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TYPE PRODUCT(S) : I,D,H,F,N,R,S INSECTICIDE (synthetic pyrethroid)

DATA ACCESSION NO.

PRODUCT MANAGER NO G. LaRocca(15)

PRODUCT NAME Karate

COMPANY NAME ICI

SUBMISSION PRUPOSE Protocol amendments

SHAUGNESSEY NO.	CHEMICAL AND FORMULATION	% A.I.
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TYPE PRODUCT(S) : I,D,H,F,N,R,S INSECTICIDE (synthetic pyrethroid)

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PRODUCT NAME Karate

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SUBMISSION PRUPOSE Protocol review

SHAUGNESSEY NO.	CHEMICAL AND FORMULATION	% A.I.
128897		

128897
Shaughnessey Number

FIELD STUDY PROTOCOL REVIEW

1. Pesticide Name: PP-321

2. Study Type: Aquatic Mesocosm
This protocol review refers to ICI Americas Inc. submission of 2/5/86 as amended by submission of 4/29/86.

3. Pesticide Use: cotton insecticide (synthetic pyrethroid)

4. Study Purpose : negate a presumtpion of hazard to aquatic ecosystem.

5. Site Description: (System Description):

Twelve ponds, about 0.22 acres each, were dug at ICI Americas Inc. facility at Goldsboro, North Carolina. Water depth ranges from about 15 cm at shalow end to 2 m at deep end. Complete design specifications and diagrams are provided. Run-off into these ponds is prevented by berms. Each pond will be divided into two (2) 0.11 acre ponds by a wall of reinforced hypolon plastic, suspended across each pond (shallow to deep) by a wood beam and float, and sealed to each pond bank and bottom as per design specifications shown in submission. The top of the hypolon wall is 45 cm above the overflow level.

Undivided mesocosms are interconnected (in parallel) while water is circulated between ponds by pump. Pumping continues through connected divded mesocosms until just prior to pesticide treatment.

The ponds are clay-lined and have a sandy-loam hydrosoil. The system is filled with water from a nearby established large pond conntaining phytoplankton and zooplankton populations. The development of the experimental ponds in 1985 is described in Kennedy,et al (1986), an appendix to the submission. Major groups of organisms were Odonata (Anisoptera, Zygoptera),Coleoptera (Dystiscidae predominate), Ephemeroptera, (Baetidae and Caenidae) and Diptera (primarily Chironomidae). Other groups less frequently sampled included Turbellaria, Gastropoda, Oligochaeta and Trichoptera. Zooplankton, including Protozoa, Rotifera and Microcrustacea were well represented.

Thirteen genera of filamentous algae were identified in the developinng ponds in 1985 (Kennedy et al , 1986).

Macrophytes were planted around each meoscosm in 1985, however since these could interfere with sampling efforts, artificial plastic strands and wooden framed cages will be used as refugia for fish.

As per the ammended protocol approximately 20-30 adult mature bluegill sunfish (Lepomis macrochirus) will be added to each divided pond between 1 and 3 weeks before the first PP-321 application. These fish will weigh approx. 40 g wet weight each, when added.

The mesocosms will be fertilized with "wheat shorts" on three ocsassions; 1, 4, and 8 weeks before pesticide applications.

6. Proposed Exposure Regime: (Figures 1a and 1b).

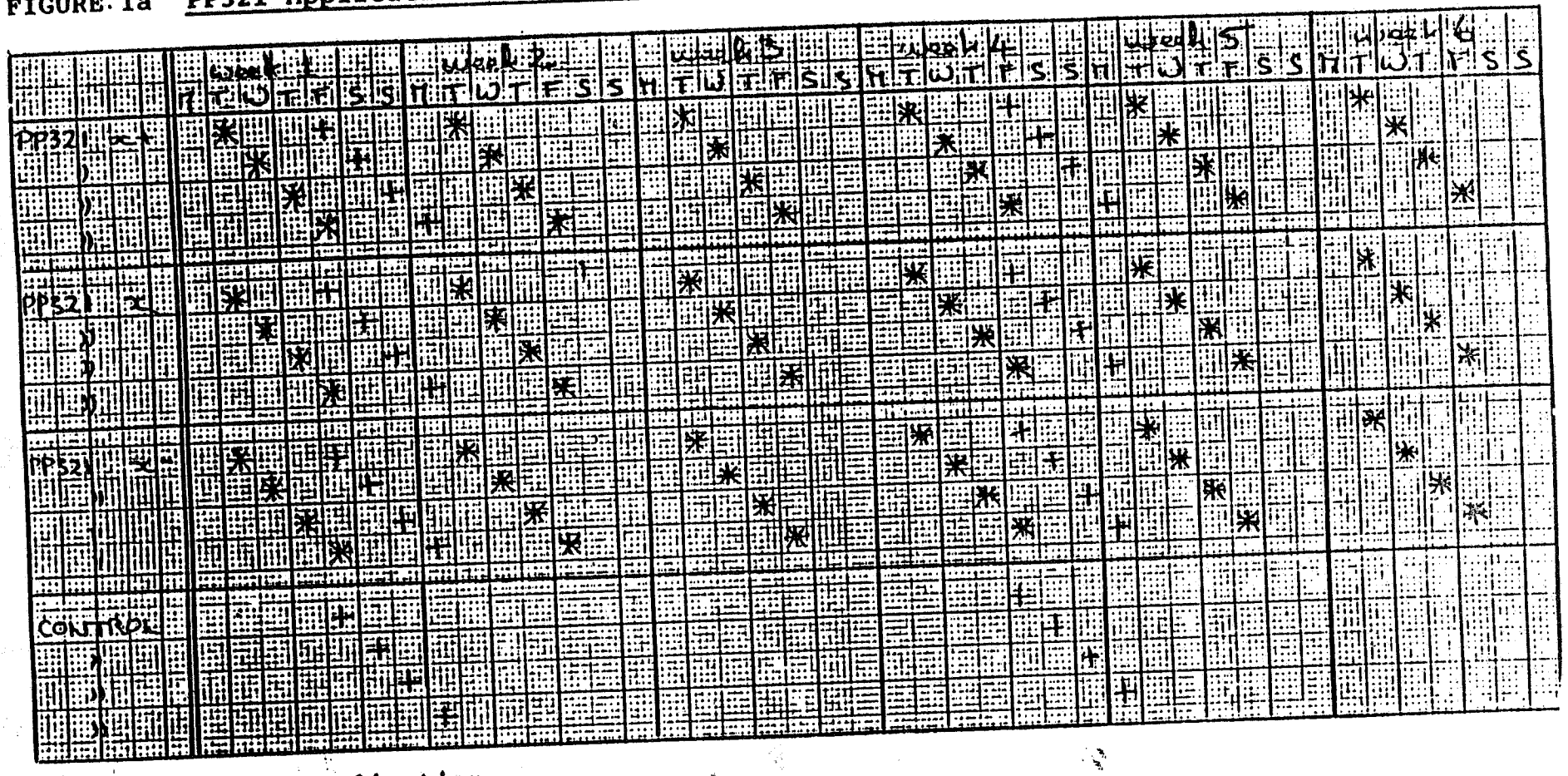
As per the amended protocol - the exposure of the ponds will attempt to simulate drift and runoff events resulting from applications to cotton. Since the label allows up to 12 applications of this material, there will be 12 simulations, i.e., once each week for 12 weeks. There will be four (4) replicates of three pesticide treatments plus a control treatment. Thus, a total of sixteen of the twenty-four available 0.11 acre mesocosms will be employed.

Treatments will be "high", "medium", and "low" doses of pesticides . The proposal includes the following design:

	"Spray Drift Applications"				"Run-off Applications"			
	Application		Rate		Application		Rate	
Rate	no.	frequency	g ai/ha	% field	no.	frequency	g ai/ha	% field
high	12	weekly	0.67	2	3	tri-weekly	0.34	1
med.	12	"	0.067	0.2	3	" "	0.034	0.1
low	12	"	0.0067	0.02	3	" "	0.0034	0.01
control	-	-	-	-	3	" "	-	-

