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DE Wastes

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Pesticide Residues in Cotton Gin Wastes

The Texas A&M University System
The Texas Agricultural Experiment Station
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CONTENTS

SUMMARY

Since the burning of gin trash is restricted, an estimated 1.1 million tons of gin trash have become a major disposal problem in Texas. To study the feasibility of using gin trash as livestock feed or organic mulch, the extent of pesticide residues in gin trash and the effect of field storage on the residues were determined.

During the 1971 and 1972 ginning seasons, half-ton quantities of cotton gin wastes were collected from selected fields at nine different locations in Texas. Wastes were moistened, stored in specially constructed bins and sampled periodically to determine the quantities of pesticides. Where feasible, analysis of the pesticide contents of the gin wastes was done for only the materials applied to the crop during the growing season.

Preplant-incorporated herbicides averaged less than one part per million in gin wastes at harvest. The chlorinated hydrocarbon insecticides applied during the season were found in the gin wastes at harvest and persisted during the 3-month storage period. The organophosphorus insecticides averaged between 1 and 2 parts per million at ginning and decomposed during storage. The phosphatic-type defoliants averaged about 8 parts per million in gin wastes at ginning and slowly diminished during storage. Paraquat, a plant desiccant, was found in the gin waste at ginning and persisted during storage.

Gin wastes from cotton fields sprayed with arsenic acid contained from 50 to 450 parts per million elemental arsenic. The arsenic concentration either remained the same or increased during the 3-month storage period.

This research was designed to show type and quantity of pesticides that may be found in gin trash but was not intended to determine or establish injurious levels or whether they may become a constituent of the meat, milk or edible products of the livestock eating them. Use of the wastes as organic mulch for field crops but not horticultural crops apparently remains the best method of disposal.

PESTICIDE RESIDUES IN COTTON GIN WASTES

C. S. Miller, W. L. Hoover and J. D. Price*

The increase in mechanized harvest of cotton was paralleled by an increase in the amounts of leaf-trash, burs, sticks and other material brought to the gin and subsequently separated there from the seed and fiber. This is especially true in the stripper areas of the State. A bale of machine-stripped cotton contains an estimated 856 pounds of trash, while a hand-picked bale contains about 80 pounds of trash (20). Thus, a gin which handles about 3,000 bales in a stripper area probably handles about 2.5 million pounds of trash and moisture (20). Since more than 65 percent of the cotton in Texas is stripper harvested (19, 22), disposal of an estimated 1.1 million tons of trash per year becomes a major problem.

Modern gins are equipped with more cleaning equipment than in the days of handpicking. The mechanical equipment includes green boll traps, driers, bur machines, green leaf-stick removers, impact cleaners, bur extractor-feeders and lint cleaners. Since the driers reduce the moisture content of the lint to a recommended 6.5 to 8 percent moisture (18), the trash is fairly dry (11). The 1 to 10 tons per hour (6) of trash handled by a gin is done principally with pneumatic conveying equipment (4). Since the trash contains particulate matter, equipment such as cyclones, lint fly catchers, inline filters and other devices are used to reduce the dust (6, 13, 28). Research is continuing on supplemental cleaning equipment such as inertial separation chambers (8) and inline air filters (2) to reduce the estimated 1 to 2 percent particulate emissions (4).

After collection, the trash is disposed of by three principal means: 1) by returning the trash directly to the field; 2) by composting, then returning the compost to the land; and 3) by incineration. Also, a limited amount is fed to livestock. Previously, incineration was the principal means of disposing of gin trash, but recent air pollution legislation prohibits burning without a permit (27).

Several studies indicated the possibility of obtaining fertilizer, moisture-holding and yield increase benefits by returning the gin trash directly to the soil (12, 21, 29). Others suggested that composting the trash before putting it back on the field might be of additional benefit since weed seed (25) and disease organisms such as *Verticillium alboatrum* (3, 25) would be reduced. Although the supposition has not been thoroughly examined, there are indications that microbial decomposition of the debris would reduce the incidence of *Xanthomonas malvacearum,* the organism responsible for bacterial blight (7).

Later composting studies (3) indicated that a bacterial starter was not necessary, as earlier suggested (17), in initiating decomposition rates of gin trash. Aeration and high moisture can increase decomposition rates to enable composting in 3 weeks as opposed to 3 months without aeration (3). Lint yields have been increased as much as 275 pounds with the use of 10 tons of composted burs per acre (5). The practice of composting burs before returning them to the field has decreased, apparently because of the increased cost of handling and the increased fire hazard. Thus, most of the burs are being returned directly to the land. In certain areas, such as the Texas High Plains, 75 percent or more of the burs were returned to the field as early as 1954 (23). In the latest survey (26), about 8,000 farms in Texas were applying cotton burs to the land.

Information was not available on the percentage of cotton trash being fed to livestock, a practice which began as early as 1935 (10). Unprocessed gin trash has been fed directly to cattle in certain locations and also has been mixed with silage. Arizona studies (11) indicated that a mixture of up to 20 percent gin trash with the silage did not reduce the amount of weight gained by cattle fed on the mixture.

Since the use of pesticides, including harvest-aid chemicals, has increased, the feeding of gin wastes to livestock has become a questionable practice. Caution has been advised on the basis of both a limited investigation of the fate of various harvest-aid chemicals (1, 9, 14, 15, 16) and regulatory restrictions which are based on unpublished evidence submitted for label registration of the pesticides with the Environmental Protection Agency.

The labels of many pesticides, especially harvest-aid chemicals, include the caution "Do not graze treated areas or feed gin wastes to livestock." These precautions are based either on the absence of residue information or on actual residue information submitted by individual chemical companies, but the amounts of the residues are not published.

**Respectively, associate professor, The Texas Agricultural Experiment Station (Department of Plant Sciences); state chemist, The Texas Agricultural Experiment Station (Agricultural Analytical Services); and agricultural chemist, The Texas Agricultural Extension Service.*

In 1971 and 1972 a study was conducted to determine the extent of pesticide residues in gin trash, the effect of field storage on the residues and the implications for use of the trash as a cattle feed or organic mulch.

MATERIALS AND METHODS

COLLECTION

Gin wastes were collected at nine different locations during the 1971 ginning season: Sebastian (Lower Rio Grande Valley); Sugarland (Coastal Plains); College Station (Brazos River Valley); Thrall, Oglesby and Dorchester (Blacklands); Pecos (Trans-Pecos); Chillicothe (Rolling Plains); and Lubbock (Southern High Plains). In 1972, the locations were the same except that Kendleton was substituted for Sugarland, and no collection was made at Chillicothe because of delays caused by the weather (Appendix Table).

Specially constructed gin trash storage bins were filled directly from the trash hoppers at each location. Just prior to trash collection, the trash hoppers were emptied so that only trash from the selected site was collected.

Bins, holding approximately one-half ton of gin wastes, constructed of redwood, were 4 feet X 4 feet X 8 feet with a center partition. One side of the bin had a slatted floor and a 1 foot X 1 foot wire cage extending the depth of the bin to allow aeration. The other side of the bin had a solid wooden bottom to minimize drainage and aeration. Each side of the bin formed a 4-foot cube. Hardware cloth was used as covers for the bins.

The trash was spread and tamped, and a 5-pound sample from each side of the bin was collected in a 13-inch X 24-inch, 4-mil polyethylene plastic bag within a few minutes after collection of the trash. The lids were replaced, and the bins were transported to the storage sites where the wastes were saturated with tap water, unless otherwise noted, to initiate composting. The bins were placed in an open site so that the trash received normal rainfall.

The samples were taken to College Station where they were spread on brown paper to air dry at 28°C and relative humidities below 40 percent. After drying, the samples were ground with the use of a No. 1 Wiley mill fitted with a coarse screen. The ground samples were mixed and divided for analysis. The second and third samples, taken at 1 and 3 months after ginning, were obtained from each side of the bins at a depth ranging from 3 to 12 inches at several places in the pile. These were handled in the same manner as the first samples.

ANALYSIS FOR PESTICIDE RESIDUES

Duplicate subsample determinations were made for each material on each sample in accordance with following procedures, except where noted:

Herbicides

Preemergence

Fluometuron (Cotoran) – Pesticide Analytical Manual (Vol II) R. E. Duggan, Food and Drug Administration

Prometryne (Caparol) – Pesticide Analytical Manual (Vol II) Method A. R. E. Duggan, Food and Drug Administration

Trifluralin (Treflan) – Pesticide Analytical Manual (Vol II) R. E. Duggan, Food and Drug Administration

Postemergence

DSMA (disodium methyl arsonate) – No specific analysis conducted; however, where arsenic acid was not used, the arsenic values can be used as a indication of the amounts remaining.

MSMA (monosodium methyl arsonate) – same as for DSMA.

Insecticides

Chlorinated Hydrocarbons

Chlordimeform (Galecron) – No residue data were obtained since a satisfactory analytical method was not readily available.

