New research on the impact of farm chemicals and the reef

By Jasmine Hunt

New studies from a north Queensland research body may reveal just how farm chemicals behave as run off and how long they persist in tropical waters, especially near the Great Barrier Reef.

The National Environmental Research Program Tropical Ecosystems hub (NERP TE) is running a number of projects focusing on pesticides, herbicides and sediments and their effect on water quality.

According to NERP, the research knowledge garnered from these projects will contribute to Queensland and Australian Government policy development. Data will inform Reef Rescue projects and Reef Plan and facilitate management of the GBR by the Great Barrier Reef Marine Park Authority (GBRMPA). Thus, this research program is extremely important for cane growers up and down the coast.

NERP covers a variety of research themes, however this edition we focus on just one: pesticides and impacts on the Great Barrier Reef ecosystems.

Project summaries

NERP TE has three major themes, of which there are 12 programs branching from the themes. From there, there are a multitude of projects focussing on each theme.

The program we are focussing on is Program 4 'Water quality of the Great Barrier Reef and Torres Strait'.

This program is led by Dr Britta Schaffelke, Australian Institute of Marine Science. Within this program, there are four projects:

- Project 4.1: Tracking coastal turbidity over time and demonstrating the effects of river discharge events on regional turbidity in the Great Barrier Reef.
- Project 4.2: The chronic effects of pesticides and their persistence in tropical waters.
- Project 4.3: Ecological risk assessment of pesticides, nutrients and sediments on water quality and ecosystem health - Phase 1.
- Project 4.4: Hazard assessment for water quality threats to Torres Strait marine waters, ecosystems and public health.

The projects that we'll be discussing here are projects 4.2 and 4.3.

Project 4.2: The chronic effects of pesticides and their persistence in tropical waters

This project, led by Dr Andrew Negri of AIMS, will include a series of experiments to examine how plants and corals are affected by herbicides (including diuron, atrazine, hexazinone and tebuthiuron) in the water in conjunction with other stressors such as temperature, low salinity and low light. The researchers list a source of herbicides in coastal waters is flood plumes from river runoff.

By creating experimental conditions similar to GBR flood plumes, the project team intends to determine how long herbicides persist and how they are transformed as they travel into coastal waters.

Why this research is needed

This project is an important one for sugarcane growers. This project will shed some light on how long herbicides live once in coastal waters, and how they react with the environment around them.

Although media coverage surrounds this subject, there is little data explaining the extent to which tropical organisms, such as seagrass, are affected by exposure to herbicides combined with sea temperature and/or declines in salinity and light.

Research update

The project has been running for approximately 12 months. Two PhD students, Phil Mercurio (herbicide persistence, University of Queensland and AIMS) and Jonathan Craft (effects on seagrass, James Cook University and AIMS) have been recruited and have begun a series of experiments at the AIMS facility near Townsville.

Dr Negri said the project is focussing on how long it takes herbicides to break down in seawater and what the long-term effects of herbicides are on seagrass.

At this point the team has only preliminarily results to report. Dr Negri said their initial results indicate that Diuron, Atrazine, Hexazinone, Tebuthiuron break down very slowly, with only minor losses observed over the first 120 days.

He said the team is also investigating the breakdown of 2,4-D, Glyphosate and Metolaclor, but there are few results available at this stage.

The experiments are being conducted at two temperatures and in the light and dark so it will be important to see if these factors affect how long the herbicides take to degrade. ▶

Many sugarcane growers have implemented methods to stop farm nutrient run-off, including wetlands.

Short-term experiments conducted over three days indicate that herbicides found in the GBR lagoon reduce photosynthesis in seagrass and the order of toxicity is Tebuthiuron (least toxic) < Atrazine < Hexazinone < Diuron (most toxic). Long-term herbicide exposure experiments with seagrass are underway and results from those experiments are expected mid-year.

Dr Negri said in the coming 12-18 months the team will study whether the breakdown products of herbicides are less toxic than the original product, and whether or not sediments can store herbicides for long periods of time in the marine environment.

In the long term, information from this project will be made available to industry, regulators and resource managers to improve the management and regulation of herbicides commonly used catchments of the GBR.

Project duration

1 July 2011 to 31 December 2014.

Project 4.3: Ecological risk assessment of pesticides, nutrients and sediments on water quality and ecosystem health – Phase 1

The purpose behind this joint project between CSIRO, JCU and AIMS is to guide monitoring, management and mitigation decisions.

Led by Jon Brodie at JCU and Dr Rai Kookana at CSIRO, the project team proposes to conduct a 'Phase 1' study to develop a robust approach that will allow them in 'Phase 2' to carry out an ecological risk assessment (ERA) of nutrients, fine suspended sediments, and pesticides used in agriculture in the Great Barrier Reef region.

Why this research is needed

This 'Phase 1' research will allow the scientists to carry out an ecological risk assessment of nutrients and other contaminants including pesticides in the Great Barrier Reef region.

This includes ranking the relative risk of individual contaminants originating from priority catchments to the GBR ecosystems using a systematic, objective and transparent approach.

This will be of great interest to government and the sugarcane growing community, as different chemicals may be of greater or reduced risk to the environment.

New research intends to determine how chemicals behave as run-off and how long they persist in tropical waters.

Research update

Researchers note that so far, a scoping study has been carried out to review risk assessment approaches being conducted by CSIRO; data availability; and the suitability of the different approaches to assess the relative risk of contaminants and associated land uses in the GBR region.

Following this Phase 1 stage a new project was initiated with funding from the Queensland Government's Reef Protection Program research funding to assess risk to the GBR from land-sourced pollution.

This new project entitled 'Assessment of the risk of pollutants to the ecosystems of the GBR including differential risk between sediments, nutrients and pesticides and between land uses, industries and catchments' is being carried out principally by JCU and AIMS with assistance from CSIRO, BRS and EHP.

It commenced in October 2012 and is due to be complete by April 2013. Project results will also be used in the just-started Reef Rescue 2 prioritisation project run by SEWPaC and also the Reef Plan 3 prioritisation initiated by the Queensland Government.

The project will look at risk to different ecosystems – coral reefs, seagrass beds, the pelagic ecosystems (fish, plankton) and to a lesser extent mangroves and coastal wetlands; analyse risk from different contaminants – suspended sediment, nitrogen, phosphorus and pesticides; analyse risk on a regional basis; trace the source of contaminants (and hence the risk) back to the landuse from where they originated; and the Reef Rescue project will also analyse the best possible land management options to reduce risk (solvability).

The research will also evaluate relative risk to different ecosystems from the different contaminants, suspended sediments versus nitrogen (and different forms of nitrogen) versus phosphorus (different forms) versus pesticides (different types).

Further information on the project can be obtained from Jon Brodie (JCU) (at jon.brodie@jcu.edu.au) for the scientific aspects and from John Bennett (EHP) for the Queensland Government role and from Kevin Gale (SEWPaC) for the Reef Rescue project.

This is the second in a series of articles on the National Environmental Research Program Tropical Ecosystems hub (NERP TE). [Editor's note: see 12 November 2012 *Australian Canegrower* for the first article in this series.] ■