4:1); the acetone was removed by washing the hexane-acetone mixtures with water, and the remaining liquid was analyzed by GLC.

Experiment 3

Water (120-ml aliquots, water characteristics unspecified) was treated with lindane (analytical grade, purity and source unspecified) at 1 ppm in actone, and placed into flasks containing 13.8 g of dry silica sand, 9.4 g of dried lake mud (obtained from the bottom of Lake Mendota in Madison, WI., at a depth of ~40 feet; mud not further characterized) or water only. Three replicates were run. The flasks were closed with glass stoppers and maintained at room temperature (unspecified) for 7 days. After 7 days the upper 50-ml water layer was removed, extracted with hexane, and the extracts analyzed for lindane by GLC. The flasks were then centrifuged and the supernatant removed and extracted with hexane. The precipitate ("soil plus water or drops of water where soil was absent") and acetone rinsings of the flasks were combined and extracted. All fractions were analyzed by GLC.

Similar tests were conducted with water treated with lindane at 0.2 ppm. In addition, the total volume of water or water and soil was centrifuged after 7-day holding period.

Experiment 4

An experiment with lake mud (4.7 g) similar to the one described in Experiment 3 was conducted except that buffer solutions were used to adjust the pH to 5, 7, and 9. Two replicates were run. Lindane (analytical grade, purity and source unspecified) was applied at 1 ppm to the water and the flasks were plugged with cotton and maintained at 25 ± 1 C for 7 or 14 days. The samples were centrifuged and analyzed for lindane by GLC as described previously.

REPORTED RESULTS:

Mobility - Leaching and Adsorption/Desorption

Insecticidal lindane residues were detected in the second through the eleventh 50-ml aliquot of eluate collected from the soil columns treated with lindane at 50 ppm. The twelfth 50-ml aliquot of leachate, collected following a 6-day aging period, also contained insecticidal residues. No insecticidal residues were detected in leachate samples collected from untreated (chloroform only) soil columns.

Results of TLC characterization of lindane residues in leachate samples after a 6-day aging period indicated ~1 ppm lindane.

When lindane was applied at 200 ppm, the mosquito mortality rates were higher in all leachate samples; however, no values were provided.

Metabolism - Aerobic Aquatic

Experiment 1

Lindane concentrations in lake water declined from 0.02 to 0.008 ppm at 5 and 7 months, respectively, after treatment with lindane at 1 ppm as determined by GLC. Results of GLC analysis of soil water found lindane concentrations of 0.27, 0.086, and 0.012 ppm at 5, 7, and 12 months, respectively, after treatment. Analysis by TLC at 7 months indicated the presence of lindane (R_f identical to reference grade compound) in both lake and soil water. Results of other analyses by TLC were not reported. The pH at 1 and 3 months after treatment was stable for both the lake and soil water (8.4-8.3 and 7.5-7.6, respectively).

Experiment 2

The concentration of lindane was essentially the same in the upper and lower water layers in the absence of soil after 7 days. However, the presence of soil reduced the concentration of lindane in the upper water layer ~50%.

Experiment 3

The concentration of lindane was essentially the same in the upper and lower water layers in the absence of sand or mud after 7 days. Lindane was not adsorbed (3% of recovered) onto the sand but was adsorbed onto the mud (90% of recovered). Lindane was fairly stable in water alone or water and sand with 104 and 102% of applied recovered, respectively, after 7 days. Only 24% of the applied lindane was recovered in the water and mud treatment after 7 days.

Results were similar for the 0.2 ppm lindane treated samples.

Experiment 4

Lindane was more stable in water with 4.7 g of mud than in water with 9.4 g of mud (Experiment 3). Approximately 80% of the applied lindane was recovered at all pHs (5, 7, and 9) after 7 days. After 14 days, <50% of the applied lindane was recovered at pH 7 and 9, while ~87% of the applied lindane was recovered at pH 5. The buffer solution adjusted to pH 5 increased to 6.1 over the 14-day test period. The percent of recovered lindane in the supernatant was the same at all pHs.

DISCUSSION:

General

1. Soil characteristics, such as pH, textural analysis, organic matter content, and CEC, were not provided.

2. The purity of the test substance was not specified.

Mobility - Leaching and Adsorption/Desorption

1. Although a nonspecific mosquito bioassay was used, residues in the leachate were characterized by TLC.

2. The soil columns were not divided into increments and analyzed for lindane; only leachate samples were collected for analysis.

3. The first 50-ml leachate sample was discarded and not analyzed for lindane residues.

4. The height of soil in the columns was not reported.

5. It could not be determined whether the chloroform was evaporated from the soil columns prior to elution of the columns with water.

Metabolism - Aerobic Aquatic (All Experiments)

1. Experiment 1 was conducted on water only, not on water plus sediment as recommended.

2. The sampling schedule was inadequate to accurately assess the degradation of the test substance.

3. The formation and decline of degradation products of the test substance was not addressed.

4. A material balance was not provided.

5. The lake water, lake mud, and soil were not characterized.

6. The volume of water added to the flasks over the 12 month test period to maintain a constant volume was not reported (Experiment 1).

7. Detection limits and recovery values for the GLC method were not provided.

CASE GS0315 LINDANE STUDY 2 PM PP# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 050530 GUIDELINE 40 CFR 163.62-10b

FORMULATION 06 - WETTABLE POWDER (WP OR W)

FICHE/MASTER ID 00096968 CONTENT CAT 02

Foschi, S., A. Cesari, I. Ponti, P.G. Bentivogli, and A. Bencivelli. 1970. Investigation into degradation and vertical movement of agricultural chemicals in soil. A translation of: without title. Notiz. Mal. Piante 82(37):?. Unpublished study received May 30, 1978 under 289-2211; submitted by Chevron Chemical Co., Richmond, CA; CDL:234046-G.

SUBST. CLASS = S.

DIRECT RVW TIME = 3 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T. Opeka DATE: Mar. 26, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSION:

Mobility - Leaching and Adsorption/Desorption

This study cannot be validated because the experimental procedures and protocols were inadequately described (e.g., method of treatment and treatment level were not reported). In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because the test substance used was not technical grade or purer and the soil extraction procedure, recovery values, and limit of detection were not reported.

MATERIALS AND METHODS:

Sandy clay loam soil (49% sand, 22% loam, 29% clay, pH 8.0, 1.5% organic matter) was placed in a column (52-mm diameter) to a height of 60-cm. The soil was treated (method and rate of treatment unspecified) with lindane (WP, purity and source unspecified) and the column was then leached with a quantity of water corresponding to 900 mm/cm^2 (~35.4 inches) over a 15-day period in a greenhouse at 26 C. After leaching, lindane residues were determined in the 0- to 5-, 5- to 20-, 20- to 40-, and 40- to 60-cm soil segments and in the column eluate using a GC equipped with an electron-capture detector.

REPORTED RESULTS:

After leaching with ~35.4 inches of water over 15 days, lindane residues of 3.57, 0.86, and 0.04 ppm were detected in the 0- to 5-, 5- to 20-, and 20- to 40-cm column segments, respectively. Lindane residues were not detected in the 40- to 60-cm segment or in the column leachate.

DISCUSSION:

1. The method of treatment (surface applied or soil incorporated in upper layer) and treatment level were not reported.

2. The test substance was a formulated end-use product.

3. The soil extraction procedure, recovery values, and detection limit for the analytical method were not reported.

4. The type of column (i.e., glass, plastic, metal) used was not reported.

5. Untreated soils (controls) were not assayed for lindane.

CASE GS0315 LINDANE STUDY 3 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 101050

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00101692 CONTENT CAT 01

Johnston, W.R., F.T. Ittihadieh, K.R. Craig, and A.F. Pillsbury. 1967. Insecticides in tile drainage effluent. Water Resour. Res. 3(2):525-537. Also In unpublished submission received Sep. 8, 1970 under unknown admin. no.; submitted by American Cyanamid Co., Princeton, NJ; CDL:120350-W.

SUBST. CLASS = S.

DIRECT RVW TIME = 6 1/2 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: TOpeka DATE: Apr. 18, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSION:

Mobility - Leaching and Adsorption/Desorption

This study cannot be validated because the description of the analytical methodologies and the data presented were inadequate to evaluate the leaching of lindane into drainage tiles. In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because the test substance was not characterized, more than one pesticide was applied to the test plot, the test method used was not one of the three recommended (soil column, soil TLC, or batch equilibrium), and soil characteristics were not provided.

MATERIALS AND METHODS:

A 100-acre plot was divided into three blocks, and seven parallel drain tile lines were installed into each block. The drain tile lines in Blocks A and B were 900 feet long, and the tile lines in Block C were 600 feet long. The average depth of all drain tiles was 6 feet, and each line discharged into an open drain. Block B was located between Blocks A and C. Block B was treated with DDT (test substance uncharacterized, source unspecified) at 2 lb ai/A and parathion (test substance uncharacterized, source unspecified) at 0.1 lb/A and the entire plot (Blocks A, B, and C) was flooded (Oct. 1963-Feb. 1964), allowed to drain, retreated with DDT at 4 lb ai/A and parathion at 0.2 lb ai/A, reflooded (July-Oct. 1964), and allowed to drain. Before the third flooding (May-Sep. 1965), during which time rice was grown on the entire plot, lindane (test substance uncharacterized, source unspecified) was applied to Block B at 3.3 lb/A. Soil samples were collected, from two locations 25 feet from every tile line, in increments to a depth of 12 feet using a 6-inch auger before and after each flooding. Drainage tile effluent water samples (4 gallon per Block; composite from all 7 drain lines in each Block) were collected and flow rates determined where the lines discharged into the open drain periodically over the study period. Flood water and tailwater effluent samples were also collected during the study.

Soil samples from each sampling depth were composited and extracted using the method of White (Insecticide analysis procedures used by Klamath Basin Study, Presented at the Pacific Northwest Pollution Control Association Meetings, Vancouver, B.C. Nov. 3-5, 1965). Soil extracts and water samples (drain tile effluent, flood water, and tailwater effluent) were analyzed for lindane using the microcoulometric GC method of Teasley and Cox (1963. J. Am. Water Works Assoc., p. 1093-1096).

REPORTED RESULTS:

The average depth of water drained through the soil and out of the tile lines was 1.19, 1.28, and 2.23 feet during the first, second, and third floodings, respectively.

Lindane was detected in every composite soil sample. Concentrations of lindane in soil were 2-14% of those found for DDT and/or DDD (no quantitative data were reported specifically for lindane).

No lindane was detected in tailwater effluent during the first and second floodings (Block A, 8/17/64; Block B, 11/5/63, 7/30/64, 8/3/10,17/64; Block C, 11/4/63). During the third flooding (5/20/65 to 9/20/65), lindane was detected at average concentrations of 215, 9233, and 55 ppt in Block A, Block B, and Block C, respectively. All tailwater samples collected during the third flooding, contained lindane. Lindane concentrations decreased from 62,000 to 160 ppt during the flooding period.

Lindane was detected at 10-20 ppt in 3 of 14 samples of flood water applied during the three flooding periods. Lindane was detected at an average of 834 ppt in tile drain effluent collected from the lindane-treated block (B) during the third flooding (Table 1).

DISCUSSION:

1. Soil characteristics, such as pH, textural analysis, organic matter content, and CEC, were not reported. Portions of the experimental site were described as fill areas. The fill material was not specified.

2. The lindane, DDT, and parathion were not characterized.

3. Meteorological data, such as temperature and rainfall amounts, were not provided.

4. More than one pesticide was applied to the test block, which may have affected the mobility of lindane in soil.

5. Precise application, flooding, and sampling dates could not be determined for all cases because some data were presented graphically.

6. Some data were presented as total chlorinated hydrocarbons, without specifying the portion (if any) represented by lindane residues. Therefore, only data specifically on lindane residues were included in this review.

7. The soil data presented were inadequate to confirm the application rate of lindane.

8. The analytical methodologies were not described. Therefore, the techniques employed to detect lindane at concentrations in the ppt range could not be evaluated and confirmed.

Table 1. Average concentration (ppt) of lindane detected in drain tile effluent.

Block	Flooding		
	1st	2nd	3rd
A	ND[b]	8	20
B	30	10	834
C	20	ND	ND

[a] Lindane applied at 3.3 lb/A to Block B prior to 3rd flooding.

[b] Not detected; detection limit not reported.

CASE GS0315 LINDANE STUDY 4 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 050530 GUIDELINE 40 CFR 163.62-10b

FORMULATION 12 - EMULSIFIABLE CONCENTRATE (EC OR E)

FICHE/MASTER ID 00103597 CONTENT CAT 01

Lichtenstein, E. 1958. Movement of insecticides in soils under leaching and non-leaching conditions. J. Econ. Entomol. 51 (June):380-383. Also In unpublished submission received Oct. 1, 1971 under 1F1070; submitted by Shell Chemical Co., Washington, DC; CDL:091958-AK.

SUBST. CLASS = S.

