Refining Pyrethroid Aquatic Exposure Assessments by Incorporating Measured Landscape and Environmental Variability using Probabilistic Approaches. III – Characterizing the probability of wind speeds and direction across multiple insecticide applications within a season

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PYRETHROID WORKING GROUP

Introduction

Because many pyrethroid use patterns permit multiple aerial applications each season, PWG has investigated the likelihood that the Tier II assumption that the wind will be blowing towards the water body at 10 mph on every application day at all Tier II exposure scenario locations. Using the hourly wind speed data for SAMSON weather stations, an analysis was performed for six application hours (0000, 0400, 0800, 1200, 1600, 2000) for "n" applications occurring "m" days apart as specified for a particular crop on pyrethroid labels for a range of feasible start dates for 30 weather years. Additionally, the presentation examines the probabilistic distribution of annual loadings from aerial drift to the standard pond when the actual wind speed, temperature, and humidity are taken into account on the day of application compared to annual loadings using AgDRIFT® (v. 2.0.10) aerial Tier I default values. These drift loadings were compared to EPA Tier II assumptions and also incorporated directly into some example AGRO-2014 model runs to compute estimated environmental concentrations (EECs).
**Wind direction analysis will be in a future publication.*

Default EPA drift assumptions

- Wind direction (WD) is always blowing towards the pond
- Wind speed (WS) is 10 mph
- Temperature (T) and relative humidity (RH) are 86º F and 50%, respectively
- Aerial drift with a 150-ft buffer was always 1.97% (AgDRIFT® model Tier I)
- Ground drift with a 25-ft buffer was always 0.05% (RegDisp model)

Drift input variable database creation

- Two SAMSON stations: W03940 (Jackson, MS) and W23155 (Bakersfield, CA)
- Extracted T, RH, WS and WD for all days from 1961 to 1990 at 0000, 0400, 0800, 1200, 1600, 2000
- T rounded to nearest 5ºF (minimum 32ºF), RH to nearest multiple of 5%, WS to nearest mph (maximum 19.9 mph)

Analysis method

- Determine start date of aerial application sequence and interval between sprays based on expert opinion/pesticide label to identify a sequence of dates for spraying
- Obtain separate sequences of drift variables for 0000, 0400…2000 for each of these days (SET 1 data) across each of 30 years
- Move start day forward 1 day and repeat (SET 2).
- Repeat for label interval period (e.g. 5 days = SETS 3, 4, and 5)
- Using AgDRIFT Tier II aerial model (medium/coarse droplet size) compute annual drift load for each set and plot cumulative probability of load and compare with default annual estimates (shown as percent of default annual load)
- Run PRZM/VFMOD/AGRO-2014 for 30 years using predicted actual event drift percentages and assuming direction was always to the pond – compare with defaults

PWG example application

- MS Cotton - 2 ground then 4 aerial applications at 5-day interval starting May 24
- CA Onion - 2 ground then 2 aerial applications at 5-day interval starting Feb 23
- All ground sprays assumed to be the default value of 0.05%

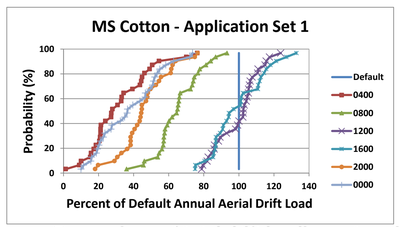
Results – 30-year variation of drift parameters for MS & CA SAMSON stations

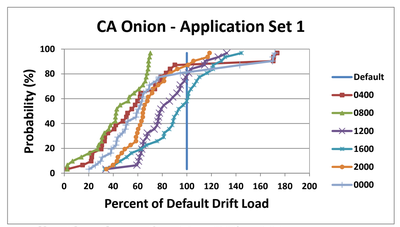
Hour	Statistic	WS, mph (Default = 10 mph)		RH, % (Default = 50%)		T, ºF (Default = 86ºF)	
		MS Cotton	CA Onion	MS Cotton	CA Onion	MS Cotton	CA Onion
0400	Max	18.79	35.34	100.00	100.00	80.06	62.96
0400	Mean	4.43	9.20	91.68	72.13	66.48	48.36
0400	Min	0.00	0.00	70.00	14.00	49.28	32.00
1200	Max	20.13	21.03	91.00	78.00	96.08	76.64
1200	Mean	9.22	8.37	52.87	50.83	83.94	62.15
1200	Min	3.36	0.00	26.00	12.00	62.06	48.02
2000	Max	18.79	21.03	100.00	100.00	87.08	66.74
2000	Mean	5.17	8.00	75.68	63.90	74.67	56.01
2000	Min	0.00	0.00	51.00	30.00	62.06	41.00

Note: Due to space limitations only 3 hours for one application set (SET 1) are shown in table

Results – Drift Loadings for Application Set 1 for MS Cotton and CA Onion

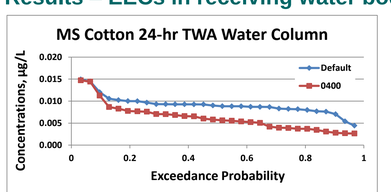
Scenario	Total Drift Loadings (kg) per Application Hour over 30 Years						
	0400 h	0800 h	1200 h	1600 h	2000 h	2400 h	Default
MS Cotton	0.0258	0.0528	0.0812	0.0809	0.0375	0.0307	0.0814
CA Onion	0.0232	0.0164	0.0312	0.0345	0.0259	0.0263	0.0375

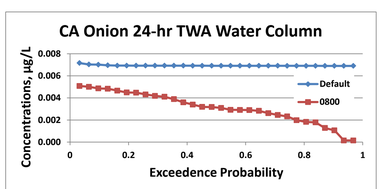


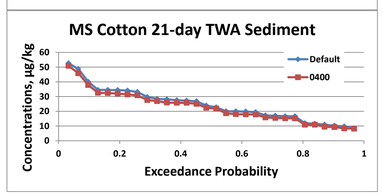


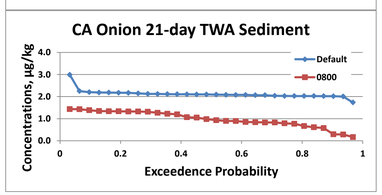
Comparison of total drift loadings at each application hour for SET 1 for 30 years

Results – EECs in receiving water body









Conclusions

- Temperature, RH, wind speed (and direction) behavior is likely to vary between all SAMSON stations
- Drift can become very significant for products labeled for multiple application sequences due to the accumulated impact of the variation
- Detailed analyses show that, even when ignoring the direction of the wind (i.e. the wind always blows towards the water body)
  - Drift loads across 30 years of weather conditions for applications conducted at any time except 1200 or 1600 indicate that over 80% of the time the regulatory assumption will be a considerable overestimate of the actual drift load. In half the years, the seasonal load will be 60% or less of the default model drift load
  - Depending upon other site characteristics, this will have a variable but significant effect on estimated water column concentrations (and sediment/pore water where runoff/erosion are not high contributors to total load) – especially for aerial applications
  - Wind speeds (at these MS/CA stations) vary systematically across the day – predicted drift loads for application sequences sprayed at 1200 or 1600 hrs are higher than at other times of the day
- If the probability of wind direction were included in these analyses, EECs would be further reduced
- Where a product label permits multiple applications, the probability of wind speed (and direction) should be considered for higher tier aquatic exposure assessments; this could be done by producing publically available data sets for temperature, RH and wind speed and direction for the 237 SAMSON sites

Results – Preliminary information on wind direction