Spot spraying reduces runoff of herbicides

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Introduction

Herbicide runoff from sugarcane in the coastal subtropics and tropics of Queensland, Australia, has the potential to degrade the quality of water in the World Heritage Area Great Barrier Reef. Targeted weed seeking, or banded and crop-shielded herbicide spraying technology, is increasingly available and can reduce the area, and therefore total volume, of herbicide applied for effective weed control. Using these targeted spraying technologies may therefore reduce the loss of herbicides in surface runoff. To mimic and test the effect of targeted herbicide spraying technology on concentrations of herbicides in runoff, rainfall simulator trials were conducted in sugar cane paddocks across four soil types and two crop management phases (Melland *et al*. submitted).

Methodology

- Recommended rates of the knockdown herbicides glyphosate, 2,4-D and fluroxypyr, and the residual herbicides atrazine and diuron were sprayed onto 0, 20, 50, 70 or 100% of the area of runoff plots
- Two trials in plant cane crops with no residue cane trash on the surface (bare - Burdekin 2012 and Mackay 2012, Figure 1a)
- Two trials in ratoon crops with cane trash residues retained (~100% cover – Bundaberg 2011 and Mackay 2011, Figure 1b)
- Simulated rainfall was applied at 70-80 mmh^{-1} to induce runoff for 20 to 50 min two days after herbicide application, before half-life differences would become apparent
- Runoff was sampled every 2-5 mins and combined into an event mean concentration of herbicide
- Water-phase (<0.45µm) herbicide concentrations were analysed at all sites
- Concentrations of herbicide in the sediment retained on filters (sediment-phase) were analysed at bare-surface sites
- Concentrations of herbicide in the soil (25 mm depth) and plant residues was measured and converted to mass per plot

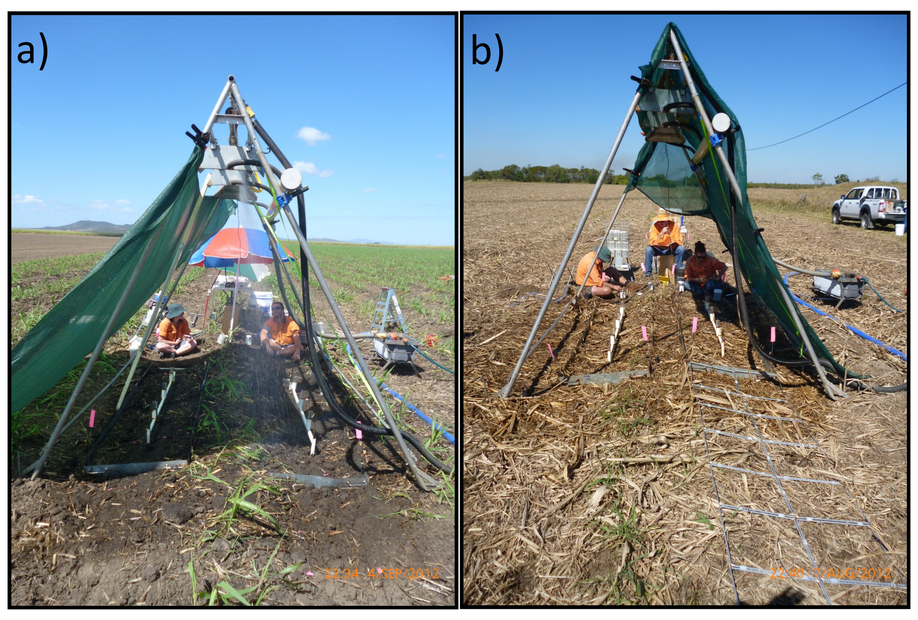

Figure 1. A-frame rainfall simulator used to generate runoff at a) Burdekin_2012 on bare plots and b) Bundaberg_2012 on cane trash

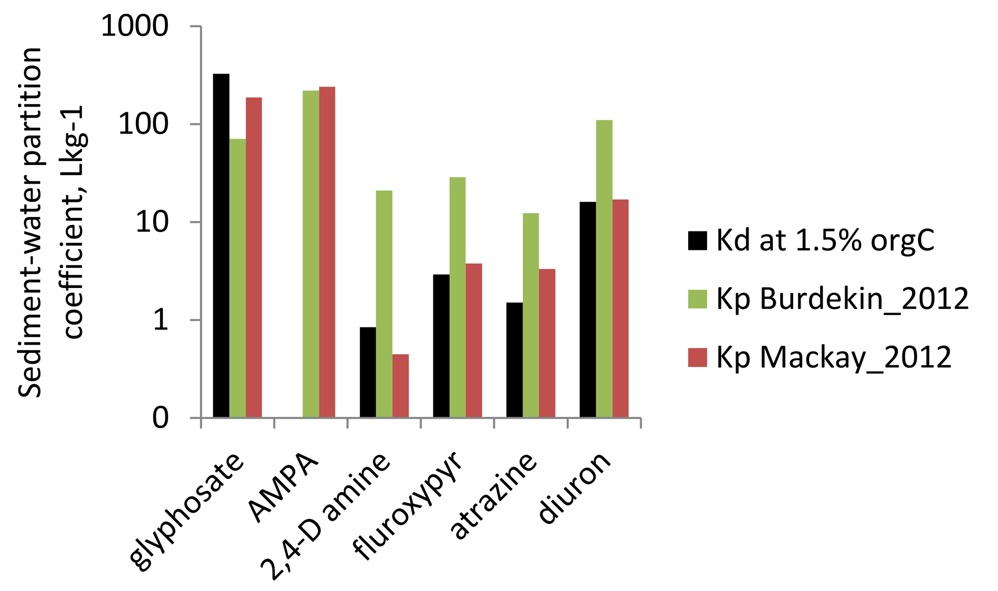

Figure 2. Sediment:water partition coefficients measured under laboratory conditions (Kd, University of Hertfordshire, 2013) and in this field study (Kp)