DIRECT RVW TIME = 6 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: TOpeka DATE: Apr. 17, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSION:

Mobility - Leaching and Adsorption/Desorption

The runoff portion of this study is scientifically invalid because non-treated areas downslope of lindane-treated areas were not sampled, the application rate and uniformity of the application technique were not confirmed by immediate posttreatment sampling, and the analytical method was referenced but not described. The portion of this study pertaining to leaching of lindane under field conditions cannot be validated because rainfall data were not reported, the data were reported as percent of recovered not as percent of applied, and the analytical method was referenced but not described. The soil column leaching portion of this study cannot be validated because the experimental design was inadequately described to permit evalution of lindane mobility in soil. In addition, some samples were contaminated with lindane residues. These studies would not satisfy EPA Data Requirements for Registering Pesticides because: runoff and leaching in the field studies field test data and complete soil characteristics were not provided, a nonspecific method was used, the test sub-

stance was not technical grade or purer, and the mobility of lindane was not determined under laboratory conditions using one of the three recommended methods (e.g., soil TLC, soil column, or adsorption/desorption). In the soil column study, complete soil characteristics were not reported, the test substance was not technical grade or purer, and a nonspecific method was used.

MATERIALS AND METHODS:

Field Studies

Field plots (100 x 29 feet) of Miami silt loam and muck soils (soils not further characterized) were treated with lindane (EC, purity and source unspecified) at 10 and 100 lb/A. Two-gallon quantities of the diluted lindane emulsion were spread evenly with a sprinkling can over successive 10 x 29 feet areas of each plot (100 x 29 feet). Lindane was incorporated to a depth of 4-5 inches using a rototiller immediately after treatment. Soil samples (49 soil cores, 0.75-inch diameter) were collected from depths of 0-3, 3-6, and 6-9 inches at 17 months post-treatment. The samples were extracted and analyzed for lindane residues using a referenced but not described, colorimetric method [Schechter and Haller. 1945. Ind. Eng. Chem. Anal. Ed. 17:704; Schechter and Hornstein. 1952. Anal. Chem. 24:544; O'Donnell et al. 1954. J. Agric. Food Chem. 2(11):573-80; Lichtenstein et al., 1956. J. Agric. Food Chem. 4(11):936].

Runoff of lindane residues was determined from some silt loam plots (15 and 5° slope). Three years after treatment (lindane at 10 and 100 lb/A) approximately 40 soil cores (sampling depth unspecified) were collected from both the upper and lower halves of each plot. The soil samples were analyzed for lindane residues as previously described.

Laboratory Study

One quart ice cream cartons with perforated bottoms were filled with five to seven cheesecloth separated layers of Plainfield sand, Miami silt loam, and muck soils (soils not further described). Lindane (test substance uncharacterized, source unspecified) was applied at 10 ppm to the two upper layers (150 g) of soil which were then placed onto three untreated layers of soil (150 g each). The columns were eluted with 100 ml of water per day for 0, 5, and 10 days. Four replicates were run. After 5 or 10 days the columns were sectioned and analyzed for lindane residues (method not reported).

REPORTED RESULTS:

Field Studies

Approximately 92-100% of the recovered lindane residues were detected in the upper 6 inches of silt loam and muck soils treated 17 months previously with lindane at 10 and 100 lb/A (Table 1).

Three years after treatment, the plot treated with lindane at 10 lb/A (15° slope) contained 2.13 times more lindane residues in the lower half (1.19 ppm), whereas the plot treated with lindane at 100 lb/A (5° slope), contained 1.47 times more lindane residues in the lower half (16.4 ppm) than in the upper half of the plot.

Laboratory Study

Lindane residues were slightly mobile in sand, silt loam, and muck soil columns (Table 2). No lindane residues were detected in the leachate from any soil column.

DISCUSSION:

Field Studies

1. The sampling protocol (e.g., 0-3, 3-6, 6-9 inches) was inappropriate because lindane was incorporated to a depth of 4-5 inches. Sampling depth for the runoff portion of the study was not reported.

2. Field test data such as depth to water table, meteorological data, and slope of all test sites, were not provided.

3. Data were presented as percent of recovered not as percent of applied.

4. The colorimetric method was referenced but not described.

5. Soil characteristics, such as pH, textural analysis, organic matter content, and CEC, were not provided.

Laboratory Study

1. The presence of lindane residues in the untreated muck soil segments of columns not eluted with water was not explained. Therefore, the presence of lindane residues below the treated segments in the muck soil columns eluted with water cannot be validated.

2. The dimensions of the soil columns were not reported; therefore, the distance moved by lindane residues and the amount of water applied (equivalent to acre-inches) could not be determined.

3. Soil characteristics, such as pH, textural analysis, organic matter content, and CEC, were not provided.

Table 1. Leaching of lindane residues (% recovered) under field conditions after 17 month posttreatment with lindane.

Soil type	Application rate (lb/A)	Sampling depth (inches) 0-3	3-6	6-9
Silt loam	10	96.0	4.0	0.0
Silt loam	100	87.7	10.0	2.3
Muck	10	62.3	29.4	8.3
Muck	100	69.8	24.3	5.9

Table 2. Distribution of lindane residues in soil columns treated with lindane at 10 ppm and eluted with 0-1000 ml of water.

Soil type	Days of watering (100 ml/day)	Treated segments		Untreated segments		
		1	2	3	4	5
		ppm				
Plainfield sand	0	9.65	9.15	0.00	0.00	0.00
	5	7.45	7.61	1.01	0.21	0.18
	10	6.62	7.98	1.31	0.14	0.06
Miami silt loam	0	10.10	9.52	0.27	0.00	0.00
	5	9.47	9.55	0.44	0.00	0.00
	10	7.48	7.44	0.57	0.08	0.08
Muck	0	10.55	10.50	0.80	0.16	0.14
	5	9.18	9.59	0.09	0.00	0.00
	10	9.17	8.88	0.15	0.05	0.07

CASE GS0315 LINDANE STUDY 5 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 050515

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00095246 CONTENT CAT 01

Kay, B.D., and D.E. Elrick. 1967. Adsorption and movement of lindane in soils. Soil Sci. 104(5):314-322. Also In unpublished submission received Nov. 14, 1977 under 464-448; submitted by Dow Chemcal U.S.A., Midland, MI; CDL:096642-H.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 1/2 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: TOpeka DATE: Apr. 22, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSIONS:

Mobility - Leaching and Adsorption/Desorption

1. This study is scientifically valid.

2. Lindane (test substance uncharacterized) was adsorbed to loamy sand, loam, sandy loam, and muck soils with K_d values of 17.3, 20.4, 22.7, and 368, respectively.

3. This study does not fulfill EPA Data Requirements for Registering Pesticides because the test substance was not characterized, the soils were incompletely characterized, and the study was conducted in water rather than a calcium ion solution.

MATERIALS AND METHODS:

Adsorption of lindane was determined in four soils (Table 1) by shaking 2-g aliquots of soil (oven dry weight, sieved to 1 mm) with 20-ml aqueous solutions containing varying concentrations of lindane (test substance uncharacterized, source unspecified) for 2 hours at 20.5 ± 0.5 C. The suspensions were centrifuged for 18 minutes at 0 C. The supernatant was removed, lindane was partitioned into hexane, quantified by electron-capture GC, and distribution coefficients (K_d) were calculated.

The equilibration period was determined by shaking 2-g soil samples with 20 ml of an aqueous solution containing lindane at 4 ppm and analyzing as described previously.

REPORTED RESULTS:

The equilibration period for the loam, loamy sand, and sandy loam soils was 2 hours; however, equilibrium was not attained in the muck soil after 10 hours.

The distribution coefficients (K_d) were 17.3, 20.4, 22.7, and 368 in loamy sand, loam, sandy loam, and muck soils, respectively (Table 1).

DISCUSSION:

1. The test substance was not characterized.

2. Soil characteristics, such as pH and CEC, were not provided.

3. Adsorption was determined in water rather than in a calcium ion solution.

4. The desorption of lindane was not addressed.

5. Recovery values and detection limits for the method were not reported.

Table 1. Soil characteristics and distribution coefficients.

Soil type	Organic matter	Sand	Silt	Clay	K_d[a]
	%				
Honeywood loam	3.56	51.10	41.42	7.48	20.4
Fox loamy sand	2.90	78.21	14.15	7.64	17.3
Brookston sandy loam	3.19	62.02	20.45	17.53	22.7
Muck	66	--	--	--	368

[a] $K_d = \frac{\text{pesticide adsorbed (µg/g of oven dry soil)}}{\text{pesticide in solution (µg/ml of solution)}}$

CASE GS0315 LINDANE STUDY 6 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 101520

FORMULATION 10 - IMPREGNATED MATERIALS

FICHE/MASTER ID 00117390 CONTENT CAT 02

Espoy, H. 1970. Determination of Lindane in air of a closed cabinet: Laboratory No. I 02692. Unpublished study received May 14, 1970 under 0H2545; prepared by Daylin Laboratories, Inc., submitted by Hazleton Laboratories, Inc., Falls Church, VA; CDL:221691-F.

SUBST. CLASS = S.

DIRECT RVW TIME = 2 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T. Opeka DATE: Apr. 11, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSIONS:

Mobility - Laboratory Volatility

1. This study is scientifically valid.

2. Lindane (test substance uncharacterized) volatilized (rate not determined) from lindane-treated paper at 24 C.

3. This study does not fulfill EPA Data Requirements for Registering Pesticides because the test substance was uncharacterized, the application rate was unspecified, and the experimental design was inappropriate for establishing the rate of volatilization of lindane from treated surfaces.

MATERIALS AND METHODS:

Paper impregnated with lindane (test substance uncharacterized, source unspecified) at 31 mg/ft^2 was placed on a shelf in an overhead wooden cabinet with double doors. The dimensions of the cabinet were 18.5 x 39.5 x 12 inches. A small hole was made in the bottom of the cabinet and sealed with a stopper. The doors were closed during the test period. The temperature was maintained at 24 ± 1 C. After 28 hours and 8 days the stopper was removed and 2.5 l of air were drawn through 15 ml of benzene. The benzene trapping solutions were evaporated to 10 ml and lindane concentrations determined by using a GC equipped with an electron-capture detector.

REPORTED RESULTS:

The concentration of lindane in air after 28 hours and 8 days was 0.031 µg/g (0.040 µg/l) and 0.028 µg/g (0.036 µg/l), respectively.

DISCUSSION:

1. The trapping efficiency of the benzene were not reported.

2. The test substance was not characterized.

3. The application rate to the cabinet was unspecified because the area of treated paper used could not be determined.

4. Recovery values and detection limits for the GC method were not reported.

5. The experimental design was inappropriate for the determination of lindane volatilization from treated surfaces. The design of this experiment attempted to determine the equilibrium concentration of lindane in the air of a closed cabinet treated with an unspecified amount of lindane.

CASE GS0315 LINDANE STUDY 7 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 05

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00090826 CONTENT CAT 01

Lichtenstein, E.P., and K.R. Schulz. 1970. Volatilization of insecticides from various substrates. J. Agric. Food Chem. 18(5):814-818. Also In unpublished submission received Nov. 1, 1971 under 0F0960; submitted by Stauffer Chemical Co., Richmond, CA; CDL:094505-E.

SUBST. CLASS = S.

DIRECT RVW TIME = 4 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T. Opeka DATE: Mar. 26, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSION:

Mobility - Laboratory Volatility

This study is scientifically invalid because the sampling protocol was inadequate to accurately assess the volatility of lindane and insufficient raw data were reported to support the conclusions. In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because the test substance was not a typical end-use product, the soil was not characterized, volatility and air concentrations were not reported, the concentration in air was not monitored continuously, and a nonspecific bioassay was used.

MATERIALS AND METHODS:

Experiment 1

Seven substrates (Table 1), including silt loam soil (uncharacterized), were measured into flasks (50 ml), then treated with 25 µg of [^{14}C]-lindane (analytical grade, specific activity and purity unspecified, Amersham/Searle) in 25 µl of ethanol. To improve distribution of the lindane in the solid substrates, 1 ml of diethyl ether was added to both the soil and the glass bead substrates. The ether was evaporated at 50 C and vapor traps were placed on each sample. The vapor traps consisted of plugs of glass wool (0.5 g) saturated with 5% corn oil in hexane,, which were placed inside glass test tubes which fit over the incubation flasks. The flasks were sealed, and shaken 24 hours at 30 C. The vapor traps were extracted with two 10 ml portions of hexane and the extracts were analyzed by LSC and GLC. The soil-water substrate was analyzed for total radioactivity.

Experiment 2

Five milliliters of soil-water (Table 1) were treated with 50 µg of [^{14}C]lindane in 50 µl of ethanol. Cages containing 50 3-day old drosophila flies were suspended 2- to 3-mm above the water surface. Controls were conducted with soil-water that had been treated with ethanol only. The containers were maintained at room temperature and mortality counts were taken periodically over 24 hours.

REPORTED RESULTS:

Experiment 1

[^{14}C]Lindane volatilization from tap and soil-water was 16.4 and 11.5% of the applied, respectively, while 15.7% volatilized from the buffer solution after 24 hours of incubation (Table 1). Volatilization was 0.92% and 1.35% from the soil and glass beads, respectively. Addition of the LAS to the buffer solution decreased volatilization to 9.50% while addition to the soil had no appreciable effect (0.98%).

