Proceedings of the Third National Workshop on
PERSISTENCE OF HERBICIDE RESIDUES in wheat cropping systems in Australia

1–3 November 1989

Editors: S. Durrant and I.G. Ferris
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State Chemistry Laboratory
Department of Agriculture and Rural Affairs (DARA)
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CONTRIBUTED PAPERS
and
WORKSHOP RECOMMENDATIONS

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PREFACE

This is the third in a series of workshops sponsored by Wheat Research Council. The aim is two-fold: to document progress in herbicide persistence research in Australia, and to attempt to quantify herbicide impact.

No major herbicide problems were identified in the 1988/89 season. Spray drift was reported as a localized problem, and steps are being taken to address this. More of a problem was the dissemination of research findings and the widespread lack of understanding about herbicides. The consensus was that failure in this area may well result in the imposition of costly political solutions.

Participants at the workshop achieved a better appreciation of the challenges facing the use of herbicides in sustainable agricultural systems. A common purpose now links all herbicide persistence research, namely, improving herbicide efficiency and safety, with a common goal of implementing sustainable cropping systems in the 1990s.
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TRANSPORT OF PESTICIDES AND NUTRIENTS IN RUNOFF FROM AGRICULTURAL CATCHMENTS TO THE DOUGLAS RIVER, NT

Naseem PeerzadaA and Mohammed DilshadB

A. School of Chemistry and Earth Sciences
Northern Territory University
Casuarina NT 0811.

B. Land Conservation Unit
Conservation Commission of the Northern Territory
Palmerston NT 0831.

INTRODUCTION

Land Management Strategies for the Semi–Arid Tropic (LAMSAT) is a joint project of the Conservation Commission of the Northern Territory (CCNT), CSIRO, Queensland Dept. of Primary Industries, and Northern Territory Dept. of Primary Industries and Fisheries, with field sites at Douglas–Daly (NT), Pinnarindi and Cardigan (Qld). It is designed to test existing soil erosion and hydrology models. The project will produce a simulation model for predicting the impact of landuse (tillage, grazing) on the risk and magnitude of water erosion over space and time for the Australian semi–arid tropics. The joint CCNT and NT University project on transport of pesticides and nutrients in runoff from agricultural catchments to the Douglas River (NT) complements LAMSAT.

LOCATION

Douglas Daly Research Farm (DDRF), Northern Territory.

The Douglas–Daly Research Farm, formerly Douglas–Daly Experimental Station, was established in 1962. It is located 250 km south–west of Darwin – three hours by road (Figures 1 and 2).

It is one of a network of research facilities used to service the various sectors of the farming industries. Its present role is to provide research and extension support to the intensive agricultural development in the Douglas–Daly region.

The main emphasis of research, until recently, has been on pasture improvement and cattle production. In recent years, crop production has started to predominate, with trials being concentrated on Blain (sandy Red Earths) and Tippera (loamy Red Earths) soils.

There are eight commercial farms in the region, with over 6000 ha of cropping. Other large areas in the region have the potential to be cropped.

FACILITIES

The infrastructure developed by the Conservation Commission of the Northern Territory, is outlined in Figure 3.
This includes:

- 56 ha of native woodland, pasture, and cropping regions; with 136 neutron probe access tubes
- electronic flow recorders, sediment water samplers, output loggers
- comprehensive weather station
- electronic and manual rain gauges
- parshall flumes
- scientific computers.

There is a field laboratory used primarily for the upkeep of field instruments and preparation of runoff samples for sediment loss, suspended matter, nutrient and pesticide loss analysis. It is also equipped with weighing and drying facilities and modems for transfer of data.

The research farm is well-equipped with farm machinery and laboratory facilities for handling plant and soil samples.

All the facilities are serviced by on site technical staff.

Overnight accommodation is also available on the research farm.

PESTICIDE – NUTRIENT PROJECT

AIMS

1. To carry out a comprehensive study of pesticides transport and concentrations in runoff from conventional and no-till crops.