Toxaphene – Pesticide Analytical Manual (Vol I)

Organophosphorus

Azinphosmethyl (Guthion) – Pesticide Analytical Manual (Vol I)

Dicrotophos (Bidrin) – Jour. Assoc. of Official Analytical Chemists. (Vol 54:513-516). General Method for Organophosphorus Pesticide Residues in Non-fatty Foods

Disulfoton (Disyston) – Pesticide Analytical Manual (Vol II). Determination of Disyston Residues in Various Crops and Products. Chemagro Corporation Report (21319) 1971 Revision

Methyl Parathion – Pesticide Analytical Manual (Vol I)

Monocrotophos (Azodrin) – same reference as for dicrotophos (Bidrin).

Parathion – Pesticide Analytical Manual (Vol I)

Phorate (Thimet) – Pesticide Analytical Manual (Vol I) General Methods for Non-fatty Foods. Sec 21.13b U. S. Dept. of Health Education and Welfare, Food and Drug Administration, 1972

Carbamate

Aldicarb (Temik) – No residue data were obtained since methodology was not readily available for the analysis.

Carbaryl (Sevin) – No determinations since cotton was treated at only one location.

Harvest-Aid Chemicals

Defoliants

DEF (S, S, S-tributylphosphorotrithioate) – Pesticide Analytical Manual. R. E. Duggan, Food and Drug Administration.

Folex (S, S, S-tributylphosphorotrithioite) – same as DEF.

Cacodylic acid (Bolls Eye) – No specific determination made, but where arsenic acid and DSMA or MSMA not used, the arsenic values can be used as an indication of the amounts remaining.

Sodium Chlorate – No residue data were obtained since methods for distinguishing applied sodium or chloride as a residue from indigenous plant uptake was not possible.

Desiccants

Arsenic Acid – The arsenic content of every sample was determined by a method of W. L. Hoover, J. R. Melton, P. A. Howard and J. W. Bassett. Atomic absorption spectrophotometric determination of arsenic. Jour. Assoc. of Official Analytical Chemists. (Vol 57:18-21 1974).

Paraquat – Results were based on an analytical method provided by Chevron Chemical Company.

Additives

Endothal (Accelerate) – No specific determinations made to determine the residues.

Pesticide concentrations in the gin wastes at the time of ginning for all locations treated with the pesticide are presented in Table 1. Variation of individual fields is shown in Appendix figures. Table 2 shows the range of quantities of pesticides found in this study and their tolerances in other crops or commodities.

The preemergence incorporated herbicides averaged less than 1 part per million in the gin wastes at harvest. The chlorinated hydrocarbon insecticides applied during the season were found in the gin wastes at harvest and persisted during the storage. The organophosphorus insecticides averaged between 1 and 2 parts per million at ginning and decomposed to less than 0.1 part per million during storage. The phosphatic-type defoliants averaged about 8 parts per million in gin wastes at ginning and slowly diminished during subsequent storage. The desiccant paraquat was found in the gin waste at ginning and persisted during storage.

Table 1. SUMMARY: AVERAGE PESTICIDE CONTENTS OF COTTON GIN WASTES AT GINNING FROM FIELDS TREATED WITH THE PESTICIDE

MATERIAL		
Trade name	Common name	PPM (air dried)
Cotoran	Fluometuron	0.63
Caparol	Prometryne	0.54
Treflan	Trifluralin	0.007
Toxaphene	Toxaphene	12.5
Methyl Parathion	Methyl Parathion	2.3
Parathion	Parathion	0.94
DEF	DEF	7.0
Folex	Merphos	9.0
Paraquat	Paraquat	9.5
ARSENIC (elemental)		
Arsenic acid		225.0
Bolls Eye	cacodylic acid	18.0
MSMA	monosodium methylarsonate	1.5
Natural Arsenic (no arsenicals applied)		1.0

The gin wastes collected from fields sprayed with arsenic acid contained from 50 to 450 parts per million elemental arsenic. There was no relationship between the amounts applied and the arsenic contents of the wastes at ginning. However, the shorter the time between treatment and harvest, the more arsenic there was in the waste at ginning. The arsenic became more concentrated during the composting in the bins.

There was no relationship between the amount applied or the number of days between treatment and harvest and the amount of material residues in gin wastes at harvest for Caparol, Cotoran, DEF, Folex or paraquat.

DISCUSSION

The lack of a positive relationship between the rates or times of pesticide application and the quantities of the residues present at ginning indicated that neither timing nor rate can be used to predict the residue amounts in gin trash at harvest. Smaller amounts of chemicals, applied earlier in the season, do not necessarily result in less residue at harvest. Residues at harvest are probably influenced primarily by weather, growing conditions and the type of harvester rather than by the amounts applied.

The major use of gin wastes has been as organic mulch returned to soils planted in field crops. This appears to remain the best method of disposal. Even when gin wastes are used as a soil amendment, the question of the fate of the pesticides is important.

Table 2. TOLERANCES OF COTTON PESTICIDES IN VARIOUS CROPS AND THE RANGE OF AMOUNTS FOUND IN GIN WASTES IN THIS STUDY

MATERIAL	TOLERANCE (ppm)	CROP OR COMMODITY[1]	GIN WASTE CONTENTS (ppm)
HERBICIDES			
Fluometuron (Cotoran)	0.1	cottonseed	0.36 - 0.96
Prometryne (Caparol)	1.0	cotton forage	0.28 - 1.02
Trifluralin (Treflan)	0.2	alfalfa	0.002 - 0.018
	0.05	cottonseed	
DSMA	0.53	cottonseed	1.3
MSMA	0.53	cottonseed	
INSECTICIDES			
Chlorinated Hydrocarbon			
Chlorphenamidine (Galecron)	5.0	cottonseed	not analyzed
Toxaphene	5.0	cottonseed	1 - 76
Organophosphorus			
Azinphosmethyl (Guthion)	5.0	alfalfa	0.1
Dicrotophos (Bidrin)	0.05	cottonseed	0.05
Methyl Parathion	5.0	alfalfa hay	0.12 - 16
Monocrotophos (Azodrin)	0.1	cottonseed	0.05
Parathion	1.0	corn forage	0.15 - 3.2
Phorate (Thimet)	1.3	alfalfa hay	0.02
Carbamate			
Aldicarb (Temik)	0.1	cottonseed	not analyzed
HARVEST-AID CHEMICALS			
Defoliants			
S,S,S-tributylphosphorotrithioate DEF	4.0	cottonseed	0.86 - 10
S,S,S-tributylphosphorotrithioite Folex	0.25	cottonseed	0.15 - 33
Cacodylic acid (Bolls Eye)	2.1	(As) cottonseed	15 - 20*
Desiccants			
Arsenic Acid (L-10)	3.0	raw cottonseed	49 - 450
Paraquat	0.5	cottonseed	2.5 - 25.6

[1]Only those which might be used for feed were selected.

*From one location only.

The small quantity of preplant herbicides, organophosphorus insecticides and defoliants present in the gin wastes applied to soil should not influence the growth of subsequent crops. The chlorinated hydrocarbon insecticide residues in gin wastes would not be detrimental to growth of crops, but might become constituents of horticultural crops due to plant uptake from soil.

The amount of arsenic contained in gin wastes from arsenic acid-treated fields possibly would be sufficient to induce growth inhibition of more susceptible plants on certain soils. The influence of various quantities of arsenic in composted gin wastes on germination and growth is under investigation.

The occurrence of pesticide residues in any agricultural product or commodity creates both legal and practical problems. From the legal standpoint, there are no established tolerances for pesticides in gin wastes. As a consequence, the feeding of gin wastes containing pesticide residues at any concentration would not be legal and would be done without the protection and assurance provided by the establishment of safe tolerances or allowable amounts. Further, on each federally registered harvest-aid chemical, the label clearly warns the user: DO NOT GRAZE TREATED AREAS OR FEED GIN WASTES TO LIVESTOCK. The data and information in this research report are presented as a summary of levels of agricultural chemicals found in cotton gin trash as a result of current agricultural production practices. There is no intent or inference as to the biological impact of these residue levels on livestock or crops where such gin trash may be subsequently utilized.

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29. Walker, H., and J. Box. Use of cotton burs to imporve productivity of irrigated land. Tex. Agr. Exp. Sta. MP-394.

ACKNOWLEDGMENTS

The following persons contributed to this study in various capacities:

Collectors–Rex Herrington, Curtis Smith and C. S. Miller, The Texas Agricultural Experiment Station (Department of Plant Sciences).

Analysts–J. D. Price, Texas Agricultural Extension Service; W. L. Hoover, Alan R. Hanks and others, The Texas Agricultural Experiment Station, (Agricultural Analytical Services); Lloyd Deuel, The Texas Agricultural Experiment Station (Department of Soil and Crop Sciences); John Calahan, Rex Herrington and Jennifer Marshall, The Texas Agricultural Experiment Station, (Department of Plant Sciences).

Interpretation and Evaluation–Harry E. Smalley, Veterinary Toxicology Laboratory, U. S. Department of Agriculture, College Station, Texas.

Graphs–Jennifer Marshall and Janice Kramer, Department of Plant Sciences.

Special thanks are due J. H. (Tony) Price, executive vice president of the Texas Cotton Ginners Association for suggesting the study.

APPENDIX

Figures *(on following pages)*

Individual pesticide contents found in gin wastes from fields treated with the materials: Solid line denotes amounts in aerated side of the bin; dash line indicates amounts in non-aerated side for various storage times. Gin waste in the bins was saturated with tap water at time of initial collection. Bars or numbers to the right of each graph indicate quantities of the pesticide found in seed cotton from the trailer just before ginning.

