

## EXPOSURE OF WORKERS TREATING CONIFER PLANTS WITH LINDANE OR DDT

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### ABSTRACT

The uptake of lindane and DDT was measured in 209 exposed workers by analysing the concentrations of these pesticides in plasma. The exposure was assessed by measuring levels of lindane and DDT in the air of the working environment.

Working with lindane gave a small, variable but significant increase of the lindane plasma concentration. The concentration, however, was not sufficient to cause liver enzyme induction. No uptake of DDT could be demonstrated. No symptoms related to the exposure were registered.

Conifer plants cultivated in pine and fir nurseries were treated with a 2% water emulsion of DDT until 1976. This treatment provided a good protection against the attack of the large brown pine weevil. The occupational risks from such intermittent application were small<sup>4,5</sup>. For ecological reasons DDT was prohibited in Sweden in 1976. Several field studies of the use of lindane for the above treatment have been carried out.

The purpose of this study was to assess possible health risks from intermittent use of lindane and DDT for the treatment of pine and fir trees by estimating plasma levels of p,p'-DDT, p,p'-DDE and lindane. Also, airborne concentrations of these chlorinated hydrocarbon pesticides in the breathing zones were measured during various forms of application. Possible acute symptoms in connection with exposure to lindane and DDT were observed and registered as well.

### EXPOSED WORKERS AND METHODS

A total of 183 persons exposed to lindane and 26 persons exposed to DDT were taken in the study. The following forms of application were studied: tunnel application indoors, tunnel application outdoors (Fig. 1), field application (Fig. 2), packing indoors, uptake of plants and planting.

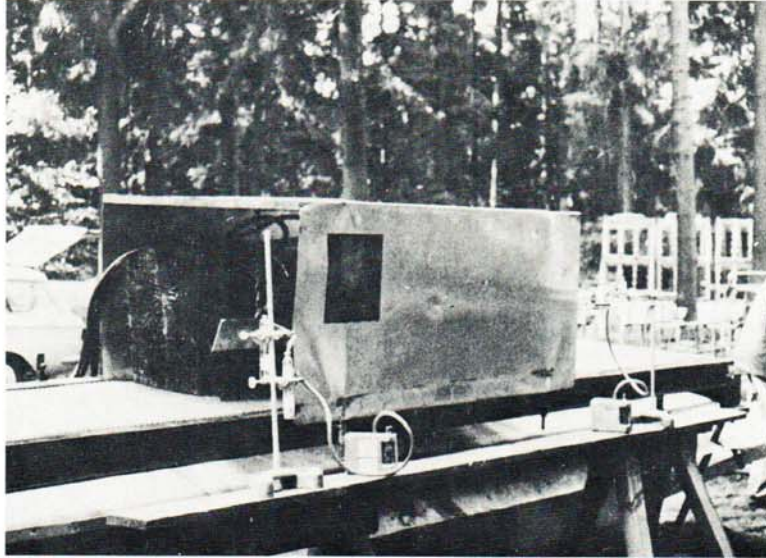


FIG. 1 - Tunnel application of lindane. Paper-pot plants.



FIG. 2 - Field application with tractor driven equipment.

The products the workers handled were 1% water emulsion of Servarin (80% lindane =  $\gamma$  isomer of hexachlorocyclohexane, Gullviks Comp.), and 2% water emulsion of Hylobin (75% p,p'-DDT Gullviks Comp.).

The protective measures included rubber boots and gloves. In the preparation of lindane the workers wore a respirator with a charcoal filter and overalls. In the preparation of DDT emulsion a dust filter (paper) was used.

Air sampling was done with a mobile and stationary equipment. Impinger flasks contained 95% ethanol. Sampling period was one hour with a flow of 1 l/min.

The plasma levels of chlorinated pesticides were determined by the method of Palmer and Kolmodin-Hedman<sup>7</sup>. Plasma was extracted with hexane after pretreatment with formic acid. Internal standard heptachlorepoide was used. No concentration step in the procedure was necessary. The practical limit of detection, calculated per ml plasma, was 0.2 ng for lindane, 1 ng for p,p'-DDE and 3 ng for p,p'-DDT.

### RESULTS AND DISCUSSION

Plasma levels of lindane are presented in Table 1.

TABLE 1  
Plasma levels of lindane (mean and range).

