A STUDY OF THE DECAY OF MEVINPHOS (PHOSDRIN) ON THE FOLIAGE AND FRUIT OF STRAWBERRIES IN SANTA CRUZ COUNTY, CALIFORNIA MAY 1977

By

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HS-375 June 14, 1977

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INTRODUCTION

Mevinphos (Phosdrin) is an extremely toxic organophosphate insecticide. All formulations sold are classified as toxicity category one pesticides on the basis of oral and dermal toxicities. It has an acute oral LD_{50} (rat) of 3.7-6 mg mevinphos/kg and an acute dermal LD_{50} (rat) of 4.2-4.7 mg mevinphos/kg Mevinphos is readily absorbed through the skin. The toxicity of this chemical is related to blood and tissue cholinesterase inhibition.

Mevinphos is used to control aphids, mites, cutworms, and many other insects on a wide range of field, forage, vegetable, and fruit crops. In 1976, its major uses were the control of insects on head lettuce and alfalfa, totaling more than 230,000 pounds. There were also more than 13,419 pounds of mevinphos applied to 15,339 acres of strawberries.

Mevinphos is marketed in the form of emulsifiable concentrates containing 4 pounds of mevinphos/gallon, concentrated water-soluble solutions that are up to 100% mevinphos and related products, and 1 and 2% dusts. The product used in this study was Vegephos 4 (Moyer, EPA No. 5967-58 AA). (A copy of the label is included in this report.) This product is an emulsifiable concentrate. The label recommends, for use on strawberries, 1 to 2 pints per acre in 10 to 20 gallons of water. There is a preharvest interval of one day and workers may not reenter a treated area "on the day of application."

APPLICATION

Pesticides were applied to three fields of strawberries at the following rates:

Phosdrin	1 qt./acre	Bufferel	1 qt./acre
Benlate	1 lb./acre	Water	20 gal/acre
Captan	4 lbs./acre		

Application was made by air on a cool, partially cloudy morning.

SAMPLING

Duplicate leaf samples and one commodity sample were taken at intervals of approximately 3-1/2 hours, 1, 2, and 3 days post-application. Each leaf sample consisted of approximately 100 leaf discs 2.5 cm in diameter. Commodity samples consisted of 25 to 30 strawberries. The leaves sampled were those closest to the berries. Samples were collected along a diagonal path across the field. Leaf samples were analyzed for total and dislodgeable residues while the commodity sample was analyzed for total residue only.

ANALYTICAL PROCEDURES (EXTRACTION)

The procedure used for the extraction of dislodgeable and total residues from leaf punches was originally published by Gunther in "The Bulletin of Environmental Contamination and Toxicology," 9, 243-249, 1973. It has been documented several times in detail, with modifications that were made to accommodate the various pesticides, and their metabolites, that the Department's Worker Safety Unit has been concerned with.

The sample container and leaf punches are weighed and the gross weight recorded.

Total Residues

1. The sample is transferred to a blending jar. The empty sample container is again weighed and the net weight of the sample recorded.

2. Approximately 50 gms of sodium sulfate and 100 mls of ethyl acetate are added.

3. The sample is blended at high speed for 3 minutes, keeping the blender cup cool by immersing it in a container of cool water. The blender cup is removed and the sample allowed to settle.

4. An aliquot is decanted into a teflon-capped bottle and stored in the freezer prior to clean up and analysis.

5. Fruit samples are handled the same as the leaf punches.

Dislodgeable Residues

1. Fifty mls of water and approximately 4 drops of Sur-Ten solution (1:50) are added to the sample containers. The containers are capped and placed in a multi-purpose rotator and rotated at 30 cycles/minute for 60 minutes. The aqueous solution is decanted through a glass wool plug into a 500 ml separatory funnel.

2. The punches are rotated a second time, using 50 mls of water and 4 drops of Sur-Ten solution, for 30 minutes. This is added to the first extraction.

3. The sample is then hand-shaken for approximately 10 secs with 30 mls of water. The container is drained into the separatory funnel with the first two extractions.

4. The aqueous solution is extracted 3 times with 50 ml of chloroform. The extract is filtered through sodium sulfate into a glass-stoppered mixing

cylinder and the volume is recorded. The extract is mixed in the cylinder. An aliquot is decanted into a teflon-capped bottle and stored in the freezer prior to clean up and analysis.

ANALYTICAL PROCEDURES (CHROMATOGRAPHY)

Samples were analyzed by gas chromatography with a Varian Series 2700 chromatograph equipped with a flame photometric detector in its phosphorus mode and the following conditions:

Column	- 3% OV-275, 100/120 Chromabsorb W (HP); 6' x 1/4" x 2 mm I.D.
Column Temp.	- 160°C
Injector Temp.	- 230°C
Detector Temp.	- 230°C
Retention Times	- Phosdrin = 2.0 min. Phosdrin = 2.8 min.

