LTRC
Louisiana Transportation Research Center

LTRC Contact:
Curtis A. Fletcher, P.E.
Phone: (504) 767-9109

TECHNICAL SUMMARY

Summary of Report Number 284

ASSESSMENT OF EXPOSURE OF WORKERS APPLYING MIXTURES (2,4-D+ ROUNDUP AND GARLON 3A+ ROUNDUP)

INTRODUCTION

It is generally accepted that mixtures of chemicals are more effective than chemicals applied individually. This is becoming increasingly apparent with the use of pesticides for agricultural and other applications. Mixtures often show greater effectiveness against target organisms, with less toxic effects on nontarget organisms. Mixtures can often be applied at rates below the levels required for single compounds, thereby reducing total chemical application, residuals in the environment, and cost.

There are some disadvantages since mixtures can pose greater danger to nontarget species and to the environment than individual compounds. Only by understanding the additive toxicity caused by chemicals in combination can the potential effects of particular chemical mixtures be evaluated.

The Louisiana Department of Transportation and Development (DOTD) uses a mixture of two herbicides, the isopropyl amine salt of 2,4-D and Roundup containing the active ingredient glyphosate. A third herbicide, Garlon 3A, containing the active ingredient Triclopyr has recently been added to the program to replace 2,4-D in certain parts of the state. These herbicides are used to kill weeds, extend pavement life, prevent obstruction of signs, maintain sight distance, and to provide a neat grass covered roadway not subject to erosion or fire.

While data on the toxic effects of these herbicides as individual compounds are available in the literature, it is important to address their behavior as chemical mixtures.

This study assesses the acute toxicity, fate and environmental impact of herbicide mixtures, including Roundup/Garlon-3A and Roundup/2,4-D because DOTD uses these chemical mixtures.

STUDY OBJECTIVES

- Assess exposure of workers applying herbicide mixtures by measuring herbicide levels in the urine of each worker and by analyzing air samples from the breathing zone of each worker.
- Determine the effect and fate of those herbicides in the environment (soil, vegetation, water and sediment).
- Determine the levels of two mixtures (Roundup/Garlon-3A and Roundup + 2,4-D) in soil, grass and water collected from areas sprayed.
- Examine the herbicide mixtures' sorption capacity in Louisiana soils.
- Study the fate of herbicide mixtures in microorganisms.

METHODOLOGY

Twenty-four hour urine samples were collected from applicators four days per week. Air samples were collected three days per week during work hours from workers' breathing zone. Urine and air samples were collected for four (June-October) spray seasons. Soil, vegetation, bayou water, and sediment samples were collected quarterly for three years.

CONCLUSIONS

Study results indicated that the exposure of workers to herbicide mixtures via inhalation was insignificant compared to threshold limit values set by the American Conference of Governmental Industrial Hygienists, the National Institute for Occupational Safety and Health, and the Occupational Safety and Health Administration.

Herbicide levels in the urine of workers were much higher than those found in breathing air. This was probably due to exposure via ingestion (eating without proper hand washing) or to exposure via dermal contact.

The trend of levels of herbicides in the urine of workers during four spray seasons indicated a slight increase during each season. However, urine results showed no herbicide carryover from one spray season to another.

Analysis of environmental samples including sediment and water collected over three years indicated that 2,4-D, Roundup and Garlon-3A did not pose an immediate (acute) risk to aquatic life in water bodies adjacent to herbicide treated areas on the right-of-way.

Testing of fish, crawfish and microorganisms showed that toxic levels were not reached with herbicide application at the manufacturers recommended rates.

Soil studies indicated that Roundup has an higher capacity to adsorb to Louisiana soils than the 2,4-D and Triclopyr.

RECOMMENDATIONS

For human and ecosystem health protection: low levels of herbicides were detected in samples collected from applicators and care should be taken in their application.

In this study, low concentrations of 2,4-D and Garlon 3A (Triclopyr) were detected in the air collected from breathing zones. Although the levels were much below the recommended threshold limit values (TLVs), precautions should be taken. All herbicide applicators should stay inside the cab, and windows should be kept closed during spraying.

Herbicide concentrations were much higher in urine than in air. This means that herbicides entered the body from routes other than inhalation, possibly through ingestion or absorption through the skin. Hands must be properly washed after handling the herbicides, especially before meals. Protective clothing should be worn and spills on skin must be avoided.

To avoid aerosol inhalation, applicators should stand upwind of the prevailing wind direction when mixing herbicides. Spraying rigs should be modified (when possible) so nozzles are located at the back of the truck.

Results of herbicide mixtures testing on fish and crawfish indicate low acute toxicity values; however, this does not preclude toxicity to other aquatic species. Chronic toxicity to all aquatic life forms may also be of concern. Therefore, spills and direct application of herbicides to water should be avoided.

ASSESSMENT OF IMPLEMENTATION POTENTIAL

Existing safety practices have been reviewed and upgraded as needed during the study to provide adequate protection for workers under present standards.

Recommendations for improved personal hygiene practices and equipment modifications are provided to further protect workers when using chemicals.

GROUPS THAT MAY BENEFIT FROM FINDINGS

- Roadside maintenance personnel
- Agriculture and forestry personnel
- Wildlife and fisheries personnel
- People involved in outdoor recreation

ECONOMIC ANALYSIS

The study documents the level of worker exposure to herbicides and the impact on the environment. Study results will help reduce the health risk to applicators and minimize the impact to the environment.

FUTURE RESEARCH

- Study the exposure of workers operating open mowing equipment in areas treated with herbicides.
- Study the extent and impact of herbicide drift.
- Evaluate the subchronic and chronic effects of these herbicides on freshwater organisms.