Quantifying the efficiency of vegetative buffers in reducing pesticide runoff losses

– Scenario development and field methodology

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Background

- FOCUS Landscape and mitigation v2 includes vegetated buffer strips as an option for reducing pesticides in surface runoff
- FOCUS L&M default values for pesticide removal efficiency of buffer strips are:
  - not compound specific,
  - are not FOCUS scenario specific,
  - may be lower than expected for specific compounds and
  - too low to demonstrate compliance in all circumstances
- Experimentally derived values for buffer strip removal efficiency, for specific compounds, may be useful to demonstrate compliance
- Generation of field data intended to be FOCUS relevant and compliment or be complimented by modelling approaches like VFSMod

Study Objectives

1. Develop compound specific, FOCUS Surface Water scenario relevant buffer removal efficiencies.
2. Characterise site and runoff event parameters as being realistic worst case to allow subsequent experimental data to be used in STEP4 risk assessments. By constraining the variables of the study to be FOCUS specific removes the need for multiple studies to fully characterise landscape.
3. Undertake buffer removal efficiency experiments specific to the FOCUS Surface Water risk assessment scenarios.

Event characteristics

Analysis of FOCUS SW scenario outputs for citrus and pome/stone fruit simulations indicated that:

1. The R4 scenario consistently generating the highest PECsw and driving the risk assessment and would be the realistic worst case scenario;
2. Max PECsw driven by small events (<1mm runoff) with low dilution so event size not appropriate for these purposes;
3. Selected event which produced the biggest runoff event in the assessment period (71 mm);
4. Analysis of hourly Roujan weather data to assess event duration and intensities appropriate for event of this size;
5. 11 mm of runoff with a pesticide concentration of 1.6 µg/L associated with a 71 mm rainfall event lasting 5 hours and occurring in late July would be the most appropriate rainfall/runoff event size and type.
6. Extremely precautionary ≈ urban drainage design event

Site characteristics

- Target site would have 3-10 year rotational grass to mimic an edge of field buffer strip
- Target soil type - sandy/silty clay loam (R3 and R4 soil) with a moderate (5-10%) slope
- Site would ideally be in use for cut grass, with no stock – to ensure no surface compaction issues
- Site would need a water supply nearby for irrigation/run-on water, or water storage facilities

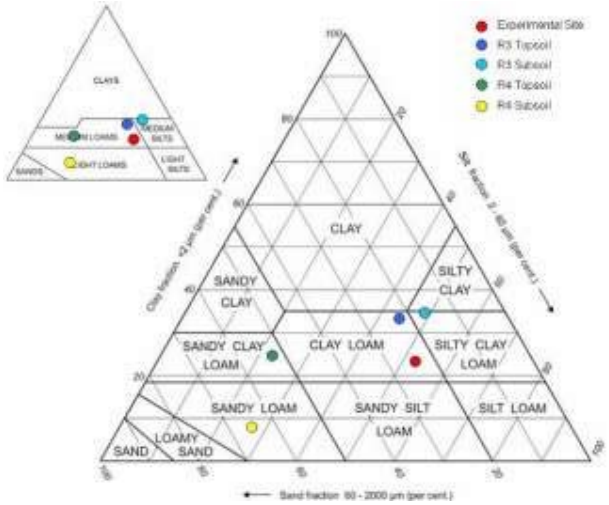
Field site acquisition

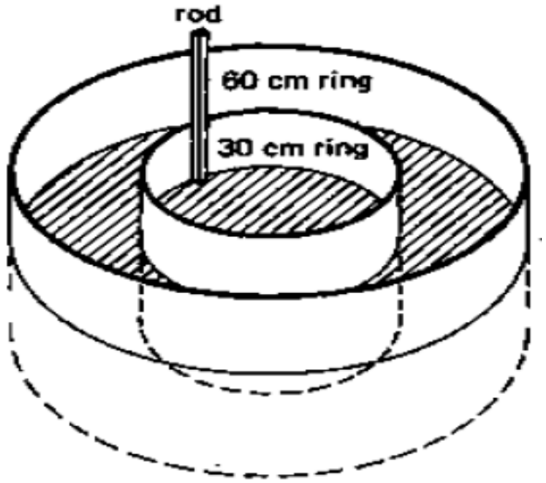
- Initially by mapping R4 soils and required slope to target likely areas
- Main issue was water supply – several prospective sites discounted
- Current site in North Notts, best fit to requirements

Site Characterisation

- Level survey – Even slope 7-7.5%
- Soil infiltration ~ 9 mm/hr (concentric ring method)
- Soil particle size determination

Sand – 26%
Silt – 51%
Clay – 23%





Site Characterisation

Vegetation cover (June 2013)