RESULTS

Daily temperatures and precipitation are recorded on Table 1. The average maximum and minimum temperatures were 61.8 and 43.9°F, respectively.

Mevinphos dissipates quite rapidly, as is shown by the degradation curves (Figures 1-4). The more toxic alpha isomer tends to dissipate a little faster than the somewhat less toxic beta isomer. The tolerance for Phosdrin on strawberries is 1 ppm. Mevinphos residues in the berries never reached that level during this study. Considering the levels of Phosdrin that are found on the surface of lettuce leaves and the evidence of systemic poisoning of lettuce field workers when fields have been entered prior to 48 hours post-application, similar levels of Phosdrin on strawberry leaves would be expected to have the same poisoning potential for field workers having hand contact with strawberry leaves. Two days post-application, it might be barely safe to have body contact with strawberry plants, but 48 hours would provide a far greater measure of safety for field workers.

TABLE 1: DAILY TEMPERATURE AND PRECIPATION
Weather Observations Taken at Watsonville,
Santa Cruz County, California

Date (1976)	TEMPERATURE (°F) Maximum	Minimum	Precipation (Inches)
5/2	63	51	-
5/3	67	47	-
5/4	64	41	-
5/5	59	42	-
5/6	61	37	-
5/7	59	41	-
5/8	60	47	0.22
5/9	61	45	0.31
Average	61.8	43.9	Total 0.53

TABLE 2: MEVINPHOS (PHOSDRIN) RESIDUES ON THE FOLIAGE
OF STRAWBERRY PLANTS IN SANTA CRUZ COUNTY

Field 1

Date (1977)	Sample Interval	Surface Residue (ppm) Alpha Phosdrin	Beta Phosdrin	Total Residue (ppm) Alpha Phosdrin	Beta Phosdrin
5/3	3 hrs.	5.80	-	10.8	4.10
5/4	26.5 hrs.	1.79	-	4.48	1.97
5/5	49.5 hrs.	0.34	-	4.19	1.63
5/6	3 days	0.28	<0.2	0.73	0.98

Field 2

Date (1977)	Sample Interval	Surface Residue (ppm) Alpha Phosdrin	Beta Phosdrin	Total Residue (ppm) Alpha Phosdrin	Beta Phosdrin
5/3	3.5 hrs.	8.62	-	8.78	2.54
5/4	25 hrs.	2.11	-	3.39	2.45
5/5	2 days	1.80	-	6.80	1.41
5/6	3 days	0.78	0.23	0.87	0.85

Field 3

Date (1977)	Sample Interval	Surface Residue (ppm) Alpha Phosdrin	Beta Phosdrin	Total Residue (ppm) Alpha Phosdrin	Beta Phosdrin
5/3	3.5 hrs.	6.71	-	6.40	1.69
5/4	25 hrs.	2.00	-	3.45	-
5/5	2 days	0.63	-	1.43	1.41
5/6	3 days	0.32	0.23	0.47	0.75

TABLE 3: MEVINPHOS (PHOSDRIN) RESIDUES IN STRAWBERRIES IN SANTA CRUZ COUNTY, CALIFORNIA

Field 1

Date (1977)	Sample Interval	Total Residue (ppm) Alpha Phosdrin	Beta Phosdrin
5/3	3 hrs.	0.51	-
5/4	26.5 hrs.	0.24	-
5/5	2 days	0.33	-
5/6	3 days	0.25	<0.10

