TECHNICAL REPORT

PESTICIDES IN THE LOWER COLORADO RIVER

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PESTICIDES IN THE LOWER COLORADO RIVER

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I. INTRODUCTION

In the Lower Colorado River Basin from Parker Dam to the international border are several irrigated agricultural areas subject to heavy pesticide usage. The possible pollution of the Colorado River resulting from application of pesticides on these lands has been an environmental concern for several years.

The objectives of this report are to: (1) assess the problem of pesticide pollution in the Lower Colorado River on the basis of current information, (2) describe legal and technical controls available, and (3) define the need for further study. Authority for preparation of this report is granted in Section 104 of the Federal Water Pollution Control Act of 1972.

Sources of information utilized include published data, STORET retrievals, telephone conversations, and a field visit to appropriate Federal, State, and local offices in the Lower Colorado River area.

II. CONCLUSIONS AND RECOMMENDATIONS

Conclusions:

1. Chronic levels of chlorinated hydrocarbon pesticides in water and fish in the Lower Colorado River are below maximum values specified by proposed drinking water and FDA standards.

2. Data are not available to define the extent of water and fish contamination by organophosphate and carbamate pesticides in the Lower Colorado River.

3. Major quantities of organophosphate and carbamate pesticides are used in the irrigated lands adjacent to the Lower Colorado River below Parker Dam.

4. There are several possible ways that contamination of surface waters by pesticides may be occurring in the Lower Colorado River.

5. Technical control measures are available to reduce pesticide concentrations in irrigation return flows.

6. Legal means of requiring implementation of pesticide control measures are available.

Recommendations

1. A short-term field investigation should be conducted in the Lower Colorado River area to determine the extent of surface water contamination by organophosphate and carbamate pesticides and the modes of contamination.

2. Based on results of the proposed investigation, EPA should recommend technical control measures needed to reduce or eliminate contamination of the Lower Colorado River by all forms of pesticides.

3. EPA should utilize all legal means available to insure implementation of recommended control measures or their equivalent.

4. Information developed from the proposed investigation should be used to re-evaluate the existing USGS/EPA monitoring program in the Lower Colorado River area.

III. THE PESTICIDE PROBLEM

A. Area of Concern

The area of concern is irrigated lands near and adjacent to the Colorado River from Parker Dam on the Arizona-California border, downstream to the Southerly International Boundary of Arizona and Mexico. These areas, shown in Figure 1, are: (1) Colorado River Indian Reservation, (2) Palo Verde Irrigation District, (3) Cibola Valley, (4) Yuma Project and Auxiliary Project, and (5) Gila Project.

Year-round cropping is practiced in the study area. Major crops are feed crops, cotton, lettuce, citrus, and cantaloupes. Crops receiving the heaviest pesticide applications are cotton, lettuce, and citrus. It is estimated that a total of approximately 300,000 acres in the study area are being irrigated (Water Resources Council, 1971). Return flows from the five areas are discharged to the Colorado River with the exception of one drain from the Yuma Project which flows to Mexico (Table 1).