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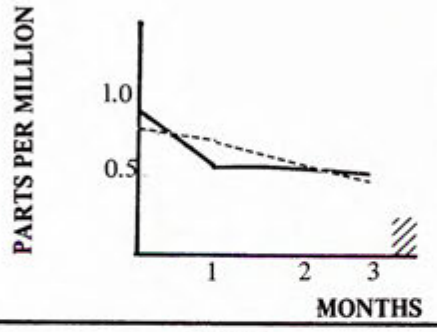
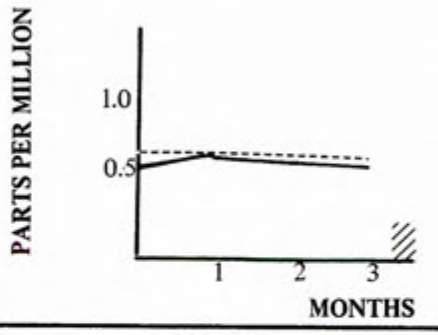
COTORAN

BRAZOS RIVER VALLEY 1971



COTORAN

KENDLETON 1972



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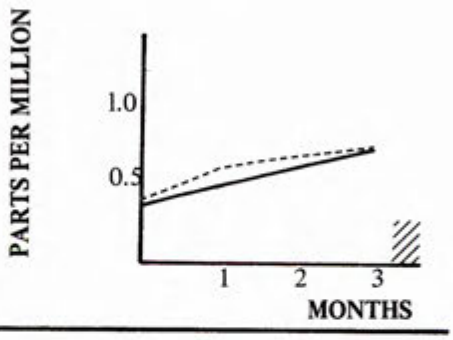
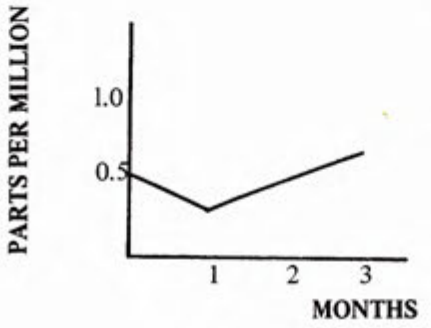


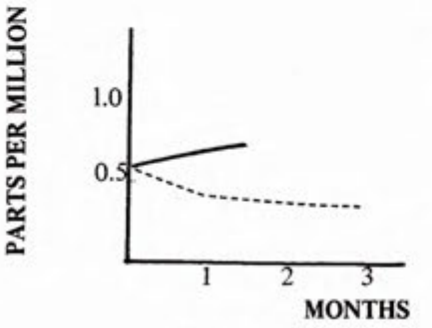
CAPAROL

SUGARLAND A 1971



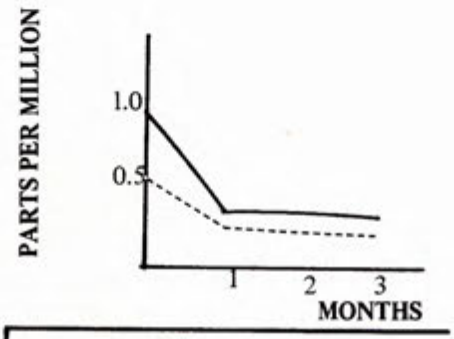
CAPAROL

SUGARLAND B 1971



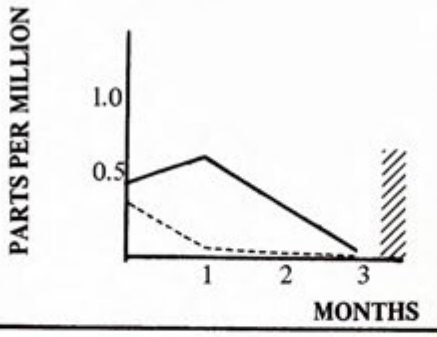
CAPAROL

THRALL 1971



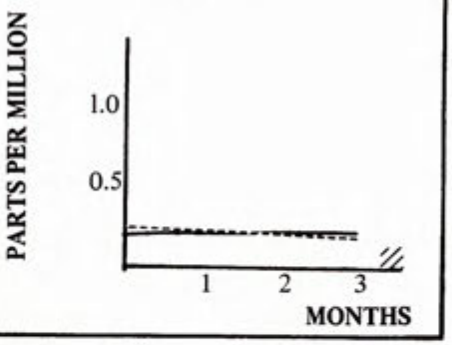
CAPAROL

DENTON 1971



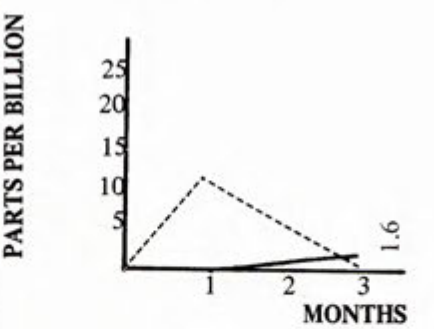
CAPAROL

LUBBOCK II 1972



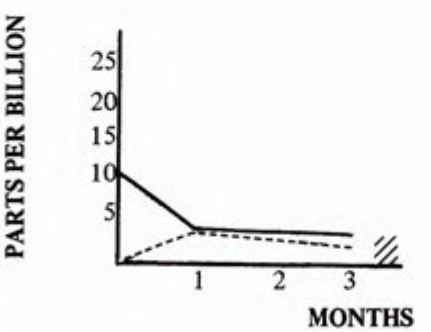
TREFLAN

LUBBOCK I 1971



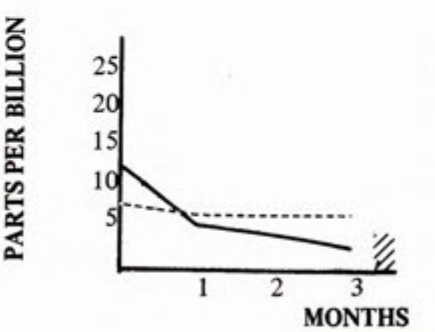
TREFLAN

LUBBOCK II 1971



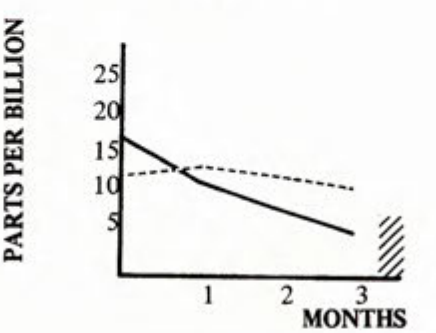
TREFLAN

PECOS VINSON 1971

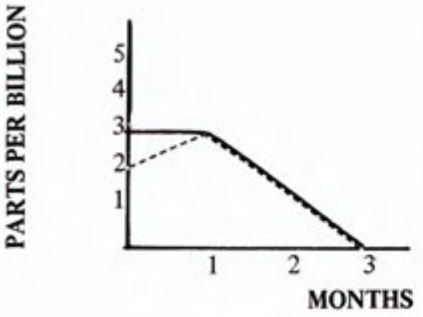


TREFLAN

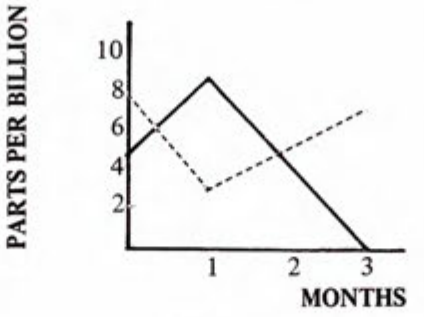
PECOS BOUNDS 1971



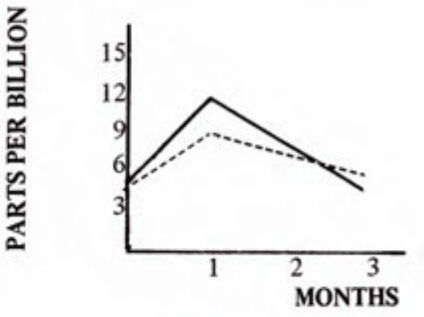
TREFLAN
SEBASTIAN 1972



TREFLAN
KENDLETON 1972



TREFLAN
BRAZOS RIVER VALLEY 1972



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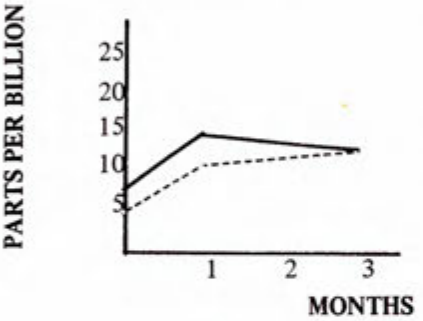