Experiment 2

After 3 hours of exposure to lindane vapors, 97% mortality of the flies was observed. Approximately 2 hours were required to cause 90% mortality.

DISCUSSION:

General

1. Soil characteristics, such as textural analysis, pH, organic matter content, and CEC, were not provided. In addition, soil adsorption coefficient (K_d) were not reported.

2. The detection limit and recovery from fortified samples were not reported.

3. Volatility ($\mu g/cm^2/hr$), air concentration ($\mu g/m^3$) and relative humidity within the sampling chamber were not reported.

4. The test substance was not a typical end-use product.

Experiment 1

1. A single 24 hour sampling is inadequate to assess the volatility of lindane. Monitoring should be conducted continuously or at intervals until a decline curve is established.

2. The diethyl ether was evaporated at 50 C prior to the attachment of the vapor traps. It was not determined how much of the lindane evaporated with the ether, and no soil samples were analyzed to confirm the concentration of lindane at the start of the study.

3. The trapping efficiency of the glass wool-corn oil-hexane plugs was not specified.

Experiment 2

1. A nonspecific bioassay was used to determine volatility of lindane.

2. A standard curve was not developed to relate the concentration of lindane in the air to the observed fly mortality.

3. Data were provided only from the 2- and 3-hour intervals.

Table 1. Volatilization of [^{14}C] lindane from various substrates at 30 C.

Substrate	Sample size	Method	Percent of applied
150 µ glass beads	3 g	LSC GLC	1.35 ± 0.40 9.80
Silt loam soil[b]	2 g	LSC GLC	0.92 ± 0.03 0.65
Silt loam soil + 0.1% LAS[c]	2 g	LSC GLC	0.98 ± 0.17 0.73
Tap water	2 ml	LSC GLC	16.4 ± 0.06 10.4
Silt loam soil water[d]	2 ml	LSC GLC	11.5 ± 0.60 11.0
Buffer solution[e]	2 ml	LSC GLC	15.7 ± 1.10 12.5
Buffer solution + 0.1% LAS	2 ml	LSC GLC	9.50 ± 0.30 5.40

[a] Detection limits were not reported.

[b] The soil was not further characterized.

[c] LAS consisted of 92% linear alkyl benzene sulfonate, 7% sodium sulfate, and 0.5 to 1.0% moisture.

[d] This substrate was obtained by mixing 250 g of silt loam soil with 1 l of tap water for 5 minutes, allowing it to settle for 18 hours and decanting the liquid.

[e] Sodium phosphate buffer, 0.1 M, pH 7.0.

CASE GS0315 LINDANE STUDY 8 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 100520

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00066550 CONTENT CAT 02

Velsicol Chemical Corporation. 1958. Residue data on soil and turf. Compilation; unpublished study received Apr. 17, 1959 under unknown admin. no.; CDL:228294-A.

SUBST. CLASS = S.

DIRECT RVW TIME = 3 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T. Opeka DATE: Apr. 12, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSIONS:

Field Dissipation - Terrestrial

This study is scientifically invalid because the sampling schedule was inadequate to accurately assess lindane dissipation from soil and the analytical methodology was insufficiently described. In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because the test substance was uncharacterized, field test data were incompletely reported, a nonspecific method was used, the patterns of formation and decline of degradates were not determined, immediate posttreatment soil samples were not analyzed to confirm lindane application rates, the soils were not characterized, and lindane was not applied at the highest registered rate.

MATERIALS AND METHODS:

Lindane (test substance uncharacterized, source unspecified) was applied as a spray at ~1.0 lb/A once a year for 5 years (1952-1956) to field plots (136 x 20 ft) in Riverside, California. The soil (characteristics unspecified) was disced to a depth of 6 inches. Four replicates were run. Soil samples (depth unspecified) were collected in the spring and/or fall starting in 1953 through 1958. Lindane residues in samples were determined by chemical analysis for organic chloride using the combustion technique (methodology not further described). Lindane residues were calculated by subtracting the amount of organic chloride found in untreated soil samples from that in the treated soil samples then dividing this figure by the percent organic chloride of lindane.

In a similar experiment, lindane (test substance uncharacterized, source unspecified) was applied at ~1.0 lb/A/yr for 5 years (1953-1957) to field plots (103.75 x 21 ft) in Riverside, California. Five replicates were run. Soil samples (depth unspecified) were collected in the fall starting in 1954 through 1958 and analyzed as described in Experiment 1.

REPORTED RESULTS:

Lindane residues did not build up in soil treated once a year for 5 years with lindane at ~1.0 lb/A.

DISCUSSION:

1. Field test data, including depth to water table, slope of test sites, meteorological data, and cultural practices during the experimental period, were not reported.

2. Soil characteristics, such as textural analysis, pH, organic matter, and CEC, were not provided.

3. The soil sampling schedule (1 or 2 samples per year) was inadequate to establish the dissipation rate of lindane from soil. Immediate posttreatment samples were not analyzed to confirm application rates and soil sampling depths were not reported.

4. The test substance was not characterized and was not applied at the highest registered rate.

5. The analytical method was nonspecific and insufficiently detailed (extraction procedure, detection limit, and recovery values not provided).

Table 1. Lindane residues in soil after repeated application.

Application date	Application rate (lb/A)	Sampling date	Lindane residues (ppm)
		Experiment 1	
9/25/52	1.0	Fall 1953	0
11/3/53	1.0	Fall 1954	0.3
11/4/54	1.0	Spring 1955	0
		Fall 1955	0
10/27/55	1.1	Spring 1956	0
		Fall 1956	0.1
10/8/56	1.1	Fall 1957	0
		1958[a]	0
		Experiment 2	
10/20/53	0.94	Fall 1954	0
10/6/54	1.0	Fall 1955	0.1
10/25/55	1.04	Fall 1956	0
9/18/56	1.0	Fall 1957	0.1
9/18/57	1.0	Fall 1958	0.3

[a] Time of year unspecified.

CASE GS0315 LINDANE STUDY 9 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 050530

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00070305 CONTENT CAT 01

Bess, H.A. and J.W. Hylin. 1970. Persistence of termiticides in Hawaiian soils. J. Econ. Entomol. 63(2):633-638. Also In unpublished submission received June 26, 1978 under 373-26; submitted by Residex Corp., Clark, NJ; CDL:231988-B.

SUBST. CLASS = S.

DIRECT RVW TIME = 7 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T. Opeka DATE: Apr. 15, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSION:

Field Dissipation - Terrestrial

This study is scientifically invalid because the test site was contaminated with lindane and six other pesticides at the end of the experiment. In addition, this study would not satisfy EPA Data Requirements for Registering Pesticides because the test substance was uncharacterized, field test data were not reported, complete soil characteristics were not provided, the sampling protocol and analytical methods were incompletely described, and the pattern of formation and decline of degradates was not determined.

MATERIALS AND METHODS:

Field plots were established in Hawaii by treating crushed coral (pH 8.3, >90% calcium carbonate), Catano loamy sand (pH 7.6, coral sand), and Waimanalo silty clay (pH 7.2, montmorillinite clay) soil samples with a 0.2 and 0.8% lindane (test substance uncharacterized, source unspecified) emulsion-water mixture at 1.5 l/ft^3 of soil (equivalent to 291 and 1,165 lb ai/12-in A). The soils were not further described. The treated soil samples were used to fill holes in the field that were 20 inches in diameter and 12 inches deep, spaced 9 feet apart. Each treatment was replicated five times and conducted for 7 years (1958-1965). Samples were collected annually in November from below the 6-inch depth and bioassay tests using 15 or 25 large nymphs or workers of G. formosanus (termite) were performed. The termites were exposed to the treated samples for 5 days and mortality counts were done. Samples were also analyzed by using GC equipped with an electron capture detector. The presence of pesticides in all samples was confirmed by GC with microcoulometric detection and TLC.

Additional samples, included in this experiment, were treated with aldrin, chlordane, DDT, dieldrin, heptachlor expoxide, and heptachlor.

REPORTED RESULTS:

The experimental site received an average of 45 inches of rainfall per year (no other meteorological data provided).

Following application of lindane at 72-402 ppm to three soils, lindane concentrations declined to 0.33-0.90 ppm over a 7-year period (Table 1). Insecticidal residues also persisted for 7 years.

At the end of the 7-year period all plots were found to be contaminated with aldrin, chlordane, DDT, dieldrin, heptachlor epoxide, heptachlor, and lindane at concentrations ranging from 0.08 to 0.59 ppm (average of 0.34 ppm). More specifically, in the plots not treated with lindane, lindane was detected at concentrations ranging from 0.22 ± 0.09 ppm to 0.53 ± 0.24 ppm.

DISCUSSION:

1. Field test data, such as slope of the test site, depth to water table, and complete meteorological data, were not provided. The rainfall data presented apparently represented averages for the general area and were not measured on site of the experiment.

2. The test substance was not characterized and complete soil characteristics were not provided.

3. The application rate was reported as a volume of solution per cubic foot of soil, pounds of active ingredient per 12-inch-acre, and ppm. It was not stated whether the application rates (ppm) presented in Table 1 were measured or calculated values.

4. The soil sampling protocol and analytical methods were insufficiently described. Extraction procedures, recovery values, detection limits, and solvent systems (TLC) were not reported. One detection limit was reported; however, it could not be determined which method it referred to.

5. The plots were contaminated with seven pesticides including lindane at the end of the experiment (7 years posttreatment). Because the nonlindane-treated plots were contaminated with lindane at 0.22 ± 0.09 to 0.53 ± 0.24 ppm (well within the range of lindane concentrations detected in the lindane-treated plots), the decline of lindane in soil cannot be determined.

6. Lindane concentrations determined by GC analysis were only presented for the 7-year posttreatment sampling interval. It was unclear whether the year 1 values were measured or calculated.

Table 1. Persistence of lindane and its insecticidal residues at 7 years posttreatment with lindane.

Soil type	Application rate (ppm)	Amount found (ppm)[a]	Percent mortality
Coral	286	0.22-0.77(0.44)[b]	0-100(53)
	72	0.25-0.43(0.33)	0-20(4)
Sandy loam	379	0.41-0.85(0.66)	0-100(40)
	95	0.30-0.56(0.45)	10-100(23)
Clay	402	0.68-1.13(0.90)	0-100(27)
	101	0.53-0.81(0.54)	0-100(5)
Controls[c]	Water only	--[d]	0-1(1)

[a] Detection limit 0.1 ppm.

[b] Average value in parentheses.

[c] All soils.

[d] Data not reported.

CASE GS0315 LINDANE STUDY 10 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 1005

FORMULATION 90 - FORMULATION NOT IDENTIFICATION

FICHE/MASTER ID 00025702 CONTENT CAT 01

U.S. Agricultural Research Service, Plant Pest Control Division. 1966. Monitoring Agricultural Pesticide Residues: A preliminary report of studies on soil, sediment, and water in Mississippi River Delta. U.S. ARS. (ARS 81-13; also In unpublished submission received Nov. 5, 1970 under 1F1060; submitted by Velsicol Chemical Corp., Chicago, IL; CDL:099195-BC.

SUBST. CLASS = S.

DIRECT RVW TIME = 11 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: TOpeka DATE: Apr. 23, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSIONS:

Field Dissipation - Terrestrial

1. This monitoring study is scientifically valid.

2. Lindane was detected (average monthly concentrations from May 1964 to February 1965 at 10 sites in Mississippi and Arkansas) in soil at <0.23 ppm (~6% of 974 samples) and in sediment at <0.04 ppm (~4% of 417 samples). Respective values for surface water (ponds and streams), runoff, and well water were <0.56 ppb (~37% of 67 samples), <0.08 ppb (~29% of 17 samples), and <0.23 ppb (<5% of 205 wells). Lindane was detected both at sites with and without known histories of lindane application.

3. This study does not fulfill EPA Data Requirements for Registering Pesticides because the test substance was uncharacterized, the soils were incompletely characterized, application rates were not confirmed, the sampling protocol was inadequate to establish a decline curve for lindane, the pattern of formation and decline of degradates was not determined, and more than one pesticide was applied.

MATERIALS AND METHODS:

A monitoring study was conducted in the Mississippi River Delta between May 1964 and February 1965. Soil, sediment, and water samples were collected monthly from 10 study areas described in Figures 1-10 and Table 1. The history of lindane use was obtained (where possible) for each study area through detailed studies of pesticide use patterns on each of the areas. The cumulative amounts of lindane applied were obtained in pounds per acre from treatment records on each field or block. Not all of the fields or blocks were treated in any 1 year; however, owing to crop rotation or other factors, all fields may have received one or more treatments over the period indicated. Cumulative totals per acre are based, therefore, on the total treated cropland acreage. This gives a basis for comparing average amounts of residues found in treated cropland with cumulative input of pesticides. In this study, 1 part per million equals approximately 1 pound per 3-inch acre. Meteorological data are presented in Table 2.