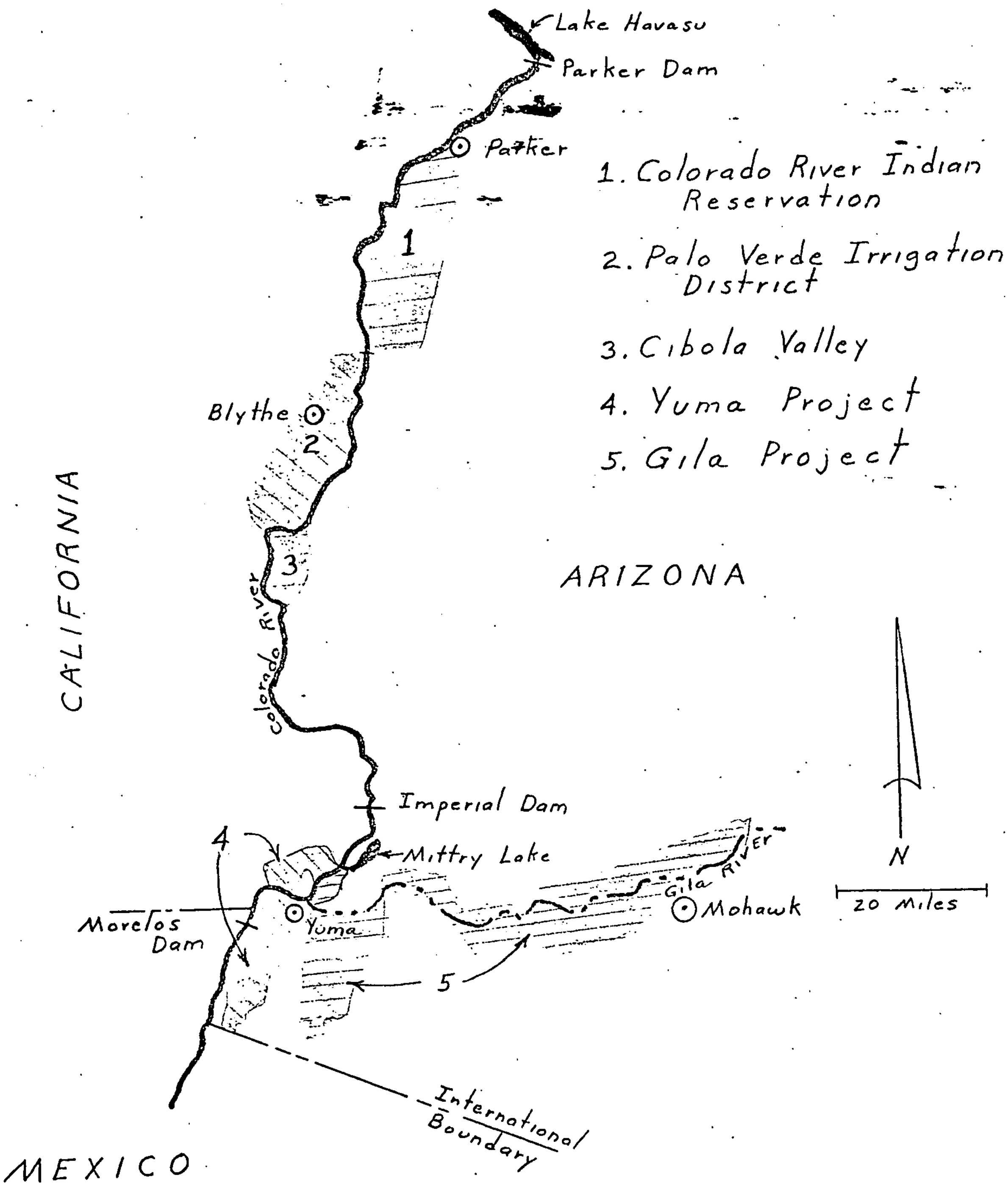

Figure 1.- IRRIGATED LANDS - LOWER COLORADO RIVER

Table 1 - IRRIGATION LANDS ADJACENT TO LOWER COLORADO RIVER

Area	Estimated* Irrigated Acres	Return Flow Disposition
Colorado River Indian Reservation	30,000	Drain to Colorado River near Palo Verde Diversion Dam.
Palo Verde Irrigation District	120,000	Drain to Colorado River 50 miles above Imperial Dam.
Cibola Valley	5,000	Drain to Colorado River near Palo Verde Drain.
Yuma Project, all Division and auxiliary projects	50,000	Reservation Division - Drain above Morelos Dam to Colorado River. Other Division - Below Morelos Dam to Colorado River and Main Drain to Mexico.
Gila Project	90,000	Drains above and below Morelos Dam to Colorado River.