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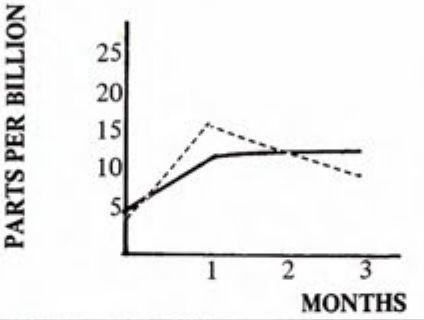
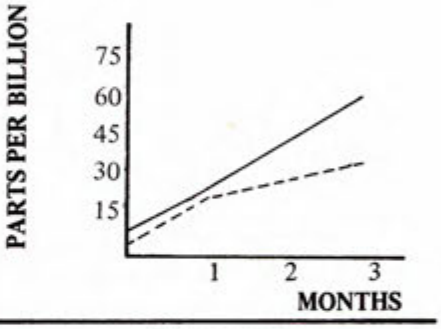
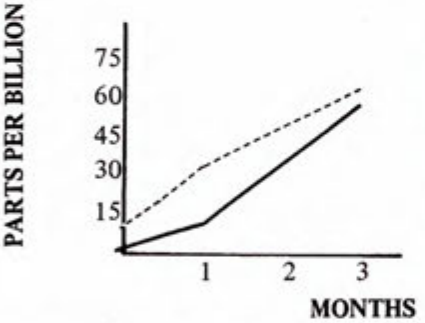


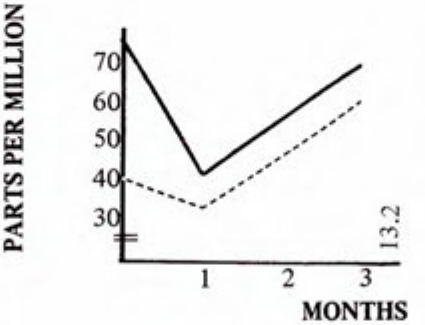
TREFLAN
PECOS SMITH 1972



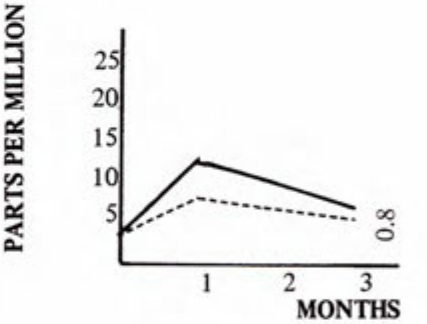
TREFLAN
PECOS McKINNEY 1972



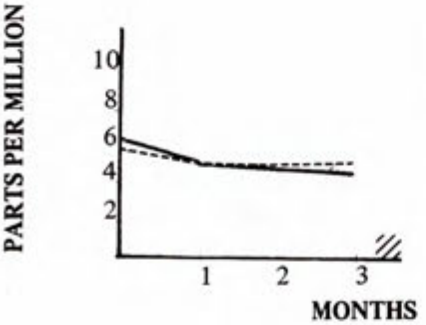
TOXAPHENE
BRAZOS RIVER VALLEY 1971



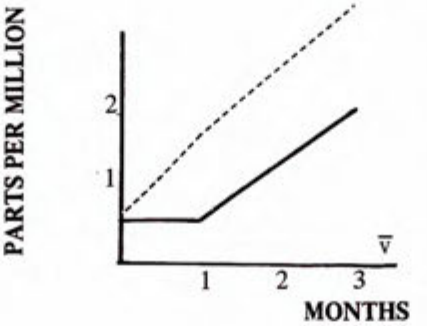
TOXAPHENE
PECOS VINSON 1971



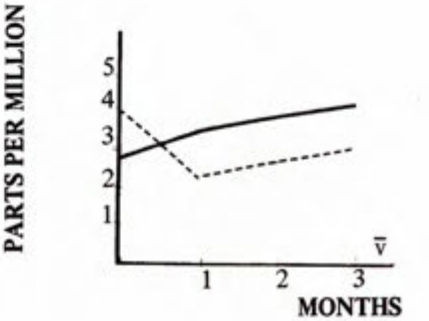
TOXAPHENE
PECOS BOUNDS 1971



TOXAPHENE
SEBASTIAN 1972



TOXAPHENE
KENDLETON 1972



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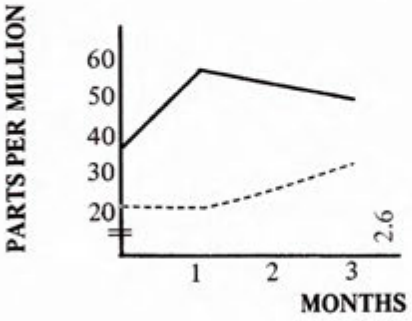
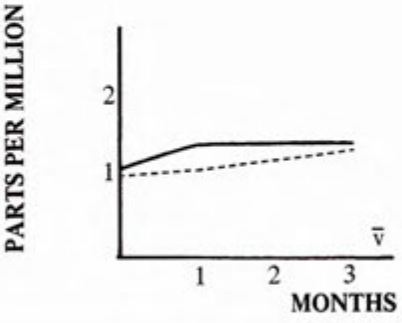
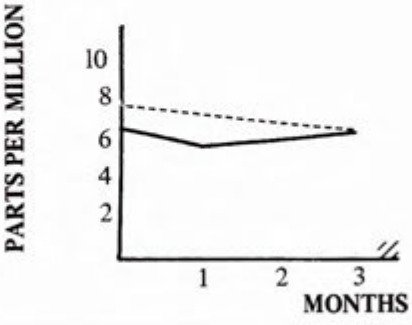
BRAZOS RIVER VALLEY 1972



TOXAPHENE
DENTON 1972



TOXAPHENE
PECOS SMITH 1972



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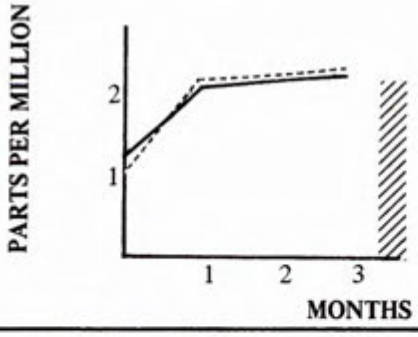
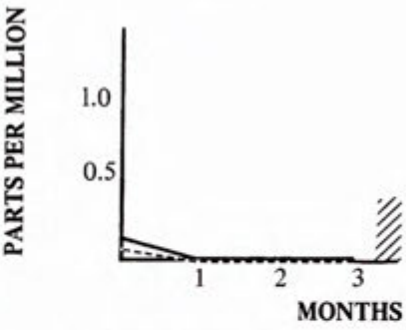
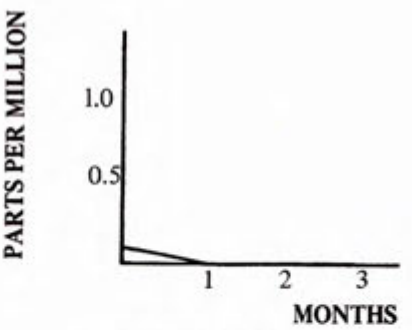
PECOS McKINNEY 1972



METHYL PARATHION
SEBASTIAN 1971



METHYL PARATHION
SUGARLAND A 1971



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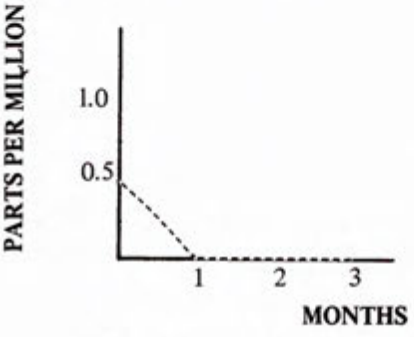
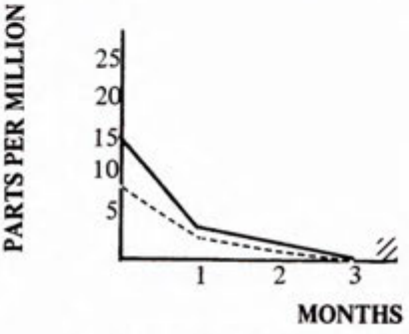


METHYL PARATHION
BRAZOS RIVER VALLEY 1971



METHYL PARATHION
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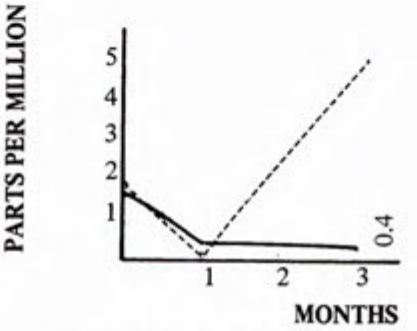
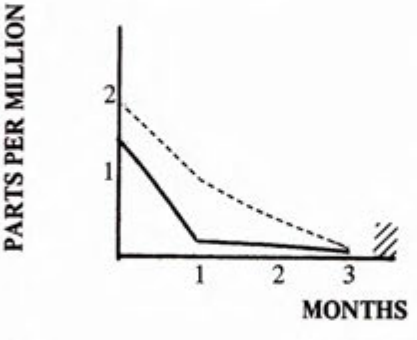


METHYL PARATHION
PECOS BOUNDS 1971



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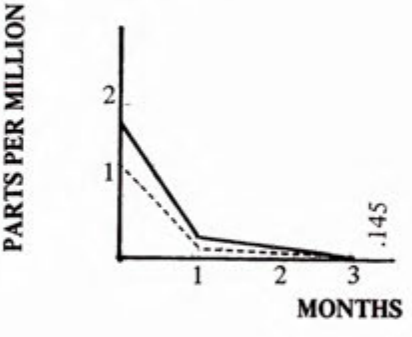

