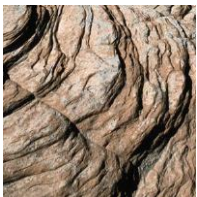




Runoff Transport of Pyrethroids from a Residential Lawn in Central California



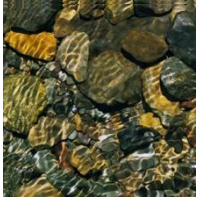
John Hanzas¹, Russell Jones², Jeffrey White¹

ACS Fall Meeting, Washington D.C.

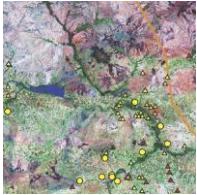
August 19, 2009

1. Stone Environmental, Inc., 2. Pyrethroid Working Group





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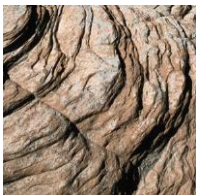
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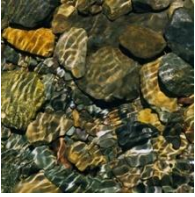
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Introduction

The Concern:

- Over-irrigation of residential lawns could transport turf chemicals to storm water drains and thus contribute residues into urban streams.

The objective was to investigate:

- the extent to which over-irrigation in the summer season might transport recently applied pyrethroids,
- how much of the applied chemical was still available to run off eight weeks later during an early winter rainstorm,
- differences in the winter storm runoff transport between plots that have been over-irrigated during the summer, compared with those irrigated using best practices,
- the effect of granular versus liquid formulations.



Introduction

- Two pyrethroids used: bifenthrin and beta-cyfluthrin
 - Two formulations: a granular and liquid of each
- Stone Environmental Inc. conducted the study on behalf of the Pyrethroid Working Group
- CRG Marine Labs conducted the pyrethroid analysis
 - April - Study design approved by CDPR
 - May - Site selection
 - June - Site instrumentation and construction
 - July - Application and over-irrigation runoff
 - September - Simulated rainfall runoff
 - Analysis of samples throughout