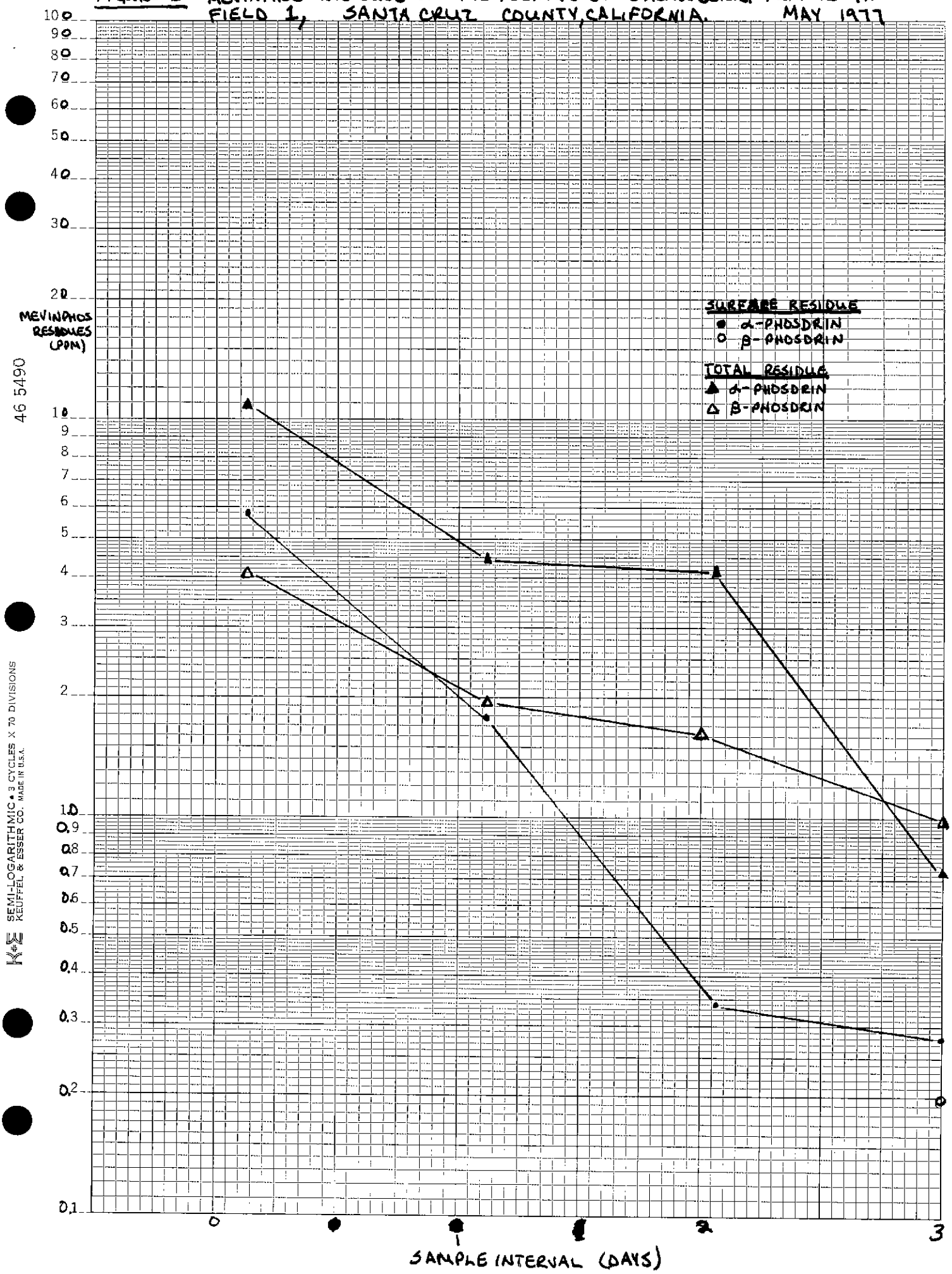
Field 2

Date (1977)	Sample Interval	Total Residue (ppm) Alpha Phosdrin	Beta Phosdrin
5/3	3.5 hrs.	0.48	-
5/4	25 hrs.	0.22	-
5/5	2 days	0.16	-
5/6	3 days	0.16	<0.10

Field 3

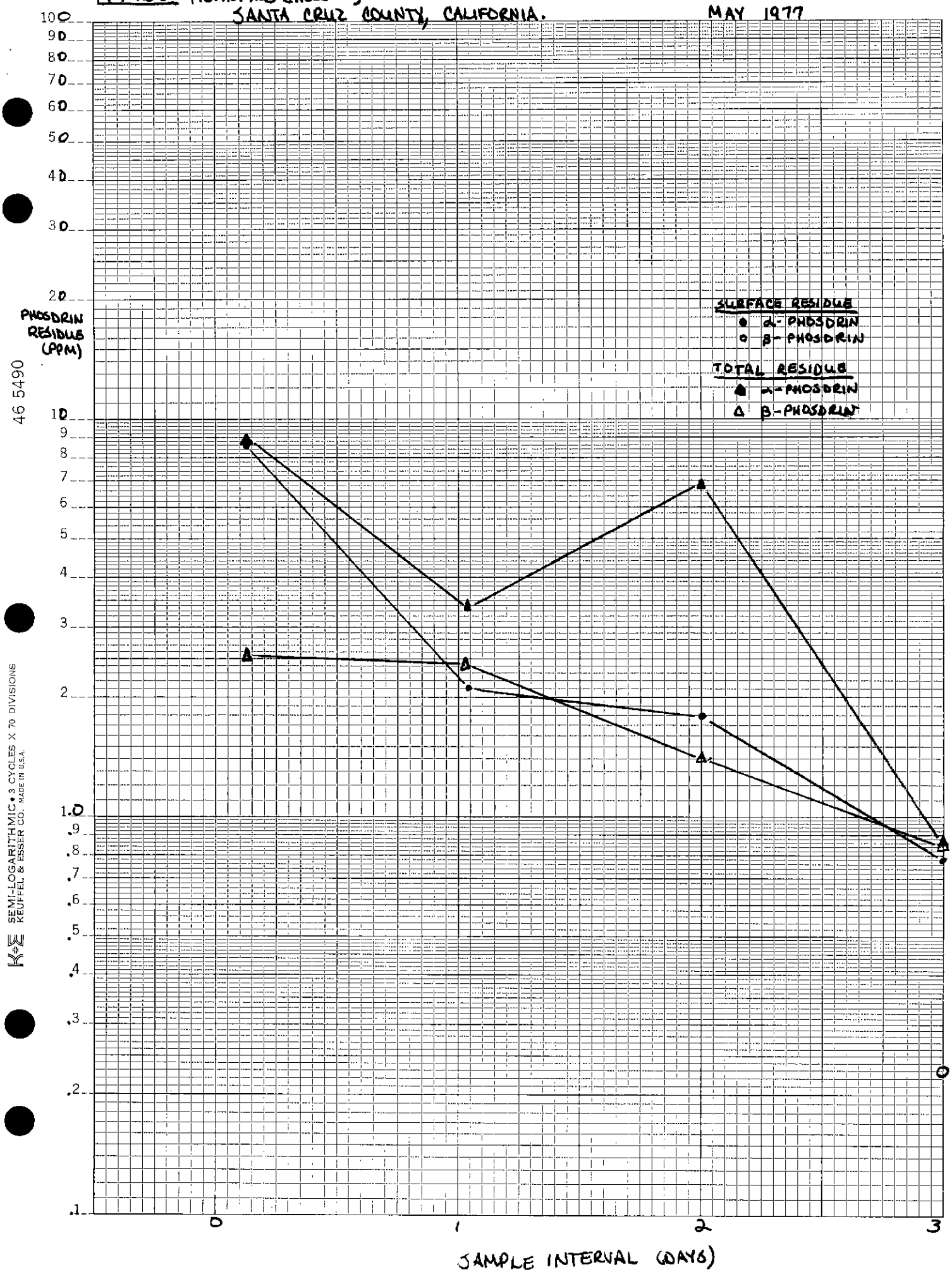
Date (1977)	Sample Interval	Total Residue (ppm) Alpha Phosdrin	Beta Phosdrin
5/3	3.5 hrs.	0.78	-
5/4	25 hrs.	0.59	-
5/5	2 days	0.92	0.21
5/6	3 days	0.29	<0.10

