

## Measurements of Year-Long Exposure to Tree Nursery Workers Using Multiple Pesticides<sup>1</sup>

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**Abstract.** A year-long nurseryworker pesticide exposure study was designed to measure and evaluate the exposure occurring to workers who had the potential for simultaneous exposure to multiple pesticides. This four-State study was conducted in five nurseries (four USDA Forest Service and one State) involved in conifer seedling production. Primary comparisons were made among nursery workers in the Pacific northwest and south central United States. Worker exposure was assessed by using patches attached to clothing, handrinse samples and urine excreted from potentially exposed workers. In addition, dislodgeable residue in rinsate from a water wash of pesticide-treated seedlings was also evaluated. Four different groups of field workers, designated as applicators, weeders, scouts and packers, were included. The pesticide absorbed dose, assessed by urine analysis of pesticide metabolites and the deposition of pesticide on patches attached to the clothing of field workers, was monitored as they performed their duties under normal conditions (e.g., typical clothing, pesticide application). Monitoring was performed for the 14 different pesticides which were used in these nurseries. Seven pesticides were studied in more detail using biological monitoring. For these compounds, metabolites known to be excreted in the urine of exposed humans or other mammals were used to estimate the dose of pesticide absorbed by the exposed workers.

The highest percentage of positive samples came from dislodgeable residue samples (8.3%) followed by patch samples (3.2%), handrinse (2.9%), and urine samples (1.3%). To summarize the conclusions from the urinary excretion data, 12 of the 73 nursery workers in the study received a low absorbed dose of pesticide. Biological monitoring revealed that three pesticides (benomyl, bifenoxy and carbaryl) were found in the urine of some of the workers. Of the 3,134 urine samples analyzed there were 42 positive; 11 urine samples were positive for benomyl, while bifenoxy was responsible for 13 positives and carbaryl accounted for the remaining 18. The 12-week continuous monitoring of urine showed that metabolites of these materials were rapidly excreted; thus, no build-up in the body is anticipated. Margins of Safety (MOS) calculations were made to provide an assessment of the significance of the expo-

sure. Based on the low frequency of positive urine samples in the study, the low levels of metabolites when they were found, their apparent rapid excretion rate and the No Observed Effect Level (NOEL) data, furnished from other sources, nursery worker exposure to pesticides in these conifer nurseries is below health threatening levels.

For the past 40 years the use of pesticides has continued to increase both in the United States and around the world. The benefits associated with their use in the areas of food production, human health and comfort have been well documented. However, accompanying these benefits are increasing concerns regarding the health of those who come into contact, or have the potential for coming in contact, with pesticides. Studies conducted in the past have shown that individuals who mix and apply pesticides are among the most highly exposed (Franklin 1985; Grover *et al.* 1986; Lavy *et al.* 1982; Nash and Kearney 1982; Nigg and Stamper 1983; Libich *et al.* 1984; Fenske *et al.* 1985).

When assessing studies which evaluate the frequency and magnitude of occupational pesticide exposure it becomes clear that relatively little effort has been devoted to studying the exposure levels of the relatively large number of field nurseryworkers associated with the production and packaging of pesticide-treated nursery stock. Studies in East Germany evaluating dermal eczema caused by pesticides showed that workers in the gardening area were most prone to exposure (Jung *et al.* 1989). Of specific interest in this country was the pesticide exposure occurring to field workers during the production of the over 100 million conifer seedlings being raised annually in the 12 USDA Forest Service tree nurseries located across the country.

In our earlier forest-worker pesticide exposure studies, considerable effort was given to documenting the absorbed dose of pesticide received by workers involved with different duties, using different means of application, or comparing different aspects of protective clothing used in conjunction with increased safety training (Lavy 1987). In the earlier studies, the main emphasis was placed on measuring the absorbed dose occurring to a worker while applying one application of a single pesticide.

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