* California Water Quality Control Board, 1967

B. Water Use and Water Quality Standards

The Colorado River is the major source of irrigation water for agricultural lands located in the study area. In addition to irrigation, beneficial uses of the Lower Colorado River include: domestic water supply for several communities, fish and wildlife propagation, recreation including whole-body contact, and industrial water supply.

Both Arizona and California Water Quality Standards have been accepted by the Secretary of the Interior (EPA Administrator) and are therefore Federal Standards. Extracts of each Standard pertaining to pesticide pollution are as follows:

California:

Biocides

Biocide concentrations in Colorado River waters shall be kept below levels which are deleterious to domestic water use and to fish and wildlife.

Arizona:

Biocides

Application of biocides in agricultural operations which could result in biocide levels in waters of the State which are deleterious to human, animal, plant or aquatic life shall be subject to abatement. Mere detection of a biocide in the water is not cause for abatement.

C. Pesticide Usage

Pesticide application in Yuma County, Arizona, in 1969 and 1970 exceeded three million pounds each year. Table 2 lists the major types of pesticides by name and usage for these years. Essentially all use is in the irrigated lands of concern. Time of application varies with a number of factors including type of crop and pest. The heaviest usage generally occurs in the months of July through October.

Pesticide usage figures have not been compiled for the California portion of the study area. Due to similarity in crops and consequently pests, types of pesticide used are probably comparable to those for Yuma County.

Table 2 - MAJOR PESTICIDE USAGE, YUMA COUNTY, ARIZONA

Pesticide		Quantities - lbs		Principal** Method of Application	Months of Heaviest Use
Name	Type*	1969	1970		
Toxaphene	(CHC)	439,767	137,884	A & G	July - Sept.
Perthane	(CHC)	132,431	39,650	A & G	July - Sept.
Thiodan	(CHC)	132,551	55,716	A & G	Sept. - Nov.
Sevin	carbamate	122, 679	208,560	A	July - Sept.
Parathion	O-P	386,049	302,463	A & G	July - Nov.
Telone	(CHC)	423,625	857,000	G	Jan., Mar.
MSMA	arsenic	183,830	218,120	G	Apr. - Aug.
Dacthal	phthalic acid	21,568	130,550	A & G	Feb. - Apr., Aug. - Nov.
Cryclite	NA_3AlF_6	139,536	184,000	A	Oct. - Nov.
Azodrin	O-P	84,177	50,274	A & G	July - Sept.
Sodium Chlorate	$NaClO_3$	89,124	62,500	A	Sept. - Oct.

* CHC - Chlorinated Hydrocarbon

O-P - Organophosphate

** A - Aerial spraying

G - Ground rigs

Detailed information on quantities of pesticides applied by ground versus aerial spraying is not available. A study by the University of Arizona (1969) reported that much work is done by ground rigs. By July, aerial spraying takes over, with an estimated 80% of the spraying taking place in the months of June through October. Aerial spraying is used on all five irrigated lands in the study area.

The potential for contamination of surface waters by pesticides is greatest during the four months of heaviest use, i.e., July - October. Specific modes of contamination include:

1. Storm runoff from fields recently dosed with pesticides.
2. Drifting of pesticide spray during aerial application.
3. Sub-surface drainage and tailwater from irrigated fields.
4. Accidental or purposeful dumping of pesticide mixes into waterways and washing of pesticide application equipment in waterways.

The relative magnitude of contamination caused by each mode has not been documented. Field inspections by the Federal Water Pollution Control Administration (1968) indicated that the dumping of excess mixes and washing of application equipment in waterways may be one of the more important sources of pesticide pollution.