Site Selection

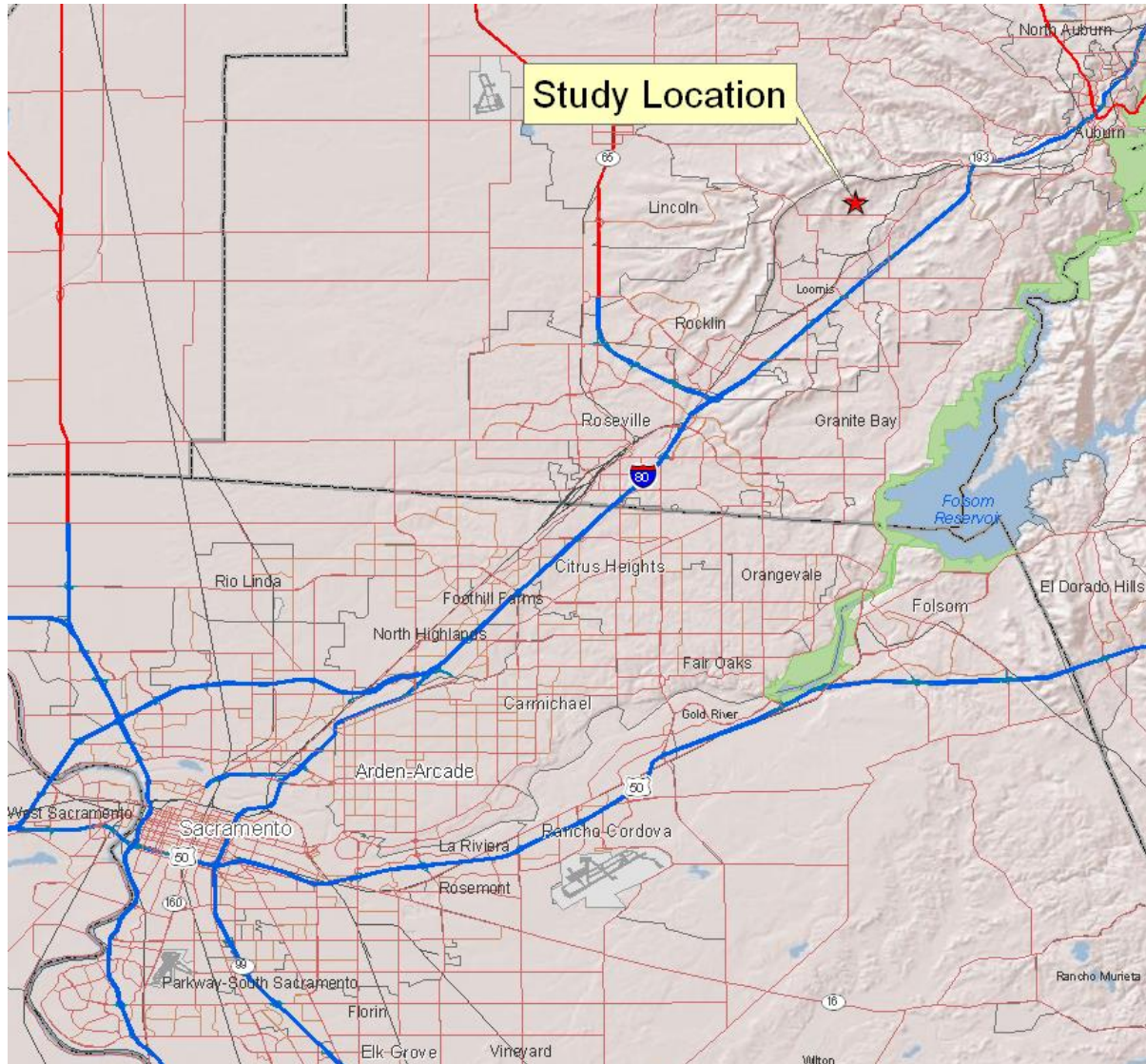
■ Search criteria

- Sufficient area for placement of four 20 x 40 foot test plots
- Uniform slope of between 5 and 10 percent
- Mature turf grasses
- Soils in hydrologic group C or D





Site Selection



- Over 220 hours of investigation
- Over 1200 miles driven
- Investigated 6 golf courses
- Investigated dozens of residential lawns
- Selected site located in Penryn, CA



Selected Site





Instrumentation



Surveying and laying out plot OIG

- June 24 – 27, 2008
- Surveyed the lawn to determine slope and uniformity of plot locations
- Laid out the plots

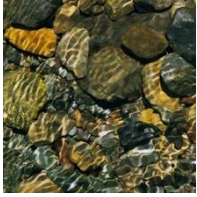


Instrumentation



- June 24 – 27, 2008
- Installed:
 - Flashing, 3 – 4 inches deep
 - 4" V-notch Gutters





Instrumentation



- Installed 5-gallon buckets
- Sump pumps with level activators transferred runoff water from the buckets to a 70-gallon tank
- The system was powered during the summer by deep-cycle marine batteries