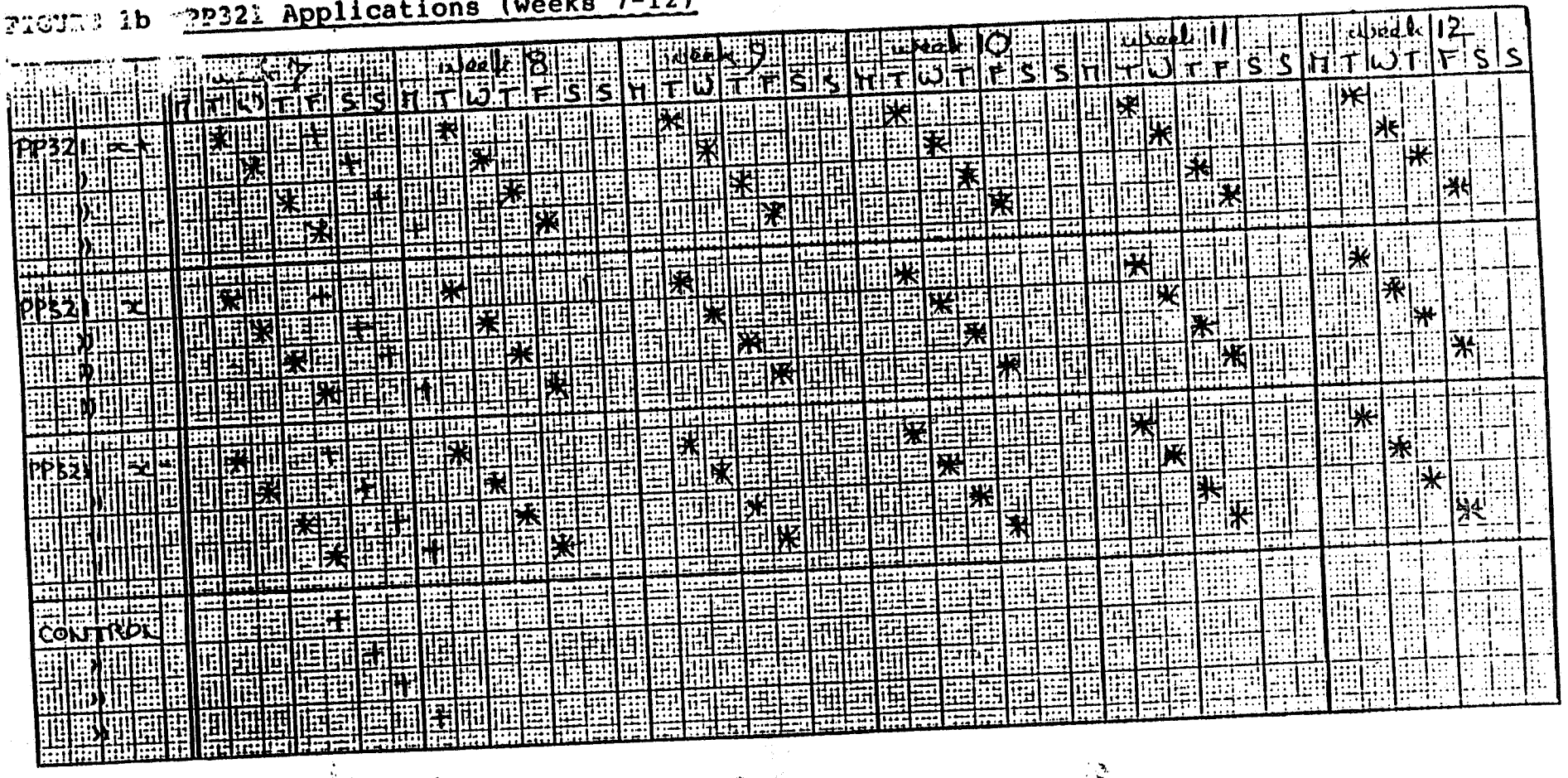
For spray drift simulations - PP-321 formulation will be added to 19 liters of water in a pressure can. Spraying, by CO_2 pressure, will be at approximately 20 psi through "flood jet nozzles". This is designed to prevent cross-contamination of ponds. Additionally, the spray unit will be hooded. As a consequence there will be no drift cards on the treatment ponds.

FIGURE 1a PP321 Applications (weeks 1-6)



* 'spray-drift' application
\+ 'run-off' application

FIGURE 1b PP321 Applications (weeks 7-12)



* 'spray-drift' applications
\+ 'run-off' applications

To simulate runoff events a soil-water suspension will be prepared in steel tanks. For each, a slurry of 2500 liters water and 250 kg of wet weight of sandy loam and mixed for 30 minutes. PP 321 formulation diluted in 10 liters water will be added to the slurry while mixing. The slurry will then be left overnight (24 ± 4 hours) before an additional 1 hr. of mixing prior to application. Applications of slurry will be pumped from the mixing tank into the water, as close to the surface as possible. The spary unit will be hooded in order to prevent cross-contamination by splash or aerosol droplets.

7. Study Methods:

Two sampling zones will be established in each mesocosm; a shallow zone (approx. 35-60 cm) and a deep zone (approx. 2 meters). Each zone is 5 m wide and spans the width of the mesocosms. Diagrams were provided for specific locations.

The basic sampling schedule is bi-weekly. Additional observations are included. The final period before termination is 3 weeks. The complete sampling schedule is shown in figures 2 a, b, c and d. The majority of sampling will be from a boat.

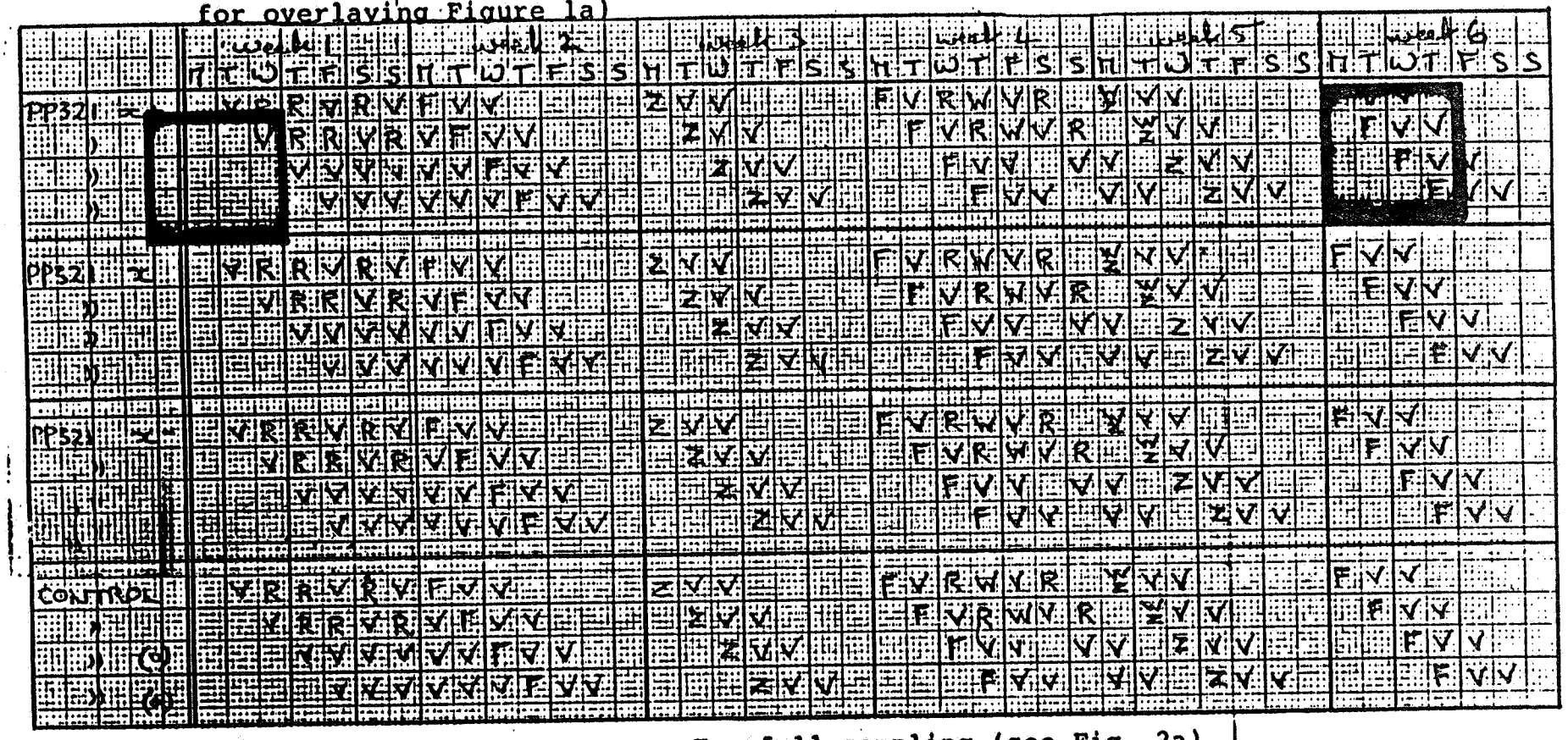
Hydrosoils, water, and chemical application mixtures will be sampled as per the indicated schedule. All residue samples will be cooled immediately after collection and frozen at <-18° C within 3 hours. Mixtures will be sampled after mixing and before spraying.. Hydrosoil cores will be sampled at 1-2 cm as per ammended protocol. Water samples will be taken at 3 points in the shallow and deep zones. In the shallow zone 3 samples will be taken at a depth of 25 cm and composited. In the deep zone, water samples will be taken at 25 cm from surface and 25 cm above hydrosoil, and each depth set will be separately composited. Fish will not be sampled during the program; only at the end. Stomach contents, fecundity and tissue residues will not be measured at any time during the study, as per the amended protocol.

FIGURE 2a Sampling Programme (weeks -5 and -1)

	week -5							week -1						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S
PP321	B							F						
"		B							F					
"			B							F				
"				B							F			
[illegible]	B							F						
		B							F					
			B							F				
				B							F			
PP329	B							F						
"		B							F					
"			B							F				
"				B							F			
CONTROL	B							F						
"		B							F					
"			B							F				
"				B							F			

B = biological sampling only
F = full sampling (biological, physicochemical and residue)

FIGURE 2b <u>Sampling Programme (weeks 1-6)</u> (a 'transparent' copy of this is provided for overlaying Figure 1a)



F = full sampling (see Fig. 2a)
Z = zooplankton sampling
V = Pond edge visual observations (on spray days, 1 hour post-application)
R = water residue samples (b) and pond edge visuals
W = water residue samples (b)
(a) = no residue samples will be taken
(b) = one composite sample (shallow zone and two depths in deep zone) per pond.

FIGURE 2c <u>Sampling Programme (weeks 7-12)</u> (a 'transparent' copy of this is provided for overlaying Figure 1a)

	Week 7							Week 8							Week 9							Week 10							Week 11							Week 12						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
PP321	Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V				
		Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V			
			Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V		
				Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V	
PP321	Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V				
		Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V			
			Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V		
				Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V	
PP521	Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V				
		Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V			
			Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V		
				Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V	
CONTROL	Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V				
		Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V			
			Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V		
				Z	V	V		V	V		F	V	V					Z	V	V					F	V	V					Z	V	V					F	V	V	

F = see Figure 2a
V = see Figure 2b
Z = see Figure 2b

FIGURE 2d Sampling Programme (weeks 14-21)(a)(b)

	week 14							week 16							week 18							week 21						
	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S	M	T	W	T	F	S	S
PP32E	F							F							F							F						
		F							F							F							F					
			F							F							F							F				
				F							F							F							F			
PP32I	F							F							F							F						
		F							F							F							F					
			F							F							F							F				
				F							F							F							F			
PP32N	F							F							F							F						
		F							F							F							F					
			F							F							F							F				
				F							F							F							F			
CONTROL	F							F							F							F						
		F							F							F							F					
			F							F							F							F				
				F							F							F							F			

F = see Figure 2a

(a) zooplankton samples will be taken on weeks 15, 17, 19 and 20
(b) all fish will be collected from the ponds, and size/weight grouped, during weeks 22-25

Dissolved oxygen, temperature, conductivity, pH, and visibility (Secchi disk) measurements will be made at two sites in each zone at each sampling interval. D.O. and temp. measurements will be made at 25 cm below surface and 25 cm above the hydrosoil (the latter in the "deep" zone only). Conductivity and pH will be taken at one depth; 25 cm in the "shallow" zone, and at 50 cm in the "deep" zone.