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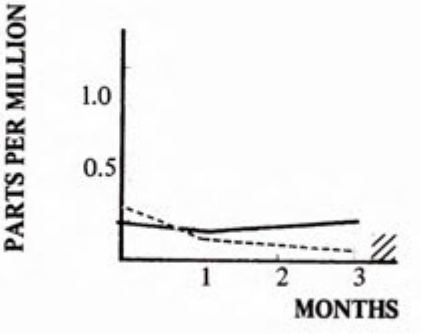
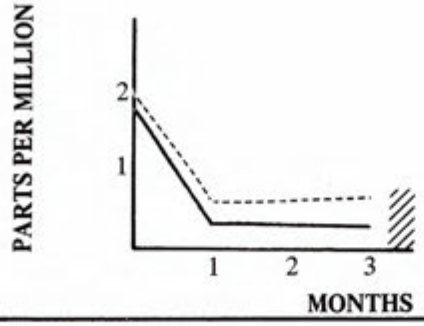
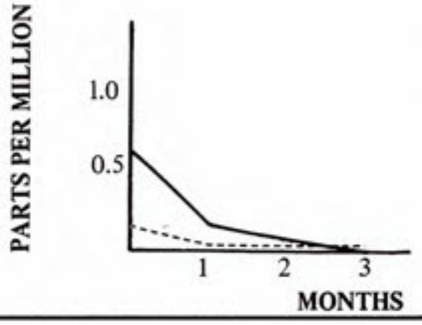
BRAZOS RIVER VALLEY 1972



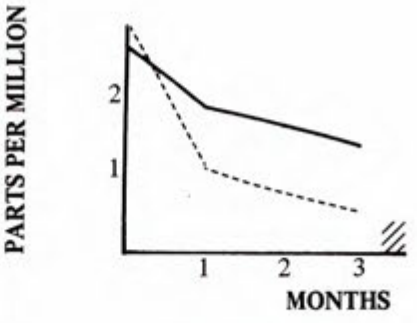
METHYL PARATHION
PECOS SMITH 1972



METHYL PARATHION
PECOS McKINNEY 1972



PARATHION
PECOS VINSON 1971



PARATHION
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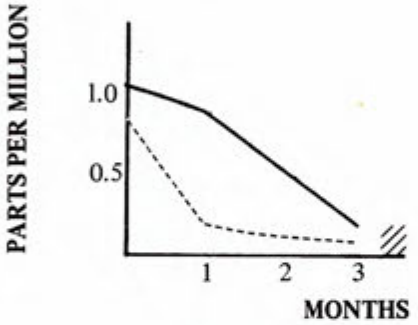
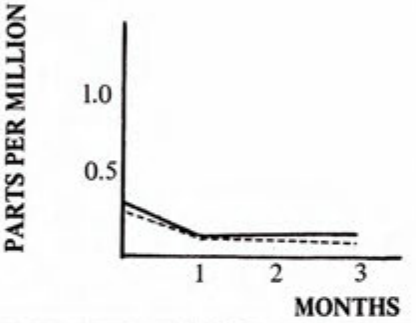


PARATHION
BRAZOS RIVER VALLEY 1972



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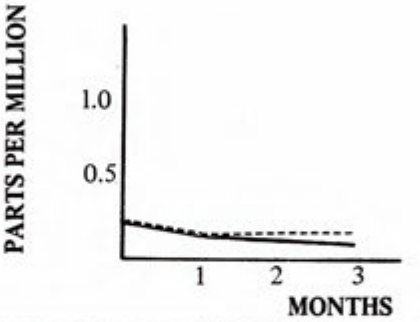
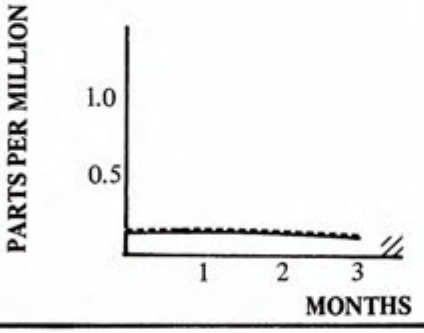
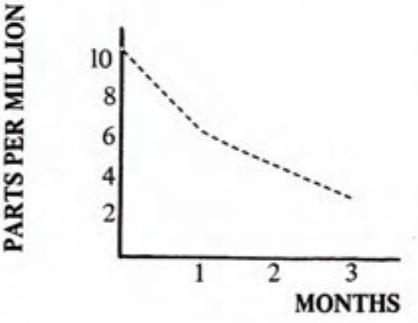
PECOS McKINNEY 1972