Sampling Procedures

Two soil samples were taken per block at each sampling. Block size, depending upon cropping practices in an area, varied considerably. One sample was taken along a line diagonally across the block, the other sample along the other diagonal of the block at an angle to the path taken by applicators during pesticide treatment. A soil corer, 2 inches in diameter, was used to collect the samples. The separate cores were spaced equidistant along the diagonals without actual measurement. Each sample consisted of 25 cores taken to a depth of 3 inches each. The composited cores were passed twice through a 1/4-inch screen to insure thorough mixing and to remove stones, roots, twigs, and grass.

Two water (ponds, streams, other surface source) samples were taken in each scheduled sampling period. The area to be sampled was divided into halves and a sample taken from near the mid-point of each half. A boat was used as required; otherwise, the sample was taken from the bank or by wading. In each case, a representative sample was collected.

Subsurface water samples were collected by using a hand pump with a hose connection to draw subsurface water from a pond or stream directly into the sample bottle, a 5-gallon carboy. This was a two-man operation--one man held the suction hose of the hand pump and gradually moved it back and forth with the intake a few inches below the surface, the other man operated the pump and directed the outlet into the sample bottle. To obtain a bottom sample, the pump sample hose was fastened to a pole long enough to reach the bottom. The inlet of the hose was fastened 1 foot from the bottom of the pole. As one man operated the pump, the other slowly moved the pole along the bottom. A certain amount of silt was stirred up in this operation and found

its way into the sample bottle. However, before extraction for analysis, the sample was decanted into a clean container.

Surface water samples were collected by using a flat scoop. The surface of the pond or stream was skimmed at representative points. Sampling was carried on until a 5-gallon composite sample was obtained.

One composite 5-gallon carboy sample was taken from wells in each area at each sampling period. Where more than five wells existed in the area, sampling was limited to that number.

Sediment samples were collected by using a soil corer, 2 inches in diameter. The soil corer, 18 inches in length, was driven into the bottom far enough to just reach solid earth. The core was emptied into a collecting container. A sample consisted of twenty-five 2-inch diameter cores of sediment collected at random over the water source. After all the cores were taken and the water decanted, a stick or dowel was used to completely mix the sediment in the sampling container.

Chemical Analysis

Soil samples (300 g, dry weight) were extracted with 600 ml of a 3:1 hexane:isopropanol solution by concentric rotation at 30 rpm for 4 hours. After setting, ~200 ml of solution was filtered into a separatory funnel, washed twice with distilled water, (discarding the water washings), and analyzed for lindane by electron-capture GC. Sediment samples were analyzed similarly except that anhydrous sodium sulfate was added after the addition of the hexane:isopropanol solution. Detection limits for soil and sediment were set as follows: concentrations of <0.1 ppm but >0.05 ppm were reported as 0.08 ppm, and concentrations of <0.05 ppm were not reported. The analytical results were not corrected for recovery. Recovery values were not provided.

Water samples (5-gallon) were extracted with 1-l of a 3:1 pentane: ether solution by rotating at 30 rpm for 20 minutes. The solution was then decanted to a flask, concentrated to 10 ml, and a 5-µl aliquot analyzed for lindane by electron-capture GC. The detection limit was reported as 0.08 ppb if <0.1 ppb, and values <0.05 ppb were not reported. The analytical results were not corrected for recovery. Recovery values were not provided.

REPORTED RESULTS:

Average monthly lindane concentrations in soil and sediment ranged from non-detectable (ND) to 0.23 ppm and ND to 0.04 ppm, respectively (Tables 3 and 4). Average monthly, lindane concentrations in well water, surface water, and runoff ranged from ND to 0.23 ppb, ND to 0.56 ppb, and ND to 0.08 ppb, respectively (Table 5).

DISCUSSION:

1. Soil characteristics, such as pH, textural analysis, organic matter content, and CEC were not provided.

2. The test substance was uncharacterized.

3. Because this was a monitoring study, application rates were not confirmed, the sampling protocols were inadequate to establish a decline curve for lindane, and the formation and decline of its degradation products was not determined.

4. Recovery values were not provided and analytical results were not corrected for recovery values. It was reported that if corrected, the values would be substantially higher.

5. Water and sediment characteristics were not reported.

6. More than one pesticide was applied to the study areas and may have affected the dissipation of lindane.

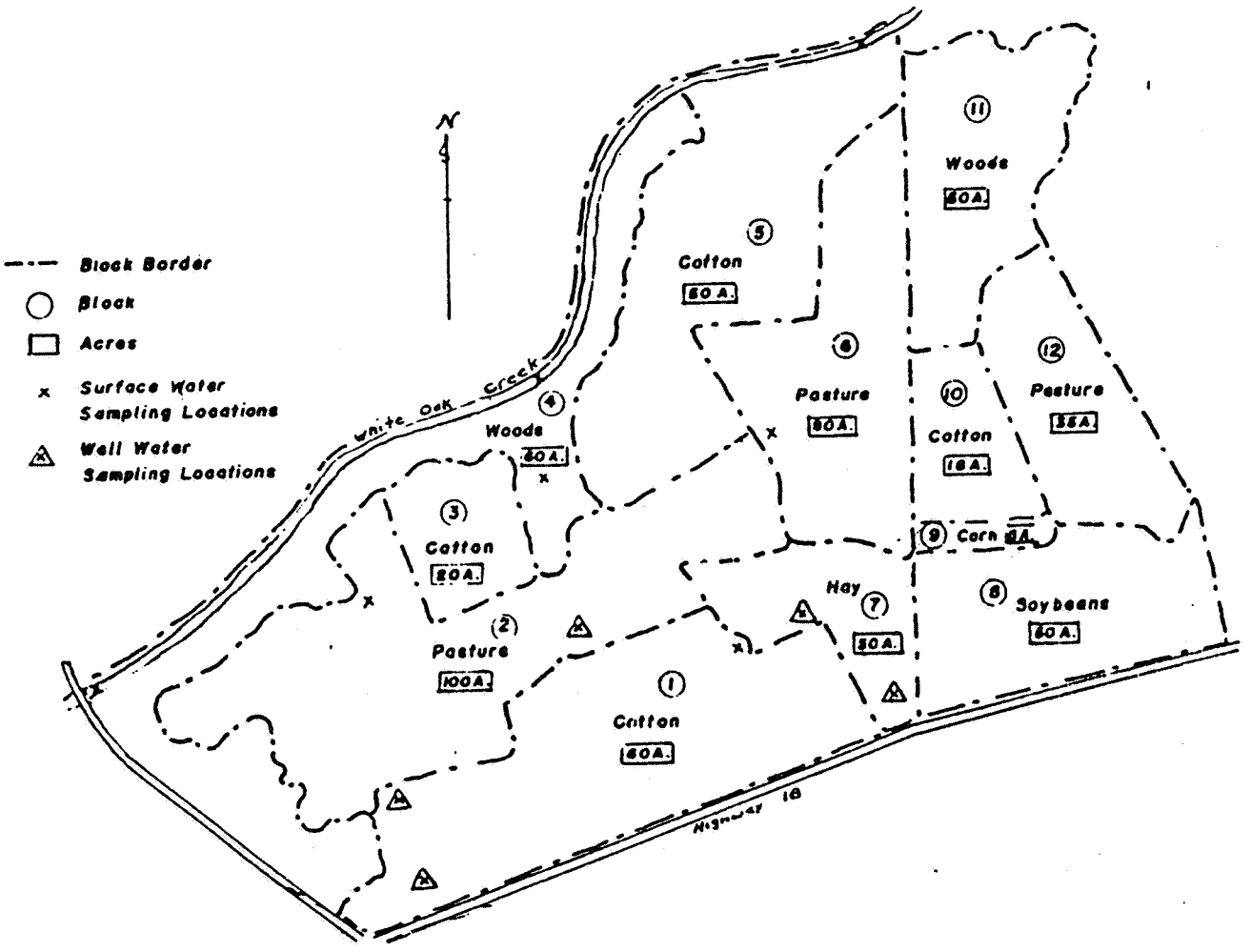


Figure 1. Study area CHA.

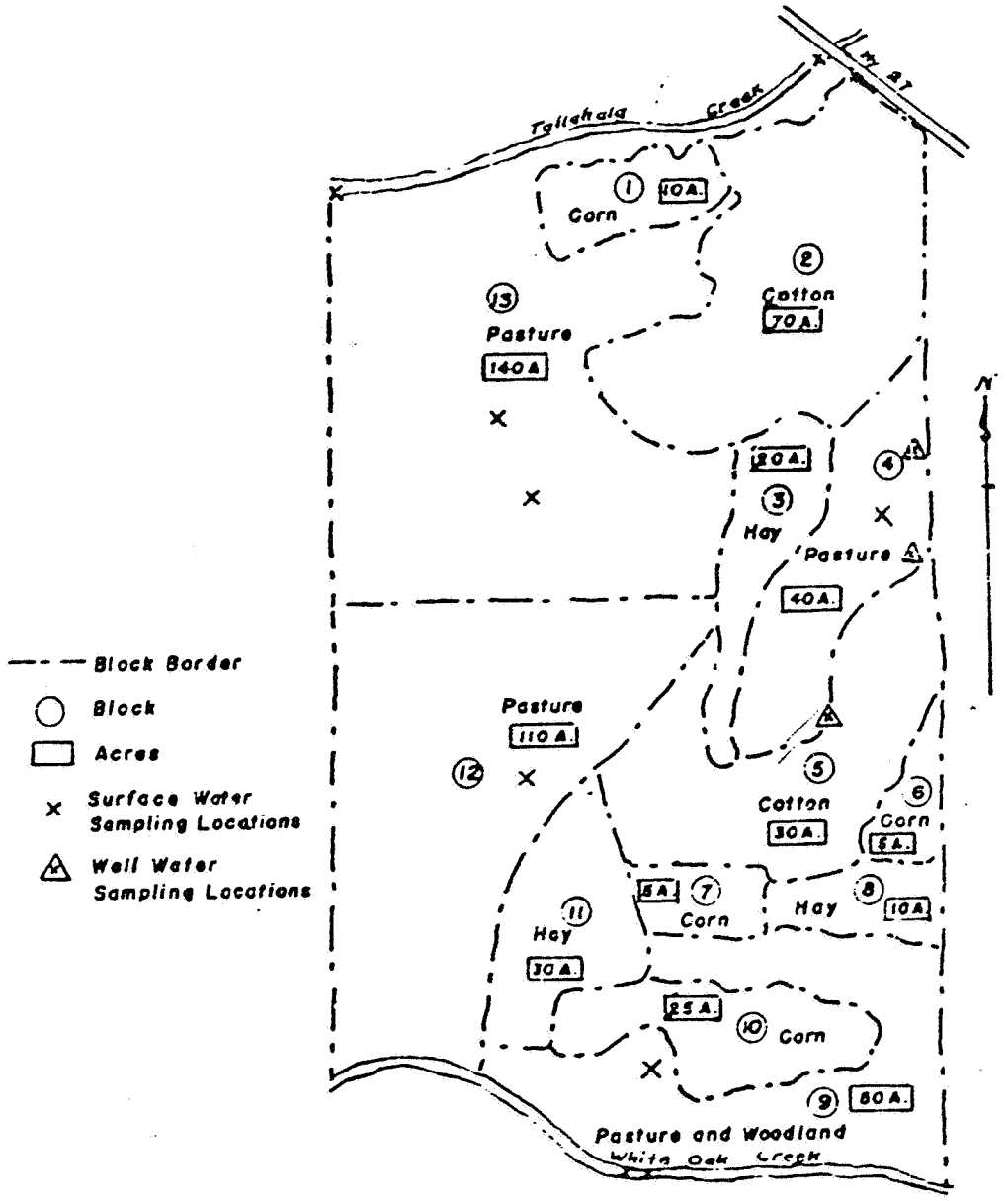


Figure 2. Study area CHB.