The biological studies are described in the following pages with these amendments.

1. Periphyton dry weights will be determined at each sampling interval.

2. Zooplankton samples will be collected weekly, however only "main" bi-weekly samples will be analyzed initially. Others will be available for analysis.

3. Numbers of "small" and "large" zooplanktons will be reported.

4. Gross fish abnormalities will be recorded when all fish are collected.

5. Macrophyte biomass will be determined at end of study. Quadrat samples will be taken by cutting off at hydrosoil level.

6. Fish will not be sampled during the study program; only at end. Stomach contents, fecundity, and tissue residue concentrations will not be measured at any time during the study.

Meterological conditions will be monitored as follows.

1. A weather station will be sited within 1 mile of the ponds to record:
   a) wind speed (average daily)
   b) air temp. (average, max. and min. daily)
   c) relative humidity (average daily)
   d) solar radiation (daily)
   e) rainfall (daily)
   f) pan evaporation (daily by claculation)

2. Rainfall and windspeed will also be measured at the mesocosm site.

3. Wind speed and direction will be recorded during all applications, from instruments on the mesocosm site.

10.2 Hydrosoil and Water Characterisation

The hydrosoil at the bottom of the mesocosms, and the mesocosm water will be comprehensively characterised using a single composite sample of each. The hydrosoil samples will be collected, prepared and transported to the analytical laboratory as described in Section 11.6. Characterisation will be carried out before PP321 application and at the end of the study before the ponds are drained.

Water samples will be collected using vertical tubes as described in Section 11.1.1.1. Six samples will be taken (three from each zone) and combined. A representative sub-sample will be frozen (at <-18°C) and transported to ICI PPD (see Section 11.6) for analysis.

The characteristics to be determined for hydrosoil and water from each mesocosm separately are given in Table 5.

11 BIOLOGICAL STUDIES

11.1. Primary Production

Two sources of primary productivity will be measured in the mesocosms: phytoplankton and periphyton.

11.1.1 Phytoplankton

Phytoplankton cells will be enumerated, major taxa identified, and cell volumes measured at each sampling date. Chlorophyll a and phaeophytin a, will be extracted and measured. Photosynthesis and respiration will also be monitored using a light and dark bottle technique.

11.1.1.1 Cell numbers and identification

Phytoplankton will be collected by lowering a calibrated transparent tube, of approximately 5cm (2 inches) inside diameter, through the water column. The plastic tube is submerged vertically through the entire water column until the device is approximately 10 cm off the pond bottom. Once filled, the tube is capped and the entire water column is collected. The height of the water in the sampling tube is recorded to the nearest cm so that the volume of water collected can be calculated.

On each sampling date at least three tube samples will be collected from each zone, composited and stirred. A 125 cm^3 sample for phytoplankton analysis will be taken from each composited sample (immediately after stirring). Phytoplankton samples will be preserved in a 1-2% Lugol's solution and stored. Samples from each zone will be kept separate.

[The remainder of the sample will be used for photo-synthetic pigment, photosynthesis/respiration and zooplankton studies (see Sections 11.1.1.2, 11.1.1.3 and 11.3)].

In the laboratory, a known aliquot is pipetted into a microscope plate chamber and settled for a minimum of 12 hours. The plate chamber with settled sample is placed on the stage of an inverted microscope. Counts of 250 algal cells will be made for each sample. All algae will be enumerated in terms of cell numbers. However, it is often difficult or impossible to observe the transverse cell walls of filamentous blue-green algae. Therefore the lengths of filamentous blue-greens will be measured; and each 25 µm length will be considered equivalent to a single 'cell'.

Cell volume estimations will be made and the principal organisms identified where possible.

11.1.1.2 Chlorophyll and phaeophytin

Chlorophyll a is a pigment which is essential for photosynthesis in plants and occurs in all algae. Concentrations of chlorophyll a provide an indirect measurement of primary production. An appropriate volume will be taken from the water collected for phytoplankton analysis immediately after stirring (see Section 11.1.1.1). Chlorophyll a and phaeophytin a in the cells collected from the mesocosms will be measured using a recognized method.

11.1.1.3 Photosynthesis and respiration

Primary productivity within the mesocosms will be monitored using a light-bottle/dark-bottle technique to provide estimates of photosynthesis and respiration.

Three sets of light/dark-bottle measurements will be made within the photic region of each zone. The method used will be that of Gaarder and Gran (1927). This is a well established oxygen method for measuring the rate of carbon uptake and net photosynthesis *in situ* (Franson, 1980).

At each sampling date, water collected for phytoplankton cell counts (see section 11.1.1.1) in each zone will be used. Three light and three dark bottles will be filled with the sample water from each zone, and the dissolved oxygen (DO) measured in each using a BOD oxygen probe with stirrer. Water displaced from the bottles by immersion of the BOD probe will be replaced with sample water. The bottles will then be capped and suspended in three pairs (a pair being one light and one dark bottle) at 25cm depth in the shallow zone and 50cm depth in the deep zone; and incubated for a predetermined period. At the end of the exposure period the DO will be immediately redetermined. Using the pre-and post-incubation DO figures, the net photosynthesis, gross photosynthesis and respiration will be calculated.

11.1.2 Periphyton

For this study periphyton are defined as those plant communities growing on stones, sticks, aquatic macrophytes and other submerged surfaces. For experimental studies, however, it is difficult to collect quantitative samples from natural surfaces. Plastic strands (see Section 6.2) will be used as artificial substrates to monitor the productivity of periphyton communities.

Three groups of plastic strands, of known surface area, will be placed in pairs in both zones of each mesocosm, one group in the vicinity of each substrate sampler (see Section 11.4 and Figure 8) and allowed to colonise for 14 days.

At the end of the colonisation period, the plastic strands will be removed and combined to give two samples. These will each be representative of the total periphyton of the water column of the shallow zone of each mesocosm.

One sample will be placed in Lugol's solution for phytoplankton cell enumeration, identification and volume estimation as outlined in Section 11.1.1.1. The second sample will be extracted in a suitable solvent for chlorophyll a and phaeophytin a analysis as outlined in Section 11.1.1.2.

11.2 Filamentous Algae and Macrophytes

Filamentous algae and macrophyte distributions occurring in the mesocosms will be observed and recorded at each sampling time (see Section 8). Total surface or submerged mesocosm coverage will also be estimated. The principal macrophytes will be identified. Composite, representative filamentous algae samples, will be collected from the mesocosms every fourth week, preserved in Lugol's solution and dominant algal genera indentified.

11.3 Zooplankton

Zooplankton cells will be enumerated and identified. A known volume of water from the sample collected in Section 11.1.1.1 (taken immediately after stirring) will be concentrated through a 60-80µm plankton net for zooplankton analysis (after the samples have been removed for phytoplankton, chlorophyll and light/dark bottle assessments; 11.1.1.1, 11.1.1.2 and 11.1.1.3). Zooplankton samples will be preserved in a 1-2% Lugol's solution. Samples from each zone will be kept separate.

In the laboratory each zooplankton sample bottle will be thoroughly shaken and all contents will be poured into a graduated cylinder. The sample container will be rinsed twice with water and each rinse will be poured into the graduated cylinder. Samples will be settled in the graduated cylinder for a minimum of 24 hours. The sample will be concentrated to a known volume by withdrawing the supernatant through a siphon (the degree of concentration depends on the density of the organisms). A 1-2 cm^3 aliquot will be taken from the concentrated sample after it has been thoroughly mixed. The withdrawn aliquot will then be placed on a Sedwick-Rafter cell (or similar) and examined at up to 100x magnification. Zooplankters will be enumerated and where possible identified.

11.4 Macroinvertebrates

Major macroinvertebrate taxa inhabiting the study mesocosms will be monitored using a variey of techniques. The primary and most intensive study will be the artificial substrate programme. In addition, emergence of adult insects will be monitored using emergence traps. Further information on free swimming macroinvertebrates will be gathered through the use of visual assessments.

11.4.1 Artificial Substrates

Artificial substrate samplers, constructed from plastic cylinders (5 cm OD x 5 cm high; manufactured as surface enchancers for sewage treatment plants) will be used to monitor macroinvertebrate populations. Each artificial substrate sampler is assembled from 14 plastic cylinders fastened together (Figure 9). Six samplers will be placed in each mesocosm zone, attached to the transect rope (see Section 8). Three will be allowed to float (material has a 'neutral' buoyancy) and three set on the hydrosoil (bottom), the latter being weighted with two bottles filled with gravel. The base of each bottom sampler is covered with 1mm nylon mesh to reduce loss of colonising invertebrates when collected. Each bottom sampler will be located by a length of nylon line attached to the transect rope.

On each designated sampling day, all the substrate samplers will be collected from each sampling zone. During retrieval, the samplers will be moved gently and snared in a net before being removed from the water. This procedure minimises loss of the colonising organisms due to water turbulence or organism escape behaviour. Samplers removed from the mesocosm will be placed in a bucket and covered with filtered mesocosm water for transport to the "work-station". At the "work-station" a water pump will be used to wash debris and colonizing organisms from each sampler. Debris and organisms will be concentrated using a No. 60 (0.18mm) U.S Standard sieve. During the initial stages of the cleaning process, care will be taken to gently wash the larger exposed

invertebrates from the substrates. Greater water pressure will be used to scour attached invertebrates and those in protected refuges, from the substrates. All three surface samplers from each zone will be combined together. Similarly, bottom samplers will be composited into a single bottom sample for each zone.

