Bull. Environ. Contam. Toxicol. (1989) 42:687–690

Bulletin of Environmental Contamination and Toxicology

Removal of Pyrazophos from Treated Fabric Using Household Laundering

Heinz E. Braun,[1] Richard Frank,[1] and Gwen Ritcey[2]

[1]Agricultural Laboratory Services, Ontario Ministry of Agriculture and Food, c/o University of Guelph, Guelph, Ontario, N1G 2W1 Canada and [2]Dept. of Environmental Biology, Ontario Agricultural College, University of Guelph, Guelph, Ontario, N1G 2W1 Canada

The insecticide pyrazophos (0-6-ethoxycarbonyl-5-methylpyrazolo-[1,5-a]pyrimidin-2-yl 0,0-diethyl phosphorothioate), (Afugan^{R}), is currently used for the control of leaf miners (Phytomza atricornis Meigen) on greenhouse-grown chrysanthemums. The recommended rate of application is a solution containing 450 mg/L (a.i.) which is sprayed until leaves are thoroughly wet and run-off just begins. During the course of this application, which is frequently carried out under restricted working space, garments and protective clothing can readily come in contact with the spray. Previous workers have studied the effects of various factors in the removal of organophosphorus insecticides from contaminated clothing. Easley et al (1981, 1982) have reported on the efficiency of various laundering procedures, detergents, and water temperatures in the removal of methyl parathion from denim fabrics. Laughlin et al (1985) studied the influence of different formulations of methyl parathion on the removal of the insecticide using conventional laundering practices.

This note describes a study which was intended to determine the efficiency of household laundering in removing pyrazophos from contaminated fabric.

MATERIALS AND METHODS

Cotton/polyester coverall fabric was cut into 10cm x 20cm strips (200 cm^2) and the edges were machine-stitched to prevent fraying. Four swatches were arranged into layers and placed randomly onto newspaper laid out on the bed of a custom-built cabinet sprayer; the sprayer consisted of an overhead mobile liter container fitted with a nozzle and pressurized by an air pump. The newspaper served to soak up spray around the target fabrics. To simulate drift and spill situations, the fabric was sprayed at rates of 48 ml/m^2 and 240 ml/m^2 respectively, using a solution of 450 mg pyrazophos per liter of water; these applications were equivalent to absolute levels of 432 μg and 2160 μg of pyrazophos per 200 cm^2-swatch. The fabric was allowed to dry for 8 hours at ambient temperature before being laundered. All treatments were replicated four times.

Send reprint requests to H.E. Braun at the above address.

Unwashed swatches from the first, second, and third layers were separately placed into containers for subsequent analysis. With those samples to be laundered, the swatches with the lower application (simulated drift) were put through the washing cycle first and these were followed by the fabrics with the simulated spill.

Laundering was carried out in a domestic automatic washing machine and consisted of the following treatments:

(1) Single wash - a 12-minute wash and spin cycle with a heavy-duty detergent followed by a double rinse and spin-dry cycle (total time 40 min).

(2) Double wash - two complete single washes (total time 80 min).

(3) Pre-soak and double wash - one hour pre-soak in luke warm water using a liquid soil and stain remover followed by two complete single washes (total time 140 min).

All samples were placed into glass jars, closed, and transferred to the laboratory for analysis. Analyses were commenced within 18 hours of treatment.

Laundered and unlaundered swatches were soaked in 250 ml dichloromethane for 16 hours (overnight); the solvent was decanted off as thoroughly as possible and the swatch and jar were rinsed with an additional 100 ml dichloromethane which was combined with the original extract. The extracts were evaporated just to dryness with rotary vacuum and residues were redissolved in a measured aliquot of acetone.

Pyrazophos was quantified by gas chromatography with flame photometric detection (P-mode) and a wide-bore fused silica capillary column, 0.53 mm i.d. x 15 m, and the following temperature program: Initial temperature - 200°C with 0 hold time; program rate - 5°/min; final temperature - 255°C; helium at ca 8 ml/min was used as the carrier gas.

Recovery rates were determined by pipetting acetone solutions of pyrazophos onto untreated 10 cm x 20 cm fabric strips at rates of 50 and 500 µg pyrazophos per 200 cm^2 of fabric. The solvent was allowed to evaporate at room temperature and the strips were then placed in sealed jars for 16 h (overnight). Extraction and determination as per the procedure described above gave recoveries ranging from 91% to 102% with a mean recovery of 93%. Data presented are not corrected for recovery.

RESULTS AND DISCUSSION

Where drift contamination was simulated, a deposit of 435 µg pyrazophos per 200 cm^2 was found on the surface layer of unwashed fabrics. The second and third layers contained trace levels at 0.6% and 0.5%, respectively, of the amount found in the surface

layer (Table 1). On the swatches with simulated spill contamination, deposits of 2225 μg pyrazophos were found on the 200 cm^2 surface area while the second and third layers of fabric contained deposits representing 0.2% and 0.3% of that on the surface.

A single wash of the drift-simulated fabric removed 78% of the pyrazophos residue while a double wash removed 92%; the addition of a pre-soak treatment failed to improve removal over the double wash. With the spill-simulated fabrics, single and double washes of the surface fabrics removed 83% and 94% of the deposits respectively. Again the pre-soak treatment failed to improve on the double wash.

Table 1. Pyrazophos on unlaundered and laundered swatches

Washing	Pyrazophos μg/200 cm^2 Simulated drift Mean±SD[1]	% Remaining	Simulated spill Mean±	% Remaining
Unwashed-First Layer	435±58	0	2250±96	0
Unwashed-Second Layer	2.5±1.8 (0.6%)	0	5.3±1.6 (0.2%)	0
Unwashed Third layer	2.0±1		7.4±3.3	0
Single Wash-First Layer	68±6	22	380±74	17
Double Wash-First layer	24±3	7.9	124±53	5.6
Soak and Double Wash First Layer	26±5	5.3	153±38	6.9
Untreated - double	-	-	85±53	(3.8)[2]

[1]Mean of four replicates.
[2]Pick-up from originally contaminated fabric.

Four untreated swatches were laundered along with the spill-simulated fabrics; these were found to pick up an average contamination of 85 μg pyrazophos which represented 3.8% of the amount found on the unwashed fabric or 68% of that found after the double wash (Table 1). These results indicate that clean water and detergent be used for successive loads of pesticide-contaminated clothing and secondly, that laundering of contaminated clothing must be carried out separately from the rest of the family wash.

REFERENCES

Easley CB, Laughlin JM, Gold RE, Tupy DR (1981). Methyl parathion removal from denim fabrics by selected laundry procedures. Bull Environ Contam Toxicol 27:101-108

Easley CB, Laughlin JM, Gold RE, Schmidt K (1982). Detergents and water temperature as factors in methyl parathion removal from denim fabrics. Bull Environ Contam Toxicol 28:239-244.
Laughlin JM, Easley CB, Gold RE, Hill R (1985). Methyl parathion residues in contaminated fabric after laundering. Dermal exposure related to pesticide use. ACS Symposium Series #273 pp 177-187.

Received June 6, 1988; accepted August 20, 1988.