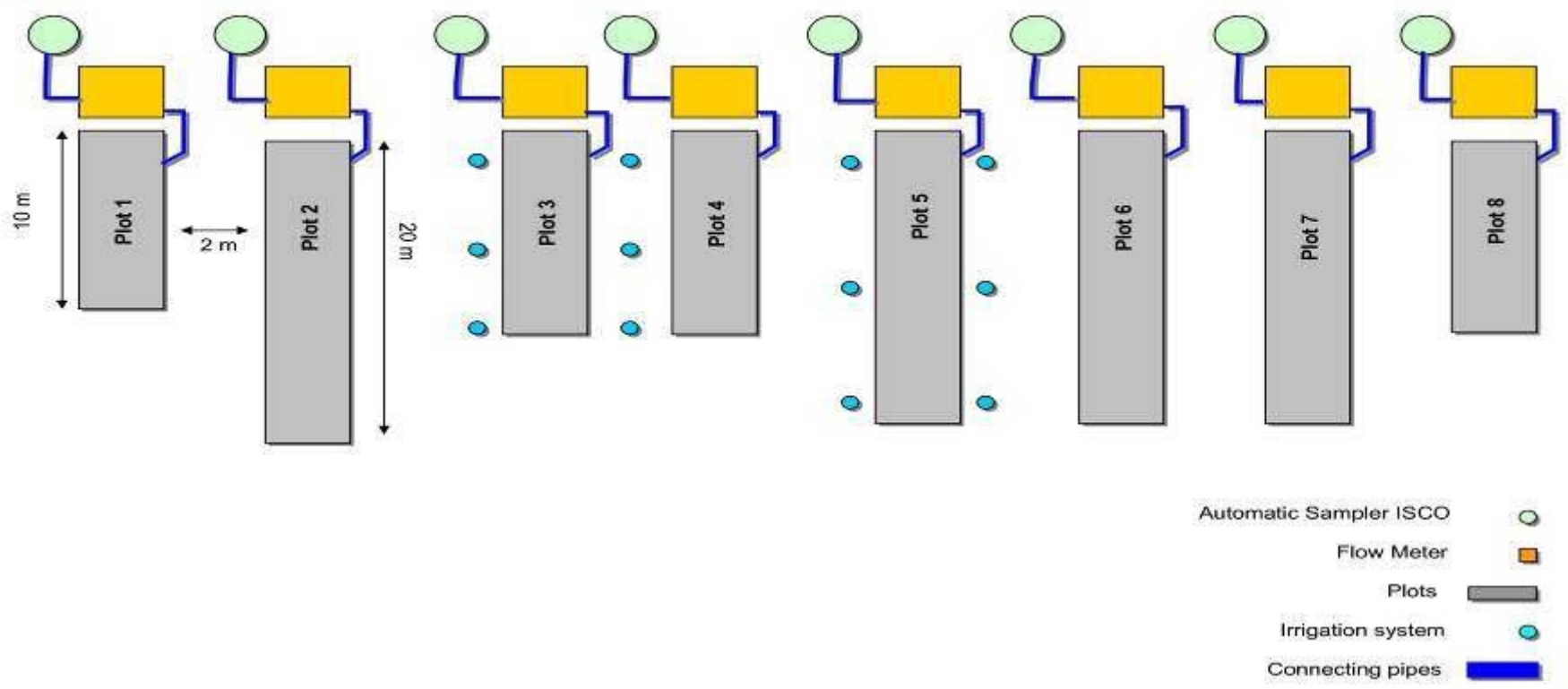
Yorkshire Fog	20%
Brome/Fescue	34%
Meadow grass	30%
Dead grass	10%
Clover	2%
Buttercup	1%
Dandelion	1%
Dock	1%
Hogweed type	1%

Grass density - 30% Tussocky

Study Design

- Runoff event simulated by applying calculated volume of water/mass of pesticide (run-on) across a grass plot
- A 100 m slope length for runoff volume generation assumed for the simulation - representative of 1 to 3 ha citrus and pome/stone fruit orchards
- Initial testing involving aqueous phase only (drives PECsw)
- Grass run-on plots 5m wide and either 10m or 20m long (4 of each). Separated by metal plates down the slope to prevent lateral movement of water
- Runoff collected at the bottom of the plot and flow quantified/sampled

Site schematic



Event implementation

- Up to 25 mm of simulated rainfall applied to the plot the day before run-on application to bring the top-soil close to saturation
- Soil left to drain for ~18 hours to represent convective storm system
- 35 mm rainfall (irrigation) applied at 14 mm/hr
- 11mm run-on applied over 1 hour (containing 1.6 µg/L active ingredient) while irrigating to a total of 71mm to simulate rainfall during the run-on event

Water supply

	10m Plot (litres)	20m Plot (litres)
Total 71 mm irrigation	3550	7100
11 mm run-on	5500	5500
Total requirement	**34000**	**50400**

30 000 Lt water storage allows up to 3 applications per day

Run-on application

5500 Lt run-on water (11 mm runoff depth) mixed in metal tank and applied as laminar flow to upslope edge of plot over 1 hour.

Run off collection/sampling

- Runoff collected by a metal gutter installed along the down-slope edge of the plot
- Piped to a tipping bucket flow meter
- Automatic water sampler to take flow proportional samples throughout event

Results

- Field phase currently underway – no analytical data yet
- Runoff collected across 10m plots - typically after 20 min following start of application. Total volume of runoff crossing 10m plot between 5 and 20% of applied
- Much less runoff crossing 20m plots - < 2% applied

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