Material washed from the substrates (debris and organisms) will be poured into a gridded enamel pan. Macroinvertebrates will be identified, enumerated and put into categories of 'normal', 'abnormal' (showing abnormal behaviour) or 'dead', at the mesocosm site. The procedure of collecting, preparing, identifying and counting the macroinvertebrates will therefore be carried out rapidly to avoid processing 'damage'. After the washing process, the artificial substrates will be reset in the zones from which they were retrieved.

Major macroinvertebrate genera will be identified at least every four weeks.

A reference collection of representative taxa will be prepared, starting from the first sampling date. The organisms will be placed in 5-10% formalin for at least 24 hours. Samples will be transferred to 70% ethanol within 12 months for permanent storage.

11.4.2 Quantitative Visual Assessment

Visual observations will be made of the mesocosm fauna occurring in two littoral areas (2 x 1m; delineated by shoreline posts, and stakes in the mesocosm) of each zone (Figure 8). Organisms observed in each area during a 2 minute period will be noted and counted. Dead organisms or those showing abnormal behaviour will be noted separately.

11.4.3 Non-Quantitative Visual Assessment

Immediately following or before the quantitative visual assessments (see Section 11.4.2), a walking circuit of the mesocosm to observe the whole littoral zone will be carried out. A record will be made of any dead organisms or of those showing abnormal behaviour. Such observations made at any other time will also be recorded.

11.4.4 Emergence Traps

During the course of the growing season, many aquatic macroinvertebrates emerge from the water as adults. When measuring macroinvertebrate populations, it is important to be aware of this process and to also be able to quantify the numbers and types of organisms leaving the mesocosm.

11.5.4 Reproduction

Tilapia zillii are nest builders. The nests are dug in shallow water and are generally visible along the shoreline. Nest building and spawning normally occurs at water temperatures of 24°C or greater. Eggs, which adhere to the nest sediment, are guarded by the parent fish. After hatching, the fry remain near the nest, forming easily observed clouds of tiny fish. Fry are protected by the parents. After 2-3 weeks the juvenile fish leave the nest and the parents recommence spawning activity until cool water or short days return. Spawning activity will continue through at least August in the Goldsboro region of North Carolina. Tilapia are sexually mature within 2 to 3 months after hatching.

The ponds will be monitored regularly (at least every week) for evidence of ~~Tilapia~~ Lepomis nesting behaviour. The number of active nests will be counted and recorded. Early developmental stages of ~~Tilapia~~ Lepomis will be collected for each pond using dip nets and/or passive traps. Larval fish will be observed for normal development, age and growth determinations.

A measure of reproductive success will also be obtained at termination of the study by collecting all the fish in the ponds (see Section 11.5.5).

BK- Leave In -MM

11.5.5 Fish Biomass

At termination of the study fish will be collected from the whole mesocosm by pumping the water out (with seining if necessary). The weight of fish (size grouped) will be recorded.

11.6 Microbial Analysis of Hydrosoil

Hydrosoil will be sampled from each pond before PP321 application and at the end of the study (Tables 2-4). A minimum of 3 hydrosoil cores will be taken to a depth of approximately 7.5cm (See Figure 8). All the samples from a mesocosm will be immediately combined and thoroughly mixed. Two subsamples will then be prepared for transportation to ICI PPD Jealott's Hill Research Station, UK.

One sample will be placed into a labelled polythene bottle; filled to the top with hydrosoil. This will be sent by 'direct shipment' air transport to I R Hill (ICI PPD UK) to arrive within approximately 7 days of field sampling. This sample will NOT be frozen as it will be used for microbial studies.

The second sample will be frozen (<-18°C) as soon as possible after sampling and sent in frozen state to I R Hill. This sample will be used for physico-chemical characterisation (see Section 11.12).

8. Protocol Evaluation:

This protocol is the product of intensive negotiations between EEB's aquatic field study team amd ICI Americas Inc. The records of these negotiations are included in the submissions of 2/5/86 and 4/29/86 . The final meeting for negotiations was held in EEB Branch Chief Office on May 1st, 1986. EEB, by its role in these negotiations, has indicated agreemnet with the general protocol as ammended and here reviewed.

While too numerous to include, all diagrams, charts, tables and figures included with the submissions of 2/5/86 and 4/29/86 are considered an integral part of the protocol and protocol review. Any changes to these must be in writing in order for EPA to consider them valid changes to the protocol. Points covered in the meeting minutes of 4/22/86 specifying monitoring of cross-contamination by drift from spray booms are considered part of this protocol. EEB will expect to see the results of monitoring studies of spray drift potential in order to prove that cross-contamination is not a problem. EEB strongly recommends keeping the larval trap studies planned with Tilapia, for the Lepomis as well. Likewise, the spawning substrate samplers should be retained for Lepomis.

9. Suggested Modifications:

The aquatic field studies team has indicated all of the Branch's suggested modifications in the record of negotiations on this protocol (see submissions of 2/5/86 and 4/29/86). These have been incorporated into the protocol reviewed here which is the amended protocol as of 4/29/86.

The remaining EEB inputs are the application rates and schedule prepared by Dr. Richard Lee. The application rates are expressed in terms of active ingredient added per mesocosm, per treatment. These were calculated for the convenience of the investigators. There are two components of applied materi[illegible] drift and runoff. These are calculated separately and [illegible]stitute additive applications. The schedule and amounts a[illegible]ailed on the following pages.

To simulate PP321 runoff from cotton fields, the Yazoo River Basin in Mississippi was chosen to run the SWWRB model. The fate data required for simulation were based on information supplied by ICI (see pages 1a & 1b). To be conservative, the average values for foliar and soil 1/2 t's were used. The Kd value was calculated based on water solubility and 1.5 % OC content to reflect Mississippi delta soil. For the Enrichment Ratio (a measurement of erosion), a universal value of 1.5, instead of the higher value of > 3.0 found in that basin, was used.

The SWRRB model was run for 8 years (1971 to 1978), with 9 applications per year (the maximum number of application per year allowable for multiple years simulation by the model) and an application rate of 0.03 lb a.i./acre, to select the certain year with a maximum (worst), an intermediate, and a minimum (least) pesticide runoff. The results of simulation show that the years of 1972, 1975 and a977 were selected as maximum-, medium- and minimum- runoff years, respectively (see resulting pesticide balance table in page 5).

These three selected years were, in turn, rerun individually with ten applications (the maximum number of applications allowed in a single year simulation by the model) to determine the total pesticide runoff for that particular year (see pages 6, 9 & 11). As a result, the annual total pesticide runoff figures were obtained as follows (from pages 8, 10 & 13):

Year	Runoff per HA (GM/HA)	Total runoff from watershed (GM/10 HA)*
1971	1.288 (0.38%)**	12.88 (3.8%)**
1975	0.792 (0.24%)**	7.92 (2.4%)**
1977	0.421 (0.13%)**	4.21 (1.3%)**

* Assume drainage basin to pond ratio is 10A:1A
** % of total annual pesticide applied (i.e., 336.250 GM)

RUNOFF APPLICATIONS

APPLICATION			RATE			
					(Definitive values)	
Rate	No.	frequency	% from treated watershed 1/	lb.ai/A	g ai/Ha	g ai/mesocosm 2
High	6	bi-weekly	1.47	0.0044	5.0	0.222 3/
Medium	6	" "	0.147	0.00044	0.5	0.0222
Low	6	" "	0.0147	0.000044	0.05	0.00222

[illegible] application rate per acre (0.03 lb) X 10 acre treated watershed to 1 A pond
[illegible] application rate per hectare (0.034 kg) X 10 Ha treated watershed to 1 Ha pond.
[illegible] EPA agree that these rate are reasonable estimates for purposes of modeling [illegible] ponds from reasonably expected runoff situations.

2 mesocosm = 0.11 A

3 $5.0\ g \times \frac{0.11\ (A)}{2.471\ (A)} = 0.222\ g$

or $453.6\ g \times 0.0044\ lb \times 0.11\ (A) = 0.222\ g$

SPRAY DRIFT APPLICATIONS

APPLICATION

Rate	No.	frequency	% of field 1/	lb ai/A	g ai/ Ha	g ai/mesocosm 5/
High	12	weekly	5 2/	0.0015 3/	1.7 4/	0.075 6/
Medium	12	"	0.5	0.00015	0.17	0.0075
Low	12	"	0.05	0.000015	0.017	0.00075

1 % of 0.03 lb = application rate per acre, or
% of 0.034 kg = " " " hectare

2 average drift, as % of application rate per acre or hectare, from adjacent fields without a buffer zone. The range is 2 - 10% at the center of a one-acre pond (i.e., 105 feet from the edge of the field); see top graph next page.