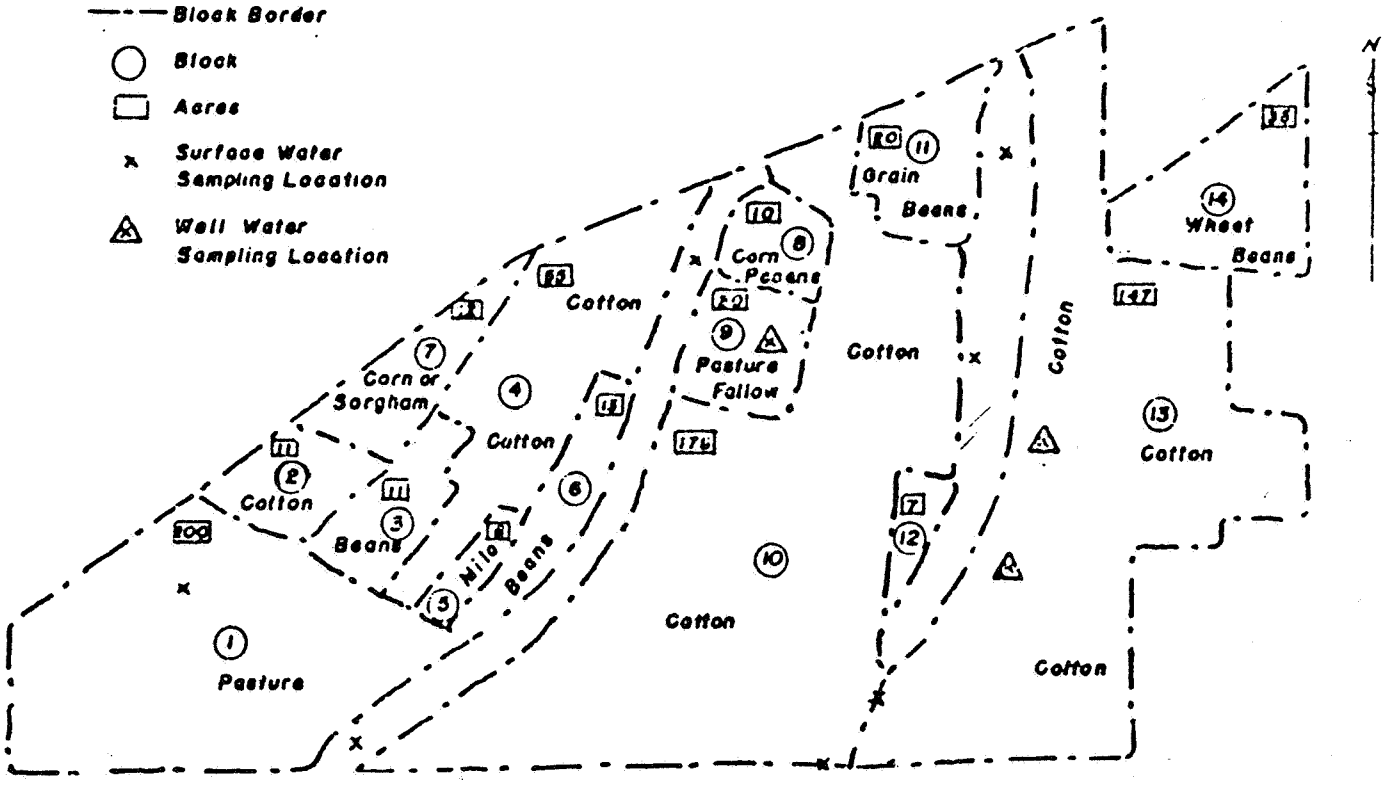


Figure 3. Study area GRA.

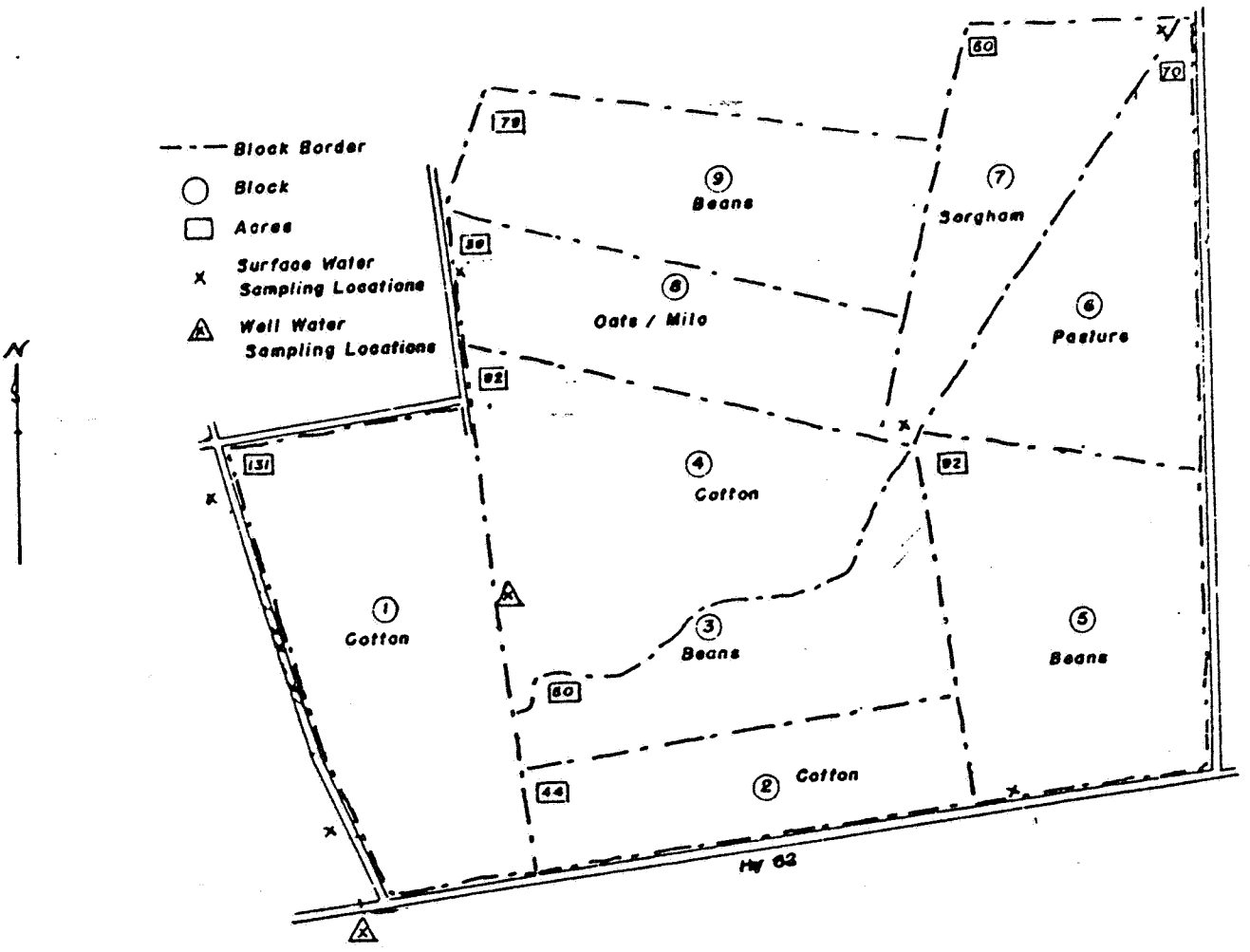


Figure 4. Study area GRB.

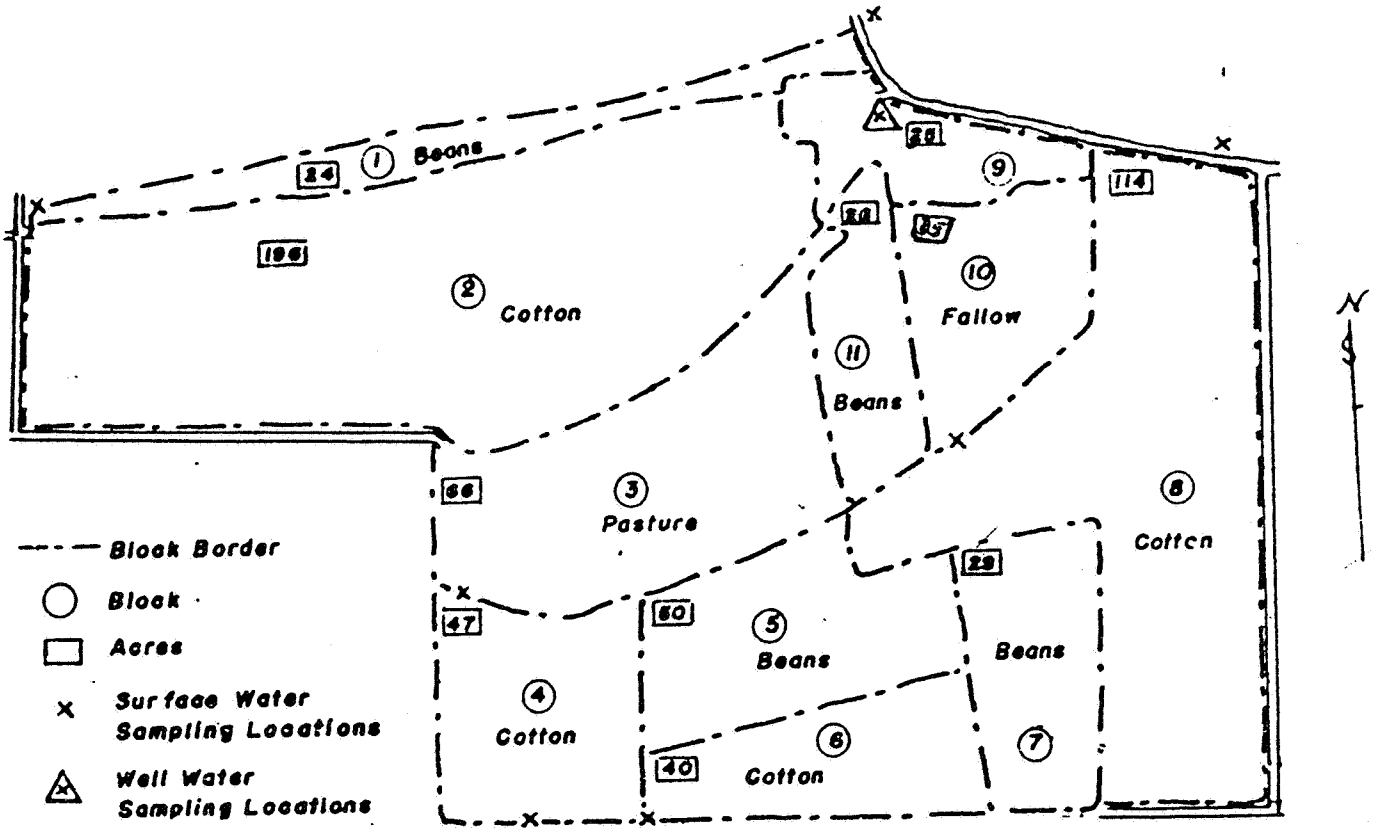


Figure 5. Study area SCA.

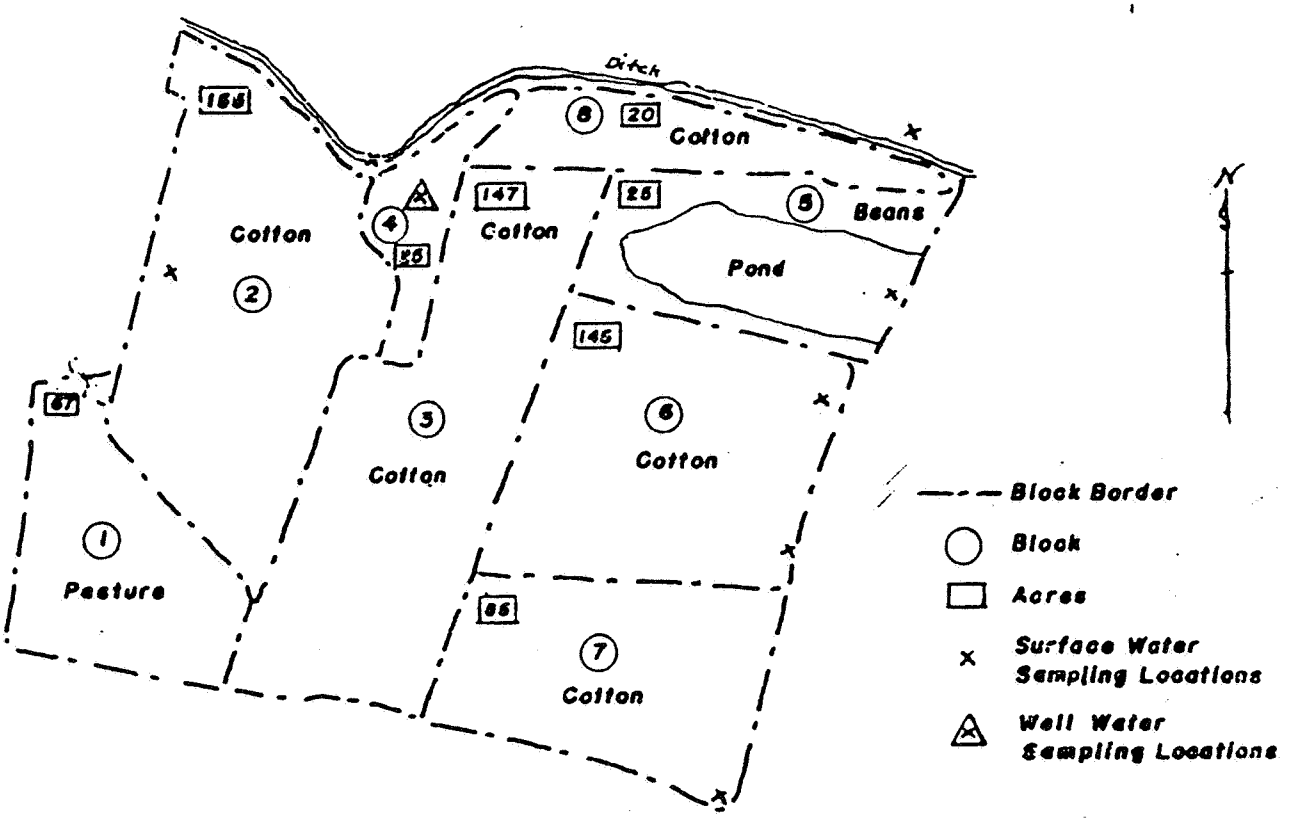


Figure 6. Study area SCB.