Instrumentation



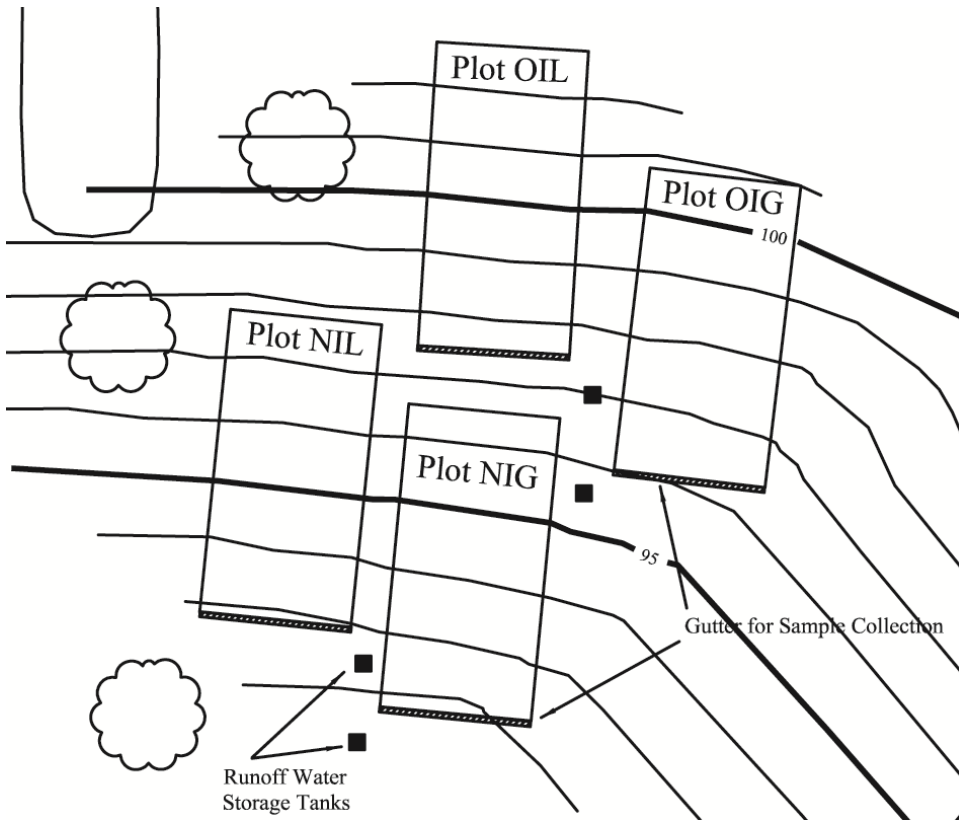
Rainbird pop-up sprinklers at Plot OIG

- Pre-application runoff on the plots (June 2008):
 - 0.8 inches per hour sprinklers
 - Runoff between 11 minutes and 42 minutes





Application – July 15, 2008



- Representative pyrethroids: bifenthrin and beta-cyfluthrin
- Plot OIL received liquid bifenthrin and granular beta-cyfluthrin
- Plot OIG received granular bifenthrin and liquid beta-cyfluthrin
- Plot NIL received liquid bifenthrin and granular beta-cyfluthrin
- Plot NIG received granular bifenthrin and liquid beta-cyfluthrin



Application



Granular application to plot OIL

- Performed by Jeff White of Stone Environmental and Rob Roy Macgregor of Clark Pest Control
- A granular and a liquid applied to each plot
- All applications made at the granular product rates for comparability
- All gutters and pump systems covered by plastic during application



Application



Liquid bifenthrin application to Plot OIL

- Beta-cyfluthrin rate 0.0015 lb ai/1000 square feet
- Bifenthrin rate 0.0048 lb ai/1000 square feet
- All chemicals applied successfully.
- Seven of eight applied at or above the target rate; one applied at 97% of the target rate.



