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Pesticides Q&A

Pesticide residues, especially herbicides are present in streams, estuaries, coastal and reef waters. Recent research on pesticide monitoring has improved our understanding of the extent, persistence and impacts of pesticides in freshwater and marine areas (Davis et al., 2012a, b; Kennedy et al., 2012a, 2012b; Shaw et al., 2012; Lewis et al., 2012).

Q. What pesticide residues are present in the Great Barrier Reef?

A. Residues commonly detected are the photosynthesis II (PS-II) herbicides, including atrazine, diuron, ametryn, hexazinone and tebuthiuron, as well as a range of other herbicides and insecticides. These are man-made compounds, not found in the natural environment. The PSII herbicides act by inhibiting photosynthesis, which is why they are so good at killing weeds, and thus affect non-target species such as seagrasses.

Q. Why are they a problem?

A. These herbicides are a concern because of their potential impacts on a range of marine plant species including corals, seagrass and macroalgae. PS-II herbicides are carried in river runoff and take a long time to break down in the environment (months to years). PS-II herbicides act additively and they have been detected inshore at concentrations high enough to affect plants and corals in the Great Barrier Reef.

Corals can recover from short-term, low-level exposure to herbicides, however chronic exposure can lead to decreased photosynthetic rates, bleaching, partial colony death and reduced fertility (Lewis et al. 2012).

The presence of herbicides (diuron, atrazine and hexazinone) increases the vulnerability of corals to the negative effects of high temperatures on photosynthesis (Negri et al. 2011). Preliminary results testing the acute effects of herbicides indicate that seagrasses are among the more sensitive non-target species to these herbicides.

Q. Where do they come from?

A. Concentrations of pesticides in rivers and streams are highest in areas of intensive agriculture, including sugarcane, but also from grazing lands (tebuthiuron). Runoff of pesticides and herbicides may be affecting the health of marine plants in wetlands, estuarine areas and the inshore coastal waters of the GBR. Pesticides have also been detected in the sediment and biota of freshwater systems and coastal waters. Monitoring of marine waters shows the highest concentrations of pesticides in marine waters near rivers with a large proportion of intensive agriculture (Kennedy et al., 2012). Pesticides have also been detected in the sediment and biota of freshwater systems and coastal waters.

Runoff of pesticides and herbicides may be affecting the health of marine plants in wetlands, estuarine areas and the inshore coastal waters of the GBR. Impacts from pesticides and herbicides may be exacerbated by additive pressures in the wet season, such as higher temperatures and lower salinity.

Key recent findings include:

- Coastal freshwater and estuarine waters have the highest concentrations of herbicides (Smith et al., 2012) and are most likely, at highest risk (Davis et al., 2012)
- The herbicide residues atrazine and diuron have been identified in water samples collected in the wet season at inshore lagoon sites at concentrations that are known to have negative effects on seagrass and corals
- Diuron and atrazine are the most

commonly detected herbicides in GBR waters and concentrations in flood plumes at times exceed ecological protection guidelines for the Great Barrier Reef Marine Park

- Herbicide residues (atrazine and diuron) persist in the lagoon at low concentrations even during non-flooding seasons
- The presence of these herbicides can increase the impact of climate change on corals and other marine species. Recent estimates suggest that at least 30 tonnes/year of the PS-II herbicides are exported to the Great Barrier Reef (Kroon et al. 2012).

References

Davis, A.M., Thorburn, P.J., Lewis, S.E., Bainbridge, Z.T., Attard, S.J., Milla, R., Brodie, J.E., In press. *Environmental impacts of fully irrigated sugarcane production: Herbicide run-off dynamics from farms and associated drainage systems*. **Agriculture, Ecosystems & Environment**, in press.

Davis, A. M., Lewis, S. E., Bainbridge, Z. T., Glendenning, L., Turner, R. D., & Brodie, J. E. (2012). *Dynamics of herbicide transport and partitioning under event flow conditions in the lower Burdekin region, Australia*. **Marine pollution bulletin**, 65(4), 182-193.

Devlin, M. and Lewis, S. (Compilers) (2011) *Advancing our understanding of the source, transport and impacts of pesticides on the Great Barrier Reef and in associated ecological systems: A review of MTSRF research outputs, 2006-2010*. Synthesis Report prepared for the Marine and Tropical Sciences Research Facility (MTSRF). Published by the Reef & Rainforest Research Centre Ltd, Cairns (37pp.).