FIGURE 1: MEVINPHOS RESIDUES ON THE FOLIAGE OF STRAWBERRY PLANTS IN FIELD 1, SANTA CRUZ COUNTY, CALIFORNIA. MAY 1977



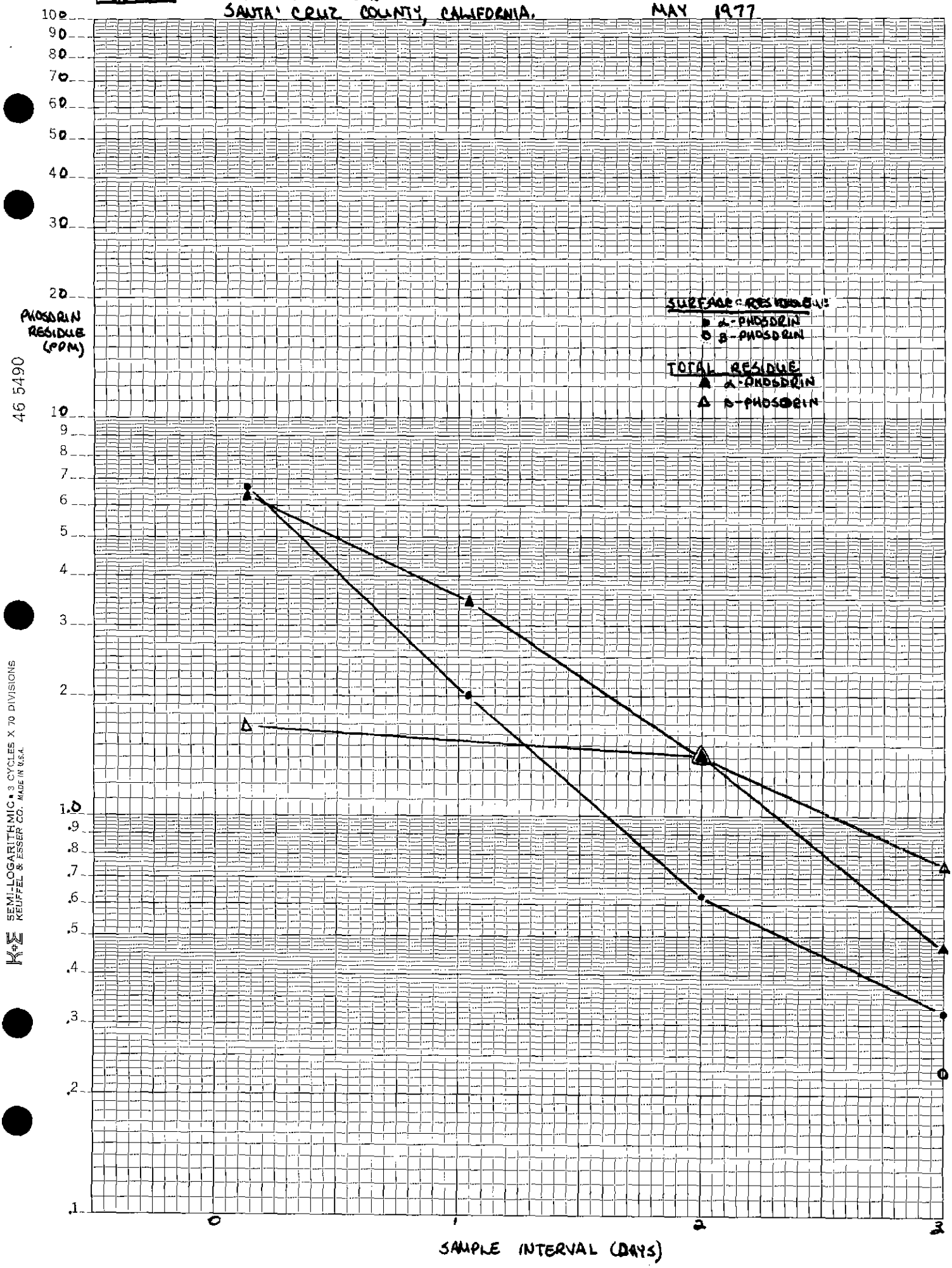
46 5490
K&E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 2: MEVINPHOS (PHOSDRIN) RESIDUES ON THE FOLIAGE OF STRAWBERRY PLANTS IN FIELD 2
SANTA CRUZ COUNTY, CALIFORNIA. MAY 1977