Form of application	Number of persons	Pre-exposure	ng of lindane/ml plasma	
			After 1 day of exposure	After 1 week of exposure
Tunnel application indoors	4	0.8 0.5-1.3	4.7 2.3- 5.6	2.2 2.2-2.3
Packing indoors	6	0.6 0.3-1.1	13.1 4.2-25.7	1.6 0.6-3.7
Field application outdoors	4	0.3 < 0.2-4.0	16.2 < 0.2-18.8	0.5 0.4-0.7
Tunnel application outdoors	3	0.9 < 0.2-2.0	3.5 < 0.2- 8.3	0.8 < 0.2-1.3
Uptake of plants outdoors	7	< 0.2 all	0.3 < 0.2- 0.5	0.2 all

Pre-exposure values were mostly below 1.0 ng/ml. In spite of short periods of exposure during the preparation of the emulsion (about 15 minutes) and spraying period (1/2-2 hours) and the use of protective clothes the mean plasma levels rose to around 4 ng/ml. Lindane levels in the breathing zones varied from 0.0003 mg/m<sup>3</sup> to 0.0028 mg/mg<sup>3</sup>. As lindane is fairly volatile,  $3.6 \times 10^6$  mm Hg, skin absorption is possible<sup>2</sup>. One week after exposure the levels declined (Table 1 and Fig. 3).

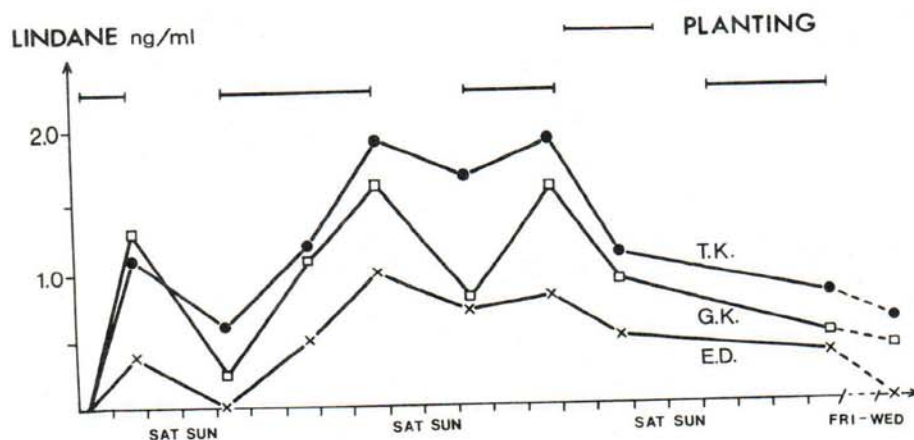


FIG. 3 - Plasma levels of lindane in three planters for three weeks of exposure. Saturday, Sunday free.

No symptoms related to exposure were registered. The concentration of lindane in plasma in most cases was not so high as to cause induction of liver enzymes. The induction limit empirically found earlier by Kolmodin-Hedman and co-workers<sup>3,4,5</sup> was 10 ng/ml.

Acute exposure to DDT increases plasma levels of DDT. After being metabolised DDT is predominantly converted to DDE thus reflecting a more chronic exposure<sup>1,6</sup>. DDT in the diet gives a background level of DDT and DDE in plasma<sup>4,6</sup>.

The DDT and DDE levels in this study are shown in Figures 4, 5, 6, 7, for applicators, those taking up plants and those planting them. Previous handling of DDT in nurseries gave large individual deviations in the DDE levels. As can be seen in Figure 4 DDT level for the subject E. O. shows a small increase from 8.5 to 12.5 ng/ml after dipping and field spraying. The subject H. O. only had a small increase. DDE levels were unchanged for both. Taking up plants and planting them did not change the plasma levels of DDE and DDT. No DDT in the air could be determined above these treated plants. As can be seen in Figure 8 the first two sets of values show air concentrations up to half the American TLV (threshold limit values) for plant dipping. Field application gives negligible airborne concentrations.

Figure 9 gives the airborne concentrations of lindane one and two weeks after application. The concentrations are low and indicate evaporation of lindane. Drops can easily be inhaled and splashes may contaminate the skin and the pump. The volatility of DDT is  $1.9 \times 10^{-7}$  mm Hg which is less than for lindane. DDT is poorly resorbed by intact skin.

No symptoms related to exposure were registered. The induction limit for DDT is much higher, over 200 ng of DDE and DDT per ml of plasma. Poland