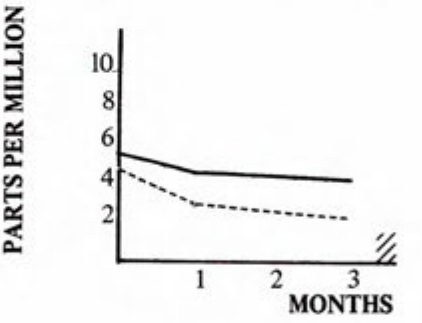
PARATHION
PECOS SMITH 1972



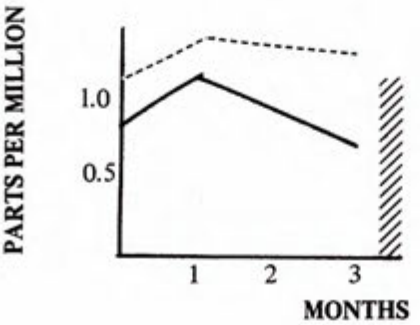
DEF
SUGARLAND B 1971



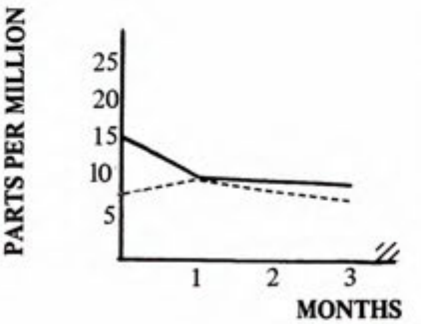
DEF
BRAZOS RIVER VALLEY 1971



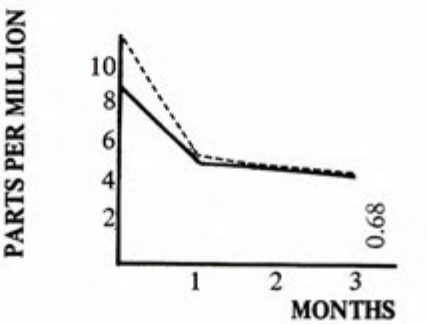
DEF
DENTON 1971



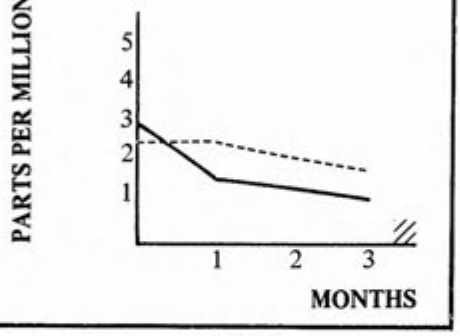
DEF
SEBASTIAN 1972



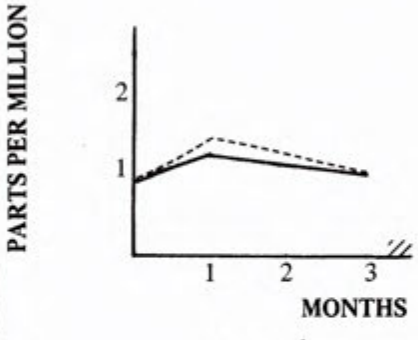
DEF
KENDLETON 1972



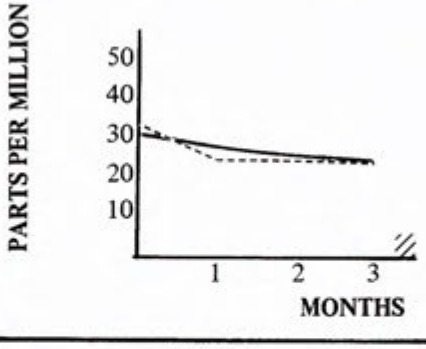
DEF
BRAZOS RIVER VALLEY 1972



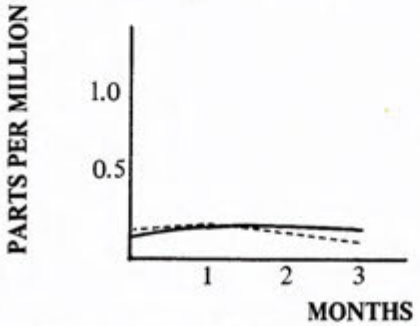
FOLEX
PECOS VINSON 1971



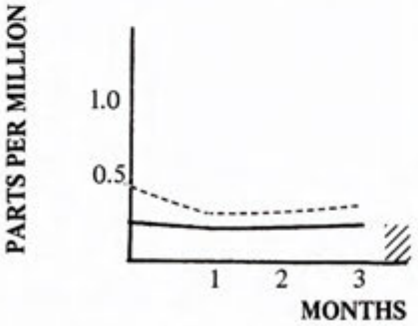
FOLEX
PECOS BOUNDS 1971



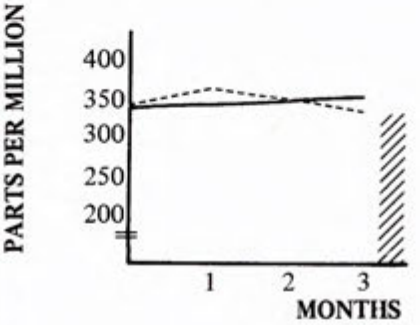
FOLEX
PECOS McKINNEY 1972



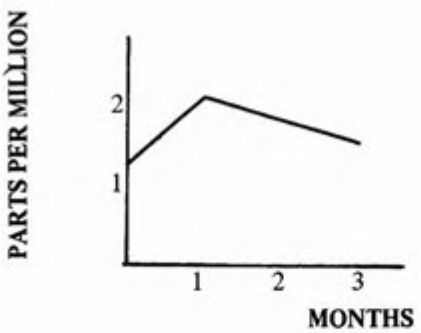
FOLEX
PECOS SMITH 1972



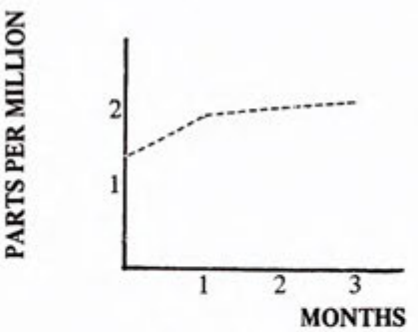
ARSENIC
SEBASTIAN 1971



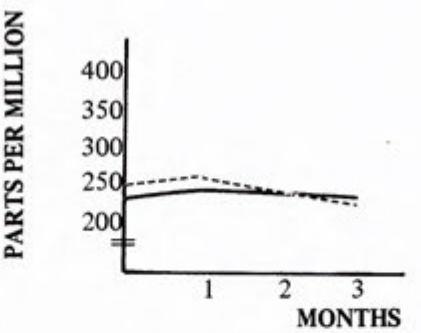
ARSENIC
SUGARLAND A 1971



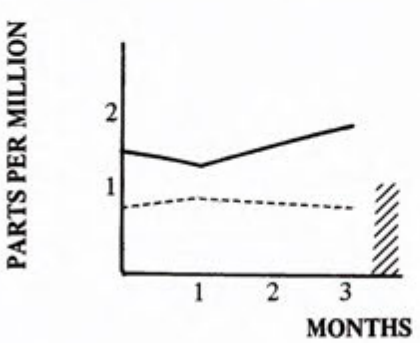
ARSENIC
SUGARLAND B 1971



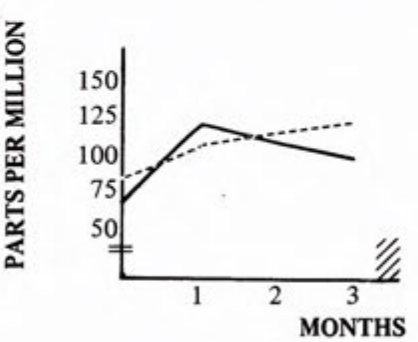
ARSENIC
THRALL 1971



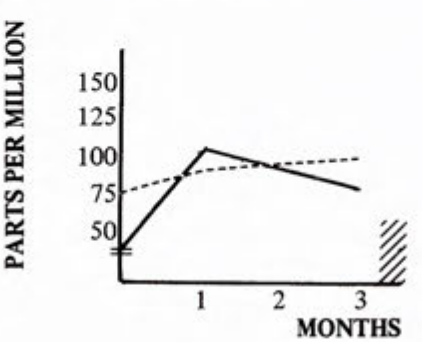
ARSENIC
BRAZOS RIVER VALLEY 1971



ARSENIC
DENTON 1971

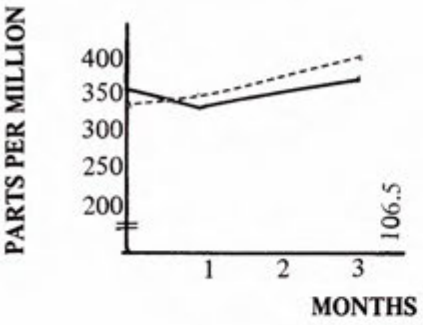


ARSENIC
McGREGOR 1971



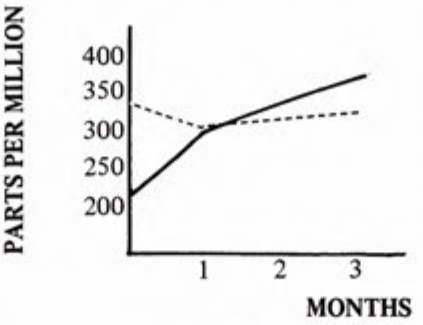
ARSENIC

PECOS BOUNDS 1971



ARSENIC

PECOS VINSON 1971



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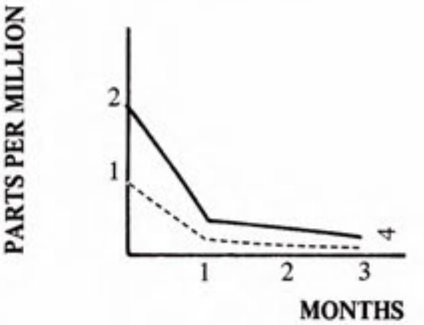

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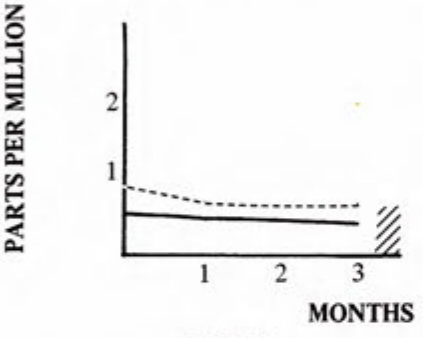

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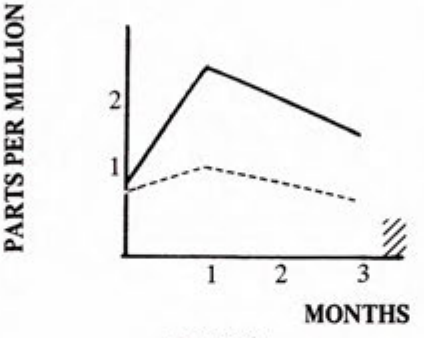

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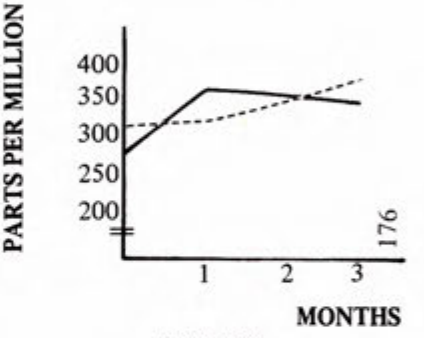

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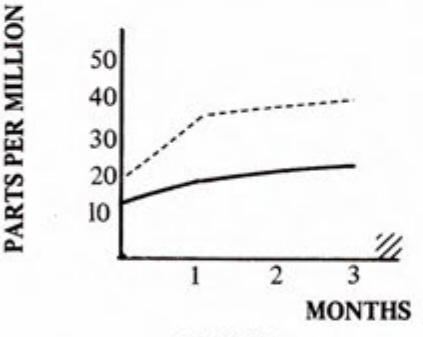
BRAZOS RIVER VALLEY 1972



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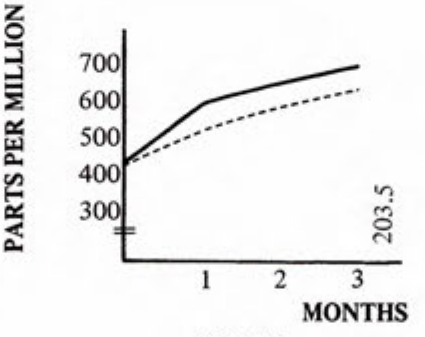

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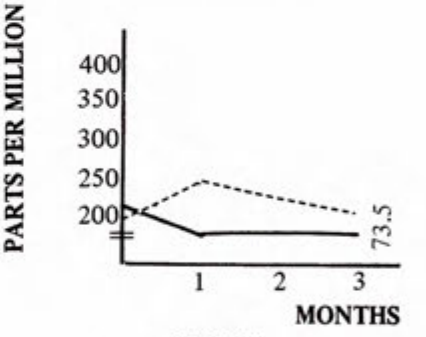

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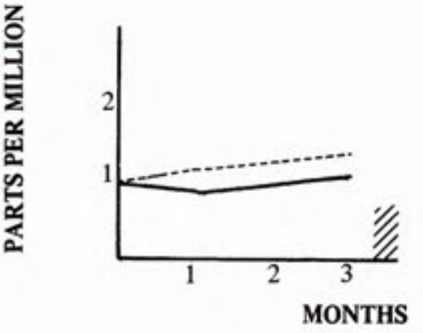
PECOS McKINNEY 1972



