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Pesticide Exposure of Applicators Working in Tea Plantations

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Pesticide applicators working in the field are at risk of both acute and chronic exposure, each of which may result in a variety of adverse health effects. Information on applicaor exposures is important for protecting agriculture workers from pesticide poisoning. Some related research has been conducted in several developed countries on various crops (Gunther et al. 1980; Davies et al. 1980; Davis 1980; Maitlen et al. 1982), but no exposure research in a tea plantation has been reported. The present study was undertaken to determine the pesticide exposure of applicators working in tea plantations under the conditions commonly adopted in China.

MATERIALS AND METHODS

The formulated pesticides fenitrothion (50-EC) and cypermethrin (10-EC) were sprayed to tea plants at commonly used application rates (fenitrothion 1000 g ai/ha; cypermethrin 40 g ai/ha) using a GongNong-16 back-pack type hand sprayer. Six applicators were selected, each of whom sprayed 12.5 g of fenitrothion (ai) and 0.5 g of cypermethrin (ai) dissolved in 20 kg of water, following the spraying method generally adopted in China. The spraying started in the early morning when there was no wind felt, and lasted about one hour. The workers were asked to put on cotton gloves and gauze masks; pads were attached to the front of their working jackets on the chest, abdomen, thigh, and ankle, prior to spraying. The pad (10 x 10 cm) was constructed by backing a 6-ply gauzy compress with a piece of filter paper and attaching these together in the centre with a staple.

To investigate the influence of the height of tea plants on the exposure, two plots (300 square meters each) were selected, of which the height of crops was 0.6 m and 1.1 m.

The exposed pads, gloves, and gauze masks were collected, and transferred to the laboratory for residue analysis, immediately after the spraying had finished.

A pad (with filter paper removed), gauze mask, or a glove was packed tightly into a chromatographic column (20 x 1.5 cm id); the column was eluted with acetone (50 mL for one pad or glove, and 100 mL for one gauze mask). The eluate was analyzed using a HP-5790A gas chromatograph with a

nitrogen/phosphorus detector for fenitrothion or a Shimadzu GC-9A gas chromatograph with a electron-capture detector for cypermethrin.

The recoveries of the pesticides were determined by fortifying clean pads with fenitrothion (20 ug per pad) and cypermethrin (10 ug per pad), and analyzing the pesticide amounts eluted from the chromatographic column, following the above described procedures. The recoveries ranged from 90 to 109%.

RESULTS AND DISCUSSION

The exposure rates of fenitrothion and cypermethrin are shown in Tables 1 and 2, respectively.

The exposure rate increases from head to foot. The cypermethrin exposure of gloves worn by worker A, B, and C was 27, 32, and 9.9 ug, respectively, whereas that of fenitrothion was 486, 3338, and 487 ug, respectively.

Table 1. Cypermethrin exposure rate to applicators

Worker monitored	Exposure rate (ug/100 cm^2)				
	Face	Chest	Abdomen	Thigh	Ankle
A	0.72	1.54	1.42	4.29	2.72
B	0.55	2.06	2.68	17.3	32.6
C	0.06	0.11	1.31	0.41	3.07
Average	0.45	1.24	1.80	7.33	12.8
D	0.15	0.16	0.09	0.50	0.15
E	0.22	0.17	0.93	2.89	0.95
F	0.13	0.25	0.23	1.42	3.54
Average	0.17	0.19	0.42	1.60	1.55

* A, B, and C worked in the 1.1-m crop plot; D, E, and F worked in the 0.6-m crop plot.

Calculation of the total dermal exposure (TDE) was based on the amount of pesticide sprayed instead of basing it on the spraying duration, considering that the spraying speed varied significantly from person to person. The TDE value was calculated by the method described by Davis (1980), assuming that the back side exposure was zero, and that the exposure rate of the arms was similar to that of the chest. The results are listed in Table 3.

The results in Table 3 suggest that the variety of pesticides has little influence on the total dermal exposure. The height of tea plant is a very important factor. The application exposure can be considerably reduced by keeping the tea plant under 0.6 m in height.

Compared to the exposure data published in the literature, the TDE values in Table 3 are much higher (Stamper et al. 1989;Franklin et al. 1982; Maitlen et al. 1982). But the acute poisoning cases in tea plantations in China are not so strikingly higher than in other countries. The reason

Table 2. Fenitrothion exposure rate to applicators

Worker monitored	Exposure rate (ug/100 cm^2)				
	Face	Chest	Abdomen	Thigh	Ankle
A	26.7	47.6	64.0	222	88.0
B	17.4	71.8	56.0	381	689
C	1.10	2.07	34.1	9.42	87.4
Average	15.1	40.5	51.4	204	288
D	5.16	9.54	10.1	11.3	6.60
E	10.4	6.45	13.9	53.4	19.4
F	2.21	1.59	5.90	35.4	45.6
Average	5.92	5.86	9.97	33.4	23.9

* A, B, and C worked in the 1.1-m crop plot, and D, E, and F worked in the 0.6-m crop plot.

Table 3. Total dermal exposure based on spraying amount

Pesticide	Height of crop (m)	mg/kg of pesticide applied	
		TDE excluding hands	Exposure on hands
Cypermethrin	1.1	1140	16.1
Cypermethrin	0.6	186	
Fenitrothion	1.1	1152	115
Fenitrothion	0.6	148	

could be that the pesticide variety used in tea plantations are generally of less mammalian toxicity (such as pyrethroids, malathion, and fenitrothion.). Another reason is that the area of tea land managed by a worker is generally less than half an acre, and thus the amount of pesticides used by each tea farmer in China is much less than that in developed countries.

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