Museum Insect Pest Control With Newer Insecticides

D. E. HOWELL, Oklahoma A. and M. College, Stillwater.

One of the major problems in maintaining an insect collection is that of protecting the specimens against insect attack. The established procedures for the purpose are the use of properly constructed containers which fit snugly enough to reduce greatly insect entrance and the use of repellents such as paradichlorobenzene or naphthalene. In addition, annual fumigations with HCN or SO_2 are often considered necessary. Unfortunately, properly constructed insect boxes are expensive, and paradichlorobenzene or naphthalene must be replaced regularly.

The effectiveness of the newer insecticides such as DDT (1, 3), chlordane, and lindane (2, 4) in protecting fabrics and stored products against dermestids and moths suggested that these materials might have a place in museum insect pest control. Promising materials were tested in three types of boxes over a three-year period.

Materials and Methods

The concentrated insecticides used in these experiments were commercial formulations. Less concentrated solutions were made by diluting the commercial preparations with acetone. Powder formulations were diluted with pyrophyllite $H_2Al_2(SiO_3)_4$. Insecticides used were DDT[1], lindane[2], and chlordane[3] solutions and DDT[1], BHC[4], chlordane, parathion[5] and paradichlorobenzene (PDB) as solids.

The boxes used in these tests were standard wooden Schmitt boxes with mitered and splined joints; cardboard Hood boxes, commonly called student collection boxes; and two sizes of insect mailing boxes (Mailmaster No. P42 and P55).

When liquids were used, the entire inner surfaces of the boxes and all outer surfaces over which insects might have to crawl to gain entrance were painted with the insecticide. Six-gram quantities of solid insecticides were placed in pill boxes with porous tops and secured in a corner of the test boxes.

Twenty-four hours after the insecticides were applied, the Schmitt and Hood boxes were partially filled with pinned insects. Ten unpinned horseflies (*Tabanus sulcifrons* Macq.) were placed in each of the insect mailing boxes. All of the boxes were placed at random in a large cardboard carton containing many horseflies and a few rodent skins heavily infested with dermestids (*Anthrenus verbasci* Linn). The carton was then stored on an upper shelf of a laboratory and examined periodically to determine the amount of insect damage in each of the boxes. From time to time insects were added to the carton to provide food for the dermestids.

The protection obtained from insecticides acting as both contact and fumigant agents was determined in three types of boxes. Insect mailing boxes 5 x 5 x 2 inches replicated four times for each material were painted with one of the following solutions: 25, 5, or 1% DDT; 20, 5 or 1% lindane; and 25, 5, or 1% chlordane. Similar tests with Schmitt and Hood boxes were replicated twice.

The same experimental plan was followed to determine the value of the insecticides as fumigants only, except that the solid materials were kept in pill boxes in the box rather than painting the inner surfaces. The

[1] p, p'-Dichlorodiphenyltrichloroethane
[2] Highly purified preparation containing not less than 99% gamma isomer of benzene hexachloride.
[3] Compound containing not less than 60% of 1, 2, 4, 5, 6, 7, 8, 8 octachloro-4, 7-methano-3a, 4, 7, 7a-tetrahydroindane with the remainder being related dicylopentadiene derivatives.
[4] 1, 2, 3, 4, 5, 6 hexachlorocyclohexane
[5] O, O-diethyl-o-p-nitrophenyl thiophosphate

insecticides used were technical DDT; 12, 6, and 1% BHC; 25, 5, and 1% parathion; 25, 5, and 1% chlordane; and technical PDB.

Boxes and the insects within were examined 24 hours after the experiment started and at the close to evaluate possible damage.

Results

The experiments using Schmitt boxes were not conclusive because insect injury occurred in only one box. That box contained 1.0 percent parathion dust and insect injury was noted at the end of the second year. It seems probable that the boxes were well enough constructed to provide adequate protection without the use of insecticides.

Only the insects in the mailing and Hood boxes which contained technical DDT were damaged by dermestids at the end of six months. At the end of a year it became evident that painted boxes were more satisfactory than those having the insecticide restricted to a small pill box in the corner. In addition, it was evident that mailing boxes were not as satisfactory for insect storage as Hood boxes. Only boxes containing 25.0 percent chlordane and 25 or 5 percent DDT solution contained insects not damaged by dermestids at the end of three years of exposure to large populations of dermestids. The detailed results of these experiments are shown in tables I and II.