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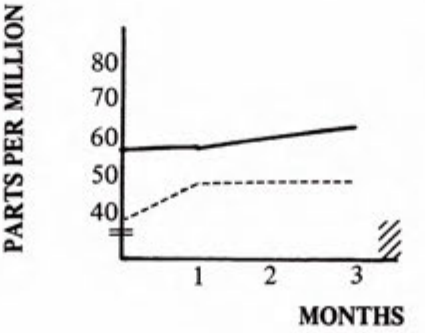

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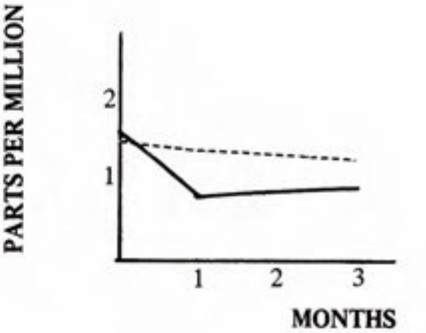

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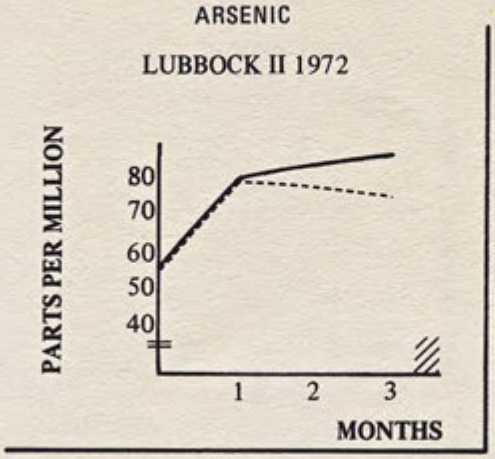
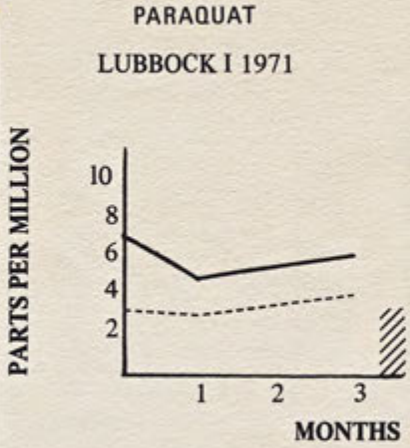


PARAQUAT

LUBBOCK I 1971



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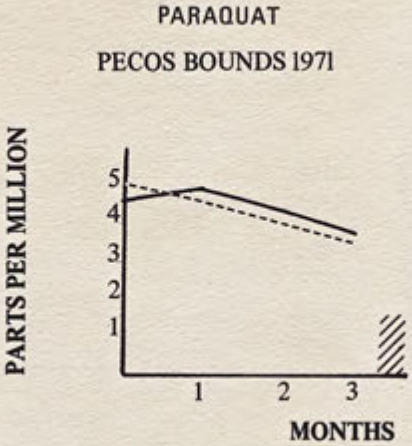
PECOS BOUNDS 1971



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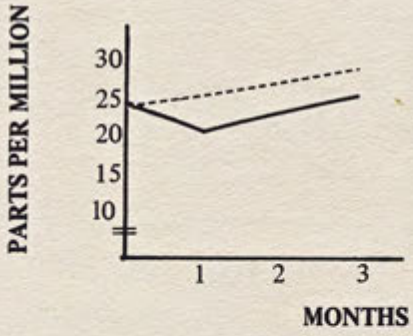

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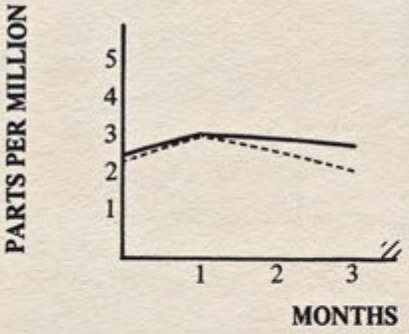

Appendix Table – BACKGROUND DETAILS OF PESTICIDE RESIDUES STUDY

Location	Grower	Gin and gin manager or owner	Cooperating Texas Agricultural Experiment Station Personnel	Storage location	Initial collection date	Pesticide application dates	Materials	Rates/acre (pounds) (liquid)
1971 Sebastian	Jack Funk	Sebastian Cotton & Grain Corp. Gin, Jack Funk, Mgr.	W. R. Cowley TAMU Agri. Res. & Ext. Center at Weslaco	Sebastian	July 20, 1971	Early	Dicrotophos (Bidrin)	0.125 (½ pt)
							Sodium Chlorate (Climax)	2.0 (1 gal)
							Arsenic Acid	7.85 H_3AsO_4 (2 qts)
1972 Sebastian	Jack Funk	"	"	"	Aug. 1, 1972	May 12	Trifluralin (Treflan)	0.5 Banded (1 pt)
						May 19	Monocrotophos (Azodrin)	0.781 (1¼ pts)
						May 28, June 10, 16, 26	Methyl Parathion	2.0 (2 qts)
						June 3, July 13	Parathion	1.0 (1 qt)
						July 3	Parathion	1.5 (1.5 qts)
						July 3, 13	Monocrotophos (Azodrin)	0.625 (1 pt)
						June 3	"	0.156 (¼ pt)
						July 18	DEF and	1.12 (1½pts)
						July 18	Endothal (Accelerate)	0.031 (½ pt)
1971 Sugarland-Side A	Texas Dept. of Corrections Jester Farm	Central State Farm Gin, Sugarland Fred Johnson, Mgr.	Marvin E. Riewe, TAMU Agri. Res. Sta. at Angleton	Angleton	Aug. 24, 1971	Jan. 22	Trifluralin (Treflan)	1.0 broadcast (1 qt)
						March 18	Prometryne (Caparol)	0.75 banded
						April 30	MSMA	1.25 broadcast (1.5 pts)
						June 26, July 1, 6	Methyl Parathion	0.5 (1 pt)
1971 Sugarland-Side B	Texas Dept. of Corrections Retrieve Farm	Central State Farm Gin, Sugarland, Fred Johnson, Mgr.	Marvin E. Riewe, TAMU Agri. Res. Sta. at Angleton	Angleton	Aug. 24, 1971	Jan. 7	Trifluralin (Treflan)	1.0 banded (1 qt)
						March 12	Prometryne (Caparol)	0.75 banded
						June 30	Methyl Parathion	0.5 (1 pt)
						Aug. 16	Parathion	1.0 (1 qt)
						Aug. 16	DEF	1.5 (1 qt)
1972 Kendleton	John Kramr	Darst Co-op Gin, Adolf Vacek, Mgr.	"	"	Aug. 17, 1972	Fall 1971	Trifluralin (Treflan)	1.0 (1 qt)
						At planting	Fluometuron (Cotaran)	1.3
						Early	Azinphosmethyl (Guthion)	0.5 (1 qt)
						Early	Dicrotophos (Bidrin)	0.2 (1 qt/ 10 acres)
							DEF and	0.56 (¾ pt)
							Endothal (Accelerate)	0.047 (¾ pt)
1971 Thrall	Stiles Farm Foundation, Calvin Rinn	Thrall Cooperative Gin Co., Ed Carlson, Mgr.	Calvin Rinn, Stiles Farm Foundation	Stiles Farm	Sept. 9, 1971	April 20	Prometryne (Caparol)	1.0
						Aug. 31	Arsenic Acid	7.85 (2 qts)

Appendix Table (continued)