D. Water Quality and Related Data

Present joint EPA/USGS monitoring of waters in the Lower Colorado River area for pesticides is limited to four stations. The sampling is performed monthly by the U.S. Geological Survey at the following locations:

1. Colorado River at Imperial Dam.
2. Colorado River at the Northerly International Boundary (NIB) above Morelos Dam.

3. Main Outlet Drain Extension (Mode) below Morelos Dam.

4. Main drain at Southerly International Boundary (SIB).

Sampling for pesticides in previous years has been conducted at:

5. Yuma Main Canal below Colorado River Siphon.

6. Colorado River at Yuma.

7. Colorado River at Parker Dam.

Samples are analyzed for Aldrin, DDD, DDE, DDT, Dieldrin, Endrin, Heptachlor, Heptachlor epoxide, Lindane, Chlordane, 2, 4-D, Silvex, and 2, 4, 5-T. Other chlorinated hydrocarbons are reported if detected during the analyses.

Organophosphates and carbamate type pesticides are increasingly being used in the area concurrent with a phasing out of the persistent chlorinated hydrocarbons. The USGS is not analyzing for organophosphates or carbamates.

A summary of available data is presented in Table 3. It indicates that chronic concentrations of chlorinated hydrocarbon pesticides in the Lower Colorado River are low. All values reported are well below proposed drinking water standards. (See Table 4.)

The existing monitoring program, with monthly sampling at four locations for the parameters indicated, is sufficient to detect long-term trends in concentrations of persistent pesticides in the Lower Colorado River. The sampling locations are such that if increased pesticide concentrations were detected, the general area of probable responsibility could be located, i.e., the Gila Project, the Yuma Project, or those upstream from Imperial Dam. The routine monthly sampling is not adequate, however, to detect possible short-term high concentrations that could result from spills or dumping of pesticides, nor to define specific drains responsible.

[redacted]Tab[redacted]3 [redacted]MM[redacted] O[redacted]SG[redacted]STI[redacted]E [redacted]A F[redacted]

LOWER COLORADO RIVER WATER SAMPLES*

Maximum Reported Concentration - μg/l

	Station**						
	1	2	3	4	5	6	7
General Period of Record	10/70-9/72	2/71-9/72	9/72	8/72-9/72	10/68-8/70	7/59-9/67	9/64-9/67
Pesticide							
Aldrin	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chlordane	"	"	"	0.090	"	0.000	"
DDD	"	"	"	0.000	"	0.001	"
DDE	"	"	"	0.000	"	0.004	"
DDT	0.010	"	"	0.010	"	0.021	"
Dieldrin	0.000	"	"	0.000	"	0.001	"
Endrin	"	"	"	0.000	"	0.000	"
Heptachlor	"	"	"	0.000	"	0.000	"
Heptachlor-Epox	"	"	"	0.000	"	0.000	"
Lindane	"	"	"	0.000	"	0.000	"

Table 3 - continued

2, 4-D	0.000	2.70	0.000	0.240	-	-	0.000
2. 4, 5-T	"	0.000	0.000	0.070	-	-	"
Silvex	"	"	0.000	0.040	-	-	"
Malthion	"	"	-	-	-	-	-
parathion	"	"	-	-	-	-	-
Diazinion	"	"	-	-	-	-	-
Methy - Parathion	"	"	-	-	-	-	-

* STORET retrieval, 12/72.

** Station numbers are those used in text.

TABLE 4 - RECOMMENDED DRINKING WATER STANDARDS*

	mg/l
Chlorinated Hydrocarbons	Health
Aldrin	0.001
Chlordane	0.003
DDT	0.05
Dieldrin	0.001
Endrin	0.0005
Heptachlor	0.0001
Heptachlor Epoxide	0.0001
Lindane	0.005
Methoxychlor	1.0
Toxaphene	0.005
Organophosphate and Carbamate (total)	0.1 (parathion)
Chlorophenoxy Herbicides	
2, 4-D	0.02
2, 4, 5-T	0.002
2,4. 5-TP Silvex	0.03

*Recommendations of EPA Federal Technical Committee on Drinking Water Standards to the EPA Advisory Committee on the Rivision and Application of DWS, (established by EPA Order 1385.9).