TABLE I.

Protection Against Dermestids Provided by Insecticides Acting as Fumigants in Mailing and Hood Insect Boxes.

CHEMICAL	PERCENT CONC.	PERCENT OF INSECTS DAMAGED AFTER 6 MONTHS		1 YEAR		2 YEARS		3 YEARS	
		MB[1]	HB[2]	MB	HB	MB	HB	MB	HB
DDT technical	78	100	60	100	100	100	100	100	100
BHC dust	12	0	0	0	0	20	5	100	100
BHC dust	6	0	0	0	3	0	25	100	100
BHC dust	1	0	0	100	75	100	100	100	100
Parathion dust	25	0	0	0	0	40	0	100	100
Parathion dust	5	0	0	100	80	100	100	100	100
Parathion dust	1	0	0	100	100	100	100	100	100
Chlordane dust	25	0	0	0	0	0	0	20	3
Chlordane dust	5	0	0	0	0	0	10	100	100
Chlordane dust	1	0	0	60	0	100	20	100	100
Paradichlorobenzene	Tech.	0	0	100	0	100	95	100	100

[1] MB = mailing box.
[2] HB = Hood box.

TABLE II.

Protection Against Dermestids Provided by Insecticides Painted on Hood or Mailing Boxes.

CHEMICAL	PERCENT CONC.	PERCENT OF INSECTS DAMAGED AFTER 6 MONTHS		1 YEAR		2 YEARS		3 YEARS	
		MB[1]	HB[2]	MB	HB	MB	HB	MB	HB
DDT solution	25	0	0	0	0	0	0	0	0
DDT solution	5	0	0	0	0	0	2	28	0
DDT solution	1	0	0	2	0	88	60	100	100
Lindane solution	20	0	0	0	0	32	0	100	92
Lindane solution	5	0	0	0	0	96	64	100	100
Lindane solution	1	0	0	8	0	100	100	100	100
Chlordane solution	25	0	0	0	0	16	0	100	4
Chlordane solution	5	0	0	0	0	80	0	100	98
Chlordane solution	1	0	0	0	0	100	100	100	100

[1] MB = mailing box.
[2] HB = Hood box.

Slight injury to the finish of all Schmitt boxes was evident when solutions were used, probably due to the solvent action on the varnish. By careful handling this was reduced to negligible proportions. Appreciable staining resulted when 25 percent chlordane solution was used and minor staining was noted on boxes treated with 5.0% chlordane. In two cases, the lining in the mailing boxes was loosened following painting with acetone solutions. DDT crystals appeared on boxes painted with 25% DDT. These showed as a white stain on the box surfaces and in some cases DDT crystals were found on the insects.

The solid insecticides caused no evident damage to the boxed insects or pins, but the odor of parathion was quite apparent and objectionable to some people for several weeks. A health hazard might result from the careless use of this highly toxic material.

Discussion

Naphthalene and PDB have been used many years for museum insect pest control. When the storage boxes fit well and the repellents are replaced regularly, excellent protection is provided. Frequently well made boxes are not available for insect storage and less satisfactory containers must be used. In such cases, the data accumulated in these experiments indicate that chlordane or DDT used as paints or chlordane dusts provide more protection than PDB or naphthalene. Unnoticed dermestids in insect specimens are killed by chlordane, lindane, or parathion, but not by DDT. Therefore, the author routinely treats boxes with 5.0% lindane or chlordane before introducing insects which may be infested with unnoticed dermestids. Staining or damage to the finish has not been serious, but care must be used in application.

Summary

1. The effectiveness of several formulations of DDT, chlordane, lindane, BHC, parathion, and PDB for protecting stored insects against dermestid attack has been tested in three types of insect boxes.
2. Schmitt boxes provide excellent protection against dermestids, regardless of the insecticide used.
3. DDT and chlordane in solution provide good control for three years. The fumigant action of chlordane, parathion, and BHC provides more protection than PDB.

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