46 5490
K+E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 3: MEVINPHOS (PHOSDRIN) RESIDUES ON FOLIAGE OF STRAWBERRY PLANTS IN FIELD 3
SANTA CRUZ COUNTY, CALIFORNIA. MAY 1977



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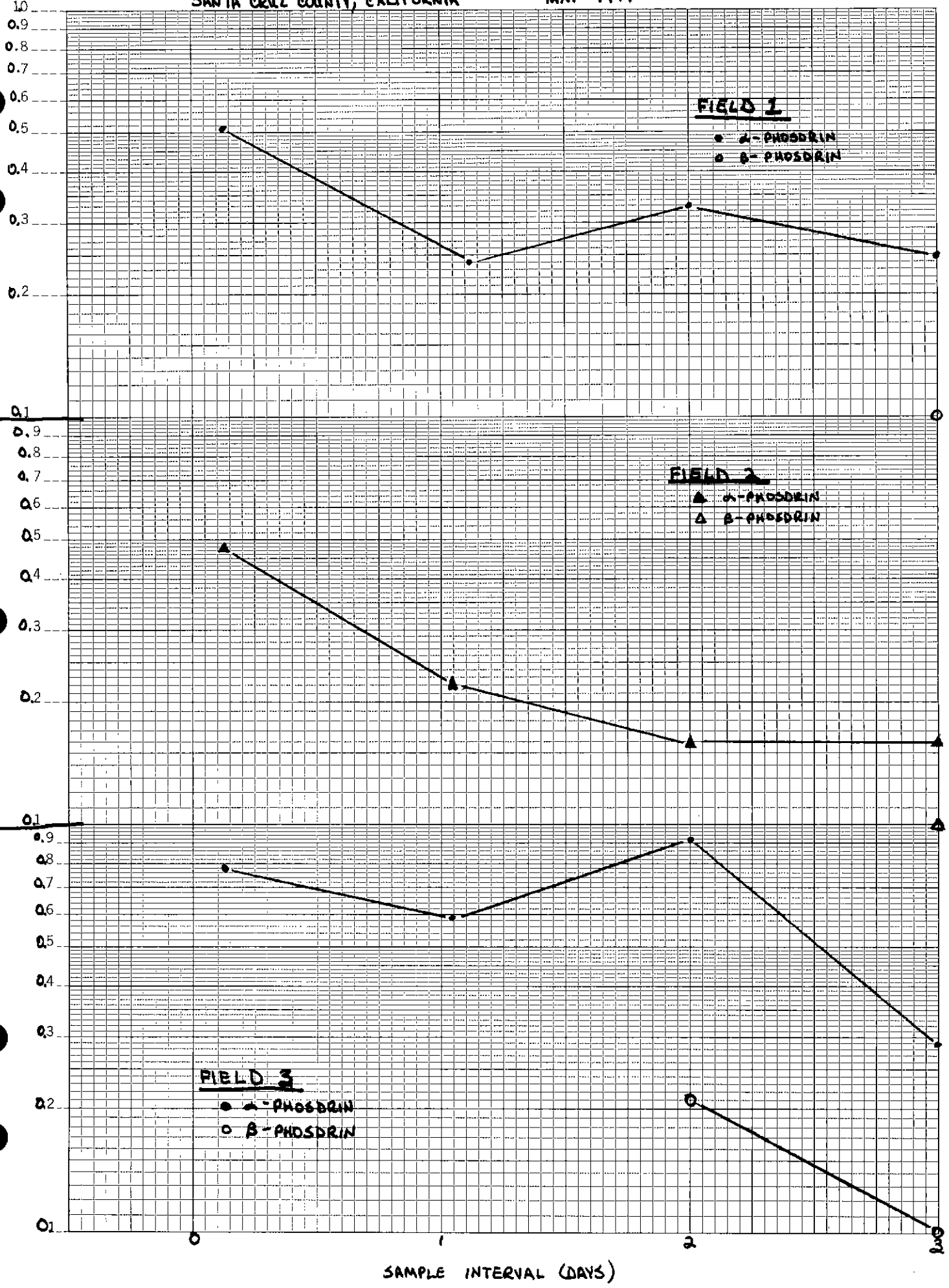
K&E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

