PESTICIDES AND AQUATIC ECOSYSTEMS

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ABSTRACT

A survey made in West Bengal to evaluate the influence of pesticides on aquatic ecosystems showed that pesticides killed many fishes in Punarbhaba River, West Dinajpur, in August 1970. The paddy fields near the river received the insecticides: DDVP, phosphamidon and parathion. The tissues of gills, alimentary tract, liver and brain of the exposed carp (Labeo rohita) and catfish (Heteropneustes fossilis) were found severely damaged. The pesticide residue in fish was in such level that may cause hazard to fish eaters.

INTRODUCTION

Pesticides used for plant protection cause degradation of aquatic ecosystems which gradually reach disastrous limits (Johnson 1968, EPA-RM 1971, McKim et al 1973, 1974, 1975). The use of pesticides may not be replaced by any other suitable plant-protection measure in the near future. Hence a judicious and highly discriminate usage of the same is warranted lest they become pollutants in many states of India. The effects of pesticides on aquatic systems are described here.

MATERIALS AND METHODS

A survey was conducted in nine districts of West Bengal, namely, Nadia, 24 Parganas, Burdwan, Birbhum, Hooghly, Howrah, Murshidabad, Malda and West Dinajpur to assess the hazards of pesticides in fishery waters. A large number of fish farmers and fishermen were interrogated. Besides, questionnaires were prepared and sent to many officials, private parties and individuals to gather information on pollution of fishery waters by pesticides.

The dying and dead fish were sampled from polluted waters for histopathological studies. Carp (Labeo rohita) and catfish (Heteropneustes fossilis) from unpolluted waters were also exposed in the laboratory (20-35 C) to acute levels of the pesticides, DDVP and phosphamidon for 168 h (Konar 1969a) and sampled for histopathological studies when they lost balance. Carps and catfish were exposed to 30 and 25 ppm of DDVP, and 200 and 110 ppm of phosphamidon. These studies were made after the methods of Lillie (1954).
RESULTS AND DISCUSSION

Magnitude of pollution

In the districts of Nadia, 24 Parganas, Hooghly, Howrah, Burdwan, Malda and West Dinajpur, the fishery waters were found to be contaminated with pesticides. The most disastrous effect of pesticide pollution was observed in the river Punarbhaba of West Dinajpur (Fig. 1). In August 1970, when the paddy fields adjacent to the river were sprayed with the insecticides, DDVP, phosphamidon and parathion, there was heavy rain, causing widespread drainage of the pesticides into the river. This caused mass mortality of carps, catfishes and other species of commercially important fish. Several kilometers of the river were affected and fish mortality continued for about seven days; thus killing several thousands of fish.

Abnormalities found in fish body

The immediate visible effect of pollution was death of fish in fishery waters. The fish exposed to organophosphorus insecticides died due to severe histopathological injuries to various organs and tissues. In carps (Fig. 2), DDVP degenerated gill epithelium (A); damaged intestinal villi (B); induced swelling, vacuolation and degeneration of parenchymal cells of liver (C); degenerated many renal tubules of kidney (D); phosphamidon degenerated nerve cells and produced fluid-filled spaces in the brain (E) and degenerated kidney tubules.
(F). In the catfish, DDVP induced severe effects (Fig. 3); gill epithelium ruptured from secondary gill filaments (A); the mucous membranes of stomach and intestine were ruptured, and epithelial and subepithelial connective tissues degenerated (B, C); the parenchymal cells of liver swelled and vacuolated (D); phosphamidon completely degenerated the epithelial cells of the mucous membranes of stomach and intestine (E, F), and induced severe parenchymatous degeneration of liver (G).

Fig. 2. Histopathological effects of the organophosphorus insecticides, DDVP and phosphamidon on carp (Lebua rohita). DDVP induced (A) degeneration of gill epithelium; (B) damage to intestinal villi; (C) swelling, vacuolation and degeneration of parenchymal cells of liver; (D) degeneration of renal tubules of kidney; phosphamidon induced (E) degeneration of nerve cells in the brain and (F) of renal tubules in kidney. HE stain; intestine 400X; others 600X. DE, degenerating epithelial cells; E, epithelium; H, hepatic cells; N, nucleus; RT, renal tubules; RV, ruptured villi; SCT, subepithelial connective tissue; SGL, secondary gill lamella; SP, fluid-filled space; V, vacuole.
Other pesticides can also induce severe histopathological lesions in carp and catfish (Konar 1969b, 1969c, 1970a). Obviously, the histopathological effects in the vital organs caused physiological disorder in fish resulting in death.

Also, DDVP retards development and hatching of fish eggs and reduce the growth of hatchlings (Konar 1969d).

**Pesticide residue**

Pesticides leave residue in water and mud even several days after their spray in the adjacent crop fields (Kallman *et al.* 1962, Spurr *et al.* MS). The
plankton and other organisms deposit pesticide residue in large quantities in their bodies (Keith 1964, Holden 1965). The amount of residue varies with the pesticide and the organism. Fishes also deposit various amounts of residual pesticides in different organs (Bridges et al 1963, Egler 1964, Gilderhus 1966). The fatty tissues retain more residues compared to edible muscles. The edible parts of fish may accumulate up to 214.28 ppm of endrin (Ferguson 1967). The pesticide residues are the lowest in water and are about 18-, 37-, 790- and 7300-fold greater respectively in mud, plankton, fish and aquatic insects compared to that in water (Hannon et al 1970).

Another aspect of pesticide pollution is the hazard of resistant organisms to consumers. The resistant fish exposed to 2 ppm of endrin for seven days, when fed to frogs, turtles, water snakes and birds, most of them died in 48 h (Rosato and Ferguson 1968). Apparently, the consumption of resistant fish with heavy pesticide residue in their bodies would be dangerous for all fish eaters including man. Obviously, judicious use of pesticides is urgently needed (Konar 1970b, 1971).

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REFERENCES


