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Nontarget Deposition and Losses of Chlorothalonil in Irrigation Runoff Water from a Commercial Foliage Plant Nursery

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Commercial foliage plant production requires the use of pesticides for controlling pests and pathogens that can reduce aesthetic qualities of crops, rendering them unwanted by consumers. Chlorothalonil is a common, broad-spectrum, foliar fungicide used for protecting plants from a variety of fungal diseases. This fungicide may also be acutely toxic to nontarget aquatic organisms due to its mode of action. This study evaluated the amount of chlorothalonil deposited on nontarget ground surfaces during normal sprayer applications at a commercial nursery using Teflon targets. One day following application, irrigation runoff events were initiated and runoff water samples were collected and analyzed for chlorothalonil. Discharge volumes were also measured to allow estimation of the total mass of chlorothalonil discharged during each event. Results indicated that 9.8 to 53.6% of the active ingredient applied landed on nontarget ground surfaces depending on plant size, spacing, and row lengths (short rows sprayed from one side vs. longer rows sprayed from both ends). On an entire production-area scale, 29.2% of the active ingredient applied was deposited on ground surfaces. Of the total nontarget deposition, 0.25 to 0.53% was detected in runoff water discharged from the production area. Concentrations ranged from 1.2 to 500 μg/L during the first runoff events following application.

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THE FOLIAGE PLANT PRODUCTION INDUSTRY is a growing, specialized sector of U.S. agriculture. This industry differs from traditional agriculture in that crops are typically grown in individual containers as opposed to row crops. Additionally, at the end of the cropping cycle the entire containerized plant is sold to customers, as opposed to only a portion of the crop (e.g., ears of corn [*Zea mays* L.] or wheat [*Triticum aestivum* L.] seeds). To be marketable, consumers demand that foliage plants be insect, blemish, and disease free. Pesticidal protection from insects and disease-causing organisms is especially important in warm and humid environments where conditions are optimal for infestations and disease development. In these situations, some pesticides must be applied multiple times throughout the crop production cycle.

Given the intensity of pest management programs needed to ensure blemish-free crops, some concern over the impacts of pest management on water quality is justified. Several studies have reported losses of pesticides in nursery runoff water (Briggs et al., 1998, 2002; Wilson et al., 1995, 1996; Keese et al., 1994; Riley et al., 1994). In all of those studies, pesticide losses were greatest during runoff events occurring shortly after application. Though not specifically measured, the majority of the losses documented in those studies may have likely originated from pesticide deposition on nontarget ground surfaces. During normal applications of pesticides using broadcast or spray methods, some of the active ingredient lands on surrounding nontarget ground surfaces. Gilliam et al. (1992) reported that 23 to 80% of broadcast-applied granular herbicides can land on nontarget ground surfaces depending on container placement. This is supported indirectly by runoff losses documented by Mahnken et al. (1999), who measured herbicide losses from simulated nursery production areas in which the herbicides were applied directly to the pots only, or broadcast-applied to the entire production area. Metolachlor concentrations during the first runoff event were 50 to 100 times greater from the areas where the herbicide had been broadcast-applied, relative to the individual pot applications (Mahnken et al., 1999). Relative to broadcast applications, 77% less herbicide was applied to the individual plot treatments, contributing to the lower losses observed (Mahnken et al., 1999). Wilson et al. (2005) reported that 15.9 to 29.7% of

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Abbreviations: EC_{50}, half maximal effective concentration; HD, high density; GSH, glutathione; LC_x, lethal concentration killing *x* percent of organisms; LD, low density; LP, large-sized palm (*Chamaedorea falcifera*); MP, medium-sized palm (*Chamaedorea elegans*); SPE, solid-phase extraction.