FIGURE 4: MEVINPHOS (PHOSDRIN) RESIDUE ON STRAWBERRIES
SANTA CRUZ COUNTY, CALIFORNIA MAY 1977



46 5490
K+E SEMI-LOGARITHMIC • 3 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

MOYER

CHEMICALS

PRODUCT BULLETIN

SAN JOSE, CALIFORNIA

FOR DISTRIBUTION AND USE ONLY WITHIN CALIFORNIA

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

VEGAPHOS 4

Lettuce, head and leaf grown outdoors: Aphids use ½ to ⅓ pint per acre. Corn earworm, Dipterous Leaf Miner Adults, Cabbage Looper, imported Cabbageworm, Grasshoppers, Spider Mites, Salt Marsh Caterpillars, False Cinch Bug, Thrips, use ¼ to ½ pint per acre. For hard to kill insects, use up to 2 pints per acre.

Do not apply within 4 days of harvest if using more than 1 pint per acre.

Do not apply within 2 days of harvest if using 1 pint or less per acre.

In Monterey, Santa Cruz or San Benito counties, use 10 to 20 gallons of water if applied by air.

FOLLOW ALL PRECAUTIONS AND DANGER STATEMENTS ON THE PRODUCT LABEL:

EPA REG. NO.	5967-58
EPA EST. NO.	5967-CA-1
EPA SLN. NO.	CA760184

TWR:cf

MOYER CHEMICALS

PRODUCT BULLETIN

SAN JOSE, CALIFORNIA

VEGEPHOS 4
~~E.P.A. Reg. No. 5967-58~~

AERIAL APPLICATION:

VEGEPHOS 4 may be applied by air, using 5 to 20 gallons of water, for those crops specified on the VEGEPHOS 4 label. Amount of VEGEPHOS 4 per acre must be exactly the same as shown on the label.

FOLLOW ALL PRECAUTIONS ON THE LABEL

T.W.R.
5-7-73

No. 30

DIRECTIONS FOR USE:

THIS MATERIAL IS AN AGRICULTURAL PESTICIDE FOR THE FOLLOWING USES:

APPLES, PEACHES, PLUMS, CHERRIES: Aphids, Grasshoppers, Lygus Bugs, Red Banded Leaf Roller—1/4-1/2 pint per 100 gallons of water. Apply 200 to 500 gallons of solution per acre. Do not apply within 1 day of harvest on Apples, Peaches and Plums; within 2 days of harvest on Cherries.

CITRUS FRUITS: ORANGES, LEMONS, GRAPEFRUIT: Aphids—2 to 4 pints in 200-400 gals. water per acre. Fruit Tree Leaf Roller, Orange Tortrix, Omnivorous Leaf Roller—2 to 4 pints in 500 gals. of water per acre. Western Tussock Moth, Citrus Cutworm, Variegated Cutworm, Pink Scavenger Caterpillar—1 to 2 quarts in 600 to 1200 gals. of water per acre. Do not apply within 1 day of harvest. Allow at least 7 days between applications.

GRAPES: Aphids, Leaf Folder, Leafhoppers, Spider Mites, Red Banded Leaf Roller, Lygus Bugs—1 to 2 pints per acre. Do not apply within 2 days of harvest.

RASPBERRY: Aphids—1/3 pint per 100 gallons of water. Apply 100 to 200 gallons solution per acre. Spider Mites, Leafhoppers, Fruit Tree Leaf Roller, Orange Tortrix—1/2 pint per 100 gallons of water. Apply 100 to 200 gals. solution per acre. Do not apply within 3 days of harvest.

STRAWBERRY: Aphids, Grasshoppers, Strawberry Leaf Roller, Salt Marsh Caterpillar, Lygus Bugs, Spider Mites—1 to 2 pints per acre. Do not apply within 1 day of harvest.

WALNUTS: Aphids—1/4 to 1/2 pint per 100 gals. of water. Apply 400 to 800 gals. solution per acre. Spider Mites, Omnivorous Leaf Roller, Orange Tortrix, Fruit Tree Leaf Roller, Western Tussock Moth—1/2 pint per 100 gallons of water. Apply 400 to 800 gals. solution per acre. Do not apply within 1 day of harvest.