3 e.g., 0.03 lb X 0.05 = 0.0015 lb

4 e.g., 0.034 kg or 34 g X 0.05 = 1.7 g

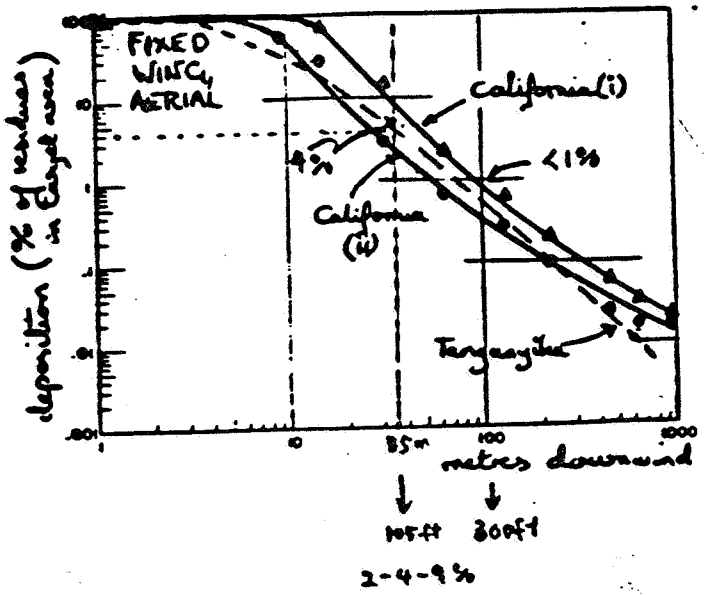
5 mesocosm = 0.11 A

6 $1.7\ g \times \frac{0.11\ A}{2.471\ A} = 0.076\ g$

or 453.6 g X 0.0015 lb X 0.11 A = 0.075 g

3.3 m/s = 11.88 km/h
= 11.88 km/h
× 60/100 = 7.1 mph

Table 2a Spray drift from pesticide applications

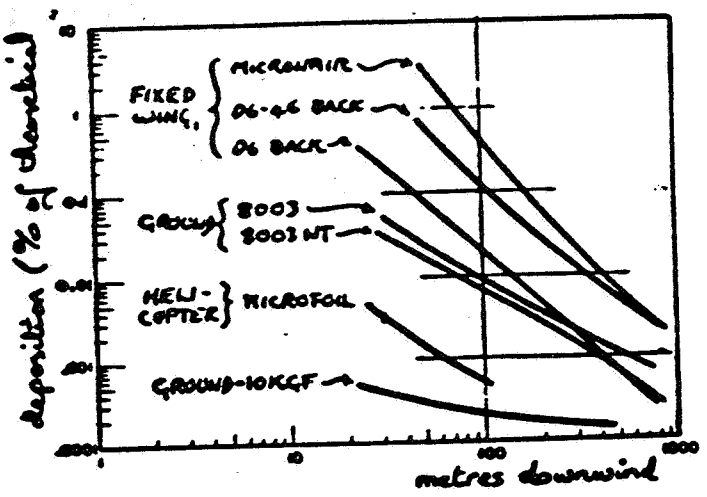


REFERENCE 9

	California (i)	California (ii)
wind velocity (m/s)	3.3	2.2
temp (°C); t2.4m	38	39
" ; t9.8–2.4m	+2.8	+2.2

(i) and (ii): Sprays of fluorescent tracer emulsions to alfalfa, California. Residues collected on alfalfa

(ii): Atomised oil spray to rangeland, Tanganyika



REFERENCE 13

	wind (m/s)	temp (°C) t10–2.5m
Micronair[1]	2.2	−0.8
D6-46[2]	5.0	+0.5
D6[3]	4.2	−0.8
8003[3]	3.8	−0.2
8003NT[3,4]	4.0	0
Microfoil[3]	1.1	+0.6
10KGF[3]	2.3	+0.4

Water based sprays used:
1= undiluted
2= as oil-water emulsion
3= as water based emulsion
4= with anti-drift adjuvant (Nalcotrol)

EIGHT YEARS SIMULATION

STORB - PP321/COTTON/YAZOO, MISS

PESTICIDE PARAMETERS

PESTICIDE TITLE = PP321/COTTON/YAZOO, MISS

ADSORPTION COEFFICIENT (KD)	1200.0
FOLIAR HALF LIFE (DAYS)	6.0
SOIL DECAY CONSTANT (/DAYS)	0.02310
APPLICATION EFFICIENCY	0.60
INITIAL PESTICIDE ON FOLIAGE (KG/HA)	0.0
INITIAL PESTICIDE ON GROUND (KG/HA)	0.0
ENRICHMENT RATIOS FOR PESTICIDE	1.50

PESTICIDE APPLICATIONS

YEAR	MM	DD	JULI	KG/HA
1971				
	6	23	174	0.034
	6	28	179	0.034
	7	5	186	0.034
	7	12	193	0.034
	7	19	200	0.034
	8	1	213	0.034
	8	8	220	0.034
	8	15	227	0.034
	8	22	234	0.034
1972				
	6	20	171	0.034
	6	28	179	0.034
	7	3	184	0.034
	7	10	191	0.034
	7	17	198	0.034
	7	24	205	0.034
	7	31	212	0.034
	8	7	219	0.034
	8	14	226	0.034
1973				
	6	20	171	0.034
	6	27	178	0.034
	[illegible]	[illegible]	185	0.034
	[illegible]	[illegible]	192	0.034
	[illegible]	[illegible]	[illegible]	[illegible]
	8	11	223	0.034
	8	18	230	0.034
1974				
	6	20	171	0.034
	6	25	176	0.034
	6	30	181	0.034
	[illegible]	[illegible]	[illegible]	[illegible]

	7	14	195	0.034
	7	21	202	0.034
	7	28	209	0.034
	8	5	217	0.034
	8	13	225	0.034
1975				
	6	20	171	0.034
	6	27	178	0.034
	7	4	185	0.034
	7	9	190	0.034
	7	16	197	0.034
	7	23	204	0.034
	7	30	211	0.034
	8	6	218	0.034
	8	12	224	0.034
1976				
	6	20	171	0.034
	6	28	179	0.034
	7	3	184	0.034
	7	10	191	0.034
	7	17	198	0.034
	7	24	205	0.034
	7	31	212	0.034
	8	7	219	0.034
	8	14	226	0.034
1977				
	6	20	171	0.034
	6	27	178	0.034
	7	4	185	0.034
	7	11	192	0.034
	7	18	199	0.034
	7	25	206	0.034
	8	1	213	0.034
	8	8	220	0.034
	8	16	228	0.034
1978				
	6	20	171	0.034
	6	27	178	0.034
	7	4	185	0.034
	7	11	192	0.034
	7	18	199	0.034
	7	24	205	0.034
	7	30	211	0.034
	8	6	218	0.034
	8	12	224	0.034

SWRRB - PP321/COTTON/YAZOO, MISS

WATER BALANCE

YEAR	RAIN (CM)	MEAS RNF (CM)	PRED RNF (CM)	EVAP (CM)	PERC (CM)	SEDIMENT (KG/HA)
1971	105.105	39.360	39.360	73.752	0.383	6585.562
1972	164.363	88.979	88.979	72.100	0.560	20199.520
1973	157.581	77.975	77.975	79.175	0.500	16697.344
1974	181.635	97.340	97.340	83.686	0.454	27795.215
1975	147.065	64.724	64.724	82.332	0.471	13147.668
1976	89.204	27.460	27.460	64.986	0.375	9384.723
1977	99.009	30.890	30.890	64.731	0.541	8113.387
1978	116.713	54.960	54.960	60.400	0.445	15790.469
TOTAL	1060.673	481.687	481.687	581.162	3.728	117713.750

SJRRB - PP321/COTTON/YAZOO, MISS

PESTICIDE BALANCE

YEAR	APPLIED (GM/HA)	DECAYED (GM/HA)	LEACHED (GM/HA)	TOT RUNOFF (GM/HA)	DIS-RUNOFF (GM/HA)	SORB-RNF (GM/HA)
1971	302.651	174.534	0.388	0.690	0.204	0.486
1972	302.651	180.382	0.270	2.311	Max 0.76% 0.437	1.874
1973	302.651	178.533	0.420	1.265	0.325	0.940
1974	302.651	179.083	0.551	1.772	0.488	1.285
1975	302.651	179.277	0.515	1.078	Min 0.36% 0.374	0.703
1976	302.651	182.401	0.226	0.584	0.109	0.474
1977	302.651	180.152	0.306	0.372	Min 0.12% 0.108	0.264
1978	302.651	180.248	0.289	0.638	0.193	0.445
TOTAL	2421.205	1434.610	2.965	8.710	2.238	6.472

1972
10 appl.

MAX. RUNOFF

p. 6

```
loc 6745
B 6745 BTRGO     AW FETCH
fetch 6745 clr
1 1
393.              TOTAL          336.250     194.713       0.276       1.288       0.304       0.984
1 'kd'
258.     0    ADSORPTION COEFFICIENT (KD)                    1200.0
1 259/1
259.
260.          FOLIAR HALF LIFE (DAYS)                          6.0
261.
262.          SOIL DECAY CONSTANT (/DAYS)                      0.02310
263.
264.          APPLICATION EFFICIENCY                           0.60
265.
266.          INITIAL PESTICIDE ON FOLIAGE (KG/HA)             0.0
267.
268.          INITIAL PESTICIDE ON GROUND (KG/HA)              0.0
269.
270.          ENRICHMENT RATIOS FOR PESTICIDE                  1.50
271.
272.
273.          PESTICIDE APPLICATIONS
274.                YEAR   MM  DD JULI   KG/HA
275.
276.                1972
277.                       6  20 171    0.034
278.                       6  28 179    0.034
279.                       7   3 184    0.034
280.                       7  10 191    0.034   10 appl
281.                       7  17 198    0.034
282.                       7  24 205    0.034
283.                       7  31 212    0.034
284.                       8   7 219    0.034
285.                       8  14 226    0.034
286.                       8  21 233    0.034
287.     1                          SWRRB -    PP321/COTTON/YAZOO, MISS/1972(MAX)
288.     0                                     OUTPUT DATA
289.
290.
291.     0        INDEX TO COLUMN DEFINITIONS
292.
293.          RAIN      DAILY PRECIPITATION  (CM)
294.          RUNOFF    MEASURED RUNOFF (CM)
295.          SEDIMT    SEDIMENT YIELD (KG/HA)
296.          PESTLCH   PESTICIDE LEACHED BELOW 1 CM (GM/HA)
297.          PESTRNF   TOTAL PESTICIDE RUNOFF (GM/HA)
298.          DISPEST   DISSOLVED PESTICIDE RUNOFF (GM/HA)
299.          SORBPES   SORBED PESTICIDE RUNOFF (GM/HA)
300.          EVAP      EVAPOTRANSPIRATION  (CM)
301.          PERC      PERCOLATION (CM)
302.          PKRNF     PEAK RUNOFF RATE (M**3/SEC)
303.          WTRYD     WATER YIELD (CM)
304.          RTNFLOW   RETURN FLOW STORAGE (CM)
305.          SOILWTR   SOIL WATER (CM)
```