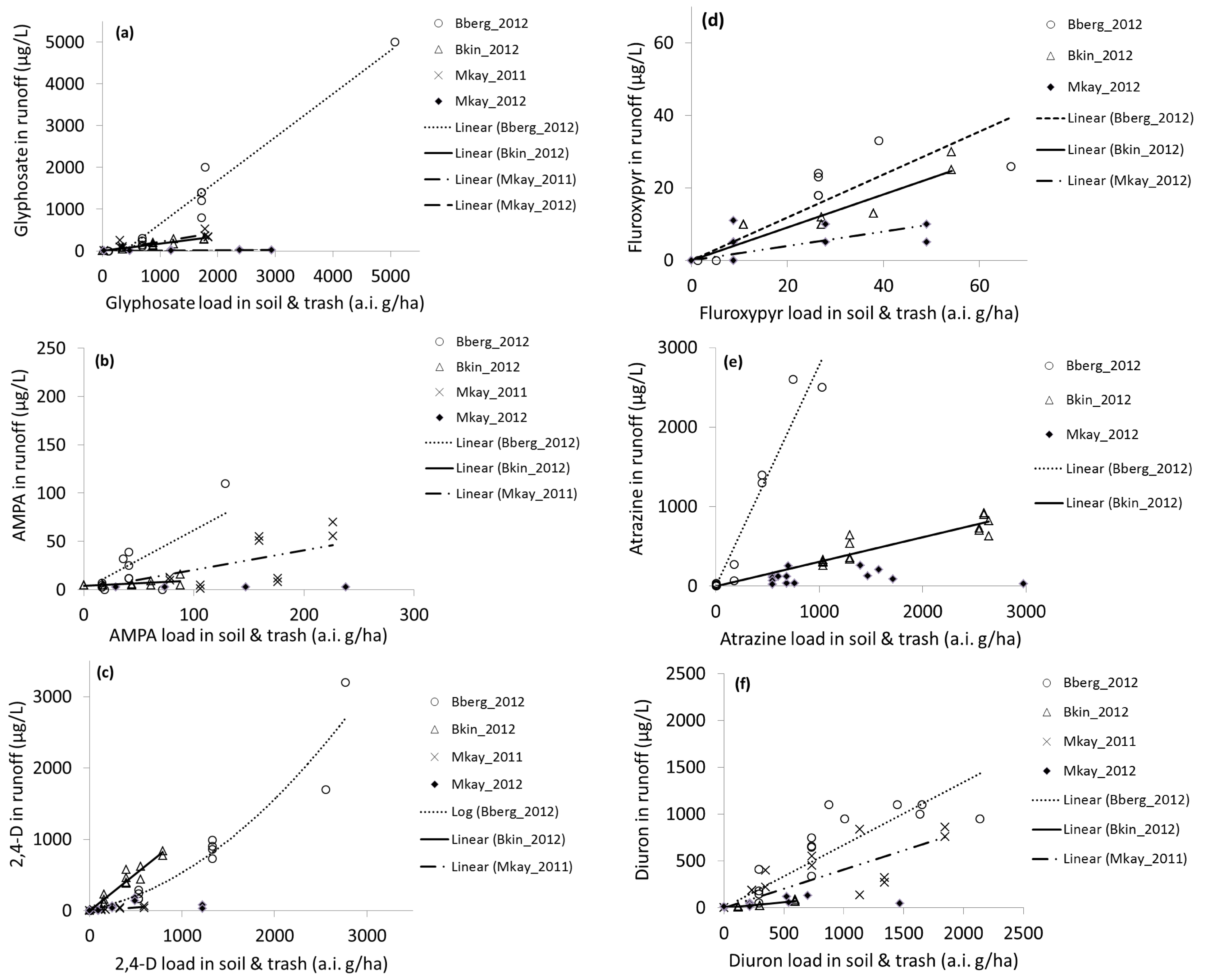

Figure 3. Regression relationships (showing intercept and slope only where significant at P<0.05) between the water-phase herbicide concentration in runoff and the equivalent load of herbicide in the soil and trash (g.a.i. ha^{-1}) for a) glyphosate, b) AMPA, a breakdown product of glyphosate c) 2,4-D, d) fluroxypr, e) atrazine and f) diuron.

Results and discussion

Sediment:water herbicide partition coefficients (sediment-phase:water-phase herbicide concentrations) were similar to laboratory values at the sandy Mackay_2012 site, and mostly higher than laboratory values at the clayey Burdekin_2012 site (Figure 2). Over 50% of all herbicides were transported in the water-phase of runoff, regardless of the herbicide's sediment-water partition co-efficient.

For most sites and herbicides, both water and sediment-phase runoff herbicide concentrations decreased with decreasing spray coverage and with decreasing herbicide mass in the soil and cane residues (Figure 3). Importantly, sites with higher infiltration prior to runoff and lower total runoff (e.g. Mackay 2012) had lower runoff herbicide concentrations than sites with less infiltration capacity (e.g. Bundaberg 2012).

Conclusion

Concentrations in runoff of knockdown and residual herbicides commonly used to control weeds in sugarcane reduced in proportion to the area of ground sprayed. If widely adopted, spot spray technology is therefore likely to reduce the loss of herbicide in runoff from sugarcane farms and will help to protect downstream waterbodies.

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References

Melland et al. (submitted) Spot spraying reduces herbicide concentrations in runoff. *Journal of Agricultural and Food Chemistry*

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