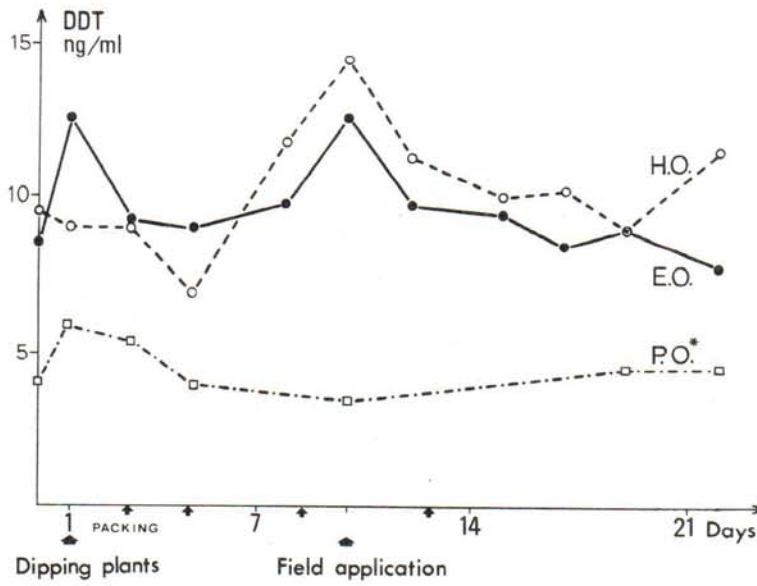


FIG. 4 - Plasma levels of p,p'-DDT in three persons before, during and after exposure to DDT (dipping, packing and field application).

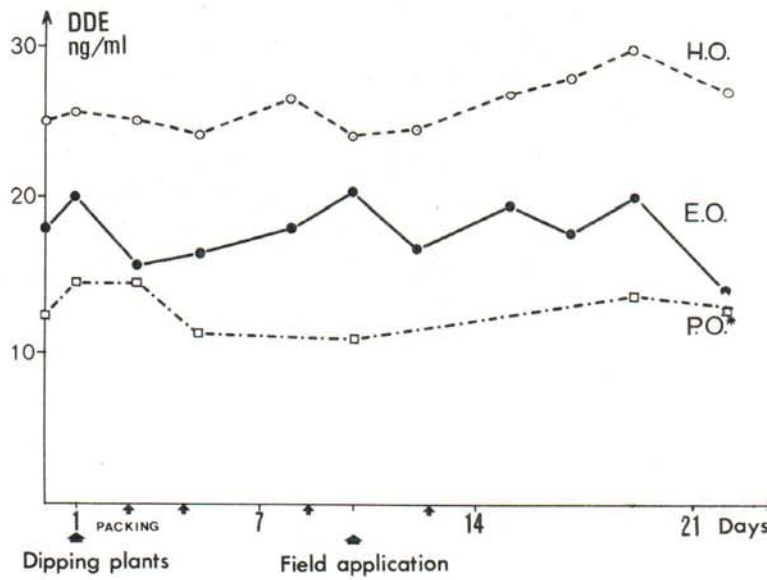


FIG. 5 - Plasma levels of p,p'-DDE in three persons before, during and after exposure to DDT (dipping, packing and field application).

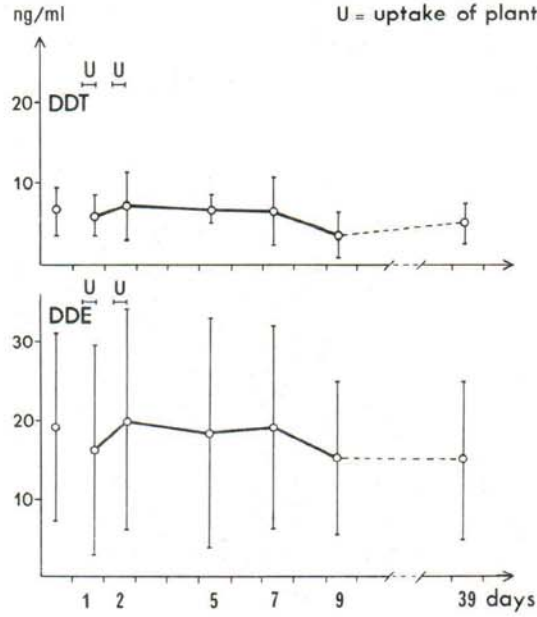


FIG. 6 - Plasma levels of p,p'-DDE and p,p'-DDT in seven persons taking up treated plants; mean and S.D.