Location	Grower	Gin and gin manager or owner	Cooperating Texas Agricultural Experiment Station Personnel	Storage location	Initial collection date	Pesticide application dates	Materials	Rates/acre (pounds)	(liquid)
1972 Thrall	Albert Freels	"	"	"	Sept. 13, 1972	Early	Carbaryl (Sevin)	10.0	10% dust/ acre
						Aug. 15	Arsenic Acid	15.7	(1 gal)
1971 Brazos River Valley	Texas A&M Plantation, A. A. Melton	Joe Varisco Gin, Joe Varisco, Owner and Mgr.	A. A. Melton	Texas A&M Plantation, College Station	Sept. 16, 1971	Nov. 1970	Trifluralin (Treflan)	1.0	(1 qt)
						At planting	Fluometuron (Cotaran)	1.0	
						June 7, 12, 29	Toxaphene	0.75	(1 pt)
						July 4, 10, 16, 21, 26, 30	Toxaphene	0.75	(1 pt)
						Aug. 5, 11, 14 19,21	Toxaphene	0.75	(1 pt)
						Sept. 1	Toxaphene	0.75	(1 pt)
						Aug. 25	Toxaphene	1.5	(1 qt)
						Aug. 28	Toxaphene	2.0	(1 1/3 qt)
						June 12, July 26	Methyl Parathion	1.0	(1 qt)
						Sept. 1	Parathion	1.0	(1 qt)
						June 29, July 4, 10, 16, 30	Parathion	1.5	(3 pts)
						Aug. 5, 11	Parathion	1.5	(3 pts)
						July 21	Parathion	0.5	(1 pt)
						Aug. 14, 19, 21, 25	Parathion	2.0	(2 qts)
						July 21, 26	Monocrotophos (Azodrin)	0.625	(1 pt)
						Aug. 28, Sept. 1	Chlorophenamidine (Galecron)	0.125	(¼ pt)
						Sept. 1	DEF	0.25	(1/3 pt)
						Sept. 8	Sodium Chlorate	2.25	(3 qts)
1972 Brazos River Valley	Texas A&M Plantation, A. A. Melton	Joe Varisco Gin, Joe Varisco, Owner and Mgr.	A. A. Melton	Texas A&M Plantation, College Station	Sept. 15, 1972	June 23	Trichlorofon (Dylox)	0.25	
						June 28, July 3, 8, 24, 29	Toxaphene	0.75	(1 pt)
						Aug. 10, 14, 18, 22, 29	Toxaphene	0.75	(1 pt)
						Aug. 3	Toxaphene	0.19	(¾ pt)
						Aug. 6	Toxaphene	0.375	(½ pt)
						July 13, 19	DDT	0.25	(1 pt)
						July 3, 19, 24, 29	Chlorphenamidine (Galecron)	0.125	(¼ pt)
						Aug. 3, 6, 10, 14, 18, 22, 29	Chlorphenamidine (Galecron)	0.125	(¼ pt)
						July 13	Chlorphenamidine (Galecron)	.062	(1/8 pt)
						June 28, July 8	Chlorphenamidine (Galecron)	0.25	(½ pt)
						July 13, 19, 24, 29	Methyl Parathion	1.5	(3 pts)
						Aug. 10, 14, 18, 29	Methyl Parathion	1.5	(3 pts)
						Aug. 3	Methyl Parathion	1.75	(3.5 pts)
						Aug. 6, 22	Methyl Parathion	2.0	(4 pts)
						Aug. 18	Monocrotophos (Azodrin)	0.156	(¼ pt)
						Aug. 29	DEF	0.375	(½ pt)
						Sept. 6	Cacodylic Acid (Bolls Eye)		(2 pts)
						Sept. 6	Endothal (Accelerate)	0.063	(1 pt)
1971 Denton	McWorter Farm	Central Growers Association, W. A. Tucker, Mgr.	C. O. Spence, Area Agronomist	Denton Exp. Station	Oct. 11, 1971	May 1	Prometryne (Caparol)	0.7	
						June 1, 10	Dicrotophos (Bidrin)	0.133	(1 qt/15 acres)
			J. H. Gardenshire, Supt. TAMU Res. Sta. at Denton			Sept. 1	DEF	0.75	(1 pt)
						Sept. 15	Arsenic Acid	15.7	(1 gal)

Appendix Table (continued)

Location	Grower	Gin and gin manager or owner	Cooperating Texas Agricultural Experiment Station Personnel	Storage location	Initial collection date	Pesticide application dates	Materials	Rates/acre (pounds)	(liquid)
1972 Denton	Shepard Farm	Central Growers Assn. Gin, Dorchester, W. A. Tucker, Mgr.	C. O. Spence, Area Agronomist, J. H. Gardenshire, Supt. TAMU Res. Sta. at Denton	Denton Exp. Station	Sept 28, 1972	May 1 at planting	Aldicarb (Temik)	8.0	
						July 20, 27	Parathion	1.0	(2 qts)
						July 20, 27	Toxaphene	1.5	(1 qt)
						Sept. 1	Cacodylic Acid (Bolls Eye)		(3 pts)
						Sept. 16	Arsenic Acid	11.78	(3. qts)
1971 McGregor	McGregor Exp. Sta.	Oglesby Gin Co., Charles C. Powell, Owner-Mgr.	Robert Lynch	McGregor Exp. Sta.	Nov. 4, 1971		DSMA	0.5	(1 pt)
							Arsenic Acid	5.89	(1.5 qt)
1972 McGregor	McGregor Exp. Sta.	Oglesby Gin Co., Charles C. Powell, Owner-Mgr.	Samuel S. Peques	"	Oct. 6, 1972	June 6	Toxaphene	1.5	(1 qt)
						June 12	MSMA (Ansar 529)	1.0	(1 qt/acre)
						Sept. 24	Arsenic Acid	7.85	(2 qts)
1971 Chillicothe	Chillicothe Exp. Sta.	Farmers Coop. Society Gin, Tom Ward, Mgr.	James R. Mulkey	Chillicothe Exp. Sta.	Jan. 25, 1972	April 15, 1971	Trifluralin (Treflan)	0.75	(1.5 pts)
						June 11	Aldicarb (Temik)	10.0	
1971 Lubbock I	Lubbock Exp. Sta.	USDA South Plains Ginning Res. Lab, Roy Baker, Engineer	Dudley T. Smith, A. W. Cooley	Lubbock Exp. Sta.	Feb. 24, 1972	March 1971	Trifluralin (Treflan)	0.5	(1 pt)
						Oct. 13	Paraquat	0.14	(2/3 pt)
1971 Lubbock II	"	"	"	"	Harvested Jan. 1972, Collected Feb. 24, 1972	March 1971	Trifluralin (Treflan)	0.5	(1 pt)
1972 Lubbock I	"	"	"	"	Nov. 16, 1972	March 3	Trifluralin (Treflan)	0.5	(1 pt)
						Oct. 17	Paraquat	0.37	(1½ pts)
1972 Lubbock II	"	"	"	"	Nov. 17, 1972	May 25	Prometryne (Caparol)	1.5	
						May 25	Fluometuron (Cotaran)	1.5	
						Oct. 16	Arsenic Acid	7.85	(2 qts)
1971 Pecos (Vinson)	Don Vinson	City Gin Co., Inc., H. L. Robertson, Mgr.	James J. Hefner	Pecos Exp. Sta.	Nov. 11, 1971	Feb. 10	Trifluralin (Treflan)	0.5	(1 pt)
						July 29	Methyl Parathion	1	(1 qt)
						Aug. 23, Sept. 7	Methyl Parathion	0.5	(1 pt)
						Sept. 7	Parathion	0.25	(½ pt)
						Aug. 19, Sept. 3	Monocrotophos (Azodrin)	0.625	(1 pt)
						Sept. 7	Monocrotophos (Azodrin)	0.312	(½ pt)
						Oct. 25	Folex	1.13	(1.5 pt)
						Oct. 30	Arsenic Acid	3.92	(1 qt)
1971 Pecos (Bounds)	Frank Bounds	Alamo Gin Co., Inc., Mr. Ysidro M. Ortega, Mgr.	James J. Hefner	Pecos Exp. Sta.	Nov. 11, 1971	Feb. 10	Trifluralin (Treflan)	0.5	(1 pt)
						July 17, 31, Aug. 16	Methyl Parathion	0.5	(1 pt)
						July 17, Aug. 16	Monocrotophos (Azodrin)	0.312	(½ pt)
						July 23, Aug. 9, 30	Monocrotophos (Azodrin)	0.625	(1 pt)
						Oct. 25	Folex	0.75	(1 pt)
						Oct. 25	Paraquat	0.031	(1/8 pt)
						Oct. 30	Arsenic Acid	3.92	(1 qt)

Appendix Table (continued)

Location	Grower	Gin and gin manager or owner	Cooperating Texas Agricultural Experiment Station Personnel	Storage location	Initial collection date	Pesticide application dates	Materials	Rates/acre (pounds)	(liquid)
1972 Pecos (Smith)	W. C. Smith	Pecos Co-op Gin, Inc., D. L. Hess, Pres.	James J. Hefner, Clyde H. Chasteen	Pecos Exp. Sta.	Nov. 9, 1972	Feb. 1972	Trifluralin (Treflan)	0.5	(1 pt)
						July 29, Aug. 12, 19	Toxaphene	0.75	(1 pt)
						July 29, Aug. 12, 19	Methyl Parathion	0.5	(1 pt)
						Aug. 28, Sept. 1, 7, 14, 20	Methyl Parathion	1.5	(1.5 qts)
						July 29, Aug. 12, 19	Monocrotophos (Azodrin)	0.312	(½ pt)
						Sept. 20	DEF	0.375	(½ pt)
						Oct. 4	Sodium Chlorate	4	(2 gal)
						Oct. 12	Arsenic Acid	7.85	(2 qts)
1972 Pecos (McKinney)	J. T. McKinney	Pecos Co-op Gin, Inc., D. L. Hess, Pres.	James J. Hefner, Clyde H. Chasteen	Pecos Exp. Sta.	Nov. 9, 1972	Early	Trifluralin (Treflan)	0.25	banded (½ pt)
						July 23, 29, Aug. 4, 12, 21, 30, Sept. 7, 17	Methyl Parathion	0.55	(1.1 pt)
						July 23, 29, Aug. 4, 12, 21, 30, Sept. 7, 17	Toxaphene	0.825	(1.1 pt)
						July 23, 29, Aug. 4, 12, 21, 30, Sept. 7, 17	Monocrotophos (Azodrin)	0.312	(½ pt)
						Oct. 13	Folex	0.857	(5 gal/35 acres)
						Oct. 13	Paraquat	0.029	(½ gal/35 acres)

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