

Removal of Fenitrothion and Cypermethrin from Contaminated Fabrics by Handwashing

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Cleaning contaminated clothes worn by pesticide applicators is an important work for limiting applicator exposure to pesticides. The effect of the fabric, detergent, pesticide formulation, wash-water temperature, laundry procedures, and other variables on removal of pesticide residues from fabric has been studied using washing machines (Easley et al. 1981; Easley et al. 1982; Kim et al. 1982; Kim et al. 1986; Laughlin et al. 1987; Laughlin et al. 1989; Braun et al. 1989). In China, however, most usually contaminated clothes are hand washed. Up to now little has been known about the cleaning efficacy of the hand wash method. The objectives of this research were to investigate the cleaning efficacy of the hand-wash method and to find out suitable procedures for removing pesticides from clothes effectively, using fenitrothion and cypermethrin, commonly used pesticides in tea plantations in China.

MATERIALS AND METHODS

Two kinds of fabrics were used. One was 100% cotton fabric, and the other a cotton-polyester fabric of unknown composition. These two fabrics are used to make shirts. The fabrics were cut into 10 x 20 cm strips, and prewashed with acetone. The formulated pesticides, fenitrothion (50-EC) and cypermethrin (10-EC) (1 mL each), were dissolved in water (1000 mL) and the diluted pesticide solution added evenly at the rate of 0.1 mL per strip (50 µg of fenitrothion and 10 µg of cypermethrin). The treated strips were allowed to dry in the air at room temperature for 12 hr before washing.

Laundering consisted of following treatment:

- (1) Soak with detergent ----- Detergent (4 g) was dissolved in 500 mL of water. A fabric strip was soaked in the solution for 12 hr and scrubbed in the soaking solution for 1 min before being rinsed in clean water and air dried.
- (2) Scrub with detergent----- A wet fabric strip was scrubbed with detergent (1g) for 1 min and rinsed in clean water and air dried.
- (3) Scrub with soap ----- Soap was applied evenly to a wet strip and the strip scrubbed for 1 min before being rinsed and air dried.

The heavy duty detergent was produced by Xuzhou Synthetic Detergent Factory (China). It contains ca. 25% of alkyl benzene sulfonate, 15% of polyphosphate salt, and 45% of sodium sulfate. The soap was produced by Hangzhou Southeast Chemical Factory. Scrubbing a strip for 1 min is roughly

equivalent to scrubbing a cloth for 30 min. The 3 treatments represent 3 commonly adopted hand-wash methods.

The fabric strips were cut into small pieces, and were soaked in acetone overnight (50 mL acetone for each strip) prior to gas-chromatographic determination. Fenitrothion was determined using a HP-5790A gas chromatograph equipped with a nitrogen/phosphorus detector. The column (1.5 m x 2 mm) was packed with 5% OV-101 on Chromosorb W HP. The oven temperature was 200 C. The carrier gas flow rate was 40 mL/min. Cypermethrin was determined using a Shimadzu GC-9A gas chromatograph equipped with a electron-capture detector. The column (1.5 m x 3 mm) was packed with 5% OV-1 on Chromosorb W HP. The oven temperature was 245 C. The flow rate of carrier gas was 50 mL/min.

To determine the recovery of the analytical method, clean fabric strips were treated with fenitrothion at the rate of 5-50 ug per strip and with cypermethrin at 1-10 ug per strip. The strips were allowed to stand in the air for 12 hr; the pesticides on the fabric strips were analyzed following the above described procedures. The recoveries were 97.4-113% for fenitrothion and 84.7-92.3% for cypermethrin.

RESULTS AND DISCUSSION

The cleaning efficacy of the three treatments are given in Table 1.

Table 1. Cleaning efficacy of the 3 laundering treatments

Treatment	Fabric type	Pesticide retained (%) \pm S.D.*	
		Fenitrothion	Cypermethrin
Soak with detergent	Cotton	5.8 \pm 1.5	19.0 \pm 1.2
	Polyester	4.0 \pm 0.2	
Scrub with detergent	Cotton	9.3 \pm 1.2	10.0 \pm 1.0
	Polyester		
Scrub with soap	Cotton	15 \pm 1.3	17.7 \pm 1.9
	Polyester	19 \pm 1.0	

* Mean of 3 replicates.

Results in Table 1 suggest that fenitrothion is easier to remove than cypermethrin. The aqueous solubility of fenitrothion is 30 mg/L, which is about 30 times higher than cypermethrin. The difference in solubility could be an important factor causing the difference in removal efficacy. The data also suggest that the fabric type has little effect on removal efficacy.

The best treatment for removing fenitrothion was soaking with detergent (treatment 1), whereas scrubbing with detergent (treatment 2) gave best efficacy of cypermethrin removal. It suggests that the amount of detergent used in treatment 1 is not enough for removing cypermethrin. When detergent is added directly to a fabric strip, like the case of treatment 2, the detergent concentration on the fabric surface is much higher than when detergent is dissolved in water to make a soaking solution, like the case

of treatment 1. It should be expected that the efficacy of treatment 1 to cypermethrin removal would be improved by increasing the detergent amount.

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- Received July 25, 1990; accepted May 1, 1991.