2. To determine the levels of nutrients in runoff from conventional and no-till crops.

3. To investigate the levels and transport of pesticides from runoff to Douglas River.

4. To assess the levels and transport of nutrients from runoff to Douglas River.

SIGNIFICANCE OF PESTICIDES – NUTRIENT PROJECT

Movement of pesticides from the target site into other parts of the environment is of concern to both agriculturalists and environmentalists. This has prompted many studies on movement of applied pesticides. Many of these involve small plants and a rainfall simulator used to create high intensity storms soon after pesticides application (1–20). The time lapse between application and rainfall has a significant effect on pesticide loss in runoff. The quantity of pesticides transported is greater with rains occurring soon after application and decreases thereafter. Historically, the mean rainfall at Douglas–Dalry Research Farm is approximately 1100 mm, with around 90% of the rain recorded between
November–March (Figures 4 and 5). Over 95% of the surface runoff events, from agricultural catchments occur in the months of December to February, inclusively (20). This is the period when the greatest bulk of herbicides and nutrients are applied. The chances, therefore, of runoff-causing rainfall events occurring after the application of agricultural chemicals are reasonably high. The potential for movement of the pesticide with runoff occurring at various times from the date of application needs to be determined and used in conjunction with rainfall studies to characterize potential pesticide movement. The rate of pesticide treatment of crops depends upon the tillage practices: for example, with no-till sorghum, 2.0 kg/ha of atrazine, and for conventionally tilled sorghum, 3.5 kg/ha is normally used. Because of the amounts applied, their solubility, and their suspended runoff, concern is raised over the potential role that these particular pesticides may have on the submerged aquatic vegetation of the Douglas River. The Douglas River is about 2 km away from the Research Farm, with an average depth of approximately 2 metres. There are no sources of anthropogenic or industrial pollution. Thus it is an ideal location to examine the effect of agricultural practices upon a river. Agriculture is the dominant land use in the area, with cultivated areas almost entirely consisting of sorghum production. Tipperary Station (11,100 km²) is also located adjacent to the Douglas River, where 1065 km² of land have recently been cleared for stock feed and improved pasture.

**RESEARCH PLAN**

Pesticides and nutrients have been used extensively for crop production at the Research Farm and surrounding areas of the Douglas and Daly Rivers for some years. So far, only a limited amount of environmental monitoring and impact studies have been carried out by us. The fate and transport of pesticides in the runoff and in the Douglas River have never been explored.

The proposal is to employ a range of analytical techniques to carry out a comprehensive study to determine the levels, concentration factors and transport of pesticides (2,4-D, dicamba, atrazine) and nutrients (potassium, nitrite/nitrate, phosphate) loss in the runoff from fields planted to no-tillage and conventionally tilled sorghum under natural rainfall conditions. It is also proposed to monitor pesticides and nutrient loads entering the Douglas River, as residual effects on submerged aquatic vegetation are not known and are important to the river ecology.

**METHODOLOGY**

**Sampling Procedure – Runoff – Douglas River**

1. Each bay has been equipped with parshall flumes for the measurement of runoff.

2. Runoff would be sampled by an electronic sediment sampler which delivers a representative fraction of the total runoff into unrefrigerated containers from which a one litre sub-sample would be obtained for analysis.

3. Three samples per event would be collected, from which average concentration and quantity of pesticides/nutrient transport could be calculated.

4. Within 24 hours after each runoff event, the liquid would be decanted and samples transferred to the laboratory and stored at 2°C until analysed.

5. The first surface water sample from the Douglas River would be obtained in May.
6. Samples from the Douglas River would be taken monthly thereafter until November.

7. Samples would be taken after every runoff event in November–March.

8. Samples would be returned to the laboratory in amber bottles and refrigerated at 20°C until analysed.

9. Each sample would be characterized by date, time, location, water depth, turbidity, salinity profile, temperature profile and surface pH.

10. Analysis of various samples will be carried out using analytical techniques such as gas chromatography; high pressure liquid chromatography, absorption spectroscopy, polarography and, where necessary, other supporting techniques.

11. Multiple regression would be used for analysing concentration and the quantity of pesticides/nutrients transported in the runoff water from the various tillages and in the Douglas River.

REFERENCES


FIG 1  Project location
FIG 2  Location Map - THE PROPOSED STUDY SITE
Fig 3. Project layout and instrumentation (not to scale)
FIG 4  Mean, Maximum and Minimum Monthly Rainfall for the Douglas District (Pine Creek 1874-1982)
FIG 5 Douglas District/Climatic Data

Months of the Year

A - mean monthly evaporation
B - mean monthly temperature