The lack of data on organophosphates and carbamates precludes an attempt to define the extent of contamination by these types of pesticides. Analysis of samples taken in 1971 at Imperial Dam and above Morelos Dam showed no traces of organophosphate; however, the number of samples was not adequate to declare an absence of contamination.

Other data related to the pesticide pollution problem are the analysis of fish samples collected in the waterways of interest. During 1967 and 1968, the Arizona Game and Fish Department sampled fish in Lake Havasu, the Colorado River above Imperial Dam, Mittry Lake, and the Main Drain which goes to Mexico. Concentrations of DDT and its related products were well below the FDA action level of 5 ppm in all samples from Lake Havasu, which is above the irrigated areas of concern. However, in the three areas below irrigated lands more than 40% of the samples collected contained levels of DDT or its decays products, in excess of 5 ppm. One sample from Mittry Lake contained 187.5 ppm (FWPCA, 1968).

Fish kills prior to 1969 also indicate a substantial problem has existed in the past. In the period 1964-1968, six fish kills caused by pesticides were reported in the Lower Colorado River area (FWPCA, 1968).

Data on pesticide concentrations in fish and fish kills subsequent to 1969 are limited. What is available does not indicate the continuance of the problem of contamination by chlorinated hydrocarbons. From 1969 through October 1972, only one fish kill resulting from pesticides was documented. The kill occurred in a drainage ditch, following a storm. The type of pesticide involved was not determined.

As part of the National Pesticide Monitoring Program, the U.S. Department of the Interior, Bureau of Sports Fisheries and Wildlife annually collects fish samples during the fall (September, October and November) from Lake Havasu and Imperial Dam in the Lower Colorado River area. Eleven chlorinated hydrocarbons insecticides are analyzed for in whole fish. All samples analyzed have been well below action levels set by the U.S. Food and Drug Administration.

In June and July 1971, EPA Region IX personnel collected whole fish samples from the Lower Colorado River area below Parker Dam. These samples were analysed for chlorinated hydrocarbons and results showed pesticide concentrations well below FDA action levels.

There are essentially no data available on the extent of organophosphate and carbamate contamination of fish. Due to the short-lived nature of these pesticides, sampling of both fish and water should be conducted during and/or immediately following application.

In summary, available information indicates that chronic contamination of the Lower Colorado River by chlorinated hydrocarbon type pesticides is not a problem. There are, however, significant gaps in the information needed to assess the significance of the total pesticide pollution problem in the area.

The existing monitoring programs are not sufficient to determine the frequency or magnitude of localized acute pollution incidents resulting from spills or the washing of pesticide application equipment in waterways. The relative significance of the various possible means of pesticide contamination has not been defined. The pesticide content of most drains discharging to the Colorado River has not been determined. Data on the contamination of water and fish by the short-lived organophosphates and carbamates do not exist.

A short-term field investigation conducted in the period of heavy pesticide usage from July to September would provide much of the needed information.

The investigation could be conducted in two phases. The first phase would be designed to determine if surface water contamination by the short-lived organophosphate and carbamate pesticides is indeed a problem. It would involve the sampling of water and aquatic life in the Colorado River and in drains from lands recently sprayed with pesticides. Sampling immediately following pesticide application and continuing for several days would be necessary. The samples would be analyzed for the specific pesticide compounds applied to the area studied.

If results of the first phase did indicate a problem, a more detailed study could then be initiated. Sampling of the various types of return flow, i.e., tail water, tile drainage, and if possible storm runoff, would be necessary to determine the relative significance of each mode of contamination. Continuous monitoring of all major drains would provide information on the specific areas contributing to the problem and the significance of dumping pesticides or washing of equipment.

Information derived from the proposed study would provide a basis for re-evaluating and developing recommended revisions to the existing USGS/EPA monitoring program in the area. Results would also be necessary prior to recommending specific control measures. With the phasing out of persistent chlorinated hydrocarbons, emphasis should be shifted to compounds receiving major usage. Frequency and location of sampling may also need to be altered due to the short-lived nature of the organophosphates and carbamates.