GREENHOUSE ORNAMENTALS, FLOWERING PLANTS: Aphids, Greenhouse White Fly, Spider Mites—3.2 fl. oz. per 10,000 cu. ft. applied as a 10% aerosol.

ALFALFA, CLOVER: Aphids, Alfalfa Caterpillar, Grasshoppers, Leafhoppers, Climbing Cutworms, Spider Mites, Alfalfa Weevil Larvae, Lygus Bugs—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

SORGHUM, FOR FORAGE AND GRAIN: Aphids, Corn Earworm, Webworms, Fall Armyworm—1/2 to 1 pint per acre. Do not apply within 3 days of harvest.

ARTICHOKE: Aphids, Plume Moth—1/2 to 2 pints per acre. Do not apply within 2 days of harvest.

BEANS: Aphids, Grasshoppers, Leafhoppers, Spider Mites, Mexican Bean Beetle—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

BEETS, INCLUDING TOPS: Aphids, Cabbage Looper, Climbing Cutworm, Dipterous Leaf Miner Adult, False Chinchbug, Grasshoppers, Imported Cabbage Worm, Leafhoppers, Spider Mites, Salt Marsh Caterpillar—1/2 to 1 pint per acre. Do not apply within 3 days of harvest.

BROCCOLI, BRUSSELS SPROUTS, CABBAGE, CAULIFLOWER Aphids, Cabbage Looper, Imported Cabbage Worm, Grasshoppers, Leafhoppers, Salt Marsh Caterpillar, Spider Mites, Climbing Cutworms, Dipterous Leaf Miner Adults—1/2 to 2 pints per acre. Do not apply within 3 days of harvest.

CARROTS: Aphids, Leafhoppers, Lygus Bugs, Spider Mites, Cabbage Looper, Dipterous Leaf Miner, Climbing Cutworms, Salt Marsh Caterpillar—1/2 to 1 pint per acre. Do not apply within one day of harvest.

CELERY: Aphids, Dipterous Leaf Miner Adults, Lygus Bugs, Salt Marsh Caterpillar, Leafhoppers, Cabbage Looper, Spider Mite—1/2 to 2 pints per acre. Do not apply within 5 days of harvest. 1 pint—Do not apply within 3 days of harvest.

CORN; FIELD, SWEET AND POP FOR GRAIN AND FORAGE ONLY: Aphids—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

CUCUMBERS, OUTDOOR: Aphids, Grasshoppers, Leafhoppers, Spider Mites—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

EGGPLANT, PEPPERS, Aphids, Grasshoppers, Leaf Miners, Spider Mites—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

LETTUCE: Aphids, Corn Earworm, Dipterous Leaf Miner Adults, Cabbage Looper, Imported Cabbage Worm, Grasshoppers, Spider Mites, Lygus Bugs, Salt Marsh Caterpillar, False Cinch Bug, Thrips—1/2 to 2 pints per acre. Do not apply within 4 days of harvest. 1 pint—Do not apply within 2 days of harvest. 2 pints—Do not apply within 4 days of harvest.

MELONS; CANTALOUPE, HONEYDEW, MUSKMELON, WATERMELON: Aphids, Cabbage Looper, Dipterous Leaf Miner Adults, Leafhoppers, Lygus Bugs, Spider Mites, False Cinch Bug, Salt Marsh Caterpillar, Climbing Cutworms, Grasshoppers—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

MUSTARD GREENS: Aphids, Cabbage Looper, Imported Cabbage Worm, Leafminer Adults, Leafhoppers—1/2-1 pint per acre. Do not apply within 3 days of harvest.

OKRA: Aphids, Climbing Cutworms, Corn Earworm, Green Stink Bug, Spider Mites, Velvet Bean Caterpillar—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

ONIONS, GREEN AND DRY: Thrips, Climbing Cutworms—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

PARSLEY: Aphids—1/2-1 pint per acre on fresh parsley; 1-2 pints per acre on dehydrated parsley. Do not apply to dehydrated within 8 days of harvest; to fresh within 5 days of harvest. Do not apply more than 3 times between harvests.

PEAS, INCLUDING VINES: Aphids, Grasshoppers, Leafhoppers, Spider Mites, Climbing Cutworms—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

POTATOES: Aphids, Grasshoppers, Leafhoppers, Spider Mites—Use 1/2 pint to 1 quart per acre. Do not make application within 4 days of harvest. Do not allow workers to re-enter treated field within 2 days of application.

SPINACH: Aphids, Cabbage Looper, Imported Cabbage Worm, Grasshoppers, Leafhoppers, Spider Mites, Dipterous Leaf Miner Adults, Climbing Cutworms, Salt Marsh Caterpillar, False Cinch Bug—1/2 to 2 pints per acre. Do not apply within 7 days of harvest. 1 pint—Do not apply within 4 days of harvest.