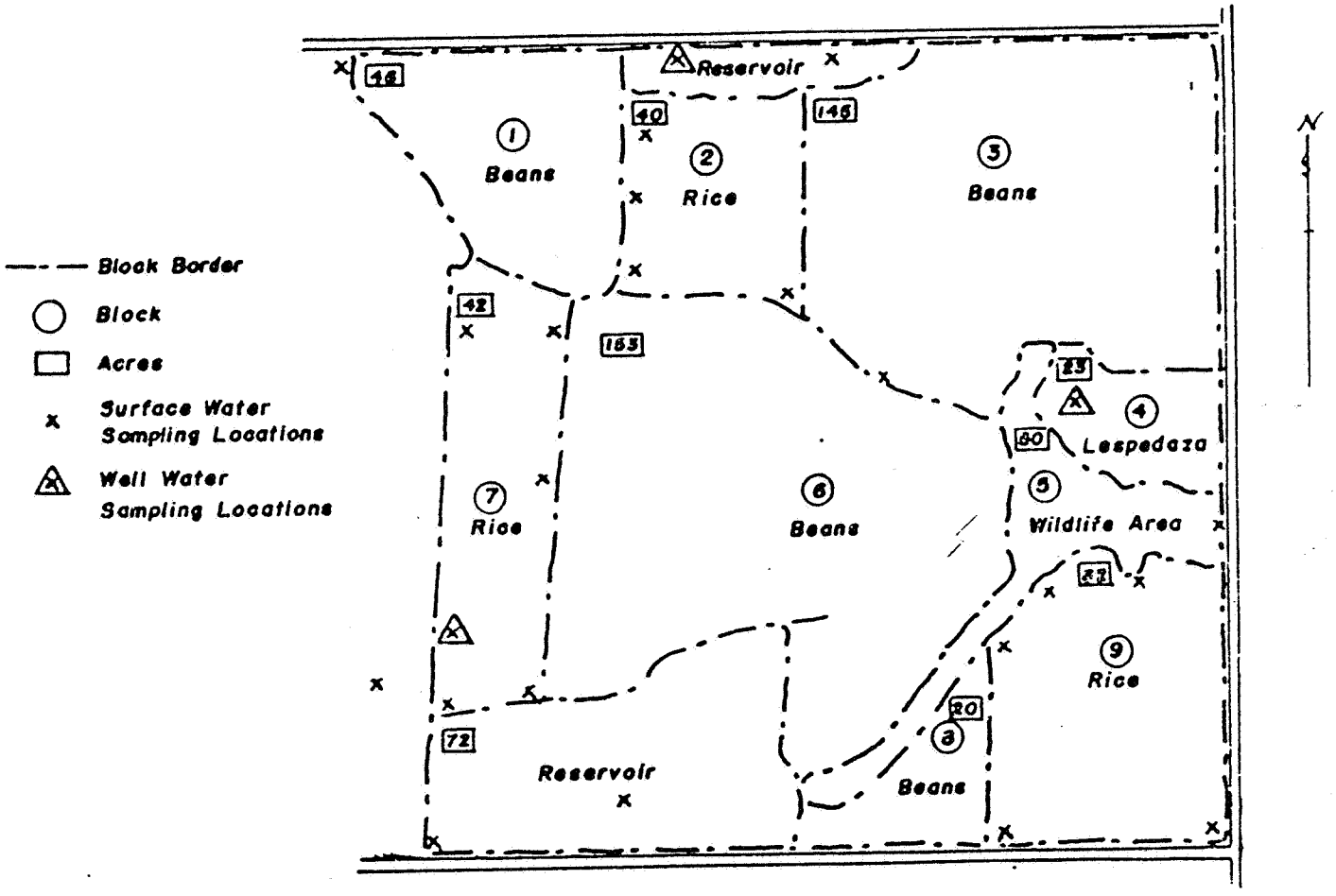


Figure 7. Study area STA.

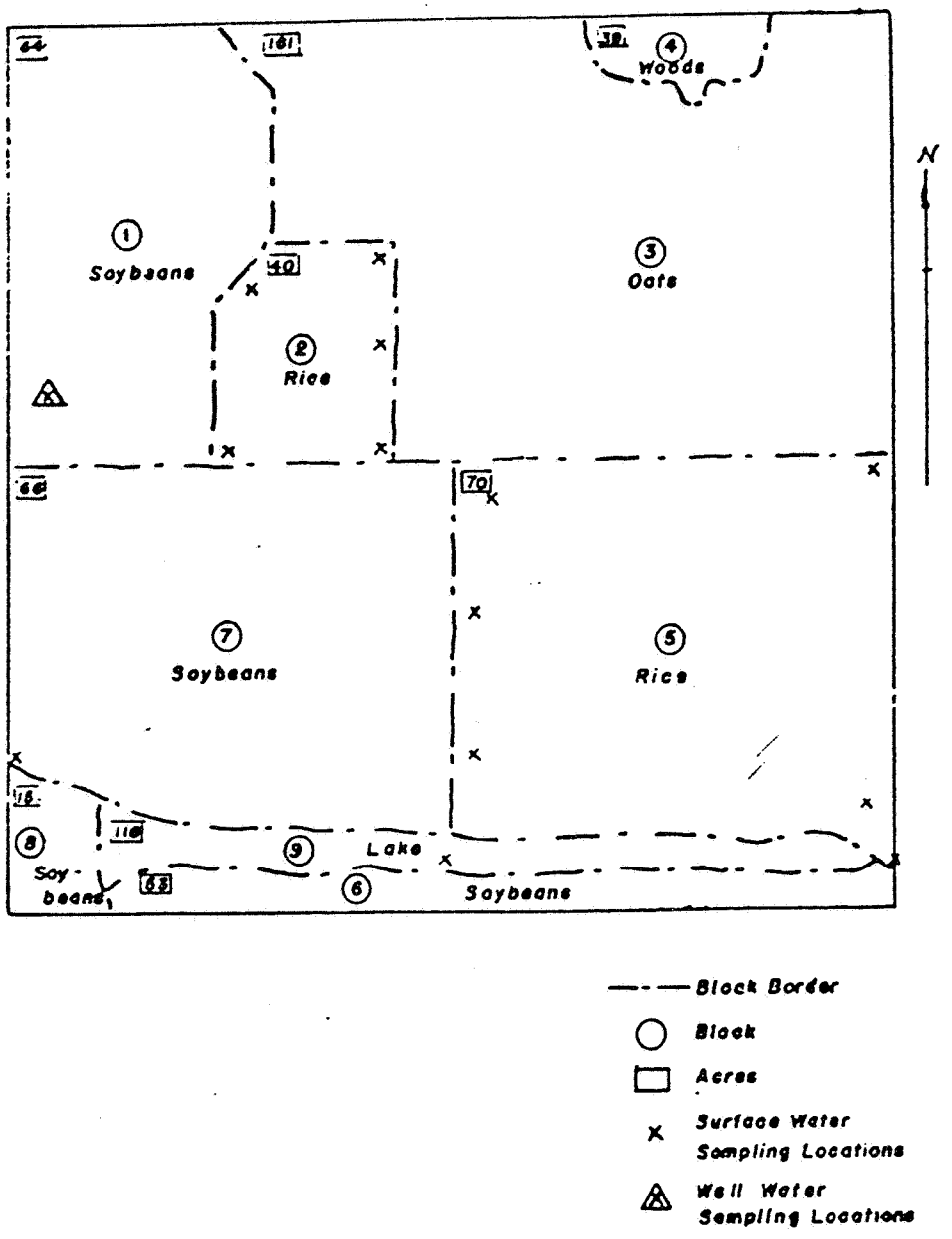


Figure 8. Study area STB.

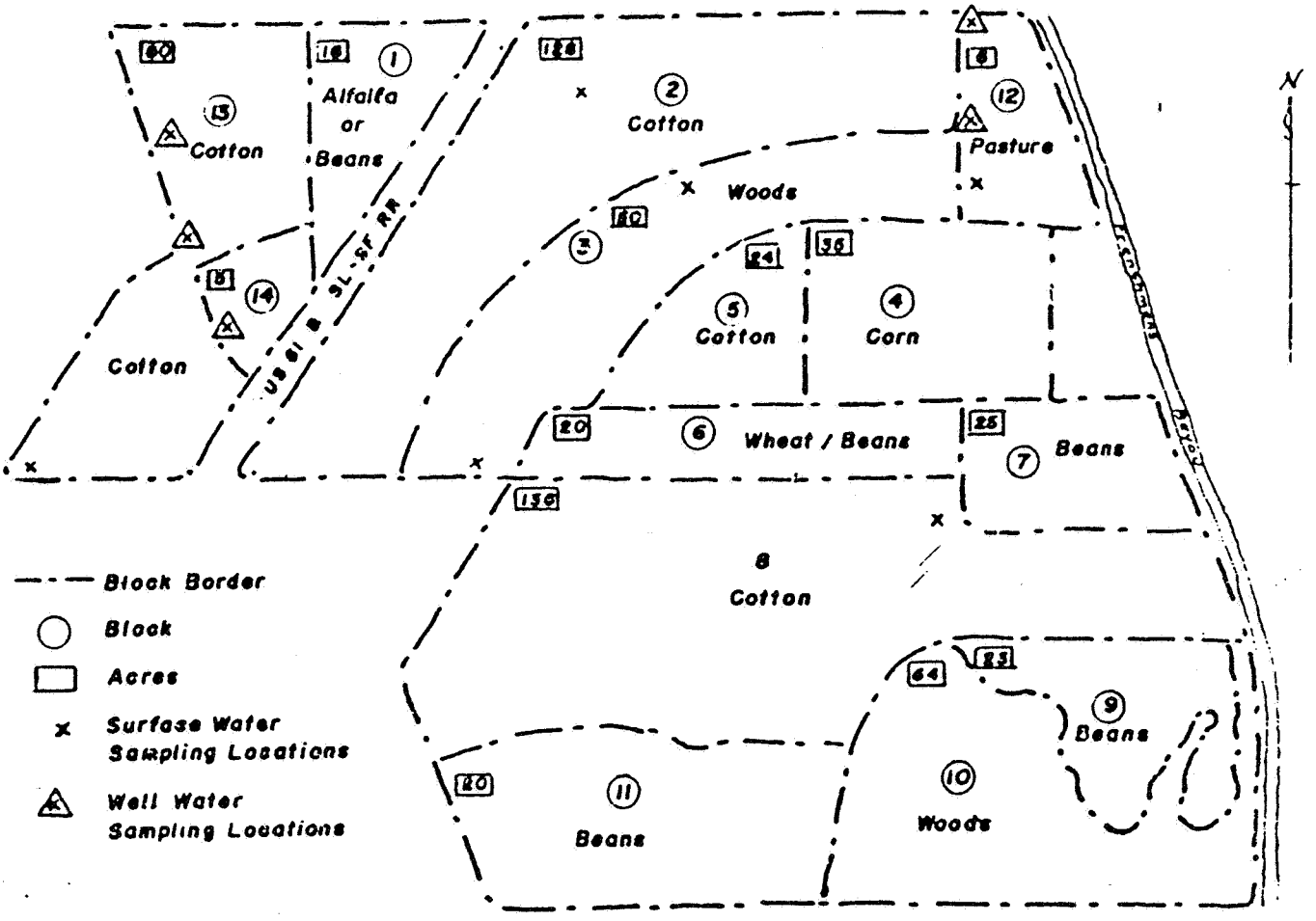


Figure 9. Study area FBA.