Technology available to reduce the pesticide pollution problem and legal means of implementing control measures are discussed in the following sections.

IV. TECHNICAL CONTROL MEASURES

A. Physical Control Measures

Pollution of surface waters as a result of pesticide applications can be greatly reduced or eliminated through properly designed drainage systems, carefully controlled irrigation practices, and intelligent farming practices.

Tail water is excess water which reaches the downslope end of each furrow when flood irrigation is practiced. Traditionally, tail water in the study area is routed to the nearest surface drain. This water usually carries large quantities of pesticide residue, crystallized salts, and debris picked up in the initial surge down the furrow. A source of pollution of surface waters, tail water can be minimized or eliminated by the careful application of irrigation water or through disposal by ponding, evaporation and infiltration.

Much of the irrigated farm land in the Lower Colorado River Basin is drained by deep tile drain systems. Water which percolates past the root zone remains in contact with the soil column for at least 6 feet before reaching the tile drain. During percolation through the column, chlorinated hydrocarbon and organo-phosphorus pesticides tend to be absorbed on soil particles. Although long-lived chlorinated hydrocarbons may subsequently be leached from the soil and continue through the drainage system to reach surface waters, the deep drainage systems are effective in limiting the return of organo-phosphorus compounds.

Recent research shows that concentrations of organo-phosphorus compounds recovered in tile drains are also reduced by increasing the time lapse between irrigation water applications. Careful timing of irrigation applications provides additional possibilities for reduction of pesticide pollution in waters receiving irrigation drainage. Thus, properly designed deep drainage systems and proper timing of water and pesticide applications can reduce the quantities of pesticides reaching surface via irrigation return drainage.

Treatment of irrigation return flows prior to their discharge to surface streams is another control possibility. Chlorinated hydrocarbons have been removed successfully from small streams and lake outlets in Missouri and California using dams constructed to cause the wastewater to pass through activated carbon. Efficiency of pesticide removal from this method has been reported to be 40 to 50 percent. Some systems employ activated carbon cylinders suspended from overhead racks in a manner causing waters to pass over and through the cylinders. The latter system has advantages in that the cylinders are quickly and easily replaced and the efficiency approaches 60 to 70 percent.

Drip basins are a recent control innovation more suited to irrigation return flows since suspended solids cause activated carbon flow-through devices to become clogged. This system relies on the fact that the newer organo-phosphorus compounds are readily and quickly hydrolyzed in alkaline waters. In practice, the wastewater is diverted into a lagoon and then is charged with slaked lime, held in suspension by aerators, and maintained at a pH of 8.5 to 9.0. After 8 to 12 hours dentention, the pesticides are degraded into phosphorus compounds that form precipitates which settle out or are broken down into harmless components such as methane and CO_2. Such systems hold promise for economic and efficient removal of organo-phosphorus compounds from irrigation drainage.

Dumping of unused pesticide mix and the clean-out of pesticide application equipment in irrigation drains and canals are believed to be a major source of pesticide pollution in the Lower Colorado River system. No satisfactory method has been employed for prevention of this activity in the Lower Colorado River growing areas. Possibile technical control measures range from elaborate schemes for the tagging of pesticides with dyes or trace elements to equally elaborate schemes of sealing and centralized inspection of application equipment.

B. Pesticide Alternatives

Much work has been and is being done on methods of pest control which reduce the necessity for application of pesticides. Farming practices designed to interrupt the life cycle of the pink bollworm, a major cotton pest, is one example. Interruption of the pest's life cycle can be attained by the burning or shredding of cotton stalk immediately after harvest, deep plowing with a mold board plow at the earliest possible date, filling of cracks and crevices in the soil after plowing, and two irrigations 7 to 10 days apart shortly after plowing. Early harvesting and clean picking are also extremely important in preventing the emergence of egg-laying moths during the following spring. Such control programs may require the impetus of regulatory action.