Over-Irrigation Runoff



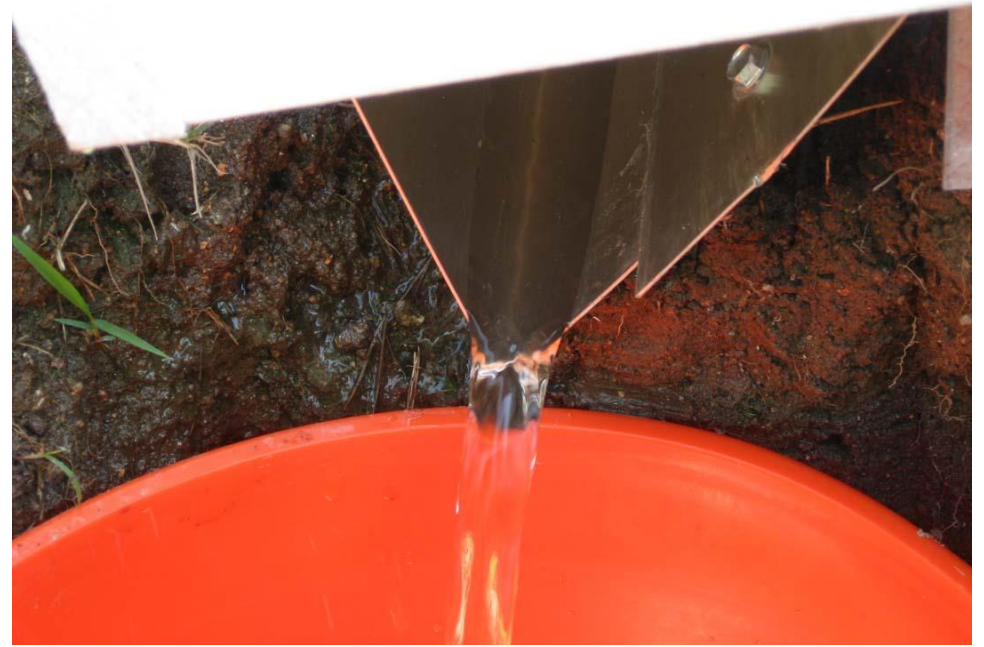
Plot OIG sprinklers



- Pre-application pre-wetting of the plots (July 14, 2008):
 - 0.8 inches per hour sprinklers did not produce significant runoff
- July 16, 2008
 - After 2 hours the sprinkler system was switched to a 1.5 inches per hour system