YR	MM	DD	DAY	RAIN (CM)	RUNOFF (CM)	SEDIMT (KG/HA)	PESTLCH (GM/HA)	PESTRNF (GM/HA)	DISPEST (GM/HA)	SORBPES (GM/HA)	EVAP (CM)	PERC (CM)	PKRNF (M3/S)	WTRYLD (CM)	RTNFLOW (CM)	SOILWTR (CM)
72	6	20	172	2.388	0.527	237.440	0.011	0.043	0.007	0.036	0.734	0.006	134.681	0.527	2.550	13.149
72	6	25	177	1.397	0.067	27.031	0.006	0.004	0.001	0.004	0.749	0.006	22.006	0.067	2.547	12.220
72	7	3	185	3.988	1.025	426.140	0.034	0.178	0.030	0.148	0.752	0.006	346.309	1.025	2.542	11.473
72	[illegible]	[illegible]	186	3.775	3.933	1423.131	0.026	0.624 (1.8%)	0.117	0.507	0.751	0.006	777.578	3.933	2.541	11.559
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.058	4.279	0.023	0.003	0.001	0.001	0.363	0.006	23.462	0.058	2.471	1.831
72	9	[illegible]	248	1.930	0.067	27.230	0.020	0.009	0.001	0.007	0.319	0.007	21.510	0.067	2.478	1.634
72	9	17	261	1.727	0.036	5.172	0.014	0.002	0.001	0.001	0.284	0.007	2.071	0.036	2.477	1.400
72	10	22	296	3.505	0.787	45.582	0.007	0.010	0.006	0.004	0.329	0.003	32.688	0.787	2.468	3.088
72	10	26	300	1.753	0.401	13.271	0.002	0.004	0.003	0.001	0.318	0.004	7.085	0.401	2.471	3.220
72	10	27	301	0.610	0.384	32.978	0.002	0.005	0.003	0.003	0.315	0.005	37.578	0.384	2.476	3.121
72	10	30	304	0.508	0.033	4.059	0.002	0.001	0.000	0.000	0.309	0.005	10.447	0.033	2.493	2.804
72	11	1	306	2.159	0.813	186.060	0.001	0.022	0.006	0.016	0.304	0.005	390.240	0.813	2.502	3.613
72	11	2	307	2.718	2.435	465.443	0.001	0.055	0.017	0.038	0.300	0.005	733.956	2.435	2.504	3.589
72	11	3	308	0.152	0.067	3.368	0.001	0.001	0.000	0.000	0.296	0.005	3.998	0.067	2.505	3.372
72	11	7	312	2.616	0.636	46.031	0.001	0.007	0.004	0.003	0.282	0.004	45.131	0.636	2.498	4.416
72	11	13	318	6.248	3.447	353.838	0.001	0.043	0.019	0.024	0.262	0.004	317.749	3.447	2.489	5.934
72	11	18	323	2.311	2.076	217.275	0.001	0.025	0.011	0.014	0.188	0.004	220.865	2.076	2.479	5.089
72	11	28	333	3.480	1.200	28.561	0.001	0.006	0.005	0.001	0.223	0.003	10.202	1.200	2.452	6.431
72	11	29	334	1.397	1.133	59.429	0.001	0.008	0.005	0.003	0.221	0.003	39.990	1.133	2.451	6.473
72	12	4	339	1.194	0.307	42.386	0.000	0.004	0.001	0.002	0.211	0.003	49.499	0.307	2.440	6.360
72	12	8	343	1.829	0.656	42.011	0.000	0.005	0.003	0.002	0.205	0.003	22.782	0.656	2.432	6.949
72	12	9	344	0.432	0.229	47.360	0.000	0.004	0.001	0.003	0.203	0.003	80.915	0.229	2.430	6.948
72	12	10	345	5.232	4.940	807.940	0.000	0.065	0.022	0.043	0.202	0.003	593.433	4.940	2.427	7.038
72	12	12	347	1.270	1.073	61.723	0.000	0.007	0.004	0.003	0.199	0.003	27.676	1.073	2.423	6.885
72	12	14	349	4.775	3.530	1037.857	0.000	0.071	0.016	0.055	0.197	0.003	1298.689	3.530	2.419	7.734
72	12	19	354	0.889	0.259	7.911	0.000	0.001	0.001	0.000	0.192	0.003	2.927	0.259	2.409	7.601
72	12	20	355	2.946	2.904	827.721	0.000	0.053	0.012	0.041	0.192	0.002	1053.801	2.904	2.407	7.451
72	12	21	356	2.769	2.058	465.517	0.000	0.031	0.008	0.023	0.191	0.002	532.058	2.058	2.405	7.969

1 SWRRB - PP321/COTTON/YAZOO, MISS/1972(MAX)
0 SUMMARY OUTPUT
0 INDEX TO MONTHLY SUMMARY ROW DEFINITIONS

RAIN PRECIPITATION (CM)
MRNF MEASURED RUNOFF (CM)
PRNF PREDICTED RUNOFF (CM)
SED PREDICTED SEDIMENT YIELD (KG/HA)
LECH PESTICIDE LEACHED BELOW 1 CM (G/HA)
PEST TOTAL PESTICIDE RUNOFF (G/HA)
DPST DISSOLVED PESTICIDE IN RUNOFF (G/HA)
SBPT SORBED PESTICIDE IN RUNOFF (G/HA)

1 SWRRB - PP321/COTTON/YAZOO, MISS/1972(MAX)
0 SUMMARY OUTPUT

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
1972													
RAIN	26.975	6.502	23.241	11.379	11.684	11.455	9.957	3.277	5.639	10.287	21.082	22.885	164.363
MRNF	21.250	1.196	15.043	4.699	6.318	1.814	4.959	0.058	0.103	1.605	11.807	16.065	84.915
PRNF	21.250	1.196	15.043	4.699	6.318	1.814	4.959	0.058	0.103	1.605	11.807	16.065	84.915
SED	2096.167	241.060	1503.278	994.437	1157.484	764.328	1849.272	4.386	32.407	95.896	1360.004	3347.958	13446.559
LECH	0.000	0.000	0.000	0.000	0.000	0.027	0.074	0.052	0.055	0.045	0.014	0.010	0.276
PEST	0.000	0.000	0.000	0.000	0.000	0.047	0.802	0.003	0.010	0.019	0.167	0.241	1.288
DPST	0.000	0.000	0.000	0.000	0.000	0.007	0.147	0.001	0.002	0.011	0.067	0.068	0.304
SBPT	0.000	0.000	0.000	0.000	0.000	0.040	0.655	0.001	0.008	0.008	0.100	0.172	0.985
0.083	93.271	0.091	101.442										

1 SWRRB - PP321/COTTON/YAZOO, MISS/1972(MAX)

YEAR	RAIN (CM)	MEAS RNF (CM)	PRED RNF (CM)	EVAP (CM)	PERC (CM)	SEDIMENT (KG/HA)
1972	164.363	84.915	84.915	81.657	2.949	13446.559
TOTAL	164.363	84.915	84.915	81.657	2.949	13446.559

SWRRB - PP321/COTTON/YAZOO, MISS/1972(MAX)
PESTICIDE BALANCE

	[illegible] (GM/HA)	[illegible] (GM/HA)	LEACHED (GM/HA)	TOT RUNOFF (GM/HA)	DIS.RUNOFF (GM/HA)	SORB.RNF (GM/HA)
[illegible]	[illegible]	[illegible].713	0.276	1.288 (0.38%)	0.304	0.984
TOTAL	336.250	194.713	0.276	1.288	0.304	0.984

0.38% x 10 A = 3.8% from 10 A. drainage basin to 1 A. pond

Event. 1975 10 mm (120, 1.5) Pred. Runoff

1 258/1

0 ADSORPTION COEFFICIENT (KD) 1200.0

FOLIAR HALF LIFE (DAYS) 6.0

SOIL DECAY CONSTANT (/DAYS) 0.02310

APPLICATION EFFICIENCY 0.60

INITIAL PESTICIDE ON FOLIAGE (KG/HA) 0.0

INITIAL PESTICIDE ON GROUND (KG/HA) 0.0

ENRICHMENT RATIOS FOR PESTICIDE 1.50

PESTICIDE APPLICATIONS

YEAR	MM	DD	JULI	KG/HA
1975	6	20	171	0.034
	6	27	178	0.034
	7	4	185	0.034
	7	9	190	0.034
	7	16	197	0.034
	7	23	204	0.034
	7	30	211	0.034
	8	6	218	0.034
	8	12	224	0.034
	8	19	231	0.034

1 SWRRB - PP321/COTTON/YAZOO, MISS,1975(MID)

0 OUTPUT DATA

0 INDEX TO COLUMN DEFINITIONS

RAIN	DAILY PRECIPITATION (CM)
RUNOFF	MEASURED RUNOFF (CM)
SEDIMT	SEDIMENT YIELD (KG/HA)
PESTLCH	PESTICIDE LEACHED BELOW 1 CM (GM/HA)
PESTRNF	TOTAL PESTICIDE RUNOFF (GM/HA)
DISPEST	DISSOLVED PESTICIDE RUNOFF (GM/HA)
SORBPES	SORBED PESTICIDE RUNOFF (GM/HA)
EVAP	EVAPOTRANSPIRATION (CM)
PERC	PERCOLATION (CM)
PKRNF	PEAK RUNOFF RATE (M**3/SEC)
WTRYD	WATER YIELD (CM)
RTNFLOW	RETURN FLOW STORAGE (CM)
SOILWTR	SOIL WATER (CM)

