Malathion Residues on Ladino Clover Seed Screenings Exposed to Ultraviolet Irradiation

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The decontamination by specific physical or chemical treatments of malathion residues from ladino clover seed screenings which are potential animal feeds has been reported (1,2). Cook (5) reported that a number of thiophosphate insecticides, including malathion, were converted on filter paper strips to more potent cholinesterase inhibitors by treatment with N-bromosuccimide and ultraviolet light. The compounds formed were, in general, relatively more soluble in water than in oil.

The present investigations were undertaken to study in the laboratory under controlled conditions the effect of a 168 hour ultraviolet light exposure at 2537Å on the stability of malathion [0,0-Dimethyl S-1,2-di(ethoxy-carbamyl)ethyl phosphorodithioate] residues on ladino clover seed screenings.

Materials and Methods

The ladino clover seed screenings were coated with analytical grade malathion in the following manner. A composited sample (14% moisture) was well mixed and analyzed for malathion and malaoxon. Neither were detected. A weighed amount of the mixed composited sample was covered with redistilled acetone containing a known amount of analytical grade malathion to result in a theoretical residue deposit of 15.0 ppm on the screenings. The solvent was evaporated at 50° to 60°C with the aid of a warm air stream until completely dry. The plant material was mixed in the solvent concentrating jar and stored for analysis. By triplicate analyses the sample contained an average of 10.9 ppm of malathion. Some of the contaminant was lost due to volatilization and other nondeterminant factors during the coating operation, but all losses due to decontamination by ultraviolet light treatment were based on the actual residue present after sample contamination.

The extraction and cleanup of the plant material, and the methods for the detection and determination of the pesticides have been described (1).

The malathion contaminated seed screenings were exposed to ultraviolet light treatment at temperatures ranging from 37° to 49°C for 168 hours, and all other conditions were as previously reported (3).

Results and Discussion

The major residues and reaction products on the ladino clover

Bulletin of Environmental Contamination & Toxicology,
Vol. 6, No. 2, 1971, published by Springer-Verlag New York Inc.

seed crop screenings irradiated with ultraviolet light are shown in Table 1. At zero time of exposure the plant material contained 10.9 ppm of malathion and no detectable malaoxon.

The total residue of malathion progressively decreased due to volatilization to a level of 3.7 ppm after 168 hours of ultraviolet light irradiation which represented approximately a 66% loss of the total residue.

Approximately 34% of the original malathion residue was detected on the seed screenings after 168 hours of ultraviolet light irradiation, but no malaoxon was detectable. The possibility of the presence of other decomposition products exists. However, due to the relative short treatment period and the type of "solvent" present (wax-like materials of the plant cuticle) the amounts of these products would be very small and probably nondetectable. Archer (1) has discussed the possibility that malathion residues on seed screenings are deposited in the wax-like materials of the plant cuticle. These materials could exert protective effects on malathion similar to those of benzeneazo-β-naphthol (4) on the photodecomposition of DDT.

TABLE 1

Levels[a] of Malathion on ladino clover seed screenings after exposure to ultraviolet[b] light

Exposure time (hours)	Malathion ppm	Percent of total residue	Malaoxon ppm
0	10.9	100.0	N.D.[c]
24	10.9	100.0	N.D.
48	9.2	84.4	N.D.
72	6.2	56.8	N.D.
96	6.5	59.6	N.D.
168	3.7	33.9	N.D.

[a] Original moisture 14%; no significant change during radiation; all results expressed on a dry weight basis.

[b] Ultraviolet light exposure (2537Å) at approximately 1.1×10^4 ergs/ cm^2; average temperature of exposure 48°C.

[c] N.D. signifies nondetectable.

Acknowledgement

The author acknowledges the technical assistance of Mr. James Stokes and Mr. Stephen Bettcher.

References

1. Archer, T.E., Poultry Sci. 48, 2075 (1969)
2. Archer, T.E. and Crosby, D.G., Residue Reviews 29, 13 (1969)
3. Archer, T.E., Bull. Environ. Contam. Toxicol. 5, 247 (1970)
4. Blackith, R.E., J. Sci. Food Agric. 3, 482 (1952)
5. Cook, J.W., J. Assoc. Offic. Agri. Chem. 38, 826 (1955)