Over-irrigation Runoff





Over-Irrigation Runoff

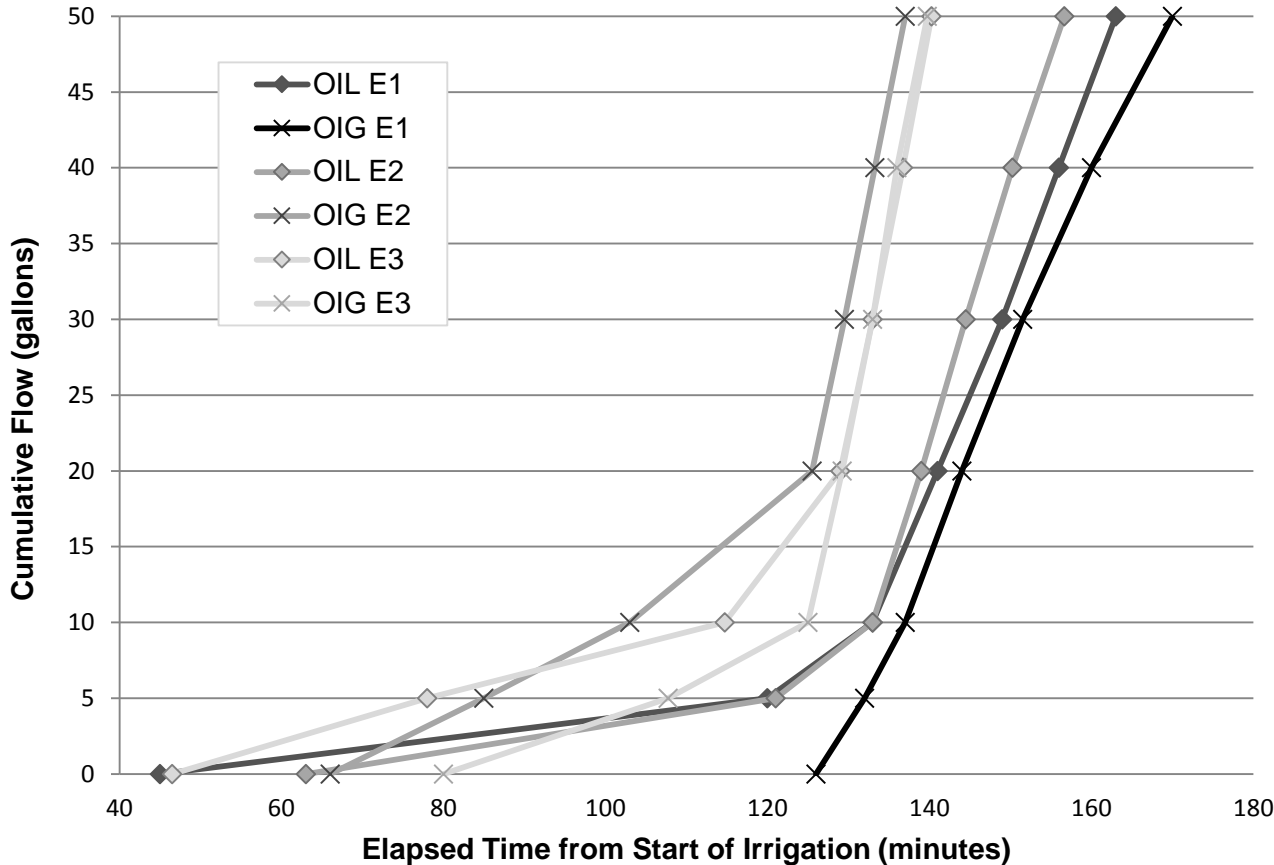


Over-irrigation runoff on plot OIL

- Irrigation system was active until 50 gallons of runoff had occurred.
- Runoff samples were collected at:
 - Breakthrough, then
 - 5, 10, 20, 30, 40 and 50 gallons of flow
 - Samples were collected at the end of the gutter, directly from the runoff stream

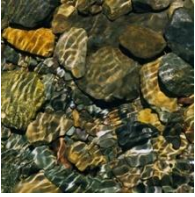


Over-Irrigation Runoff



- Three runoff events on each plot
- Starting the day after application and every other day thereafter
- Samples were shipped overnight to CRG Marine Labs in Torrance, CA

Plot hydrographs by event



Over-irrigation Runoff

Bifenthrin and Beta-cyfluthrin analysis conducted at CRG Marine Labs

- Samples were typically extracted the day of receipt using methylene chloride
- Samples were analyzed using an Agilent GCMS in the Negative Ionization mode
- LOD – 1 part per trillion
- LOQ – 10 parts per trillion



Simulated Rainfall Runoff



Rainfall simulator over Plot OIG

- September 10, 2008
- Representative of a 1 in 5 year 1 hour winter storm – target of 0.75 inches per hour
- Simulator was calibrated two days before use to 0.77 inches per hour
- One storm on each plot
- Duration of 1 hour or 50 gallons of runoff whichever came first