1 SWRRB - PP321/COTTON/YAZOO, MISS,1975(MID)

DAILY VALUES

YR	MM	DD	DAY	RAIN (CM)	RUNOFF (CM)	SEDIMT (KG/HA)	PESTLCH (GM/HA)	PESTRNF (GM/HA)	DISPEST (GM/HA)	SORBPES (GM/HA)	EVAP (CM)	PERC (CM)	PKRNF (M3/S)	WTRYLD (CM)	RTNFLOW (CM)	SOILWTR (CM)
75	6	22	173	1.372	0.150	89.010	0.005	0.015	0.002	0.013	0.736	0.006	82.088	0.150	2.546	13.016
75	7	10	191	2.083	0.112	64.913	0.034	0.028	0.003	0.024	0.749	0.005	110.579	0.112	2.536	6.421
75	7	19	200	2.413	0.186	81.176	0.033	0.036	0.006	0.030	0.695	0.005	98.729	0.186	2.517	3.077
75	7	24	205	2.057	0.095	15.304	0.034	0.009	0.003	0.006	0.596	0.004	9.880	0.095	2.496	2.683
75	8	3	215	2.743	0.322	12.762	0.028	0.012	0.008	0.004	0.563	0.003	28.364	0.322	2.460	2.654
75	8	17	229	9.169	4.582	289.003	0.034	0.261	0.149	0.113	0.659	0.003	523.996	4.582	2.439	4.894
[illegible]				[illegible]	[illegible]	[illegible]	0.025	0.005	0.003	0.002	0.328	0.007	1.130	0.122	2.442	1.697

31

321.	75	9	16	259	2.438	0.479	195.061	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
322.	75	9	20	263	1.448	0.106	22.172	0.007	0.007	0.002	0.005	0.453	0.003	9.447	[illegible]	[illegible]	[illegible]
323.	75	10	25	298	3.937	0.822	160.807	0.009	0.027	0.008	0.019	0.323	0.006	297.400	0.822	2.437	3.090
324.	75	10	26	299	0.254	0.090	7.402	0.006	0.002	0.001	0.001	0.318	0.005	11.091	0.090	2.452	2.916
325.	75	11	3	307	5.309	2.022	105.657	0.004	0.025	0.015	0.010	0.300	0.005	62.596	2.022	2.452	4.686
326.	75	11	4	308	2.946	2.662	636.871	0.003	0.088	0.023	0.066	0.296	0.004	1175.302	2.662	2.457	4.665
327.	75	11	6	310	5.588	5.294	195.713	0.001	0.053	0.037	0.016	0.289	0.004	71.863	5.294	2.459	4.477
328.	75	11	26	330	3.327	0.797	163.660	0.003	0.018	0.005	0.013	0.230	0.003	346.933	0.797	2.419	5.743
329.	75	11	30	334	4.343	2.402	465.866	0.001	0.049	0.015	0.035	0.221	0.003	745.170	2.402	2.414	6.785
330.	75	12	6	340	2.388	1.090	192.192	0.001	0.020	0.006	0.013	0.210	0.002	206.955	1.090	2.405	6.933
331.	75	12	25	359	3.150	0.931	189.107	0.003	0.016	0.005	0.011	0.189	0.002	235.398	0.931	2.369	7.613

332. 1 SWRRB - PP321/COTTON/YAZOO, MISS,1975(MID)
333. 0 SUMMARY OUTPUT
334. 0 INDEX TO MONTHLY SUMMARY ROW DEFINITIONS
335.
336. RAIN PRECIPITATION (CM)
337. MRNF MEASURED RUNOFF (CM)
338. PRNF PREDICTED RUNOFF (CM)
339. SED PREDICTED SEDIMENT YIELD (KG/HA)
340. LECH PESTICIDE LEACHED BELOW 1 CM (G/HA)
341. PEST TOTAL PESTICIDE RUNOFF (G/HA)
342. DPST DISSOLVED PESTICIDE IN RUNOFF (G/HA)
343. SBPT SORBED PESTICIDE IN RUNOFF (G/HA)

SWRRB - PP321/COTTON/YAZOO, MISS,1975(MID)
SUMMARY OUTPUT

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
1975													
RAIN	9.576	13.360	18.288	11.938	13.665	12.065	7.264	14.630	10.211	5.664	23.216	7.188	147.065
MRNF	3.818	6.806	11.374	4.391	5.094	3.504	0.392	4.914	1.623	0.920	13.196	2.080	58.111
PRNF	3.818	6.806	11.374	4.391	5.094	3.504	0.392	4.914	1.623	0.920	13.196	2.080	58.111
SED	424.283	2241.653	799.718	739.377	1363.218	1972.968	161.398	302.044	380.169	168.450	1568.064	390.254	10511.469
LECH	0.000	0.000	0.000	0.000	0.000	0.005	0.113	0.195	0.120	0.032	0.022	0.011	0.499
PEST	0.000	0.000	0.000	0.000	0.000	0.015	0.072	0.274	0.132	0.029	0.234	0.036	0.792
DPST	0.000	0.000	0.000	0.000	0.000	0.002	0.012	0.157	0.035	0.009	0.095	0.011	0.321
SBPT	0.000	0.000	0.000	0.000	0.000	0.013	0.060	0.117	0.097	0.020	0.139	0.025	0.470

0.096 107.448 0.077 85.986

SWRRB - PP321/COTTON/YAZOO, MISS,1975(MID)
WATER BALANCE

YEAR	RAIN (CM)	MEAS RNF (CM)	PRED RNF (CM)	EVAP (CM)	PERC (CM)	SEDIMENT (KG/HA)
1975	147.065	58.111	58.111	91.936	2.652	10511.469
TOTAL	147.065	58.111	58.111	91.936	2.652	10511.469

SWRRB - PP321/COTTON/YAZOO, MISS,1975(MID)
PESTICIDE BALANCE

YEAR	APPLIED (GM/HA)	DECAYED (GM/HA)	LEACHED (GM/HA)	TOT RUNOFF (GM/HA)	DIS.RUNOFF (GM/HA)	SORB.RNF (GM/HA)
1975	336.250	193.434	0.498	0.792 (0.24%)	0.321	0.470
TOTAL	336.250	193.434	0.498	0.792	0.321	0.470