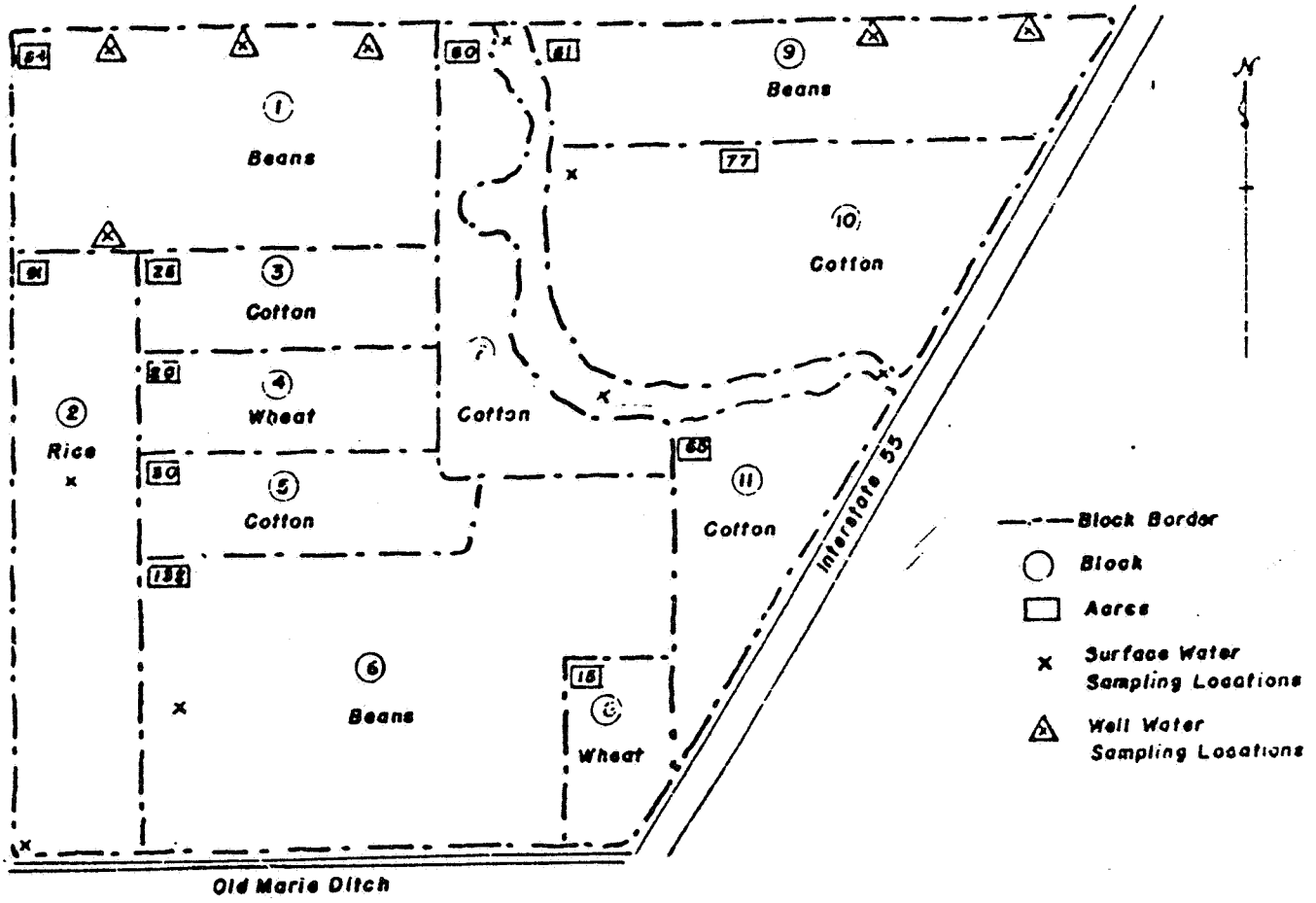


Figure 10. Study area FBB.

Table 1. Location and soil type of each study area.

Study area	Location	Soil type[a]
CHA	Crystal Springs, MS	Silt loam
CHB	Utica, MS	Silt loam
GRA, SCA	Greenville, MS	Silty loam
GRB	Indianola, MS	Clayey-silty
STA, STB	Stuttgart, AR	Silt loam
FBA, FBB	Wilson, AR	Clayey
SCB	Greenville, MS	Sandy loam

a Soil type presented as reported in hardcopy.

Table 2. Meteorological data.

Year	Month	Average temperature (F) Maximum	Average temperature (F) Minimum	Average humidity (%) Maximum	Average humidity (%) Minimum	Total rainfall (inches)
			Study area CHA			
1964	May	85.00	60.09	--	--	2.01
	June	87.03	64.18	--	--	1.72
	July	90.25	69.01	--	--	10.16
	Aug.	91.02	69.30	--	--	3.27
	Sept.	88.25	63.05	90.24	38.08	4.16
	Oct.	77.29	49.01	89.06	34.17	7.66
	Nov.	73.18	48.20	86.16	38.11	9.14
	Dec.	64.13	43.20	87.19	45.10	8.06
1965	Jan.	73.13	44.14	88.30	44.10	2.92
	Feb.	62.13	39.11	88.03	40.12	6.58
			Study area CHB			
1964	May	85.00	60.09	--	--	2.01
	June	90.03	66.24	--	--	1.72
	July	90.25	69.01	--	--	10.16
	Aug.	91.02	69.30	--	--	3.27
	Sept.	88.25	63.05	90.24	38.08	4.40
	Oct.	77.29	49.01	88.07	34.16	6.69
	Nov.	71.17	45.05	93.02	48.04	10.72
	Dec.	60.20	39.03	92.14	54.05	7.81
1965	Jan.	58.29	36.05	92.21	43.19	2.14
	Feb.	57.24	36.02	92.06	44.03	5.28
			Study area GRA			
1964	May	83.28	62.22	--	--	--
	June	92.12	69.06	93.05	38.11	1.30
	July	92.24	71.11	98.29	44.26	2.30
	Aug.	89.27	69.28	99.17	50.28	5.09
	Sept.	86.11	63.13	98.11	47.16	2.86
	Oct.	72.28	47.07	97.21	40.27	0.96
	Nov.	67.03	45.10	98.04	50.29	4.36
	Dec.	55.22	39.12	96.28	60.18	5.04
1965	Jan.	56.01	37.02	95.11	52.14	2.36
	Feb.	55.02	36.16	95.11	51.26	7.29
	Mar.	54.12	40.05	96.01	58.09	3.14
	Apr.	77.13	58.13	97.16	47.02	2.65

Table 2 Continued.

Year	Month	Average temperature (F) Maximum	Average temperature (F) Minimum	Average humidity (%) Maximum	Average humidity (%) Minimum	Total rainfall (inches)
			Study area GRB			
1964	May	85.28	62.22	--	--	1.48
	June	92.12	68.16	65.08	28.07	1.16
	July	92.24	71.11	98.29	44.26	3.86
	Aug.	90.10	69.26	96.11	49.13	3.40
	Sept.	87.29	62.23	95.25	42.18	4.64
	Oct.	72.28	47.07	97.21	40.27	0.68
	Nov.	67.11	44.27	98.04	50.29	4.32
	Dec.	56.27	41.05	96.05	64.15	4.62
1965	Jan.	55.09	36.25	94.08	57.18	2.37
	Feb.	52.24	36.10	93.15	54.21	5.69
	Mar.	54.14	39.10	94.12	60.05	5.24
			Study area SCA			
1964	May	85.28	62.22	100.00	--	4.25
	June	92.12	65.77	100.00	--	0.50
	July	92.23	71.11	--	--	4.98
	Aug.	90.10	69.26	--	--	1.97
	Sept.	85.20	62.14	99.18	63.13	1.92
	Oct.	72.14	47.12	100.00	55.24	0.03
	Nov.	67.17	45.11	99.25	69.09	4.84
	Dec.	55.08	38.00	100.00	84.06	5.50
1965	Jan.	55.07	35.16	99.13	65.19	2.79
			Study area SCB			
1964	May	85.28	62.22	100.00	--	3.94
	June	92.12	69.12	--	--	0.98
	July	92.23	71.11	--	--	3.39
	Aug.	90.10	69.26	--	--	1.88
	Sept.	85.16	61.09	99.18	59.09	1.51
	Oct.	72.14	47.12	100.00	55.24	0.04
	Nov.	64.01	44.05	99.25	67.17	4.02
	Dec.	55.15	37.24	99.18	72.19	5.98
1965	Jan.	57.12	36.26	99.27	65.16	4.10
			Study area STA			
1964	May	85.08	63.13	--	--	0.40
	June	90.00	69.07	--	--	1.07
	July	92.10	71.12	--	--	3.79
	Aug.	88.22	69.21	--	--	3.49

Table 2 Continued.

Year	Month	Average temperature (F) Maximum	Average temperature (F) Minimum	Average humidity (%) Maximum	Average humidity (%) Minimum	Total rainfall (inches)
	Sept.	85.06	61.17	98.10	54.21	3.71
	Oct.	72.15	45.09	100.00	46.04	0.34
	Nov.	66.07	44.12	98.11	53.24	3.59
	Dec.	55.18	38.14	99.15	65.18	5.89
1965	Jan.	54.12	35.02	98.09	58.20	3.88
	Feb.	54.10	34.11	0.99	55.01	6.35
			Study area STB			
1964	May	85.08	63.13	--	--	0.40
	June	90.00	69.07	--	--	1.51
	July	92.10	71.12	--	--	4.62
	Aug.	88.22	69.21	--	--	4.60
	Sept.	85.14	62.07	98.10	54.21	3.86
	Oct.	71.29	45.00	100.00	46.04	3.79
	Nov.	65.18	43.14	97.19	50.10	3.74
	Dec.	52.29	35.28	94.26	58.22	7.60
1965	Jan.	53.09	33.24	98.04	59.26	4.27
	Feb.	53.10	32.20	100.00	59.17	6.72
			Study area FBA			
1965	May	82.12	61.24	89.21	52.06	3.12
	June	90.16	68.07	85.06	40.13	0.96
	July	91.01	70.02	93.22	53.28	4.18
	Aug.	87.08	67.03	94.30	61.00	5.78
	Sept.	82.01	60.20	90.20	50.26	5.18
	Oct.	71.23	44.11	93.17	42.01	1.16
	Nov.	63.12	43.20	98.08	54.14	3.23
	Dec.	49.26	33.17	95.00	62.29	8.56
1964	Jan.	52.03	34.29	95.15	58.04	3.18
	Feb.	51.27	32.18	97.03	53.12	5.56
			Study area FBB			
1964	May	82.12	61.24	91.03	51.23	3.12
	June	90.16	68.08	85.10	44.07	0.79
	July	91.01	69.30	93.22	53.26	4.18
	Aug.	87.08	66.24	94.30	59.02	3.33
	Sept.	82.01	60.02	93.10	50.26	4.99
	Oct.	71.23	44.11	93.17	42.01	.86
	Nov.	62.26	42.29	98.09	55.20	3.72
	Dec.	49.02	33.11	91.06	63.16	8.52
1965	Jan.	49.17	31.11	92.07	54.02	3.34
	Feb.	51.05	29.26	94.14	51.11	4.98

Table 3. History of lindane application and concentrations in soil.

Study area		Years applied	Average number of applications per year	Cumulative amount applied (lb/A)	Average rate per application (lb/A)	Total applied analyzed	Average amount residue per sample (ppm)	Sample, positive (%)	Average amount residue per positive sample (ppm)
CHA	Cropland	1955-63	---	7.30	---	72	0.22	19.44	0.12
	Uncultivated	---	---	---	---	70	0.01	2.85	0.23
CHB	Cropland	1955-58	3.4	3.56	0.31	70	<0.01	1.42	0.08
	Uncultivated	---	---	---	---	84	ND	0	---
GRA	Cropland	1948-55,59	6.0	---	0.30	156	0.10	9.61	0.12
	Uncultivated	---	---	---	---	12	ND	0	ND
GRB	Cropland	---	---	---	---	96	0.01	7.29	0.08
	Uncultivated	---	---	---	---	12	ND	0	---
SCA	Cropland	---	---	---	---	107	0.01	12.14	0.08
	Uncultivated	---	---	---	---	11	ND	0	---
SCB, STA, and STB		NA[a]	---	---	---	---	---	---	---
FBA		---	---	---	---	162	<0.01	1.85	0.11
FBB	Cropland	---	---	---	---	122	0.01	0.81	0.06

[a] No known history of lindane application and no lindane detected in soil.

Table 4. Average lindane concentrations (ppm) in sediment collected monthly in surface water.

Study area[a]	1964 May-June	1964 July	1964 Aug.	1964 Sept.	1964 Oct.	1964 Nov.	1965 Dec.	1965 Jan.	1965 Feb.
CHA	ND[b]	0.02	ND	ND	ND	--	ND	ND	ND
GRA	0.06	<0.01	0.01	<0.01	ND	ND	ND	0.09	ND
GRB	ND	<0.01	0.01	ND	0.04	ND	--	0.10	ND
SCA	ND	ND	ND	ND	0.03	0.03	I[c]	ND	ND
FBA	ND	ND	ND	ND	--	--	0.03	ND	ND
FBB	ND	ND	ND	ND	--	--	0.02	ND	ND

a No lindane detected in sample collected in CHB, SCB, STA, and STB.

b ND - non detectable.

c I - illegible.

Table 5. Average monthly (May 1964-Feb. 1965) lindane concentration (ppb) in water.

Study area	Well water	Surface water	Runoff
CHA	ND[a]	ND-0.56	ND
CHB	ND	ND	ND
GRA	ND	ND-0.08	ND
GRB	ND-0.23	ND-0.18	ND
SCA	ND	ND-0.08	ND
SCB	ND	ND-0.03	ND-0.01
STA	ND	ND-0.21	0.06-0.08
STB	ND	ND-0.25	0.08
FBA	ND	ND-0.04	ND
FBB	ND-<0.01	ND	ND

[a] Non detectable.

CASE GS0315 LINDANE STUDY 11 PM PM# 04/05/84

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 052015 GUIDELINE 40 CFR 163.62-10d

FORMULATION 90 - FORMULATION NOT IDENTIFIED

FICHE/MASTER ID 00064463 CONTENT CAT 01

Brady, V.E., F.L. Hastings, and R. Chadwick, et al. 1978. Fate, distribution and effects on non-target organisms of lindane and sumithion used as bark beetle sprays in the southeastern United States. Unpublished study received Nov. 14, 1980 under 476-2200; prepared by Univ. of Georgia, Dept. of Entomology and others, submitted by Stauffer Chemical Co., Richmond, CA; CDL:233713-C.

