Aerial Movement and Deposition of Diazinon, Chlorpyrifos, and Ethyl Parathion

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EXECUTIVE SUMMARY
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"Aerial Movement and Deposition
of Diazinon, Chlorpyrifos, and Ethyl Parathion"

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PURPOSE

Previous studies have demonstrated that some organophosphorus pesticides (OPs) move from application sites to non-target crops. The purpose of this study was to determine if aerial movement and deposition of three organophosphate insecticides (chlorpyrifos, diazinon and parathion or their oxygen analogs) occur on non-target crops as a result of agricultural applications during the summer months in two agricultural regions of California.

BACKGROUND

During the winters of 1989 and 1990 the California Department of Pesticide Regulation monitored the aerial movement of three OPs used as dormant sprays in California orchards.

This monitoring demonstrated that during the winter, OPs are regionally transported and deposited on non-target vegetation during fog and dry weather as a result of drift either during or after application. The results suggested that pesticides contained in fog may have come from applications made outside a 400 meter zone as well as from closer applications. If inadvertent OP residues occur on non-target vegetation during the winter months, it is possible that OPs applied during other times of the year might also move to non-target crops. The following investigations were conducted during the 1991 summer months to confirm this possibility.

STUDY METHODS

Since Fresno and Monterey County have high summer agricultural use of the three OPs, 14 and 15 monitoring sites, respectively, were selected in these counties. Monitoring sites were located at least 0.4 km from anticipated applications of these OPs.

Potted parsley and bell pepper plants were used to capture OPs and their oxygen analogs that have aerially transported from a distance greater than 0.4 km from anticipated applications. The vegetation was sampled after two weeks and four weeks of exposure to ambient air. In addition, air samples were collected at two of the monitoring sites in each county on three different days for eight hours by drawing air through Hi-Vol glass jars. Furthermore, deposition of pesticide residues on mass deposition sheets during the dry season was investigated to see if measurable deposition occurred over short time periods. Deposition sheets were set out at each monitoring site at the same time plants were deployed and the sheets were collected the following week.

RESULTS

Fresno County

After two weeks exposure to air, the parsley plants at one site contained a residue concentration of 41 ppb for diazinon, while three other sites contained residue concentrations of 26, 10 and 31 ppb for chlorpyrifos. After four weeks exposure to air, the parsley plants contained diazinon at two sites with concentrations of 110 and 22 ppb and chlorpyrifos at two other sites with concentrations of 12 and 24 ppb. Additionally, one site contained residue concentrations of 48 ppb for diazinon and 27 ppb for chlorpyrifos.

Diazinon, chlorpyrifos, parathion, and diazoxon (diazinon analog) were detected in ambient air samples collected with maximum concentrations of 2.9, 0.077, 0.025 and 6.2 ppt, respectively. These OPs were detected in four of the six total air samples collected at the two monitoring sites. Chlorpyrifoxon (chlorpyrifos analog) and paraoxon (parathion analog) were not detected.

Monterey County

After two weeks exposure to air, diazinon and chlorpyrifos were each detected at two sites, at a maximum concentration of 23 and 13 ppb, respectively. After four weeks exposure to air, the parsley plants contained residues of diazinon at two sites while seven sites contained residues of chlorpyrifos. Concentrations of diazinon were 60 and 99 ppb and chlorpyrifos residues ranged from 11 to 100 ppb. One site had residues of both diazinon and chlorpyrifos. However, this site did not meet the original site selection criteria because an application of chlorpyrifos was made within the 0.4-km radius during the exposure period.

The three OPs were detected in all six air samples while the oxygen analogs were detected in three samples. Maximum air concentrations were 0.032, 1.8, 0.051, 0.085, 1.0 and 0.054 ppt for diazinon, chlorpyrifos, parathion, diazoxon, chlorpyrifoxon, and paraoxon, respectively.

There were no detectable residues of OPs or oxygen analogs on bell pepper, or oxygen analogs on parsley in both counties. No OP residues or their oxygen analogs were detected on any of the 29 mass deposition sheets after one week of exposure to ambient air.

CONCLUSIONS

The presence of all three OPs and oxygen analogs in ambient air samples and residues of diazinon and chlorpyrifos on parsley demonstrated that regional aerial movement and deposition of organophosphorous pesticides occurred in Fresno and Monterey Counties, California during the summer months. The Medical Toxicology Branch of the California Department of Pesticide Regulation determined that the concentrations found do not constitute a human health concern. These results suggest that economic loss could occur if inadvertent pesticide residues are regionally transported from an agricultural application site onto crops which do not have established tolerances for the pesticide. The diazinon residues found are well below the tolerance level of 750 ppb on parsley. However, there are not tolerances established for chlorpyrifos and parathion on parsley. Typical established tolerances on other crops range from 50 ppb to 15,000 ppb for chlorpyrifos and 1000 ppb to 5000 ppb for parathion.

In addition, bell pepper plants and mass deposition sheets appear to be inefficient surfaces to capture residues of these OPs and their oxygen analogs under the conditions of the study. This finding indicates that not all crops would be susceptible to inadvertent residues as a result of regional transport.

Factors that influence regional aerial movement to non-target vegetation include the proximity of the application to the monitoring site and regional wind patterns.

Future research concerning off-site movement might include examining factors which can be controlled such as 1) applying different pesticide formulations and measuring subsequent off-site movement; 2) using different application methods under varying meteorological conditions and documenting the mass of pesticide moving off-site; and 3) using tracer analysis to facilitate the determination of the pesticide source and distance of pesticide movement.

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