POTENTIAL EXPOSURE TO PESTICIDES IN CARNATION GREENHOUSES

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INTRODUCTION

In the European Union, Council Directive 91/414/EEC controls the authorization, placing on the market, use and control of plant protection products. Annex VI of the Directive provides detailed rules (Uniform Principles) for the evaluation of information submitted by applicants and for the authorization of plant protection products by individual member states. A specific principle of the evaluation process relates to assessment of the impact on human health. The assessment requires that member states shall evaluate operator exposure, using by preference realistic data on exposure and, if such data are not available, a suitable, validated calculation model.

The EUROPOEM (European Predictive Operator Exposure Model) database of monitored studies on plant protection products in Europe, contains insufficient data from southern European countries, particularly from greenhouse conditions. This study is part of the EU funded project SMT4-CT96-2048, in which data is currently being generated to begin to fill gaps in the database.

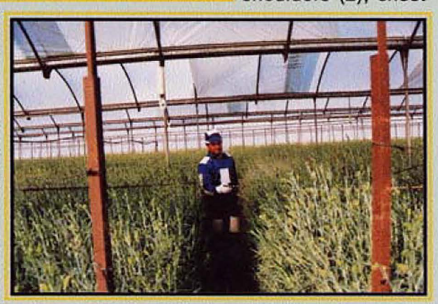
The potential dermal and respiratory exposure to endosulfan was assessed during a high volume application in carnation greenhouses in southern Spain.

MATERIALS AND METHODS

The treatment of carnations was carried out simultaneously by three applicators on two dates in different greenhouses. The application method consisted of hand held pistols supplied with the pesticide mixture via hoses which were connected to fixed points in the greenhouse. The applicators were separated by distances so that there was no cross contamination between them. Details of the application are given in the results tables.

Endosulfan (35%, emulsifiable concentrate) was the selected pesticide as it is commonly used in carnations and has well established analytical methodology. Exposure was assessed during mixing/loading and application operations and the method used was carried out according to OECD Guidance Document for the Conduct of Studies of Occupational Exposure to Pesticides During Agricultural Application.

Potential dermal exposure was assessed using a patch method which involved placing 17 polyethylene-backed absorbent paper pads on the operators clothing. Each pad had an area of 10 cm x 10 cm and they were located on: head (1), shoulders (2), chest (1), back (1), upper arms (2),forearms (2), upper legs (4), lower legs (4). Hand exposure was measured directly using cotton gloves with rubber gloves underneath.



Potential respiratory exposure was measured using personal air samples in the proximity of the workers breathing zone, connected to sampling pumps. Sampling medium was a XAD-2 tube with glass fiber filter enclosed, recommended by OSHA.

Endosulfan in the pads, gloves and tubes was extracted with toluene and analysed by gas chromatography - electron capture detection.

RESULTS

The rate of exposure per unit area (μg/cm².h) is calculated from the quantity of endosulfan deposited on each of the patches (μg/100 cm²), and the duration of each of the applications. Similarly the quantity of endosulfan on each of the gloves is expressed in the same units, so that it can be compared to other regions of the body. The area of each glove is taken as 410 cm² (US EPA, 1987). In Table 1 the mean exposure values of the three applicators at the two application dates are presented.

Table 2 the corresponding potential dermal exposure values for each of the body regions are presented. These values have been calculated by extrapolating from the quantity of pesticide deposited on the patches representing each particular body region using the guidelines of the EPA protocol. If there was more than one patch on each body region the mean value was used for the calculations. To determine the exposure of the front of the neck, the value from the patch on the chest was used, and for the back of the neck, the value from the patch on the back of applicator was used.

The values for potential dermal exposure during the mixing and loading operation carried out on each of the days are presented in Table 3.

The potential inhalation exposure was estimated from the concentration of endosulfan in the air, and the ventilation rate. The values were negligible in all cases (below 0.1% of the potential dermal exposure).

TABLE 1

MEAN VALUES OF PATCHES AND GLOVES DURING THE APPLICATION (μg / cm². h)

PATCHES / GLOVES	Day 1 [1]	Day 2 [2]
Head	0.679	0.505
Right shoulder	1.242	1.447
Left shoulder	1.136	1.121
Chest	1.458	3.793
Back	0.411	0.349
Right upper arm	0.788	7.779
Left upper arm	0.680	1.658
Right forearm	0.754	2.999
Left forearm	0.966	3.292
Right upper leg front	5.874	28.515
Right upper leg back	2.109	1.161
Left upper leg front	20.277	30.070
Left upper leg back	0.660	2.207
Right lower leg front	33.721	45.362
Right lower leg back	2.963	7.900
Left lower leg front	55.125	44.253
Left lower leg back	6.606	17.274
Right hand	31.201	23.497
Left hand	19.573	21.682

TABLE 2

DERMAL EXPOSURE PER BODY REGION DURING THE APPLICATION (mg / h)

BODY REGION	Area (cm²)	Day 1 [1]	Day 2 [2]
Head	1300	0.883	0.656
Neck front	150	0.219	0.569
Neck back	110	0.045	0.038
Chest	3550	5.176	13.465
Back	3550	1.459	1.239
Upper arms	2910	2.136	13.729
Forearms	1210	1.041	3.807
Upper legs	3820	27.619	59.164
Lower legs	2380	58.557	68.299
Hands	820	20.819	18.523
Total dermal exposure		117.954	179.489

1 Spray mix concentration 1.08 g active ingredient / litre diluent. Duration of contamination sampling period 30 - 31 min. Crop height 80 cm. Row spacing 90 cm. Total volume of spray per applicator 156.7 litres.

2 Spray mix concentration 1.05 g active ingredient / litre diluent. Duration of contamination sampling period 33 min. Crop heigh 125 cm. Row spacing 60 cm. Total volume of spray per applicator 123.3 litres.

TABLE 3

DERMAL EXPOSURE DURING MIXING / LOADING (mg / h)

HAND	Day 1 [1]	Day 2 [2]
Right	393.202	118.256
Left	627.840	34.400
Total dermal exposure	1021.042	152.656

1 Duration of contamination sampling period 10 min

2 Duration of contamination sampling period 15 min

CONCLUSIONS

The comparison of the amount of pesticide deposited on the gloves and patches during the application shows that the most exposed parts of the body are the legs, thighs and hands.

It is seen that the level of potential dermal exposure increases as the crop height increases and as the row spacing decreases.

With respect to the hands, it is also observed that the mixing and loading operation resulted in greater potential dermal exposure than the application of the spray mixture, as the former involved the handling of the concentrated pesticide. The levels of exposure during mixing and loading are also very variable.

The potential inhalation exposure is negligible compared to the dermal exposure.

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