SUMMER SQUASH: Aphids, Cabbage Looper, Dipterous Leaf Miner Adults, Leafhoppers, Lygus Bugs, Spider Mites, False Cinch Bug, Salt Marsh Caterpillar, Climbing Cutworms, Grasshoppers—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

TOMATOES, OUTDOOR: Aphids, Grasshoppers, Leafhoppers, Spider Mites—1/2 to 1 pint per acre. Do not apply within 1 day of harvest.

TURNIPS: Aphids, Cabbage Looper, Imported Cabbage Worm, Grasshopper, Leafhoppers, Spider Mites, False Cinch Bugs, Dipterous Leaf Miner Adults—1/2 to 1 pint per acre. Do not apply within 3 days of harvest.

MOYER

VEGEPHOS 4

ACTIVE INGREDIENTS	By Weight
2-Carbomethoxy-methylvinyl dimethyl phosphate (alpha isomer)	28.2%
Related Compounds	18.8%
Petroleum Solvent	47.0%
INERT INGREDIENTS	6.0%
TOTAL	100.0%

Contains 4 lbs. Phosdrin* per gallon.

* TRADEMARK SHELL CHEMICAL CORP.

STATE REGISTRATION NO. 05967 50245 AA

DANGER POISON

(SEE RIGHT PANEL FOR ANTIDOTE AND OTHER REQUIRED WARNING STATEMENTS)

CAUTION: KEEP OUT OF REACH OF CHILDREN

LABEL NO. 390-3-7/72

MANUFACTURED BY

MOYER CHEMICAL COMPANY

1310 BAYSHORE HIGHWAY P. O. BOX 945 SAN JOSE, CALIFORNIA

DIRECTIONS FOR MIXING AND SPRAYING

DIRECTIONS FOR MIXING: *Mix in water with agitation;* agitate while spraying. Use designated amount of product in the following gallons of water per acre unless otherwise noted: *Vegetable and field crops*—20 to 250 gallons by ground, 5 to 10 gallons by air. Small fruits—20 to 250 gallons by ground, 7 to 10 gallons by air. Tree Fruits—40 to 800 gallons by ground, 10 to 20 gallons by air. Citrus—100 to 3,000 gallons by ground, 10 to 20 gallons by air. On young fruit trees, use a minimum of 20 gallons by ground per acre.

Do not permit workers to enter the treated area where substantial contact will be made with treated foliage until following indicated days have lapsed after application: Grapes 4, Peaches & Nectarines 4, Citrus 4.

COMPATIBILITY

Do not combine with lime, sulfur, Bordeaux mixture, Zinc Sulfate—lime mixtures or other mixtures containing lime or other alkaline materials. Do not combine with Sevin as injury may occur to certain crops.

NOTICE TO BUYER — Seller makes no warranty, expressed or implied, concerning the use of this product other than indicated on the label. Buyer assumes all risk of use and/or handling of this material when such use and/or handling is contrary to label instructions.

— NON-RETURNABLE —

NET CONTENTS.....GALLONS

DANGER POISON

ANTIDOTES:

If swallowed. Give a tablespoonful of salt in a glass of warm water and repeat until vomit fluid is clear. Have victim lie down and keep quiet. Call a Physician Immediately!

If on skin. Remove contaminated clothing and wash skin immediately with soap and water. Call a Physician Immediately!

DANGER

Poisonous If Swallowed, Inhaled, or Absorbed Through Skin or Eyes! Rapidly Absorbed Through Skin! Do not get in eyes or on skin. Wear natural rubber gloves, protective clothing and goggles. In case of contact wash immediately with soap and water. Wear a mask or respirator of a type passed by the U. S. Department of Agriculture for phosdrin protection. Keep all unprotected persons and animals out of operating areas or vicinity where there may be drift. Vacated areas should not be reentered on the day of treatment. Do not store near feed and food products. Wash hands, arms, and face thoroughly with soap and water before eating or smoking. Wash all contaminated clothing with soap and hot water before reuse.

NOTE TO PHYSICIAN

WARNING SYMPTOMS: Symptoms include weakness, headache, tightness in chest, blurred vision, non-reactive pin-point pupils, salivation, sweating, nausea, vomiting, diarrhea and abdominal cramps.

Addendum to HS-375
Recalculation of Dislodgeable Residues

Results of Analysis of Strawberry Foliage for
Dislodgeable Residues of Mevinphos

Date	Sampling Interval	Mevinphos (ug/cm2) alpha	beta
(field 1)			
5/3	3-hour	.037	ND
5/4	24-hour	.012	ND
5/5	48-hour	.002	ND
5/6	3-day	.002	ND
(field 2)			
5/3	4-hour	.043	ND
5/4	24-hour	.012	ND
5/5	48-hour	.010	ND
5/6	3-day	.006	.002
(field 3)			
5/3	4-hour	.038	ND
5/4	24-hour	.011	ND
5/5	48-hour	.004	ND
5/6	3-day	.002	.002