Biological control holds substantial promise for reducing pest insect populations without the need for application of dangerous chemicals. At the present time, two such techniques are in the experimental stages. One technique involves sterilization of the males of the target species, such as the pink bollworm or screw worm. The sterilized males are then broadcast by the millions throughout infested areas where they mate with normal females which then lay non-viable eggs. This technique has been successful and resulted in the virtual elimination of screw worm populations in the southwest.

The second technique involves the enhancement of populations of parasites. Experimental work has shown that wasps can be effective in controlling populations of insects such as the pink bollworm. The female wasp attacks and kills the target organism and deposits her eggs in its carcass. Upon hatching, the young wasps utilize the carcass for food and as they reach adulthood the cycle is repeated. Other than as a nuisance factor to man, wasps are harmless. Their prolific nature causes them to be useful in the protection of crops from insect pests. Experimental and test scale work utilizing other predator parasite organisms is also underway at and by a number of research organizations.

A third method of biological control, already experiencing success against insect pests on lettuce, kale, and similar crops, is the bacillus insecticide. The material applied is a bacterial culture which is antagonistic to a specific pest. A brand name now in routine use is "Thuricide."

Perhaps the greatest disadvantage in the employment of biological control is that it requires the participation of every farmer in an area, and each participant runs the risk of losing one or more crops until success is achieved. A possible solution to this aspect of the problem would be protection through federally sponsored crop insurance for the period of time required to attain control.

Until physical and biological controls can be made completely effective, applications of chemical pesticides will continue. The effects on water quality can be minimized through judicious selection of the chemical to be used. Organo-phosphorus compounds and carbamates are readily degraded in the environment, while chlorinated hydrocarbons are extremely persistent. The acute and chronic toxicity levels of the organo-phosphorus compounds are on the order of 100 to 1,000 times more than for chlorinated hydrocarbons. The organo-phosphorus compounds have a more immediate lethal effect on the insect pest, are much more expensive than chlorinated hydrocarbon compounds, require more frequent application, and are extremely hazardous to use.

It follows that the chlorinated hydrocarbon pesticides require heavier applications to obtain a kill but have a more lasting effect resulting in fewer applications and lower costs, and are safer to use. Economics and personal safety are much more compelling arguments than is water quality to the farmer who makes the selection for pesticide control. Thus, further regulatory activity may be necessary in order to bring about the use of non-persistent pesticides.

V. LEGAL CONTROLS

There are several legal approaches that could be used to control pesticides in the Lower Colorado River. Since all of them are extensions of the legal precedents of existing statutory or case law, any opinion on the subject is a prediction and necessarily subject to some uncertainty. The following describes some legal approaches that have a likelihood of success.

Pesticides may reach the Lower Colorado River from agricultural runoff in several different ways. There are two types of irrigation return flow: (1) the collection of irrigation water at the lower end of the irrigating furrow which is collected and transported by pipe, flumes, or other conveyance to the river. This is called "tail water." Another source is the collection of excess irrigation water in subsurface drainage pipes that collects percolating irrigation water below the root zone. This too is collected and transported by pipes to the river and is called "tile drainage." A third important source of pesticides in the Lower Colorado River is the careless handling, rinsing or dumping of pesticide containers. This last may be called "dumping." There seem to be remedies for each of the foregoing.

A source of pesticides in the river that is not as subject to control is the leaching of pesticides that have been dissolved in either rain or irrigation water, through the ground, without being collected and transported. This is sometimes called "mass percolation."

The first three cases (tail water, tile drainage, and dumping) as sources of pesticides in the Lower Colorado River can be grouped for discussion. There are remedies available for their control. The fourth "mass percolation" must be discussed separately.