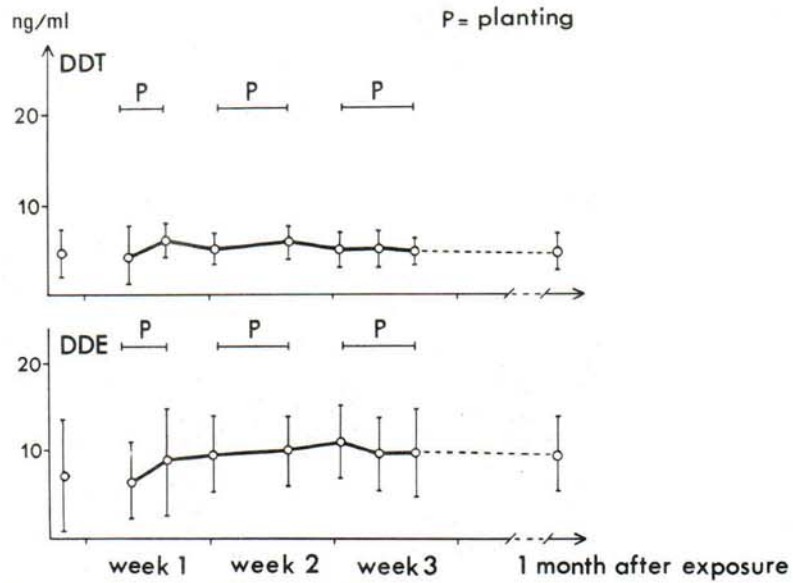


FIG. 7 - Plasma levels of p,p'-DDE and p,p'-DDT in nine persons planting DDT treated; mean and S.D.

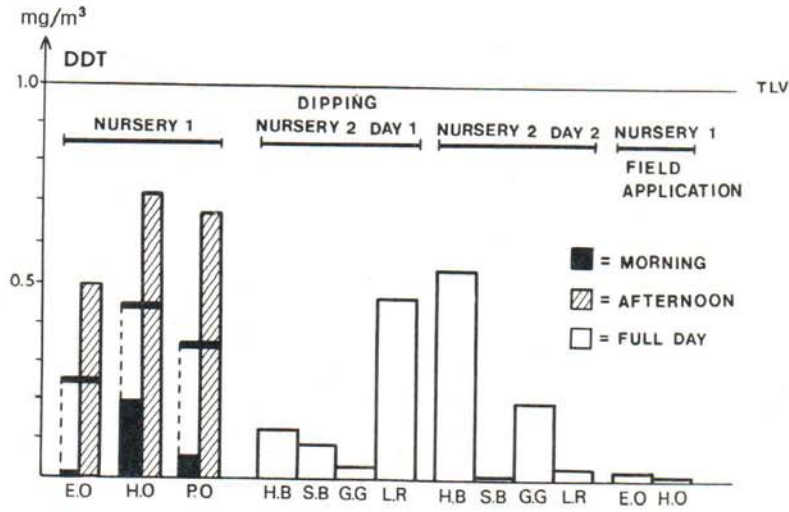


FIG. 8 - Air concentrations in individual breathing zones of DDT at dipping and field application. Time-weighted average, mg/m<sup>3</sup>.

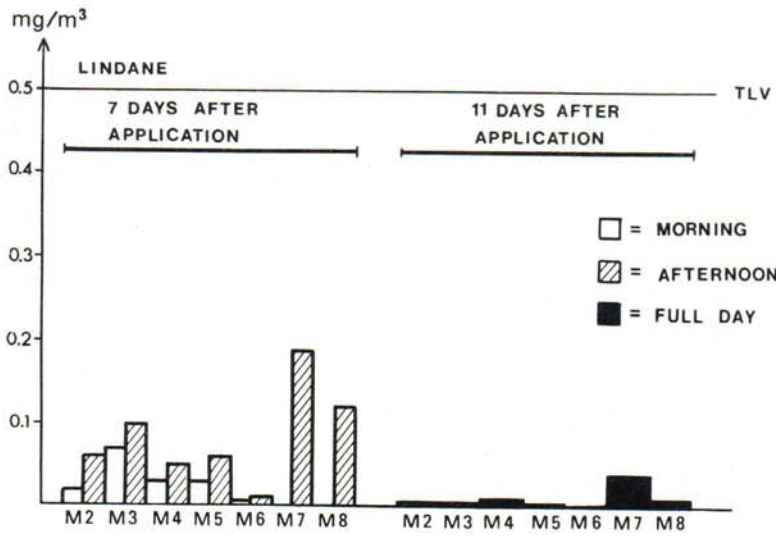


FIG. 9 - Air concentrations in individual breathing zones of lindane. Uptake of plants. Time-weighted average, mg/m<sup>3</sup>.

and co-workers<sup>8</sup> found a decrease in the half-lives of phenylbutazone at plasma levels around 1000 ng of  $\Sigma$  DDE + DDT per ml of plasma.

#### CONCLUSIONS

From the occupational point of view both DDT and lindane might be used as protective insecticides for the treatment of conifer plants. Lindane is more volatile, slightly more toxic, more easily penetrates the skin than DDT. If taken up, it is rapidly eliminated. Levels in plasma around 10 ng/ml cause induction of hepatic microsomal enzymes. No clinical symptoms related to exposure were registered.

DDT is retained in the body and accumulates in ecosystems much more than lindane. The insecticidal effect of lindane on the large brown pine weevil is good but of shorter duration than that of DDT.

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