Kennedy, K., Schroeder, T., Shaw, M., Haynes, D., Lewis, S., Bentley, C., ... & Mueller, J. F. (2012a). *Long term monitoring of photosystem II herbicides–Correlation with remotely sensed freshwater extent to monitor changes in the quality of water entering the Great Barrier Reef, Australia*. **Marine Pollution Bulletin**, 65(4), 292-305.

Kennedy, K., Devlin, M., Bentley, C., Lee-Chue, K., Paxman, C., Carter, S., ... & Mueller, J. F. (2012b). *The influence of a season of extreme wet weather events on exposure of the World Heritage Area Great Barrier Reef to pesticides*. **Marine Pollution Bulletin**.

Kroon F.J., Kuhnert K.M., Henderson B.L., Wilkinson S.N., Kinsey-Henderson A., Brodie J.E. & Turner R.D.R. (2012) *River loads of suspended solids, nitrogen, phosphorus and herbicides delivered to the Great Barrier Reef lagoon*. **Marine Pollution Bulletin** 65, 167-181.

Lewis S.E., Schaffelke B., Shaw M., Bainbridge Z.T., Rohde K.W., Kennedy K.E., Davis A.M., Masters B.I., Devlin M.J., Mueller J.F. and Brodie J.E. 2012. *Assessing the risks of PS-II herbicide exposure to the Grate Barrier Reef*. **Marine Pollution Bulletin** 65, 280–291.

Negri A.P., Flores F., Röthig T. & Uthicke S. (2011). *Herbicides increase the vulnerability of corals to rising sea surface temperature*. **Limnology and Oceanography** 56, 471-485.

Smith, R., Middlebrook, R., Turner, R., Huggins, R., Vardy, S.,Warne, M., 2012. *Large-scale pesticide monitoring across Great Barrier catchments – Paddock to Reef Integrated Monitoring, Modelling and Reporting Program*. **Marine Pollution Bulletin**. doi:10.1016/j.marpolbul.2011.08.010

Shaw, C. M., Brodie, J., & Mueller, J. F. (2012). *Phytotoxicity induced in isolated zooxanthellae by herbicides extracted from Great Barrier Reef flood waters*. **Marine Pollution Bulletin**, 65(4), 355-362.

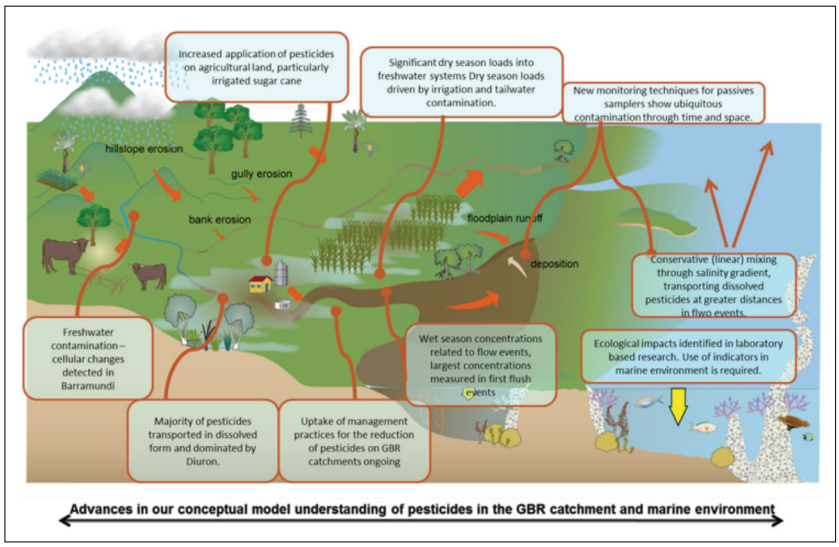

Figure 1: Advances in conceptual understanding of sources, transport and impact of pesticides in the GBR. Source: Devlin and Lewis (2011).

CONTACT US

T: +61 (0)7 4050 7400 **F: +61 (0)7 4031 7550** **E: enquiries@rrrc.org.au**

rrrc.org.au

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