The Federal Water Pollution Control Act Amendments of 1972 (FWPCA) clearly applies to pesticides (Section 502(6)). These discharges may be regulated under the FWPCA in any of several ways. For tail water, tile drainage and dumping, the water containing the pesticides is conducted through a channel and is discharged from a "point source." These discharges contain pollutants and are prohibited by FWPCA Section 301 unless the discharge has a permit.

A permit if granted can be so conditioned that pesticides are removed or otherwise rendered innocuous. As to mass percolation, the rule is not so clear. Although FWPCA Section 502(14) includes "concentrated animal feeding operation" as being within the definition of "point source", a fair reading of the whole Act indicates that inclusion of this operation was a legislative fiat for policy reasons not an extension of the logic of the other inclusions. It is doubtful that a cultivated field could be called a "point source" or can be controlled by FWPCA, Section 301.

The discharge of toxic substances is prohibited by FWPCA Section 301 except as it may be in compliance with Section 307. Section 307 provides for regulations for effluent standards for toxic substances. These have not been promulgated. Therefore, any discharge of a toxic substance is prohibited until tolerable effluent standards are established by regulation. After regulations are adopted, the discharge of toxic substances may be permitted only within those limits. FWPCA Section 307(d) prohibits the violation of any of these standards from any source not limiting it to any point source. It could be argued that this permits a prohibition that would be applied to "mass percolation" as well as to point sources, but until the effluent standards have been promulgated (and presumably litigated), this is viewed as premature.

In the meantime, if it can be factually established that the discharge from any of these three classes of sources (tail water, tile drainage, dumping) is toxic, Section 301 prohibits the discharge at this time. As to "mass percolation", establishing the conditions necessary to meet a burden of proof will not be easy. If because of dilution or degradation the pesticides are not in fact toxic as they reach the river, it will be difficult to persuade a court to give relief. After all, anything is toxic in some concentration and therefore since "toxic Pollutants" as used in the Act must be given some discrete meaning, it must mean toxic in fact, as found in the environment.

The Refuse Act, Section 13 (33 USC Section 407) could be used to cover any of these discharges but the language of that Act has already been stretched almost to a breaking point. Except for the case of "dumping", it is likely that a court would be unwilling to extend the Refuse Act further. Since Congress has now passed to the FWPCA Amendments of 1972, it is likely that a court would be less inclined to stretch the meaning of the Refuse Act. Questions of proof and marshalling evidence seemed to be great under this Act as compared to the FWPCA.

If these substances can be called "hazardous substances" within the meaning of FWPCA Section 311(a)(14), their discharge may be absolutely prohibited. There is, however, a logical inconsistency in the Environmental Protection Agency registering the application of pesticides under FIFRA and prohibiting their discharge under FWPCA. It may be that regulations to be promulgated under FWPCA Section 311 can be framed to resolve this problem; if so, it will require some very careful drafting.

Section 504 FWPCA contains a certain power for the Environmental Protection Agency to respond to emergencies and this can include a situation where there is endangerment to the welfare of persons. This procedure can certainly be used in an episodical situation, but it is difficult to foresee a District Judge granting emergency relief under this section in a situation that is essentially continuous. Of course, in the case of a genuine episodical emergency event, Section 504 should be used and is certainly available.

It is now fairly well established that there is a Federal common law of nuisance (Illinois vs. the City of Milwaukee, 4 ERC 1001). This is still, however, a comparatively novel remedy and it might be difficult to build a sufficiently strong factual basis to support this relief. If the discharged pesticides are extremely difficult to identify after they reach the river, nuisance would be a difficult remedy to apply.

In conclusion, the FWPCA offers the best enforcement tool for control of tail water and tile drainage. Either the Refuse Act or the FWPCA can be used to control dumping. A very strong factual case would have to be built to use other remedies such as nuisance. Lacking such evidence, cooperation of other agencies having to do with irrigation supply and return flow is the only feasible means to control mass percolation.

APPENDIX A - BIBLIOGRAPHY

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