0.24% x 10 = 2.4% from 10 A. drainage basin to 1 A. pond

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1977 MIN. RUNOFF

P.11

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fetch 6977 clr
? 1 258/1
258.     0    ADSORPTION COEFFICIENT (KD)                          1200.0
259.
260.          FOLIAR HALF LIFE (DAYS)                                 6.0
261.
262.          SOIL DECAY CONSTANT (/DAYS)                            0.02310
263.
264.          APPLICATION EFFICIENCY                                 0.60
265.
266.          INITIAL PESTICIDE ON FOLIAGE (KG/HA)                   0.0
267.
268.          INITIAL PESTICIDE ON GROUND (KG/HA)                    0.0
269.
270.          ENRICHMENT RATIOS FOR PESTICIDE                        1.50
271.
272.
273.          PESTICIDE APPLICATIONS
274.                YEAR   MM  DD JULI   KG/HA
275.
276.                1977
277.                       6  19 171    0.034
278.                       6  26 178    0.034
279.                       7   3 185    0.034
280.                       7  10 192    0.034
281.                       7  17 199    0.034
282.                       7  24 206    0.034
283.                       7  31 213    0.034
284.                       8   7 220    0.034
285.                       8  15 228    0.034
286.                       8  22 235    0.034
287.     1                          SWRRB -    PP321/COTTON/YAZOO, MISS/1977(MIN)
288.     0                                     OUTPUT DATA
289.
290.
291.     0        INDEX TO COLUMN DEFINITIONS
292.
293.          RAIN       DAILY PRECIPITATION  (CM)
294.          RUNOFF     MEASURED RUNOFF (CM)
295.          SEDIMT     SEDIMENT YIELD (KG/HA)
296.          PESTLCH    PESTICIDE LEACHED BELOW 1 CM (GM/HA)
297.          PESTRNF    TOTAL PESTICIDE RUNOFF (GM/HA)
298.          DISPEST    DISSOLVED PESTICIDE RUNOFF (GM/HA)
299.          SORBPES    SORBED PESTICIDE RUNOFF (GM/HA)
300.          EVAP       EVAPOTRANSPIRATION  (CM)
301.          PERC       PERCOLATION (CM)
302.          PKRNF      PEAK RUNOFF RATE (M**3/SEC)
303.          WTRYD      WATER YIELD (CM)
304.          RTNFLOW    RETURN FLOW STORAGE (CM)
305.          SOILWTR    SOIL WATER (CM)
306.     1                          SWRRB -    PP321/COTTON/YAZOO, MISS/1977(MIN)
307.                                                  DAILY VALUES
308.
309.
310.          YR MM DD DAY    RAIN     RUNOFF   SEDIMT   PESTLCH  PESTRNF  DISPEST  SORBPES   EVAP     PERC     PKRNF    WTRYLD   RTNFLOW  SOILWTR
                                                                  (GM/HA)  (GM/HA)  (GM/HA)   (CM)     (CM)     (M3/S)   (CM)     (CM)     (CM)
```

33

313.	77	7	28	209	2.007	0.091	11.381	0.020	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
314.	77	8	14	226	2.997	0.383	13.842	0.025	0.012	0.008	0.004	0.468	0.006	27.608	0.383	2.451	2.305
315.	77	8	28	240	2.210	0.128	14.401	0.025	0.008	0.003	0.004	0.347	0.007	88.586	0.128	2.460	1.751
316.	77	9	24	267	3.683	0.682	264.646	0.014	0.060	0.011	0.049	0.397	0.007	122.676	0.682	2.482	2.569
317.	77	9	30	273	4.445	1.667	973.045	0.006	0.186	0.023	0.163	0.453	0.004	513.176	1.667	2.492	4.207
318.	77	10	2	275	0.635	0.407	25.688	0.005	0.008	0.005	0.004	0.439	0.004	22.696	0.407	2.494	3.537
319.	77	10	7	280	2.921	0.746	92.963	0.005	0.020	0.008	0.012	0.418	0.004	123.234	0.746	2.488	3.913
320.	77	11	1	305	3.988	0.839	44.882	0.007	0.009	0.006	0.004	0.308	0.005	29.852	0.839	2.441	3.590
321.	77	11	16	320	3.962	0.887	54.021	0.005	0.009	0.005	0.004	0.256	0.004	43.063	0.887	2.429	4.973
322.	77	11	21	325	1.270	0.195	4.540	0.001	0.001	0.001	0.000	0.242	0.003	2.353	0.195	2.426	5.569
323.	77	11	29	333	4.445	2.056	241.457	0.001	0.026	0.011	0.015	0.223	0.003	269.274	2.056	2.410	6.893
324.	77	11	30	334	4.445	4.154	561.123	0.001	0.057	0.022	0.035	0.221	0.003	600.749	4.154	2.408	6.962
325.	77	12	4	338	0.254	0.090	10.172	0.000	0.001	0.000	0.001	0.146	0.002	13.137	0.090	2.402	6.405
326.	77	12	8	342	1.397	0.295	44.220	0.000	0.004	0.001	0.003	0.206	0.002	55.480	0.295	2.395	6.814
327.	77	12	13	347	2.591	0.934	146.909	0.000	0.013	0.004	0.008	0.199	0.002	149.469	0.934	2.387	7.523
328.	77	12	16	350	0.381	0.206	20.035	0.000	0.002	0.001	0.001	0.196	0.002	19.306	0.206	2.382	7.105

329. 1 SWRRB - PP321/COTTON/YAZOO, MISS/1977(MIN)
330. 0 SUMMARY OUTPUT
331. 0 INDEX TO MONTHLY SUMMARY ROW DEFINITIONS
332.
333. RAIN PRECIPITATION (CM)
334. MRNF MEASURED RUNOFF (CM)
335. PRNF PREDICTED RUNOFF (CM)
336. SED PREDICTED SEDIMENT YIELD (KG/HA)
337. LECH PESTICIDE LEACHED BELOW 1 CM (G/HA)
338. PEST TOTAL PESTICIDE RUNOFF (G/HA)
339. DPST DISSOLVED PESTICIDE IN RUNOFF (G/HA)
340. SBPT SORBED PESTICIDE IN RUNOFF (G/HA)
341. 1 SWRRB - PP321/COTTON/YAZOO, MISS/1977(MIN)
342. 0 SUMMARY OUTPUT
343.
344.

345. YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL
346.													
347.													
348.													
349. 1977													
350. RAIN	6.528	4.343	11.176	8.636	2.692	12.954	4.623	5.791	12.395	4.064	20.422	5.385	99.009
351. MRNF	2.136	0.598	6.033	3.784	0.113	5.557	0.091	0.511	2.354	1.153	8.157	1.526	32.012
352. PRNF	2.136	0.598	6.033	3.784	0.113	5.557	0.091	0.511	2.354	1.153	8.157	1.526	32.012
353. SED	167.819	307.618	878.757	675.089	6.258	1489.464	11.388	28.250	1238.155	118.657	907.889	221.342	6050.613
354. LECH	0.000	0.000	0.000	0.000	0.000	0.004	0.061	0.086	0.085	0.037	0.028	0.007	0.309
355. PEST	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.020	0.246	0.028	0.102	0.020	0.421
[illegible] DPST	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.012	0.034	0.013	0.044	0.007	0.112
[illegible] SBPT	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.008	0.212	0.016	0.058	0.012	0.310

357. 0.083 92.926 0.091 101.960
358. 1 SWRRB - PP321/COTTON/YAZOO, MISS/1977(MIN)
359. 0 WATER BALANCE
360.
361.

362. YEAR	RAIN (CM)	MEAS RNF (CM)	PRED RNF (CM)	EVAP (CM)	PERC (CM)	SEDIMENT (KG/HA)
363.						
364.						
365.						
366. 1977	99.009	32.011	32.011	72.286	1.525	6050.613
367.						
368.						
369. TOTAL	99.009	32.011	32.011	72.286	1.525	6050.613

370.
371. 1 SWRRB - PP321/COTTON/YAZOO, MISS/1977(MIN)
372. 0 PESTICIDE BALANCE
373.
374.

375. YEAR	APPLIED (GM/HA)	DECAYED (GM/HA)	LEACHED (GM/HA)	TOT RUNOFF (GM/HA)	DIS.RUNOFF (GM/HA)	SORB.RNF (GM/HA)
376.						

378.	1977	336.250	194.886	0.309	0.421	0.112	0.309
379.					(0.13%)		
380.							
381.	TOTAL	336.250	194.886	0.309	0.421	0.112	0.309

0.13% × 10 = 1.3% from 40 A. drainage basin to 1 A. pond

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142 PAGE READS, 198 PAGE WRITES
19 DISK READS, 3 DISK WRITES
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THE ESTIMATES OF PP 321 DRIFT AND RUNOFF LOADINGS FROM COTTON FIELDS ARE QUITE CONSERVATIVE BASED ON THE FOLLOWING CONSIDERATIONS

1) THE AVERAGE VALUES FOR FATE DATA, SUCH AS K_d, FOLIAR AND SOIL HALF-LIVES WERE USED.

2) IF A HIGHER VALUE FOR ENRICHMENT RATIO (e.g., >3 AS FOUND IN MISSISSIPPI DELTA) WERE USED, THE AMOUNT OF PP 321 RUNOFF FROM FIELDS COULD BE DOUBLED.

3) PP 321 CONSISTS OF SURFACE WATER RUNOFF (FREE WATER DISSOLVED COMPONENT AS HIGH AS 41%) AND EROSION (SOIL BOND COMPONENT) . HOWEVER, ICI INTENDS TO TREAT THE TOTAL LOADING AS A "SLURRY" WITHOUT DISTINGUISHING BETWEEEN THE WATER PHASE AND THE SOIL BOUND PHASE. THIS WILL POSSIBLY RESULT IN A "DEFICIENCY" OF DISSOLVED CHEMICAL CONCENTRATION IN THE WATER PHASE "RUNOFF" TO THE MESOCOSM.

4) IN A SINGLE YEAR SWRRB SIMULATION, ONLY TEN APPLICATIONS WERE USED TO DETERMINE THE TOTAL PESTICIDE RUNOFF.

APPENDIX I: Information Required for Calculating PP321 Aquatic Entry Rates

A. PRODUCT LABEL

This is attached as Appendix II.

The product is a 1E (13% ai) emulsifiable concentrate (EC) for aerial or ground application to cotton. Applications for cotton pest control normally commence in ~~late June/early~~ July. However, a single application may be used in late April/early May to control "early season" pests. The maximum annual use is 420 g ai/ha (0.375 lbs/acre); and the maximum application rate is 33.6 g ai/ha ~~(0.03 lbs/acre)~~. Therefore, ~~12~~ 'spray drift' applications will be made to the mesocosms (see Section 6 of this protocol amendment).

B. PP321 PROPERTIES

i)	Water solubility	= ~5µg/liter	(Ref. I/1)
ii)	Log_{10} Kow (20°C)	= 7.0	(Ref. I/1)
iii)	Kd (calc. from Kow)	= ~~500~~	(see Appendix III)
iv)	Foliar half-life	= ~~5-7~~ 6 days	(from analysis of total cotton leaf residues); personal communication, R. D. Fitzpatrick, ICI Americas
v)	Soil half-life	= ~~20-40~~ 30 days	(Visalia, Calif; 22 days, Vicksburg, Miss; 25 days, Champaign, ILL; 39 days, Goldsboro, NC; 40 days; Ref. I/2)
vi)	Ks (soil decay const) (0.693/T½).	= 0.035-0.017	0.693/30 = 0.0231

C REFERENCES

I/1 Wollerton C. (1984). Physico-chemical data file. ICI Plant Protection Division Report RJ0366B.

I/2 Fitzpatrick R. D. (1985). PP321 dissipation in US soils - 1983. ICI Americas Report TMU1809.

IAN/REG

APPENDIX III Calculation of Soil Adsorption Coefficient (Kd) for PP321

A. PP321 CALCULATION USING KOW

Log Kow	=	7.0
Log Loc	=	0.544 log Kow + 1.377 (Ref II/1)
	=	3.808 + 1.377 = 5.2
∴ Koc	=	1.5×10^5
Koc	=	(Kd/%oc) x 100 (Ref II/2)
if om	=	1.724 x oc
∴ Kd, soil om 1%	=	890
Kd, soil om 4%	=	3600

B. PP321 CALCULATION USING WATER SOLUBILITY

Water solubility(s)	=	5µg/liter
Log Koc	=	-0.55 log S + 3.64 (Ref II/1)
	=	1.266 + 3.64 = 4.9
∴ Koc	=	8.0×10^4
Kd, soil om 1%	=	470
Kd, soil om 4%	=	1900

%OC = 1.5 Mississippi delta surface layer

$Kd = Koc \times \frac{1.5}{100} = 1200$

C. VALIDITY OF CALCULATED KD VALUES USING CYPERMETHRIN

Log Kow	=	6.6 (Ref II/3)
Water solubility	=	4 µg/liter (Ref II/3)
Soil om 2.1%	:	Kd calc. as in A above = 1100
		Kd calc. as in B above = 1100
		Kd measured (Ref II/4) = 2000

Therefore calculations for cypermethrin understimate the actual Kd value.

D. REFERENCES

II/1 Kenaga E. E. and Goring C. A. I. (1980). Relationship between water solubility, soil sorption, octanol-water partitioning and bioconcentration of chemicals in the biota. ASTM 3rd Aquatic Tox. Sym, ASTM STP707.

II/2 Lyman, Reehl and Rosenblott. Handbook of Chemical Property Estimation Methods.

II/3 Wells, D. (1981). PP383 Chemical data file. ICI Plant Protection Division Report CDF 12C.

II/4 Stevens J. E. B. and Poole, N. J. (1981). Cypermethrin: Adsorption and desorption in soil. ICI Plant Protection Division Report RJ0184B.

IAN/REG

10. Conclusions:

Protocol accepted _____

Protocol accepted with modifications ___X___

Protocol rejected _____

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