Simulated Rainfall Runoff



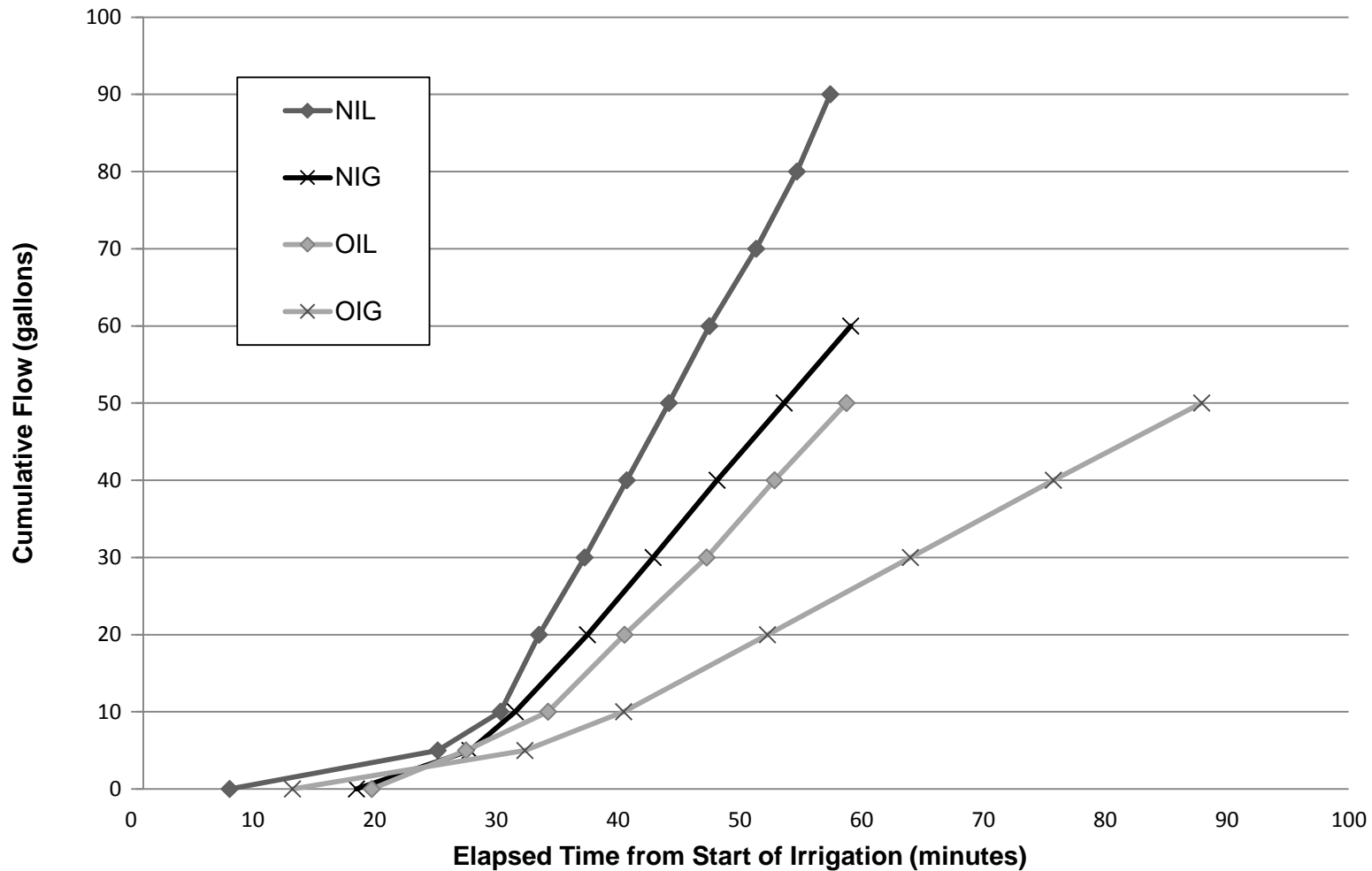
Rainfall simulator over Plot NIL

- Samples were collected on the same scheme as over-irrigation runoff
- If more than 50 gallons of runoff occurred then samples continued to be collected at 10 gallon intervals
- Runoff began on all plots between 8 and 20 minutes after start of the simulator



Simulated Rainfall Runoff

Hydrograph of all four simulated rainfall runoff events



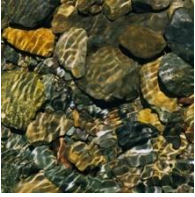


Results and Conclusions

Mass Transport in Percent of Mass Applied

Beta-cyfluthrin Treatment	Over-Irrigation Event 1	Over-Irrigation Event 2	Over-Irrigation Event 3	Simulated Rainfall
Plot OIL-Granular, Over-Irrigation	0.58%	0.075%	0.026%	0.005%
Plot NIL-Granular, Normal Irrigation	n/r	n/r	n/r	0.011%
Plot OIG-Liquid, Over-Irrigation	0.23%	0.064%	0.021%	0.006%
Plot NIG-Liquid, Normal Irrigation	n/r	n/r	n/r	0.010%

Bifenthrin Treatment	Over-Irrigation Event 1	Over-Irrigation Event 2	Over-Irrigation Event 3	Simulated Rainfall
Plot OIG-Granular, Over-Irrigation	0.052%	0.037%	0.015%	0.003%
Plot NIG-Granular, Normal Irrigation	n/r	n/r	n/r	0.003%
Plot OIL-Liquid, Over-Irrigation	0.081%	0.013%	0.006%	0.002%
Plot NIL-Liquid, Normal Irrigation	n/r	n/r	n/r	0.006%



Results and Conclusions

- The extent to which over-irrigation might transport recently applied pyrethroids
- Over-irrigation one day after application can move between 0.05% and 0.6% of applied chemical. However, transport in the second runoff event is between 1.4 and 8 times lower than in the first event.
- How much of the applied chemical was still available to run off eight weeks later during an early winter rainstorm and how does this compare with those irrigated using best practices
- The amount of chemical transported from residential turf by an early winter storm event is low ($\leq 0.011\%$ and $\leq 0.006\%$ of applied for beta-cyfluthrin and bifenthrin, respectively.)
- Chemical transport is low whether the rainfall follows a season of over-irrigation or best practice irrigation over the summer months.
- The effect of granular versus liquid formulations
- The difference between transport of the granular and liquid formulations for either molecule was not great (≤ 2.5 fold).



Acknowledgements

Pyrethroid Working Group

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