SUBST. CLASS = S.

DIRECT RVW TIME = 8 1/2 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T Opeka DATE: Apr. 22, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSION:

Field Dissipation - Forestry

This study cannot be validated because the sampling protocols, analytical methods, and experimental sites were inadequately described and the data were inconsistently reported. In addition, this study would not fulfill EPA Data Requirements for Registering Pesticides because characteristics of the soil, litter, water, and test substance were incomplete; the pattern of formation and decline of degradates was not determined; field test data were not reported; and application rates could not be confirmed as highest registered rate.

MATERIALS AND METHODS:

Experiment 1

The trunks of a group of 20-21 year old white pine trees near Franklin, North Carolina were sprayed (hydraulic sprayer at 300 psi) to the point of runoff with a 0.5% aqueous solution of lindane (EC, purity and source unspecified). There were three treated and three control areas located in watershed 3 (not described). Four samples of forest litter and soil were taken at equal distances (0-40 feet downslope) from the base of different trees. Four additional samples of litter and soil were taken at the edge of the stream. The concentrations of lindane were monitored on the bark, in soil and litter samples at the spray site, and near the edge of the stream (~100 feet downslope of the treated areas). The runoff was monitored with a Brailsford Proportional Sampler during the study period (302 days). Lindane concentrations were determined by using GC equipped with an electron-capture detector with proper standards and replication.

The dissipation of lindane on the bark of loblolly pine was determined in time course studies with radiolabeled lindane.

Experiment 2

Lindane (20% by weight, formulation and source unspecified) was applied as a 0.5% aqueous solution with a Hudson hand type sprayer to the understory of a mature loblolly pine stand (old field growth) at N.C. State University's New Hope Forest near Chapel Hill, North Carolina. There were two treated and two control plots and each was divided into nine 10 x 10 foot plots. The surface of the plots was sprayed (trees not sprayed). Lindane residues were determined in the litter (upper 3 cm) and soil (depth unspecified) at 1-182 days after treatment.

REPORTED RESULTS:

Experiment 1

In bark, 94% of the applied lindane had dissipated at 302 days after treatment (Table 1). At 240 days posttreatment, residues on the bark were identified as 92 ppm of lindane, and <1 ppm combined residues of alpha hexachlorocyclohexane, hexachlorohexene, tetrachlorocyclohexane, and trichlorophenol. Lindane was more persistent in litter and soil (Tables 2 and 3). Water analysis indicated lindane did not move into a stream ~100 feet downslope from the three lindane application sites. With the exception of the 10 day posttreatment samples, no lindane was detected in water (value reported both as 0.001 and 0.006 ppm).

Experiment 2

Lindane residues ranged from ~18 to 28 ppm and 0.146 to 0.470 ppm in litter and soil, respectively, over a 182-day period following application of lindane as a 0.5% aqueous solution (Table 4).

DISCUSSION:

Both Experiments

1. The experimental sites were incompletely described. The portion of the trees in the forest canopy, thickness of the canopy, ground cover and undergrowth, and the thickness and composition of the litter layer, were not reported. Experiment 1 was located in watershed 3; however, no description of watershed 3 was included.

2. The extraction procedures for analyzing litter, soil, and water samples were not provided. Recovery values and detection limits for the GC method were not reported.

3. Insufficient methodology was presented for the dissipation of radiolabeled lindane from the bark of loblolly pine. The application rate, application technique, sampling protocol, extraction procedure, analytical method, and reported results, were not provided. Data was reported on the dissipation of unlabeled lindane from white pine bark; however, no materials and methods were provided.

4. Soil characteristics, such as textural analysis, organic matter content, pH, and CEC, were not reported.

5. The test substance was incompletely characterized.

6. Field test data, such as slope of the test plots; depth to water table; depth, weight, or volume of each sample collected; and meteorological data, were not reported.

7. The pattern of formation and decline of degradates was not determined.

8. The application rate of experiment 2 could not be determined because the spray volume was not specified.

9. From the data presented in various locations in the hardcopy, it could not be determined whether stream water samples or runoff water entering the stream was collected and analyzed.

Table 1. Lindane (ppm) in bark of standing white pines at various intervals after treatment with unlabeled lindane.[ab]

Days after treatment	Lindane treated	Control
0	442 ± 172	<0.1
14	308 ± 77	<0.1
28	330 ± 167	<0.1
64	201 ± 50	<0.1
98	164 ± 35	<0.1
161	126 ± 63	<0.1
218	55 ± 25	<0.1
302	26 ± 11	<0.1

[a] Each figure is the mean ± 1 S.D. of two samples from each of three plots. Expressed as µg lindane/g bark (dry weight).

[b] The application rate of lindane was not reported.

Table 2. Lindane (ppm) in litter and soil at indicated intervals following lindane treatment of white pines.[a]

Days after treatment	Lindane treatment (LT)	Control Adjacent (CA) to LT	Control down from LT	Control down from CA
		Litter		
0[b]	0.05 ± 0.05	0.06 ± 0.04	--	--
0.2	172 ± 77	0.14 ± 0.05	0.16	--
14	400 ± 159	0.30 ± 0.18	0.15 ± 0.08	0.51 ± 0.68
28	458 ± 110	0.97 ± 1.55	0.18 ± 0.08	0.34 ± 0.41
64	400 ± 142	0.35 ± 0.37	0.148 ± 0.07	0.65 ± 0.86
98	364 ± 132	0.14 ± 0.11	0.18 ± 0.11	0.41 ± 0.53
161	174 ± 39	0.44 ± 0.20	0.22 ± 0.12	--
307	110 ± 64	0.06 ± 0.03	0.05 ± 0.02	--
		Soil		
0[b]	0.30 ± 0.58	0.04 ± 0.02	<0.02	--
64	6.99 ± 6.36	0.07 ± 0.04	--	--
161	4.11 ± 1.16	0.05 ± 0.03	--	--
302	8.81 ± 0.25	0.04 ± 0.02	<0.02	--

[a] Each data point is the mean ± 1 S.D. of two samples from each of three plots.

[b] Pretreatment.

Table 3. Lindane (ppm) in litter and soil at indicated distances downslope from application site.[a]

Days after treatment	Distance downslope (ft) 0	5	10	20	40
			Litter		
0[b]	0.05 ± 0.05	--	--	--	--
0.2	172 ± 77	179 ± 37	7 ± 20	8.4 ± 16.2	0.3 ± 0.3
64	400 ± 142	180 ± 74	65 ± 46	2.5 ± 1.9	0.5 ± 0.3
161	174 ± 39	140 ± 69	36 ± 9	2.1 ± 0.7	0.9 ± 0.6
302	110 ± 64	39 ± 38	17.8 ± 14	0.9 ± 0.6	0.7 ± 1.15
			Soil		
0[b]	0.30 ± 0.58	--	--	--	--
0.2	--	1.08 ± 0.63	0.94 ± 1.11	0.02 ± 0.01	<0.02
64	6.99 ± 6.36	2.26 ± 1.76	1.13 ± 0.18	<0.002	<0.02
161	4.11 ± 1.16	0.64 ± 0.42	1.08 ± 1.42	<0.02	<0.02
302	8.81 ± 10.25	6.99 ± 5.16	1.10 ± 0.93	<0.02	<0.02

[a] Each data point is the mean ± 1 S.D. of a sample from each of three plots except the 0 distance data which are means of two samples from each plot.

[b] Pretreatment.

Table 4. Lindane (ppm) in litter and soil at indicated intervals following spray of application of lindane.[ab]

Days after treatment	Litter	Soil
1	18.5 ± 4.1	0.411 ± 0.232
15	28.3 ± 15.2	0.213 ± 0.093
29	27.1 ± 18.0	0.146 ± 0.097
107	24.9 ± 13.5	0.470 ± 0.386
182	20.6 ± 16.6	0.229 ± 0.161

[a] Each number is the average of three replicates.

[b] Samples were from homogenous mixtures of 8 treatment plots.

CASE GS0315 LINDANE STUDY 12 PM PM# 04/05/85

CHEM 009001 Lindane

BRANCH EFB DISC 30 TOPIC 052020

FORMULATION 00 - ACTIVE INGREDIENT

FICHE/MASTER ID 00098842 CONTENT CAT 01

Sanborn, J.R. 1974. The fate of select pesticides in the aquatic environment. By Illinois, Natural History Survey. Corvallis, Oreg.: U.S. Environmental Protection Agency, National Environmental Research Center. EPA-660/3-74-025; available from: Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402 and NTIS, Springfield, VA 22151: PB 239-749; published study; CDL:232569-Z.

SUBST. CLASS = S.

DIRECT RVW TIME = 5 (MH) START-DATE END DATE

REVIEWED BY: T. Opeka
TITLE: Staff Scientist
ORG: Dynamac Corp., Enviro Control Division, Rockville, MD
TEL: 468-2500

SIGNATURE: T. Opeka DATE: Apr. 10, 1985

APPROVED BY:
TITLE:
ORG:
TEL:

SIGNATURE: DATE:

CONCLUSION:

Laboratory Accumulation - Fish

This study is scientifically invalid because the procedures were inadequate to estimate the potential of lindane to accumulate in aquatic organisms; i.e., the concentration of water was not compared with the concentration in aquatic organisms over sufficient time to generate accumulation data. This study would not fulfill EPA Data Requirements for Registering Pesticides because aquatic organisms were not exposed to a constant concentration of lindane, samples were not fractionated into edible and visceral tissues, the test substance was not characterized, incubation conditions were incompletely characterized, and an adjuvant was applied with lindane.

MATERIALS AND METHODS:

Model ecosystems were established in small aquaria with terrestrial and aquatic portions following methodology described by Metcalf et al. (1971. Environ. Sci. Technol. 5(8):709-713). [^{14}C]Lindane (test substance uncharacterized, source unspecified) was mixed with the adjuvant Aroclor 5460 (1:5, w:w) and applied to sorghum plants at ~1 lb ai/A (5 mg). Salt marsh caterpillars (Estigmene acrea) were allowed to feed on the plants as the first member of the food chain. Also in the water were algae (Oedogonium cardiacum), water fleas (Daphnia magna), and snails (Physa sp.).

After 27 days mosquito larvae were added to the system and 3 days later a mosquito fish (Gambusia affinis) was added as the last member of the food chain.

At 33 days quantitative estimates of the radioactivity in water and aquatic organisms were carried out by extraction, TLC, and autoradiograpy. The TLC plates were developed in petroleum ether:carbon tetrachloride (1:1, v:v). Radioactivity was determined using LSC. Identification of degradates was made by cochromatography with proposed degradates as well as IR, NMR, and MS.

REPORTED RESULTS:

After 33 days fish, algae, snail, mosquito, and Daphnia contained lindane at 26.379, 6.178, 5.658, 4.212, and 2.166 ppm, respectively (Table 1). Unknown II (unidentified) was detected at 1.004 ppm in fish, with lesser amounts (0.108-0.410 ppm) detected in the other organisms. Unknown I (unidentified) was found in snails at 0.110 ppm.

DISCUSSION:

1. A flow-through system was not employed and no effort was made to ensure a constant level of exposure.

2. The fish were exposed to lindane and any potential degradation products for only 3 days. This exposure period is not long enough to estimate the potential of lindane to accumulate in fish. There was also no depuration period.

3. Total residue levels in the whole body, edible tissue, and viscera of fish were not differentiated.

4. Characteristics of the water in the ecosystem, such as dissolved oxygen, dissolved salts, and pH, were not provided. Complete soil characteristics such as texture, pH, and organic matter were not provided. The test substances were not characterized.

5. Characteristics of the fish, including size, observed mortality, and acclimation procedures, were not provided.

6. An adjuvant (Aroclor 5460) was applied with lindane.

Table 1. Concentration (ppm) of [^{14}C]lindane and extractable degradation products in organisms and water from a model ecosystem after TLC analysis.

Residue	Water		Algae	Daphnia	Fish	Mosquito	Snail
	Unhydrolyzed	Hydrolyzed					
A[a] (R_f 0.75)	0.0000608	--	--	--	0.025	--	--
Lindane (R_f 0.40)	0.0125	--	6.178	2.166	26.379	4.212	5.658
B[b] (R_f 0.19)	0.000471	0.000056	--	--	--	--	--
C[c] (R_f 0.13)	0.000418	0.000182	--	--	--	--	--
Unknown I (R_f 0.06)	0.000433	0.000352	--	--	--	--	0.110
Unknown II (R_f 0.00)	0.00124	0.00144	0.285	0.127	1.004	0.108	0.410
Extractable ^{14}C	0.01520	0.00202	6.463	2.293	27.408	4.320	6.178
Unextractable ^{14}C	0.00740	0.00430	0.803	0.164	0.087	0.309	0.522
Total ^{14}C Recovered	0.0226	0.00632	7.266	2.457	27.495	4.629	6.700

[a] Pentachlorocyclohexane.

[b] 2,4,6-Trichlorophenol.

[c] 2,4,5-Trichlorophenol.