Current Use Pesticides in the Atmosphere of Agricultural Regions of Western Canada

Renata Raina-Fulton, Lin Sun, Patricia Hall,
Erika Smith, Nicole Dunn (Fergus), Noof Al-Zahrani
University of Regina
Regina, SK

Nov 2012

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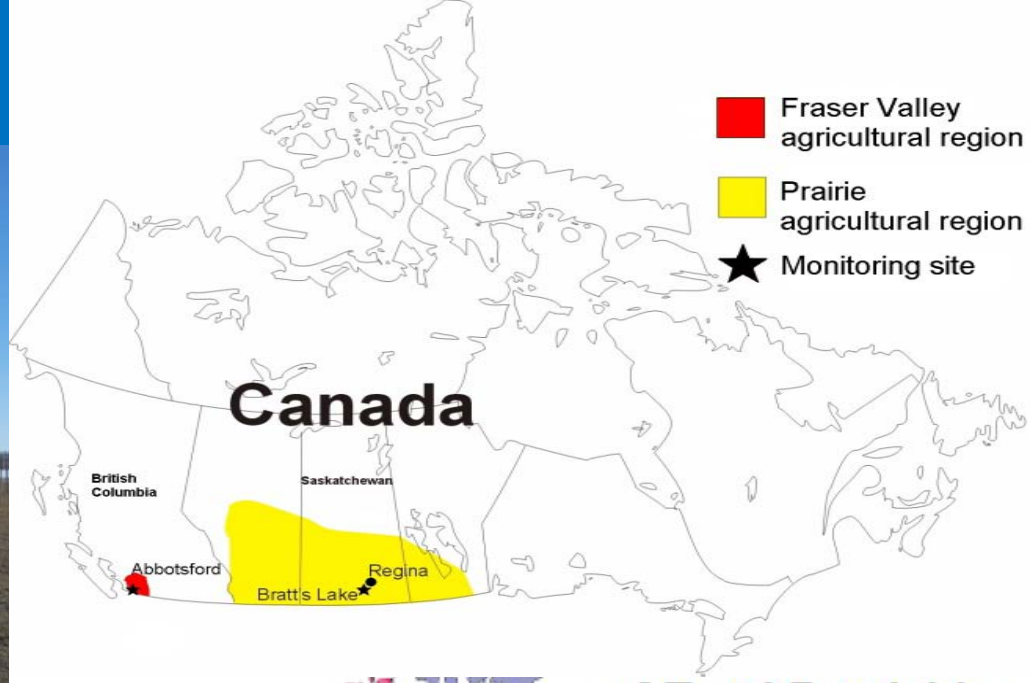
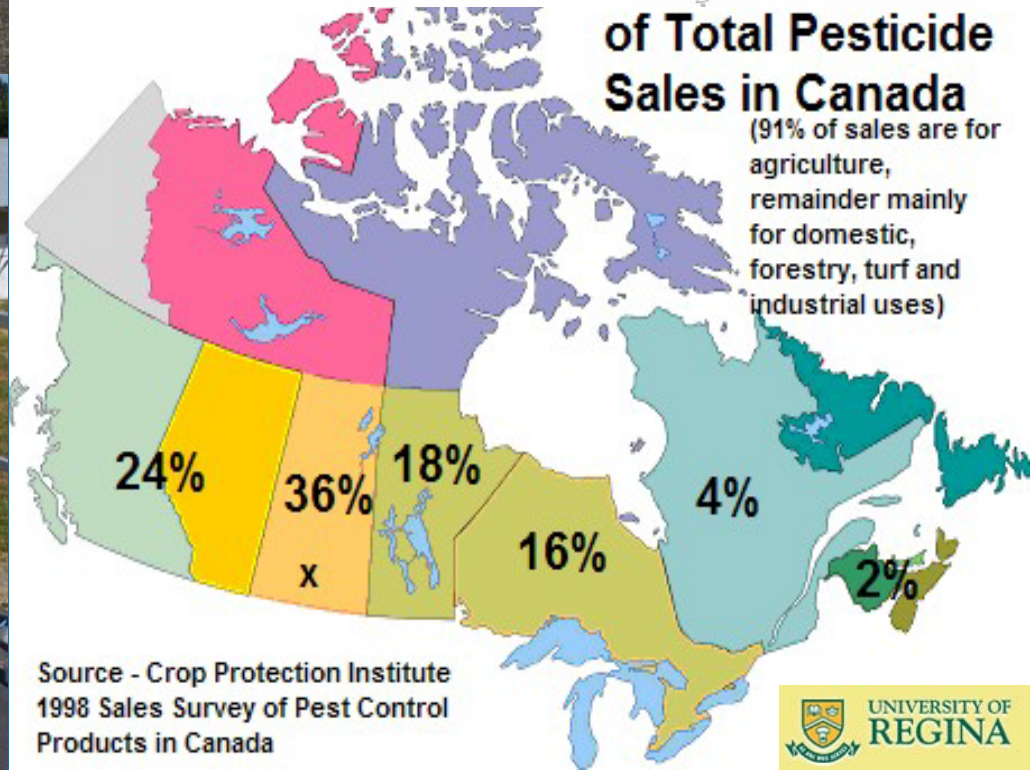
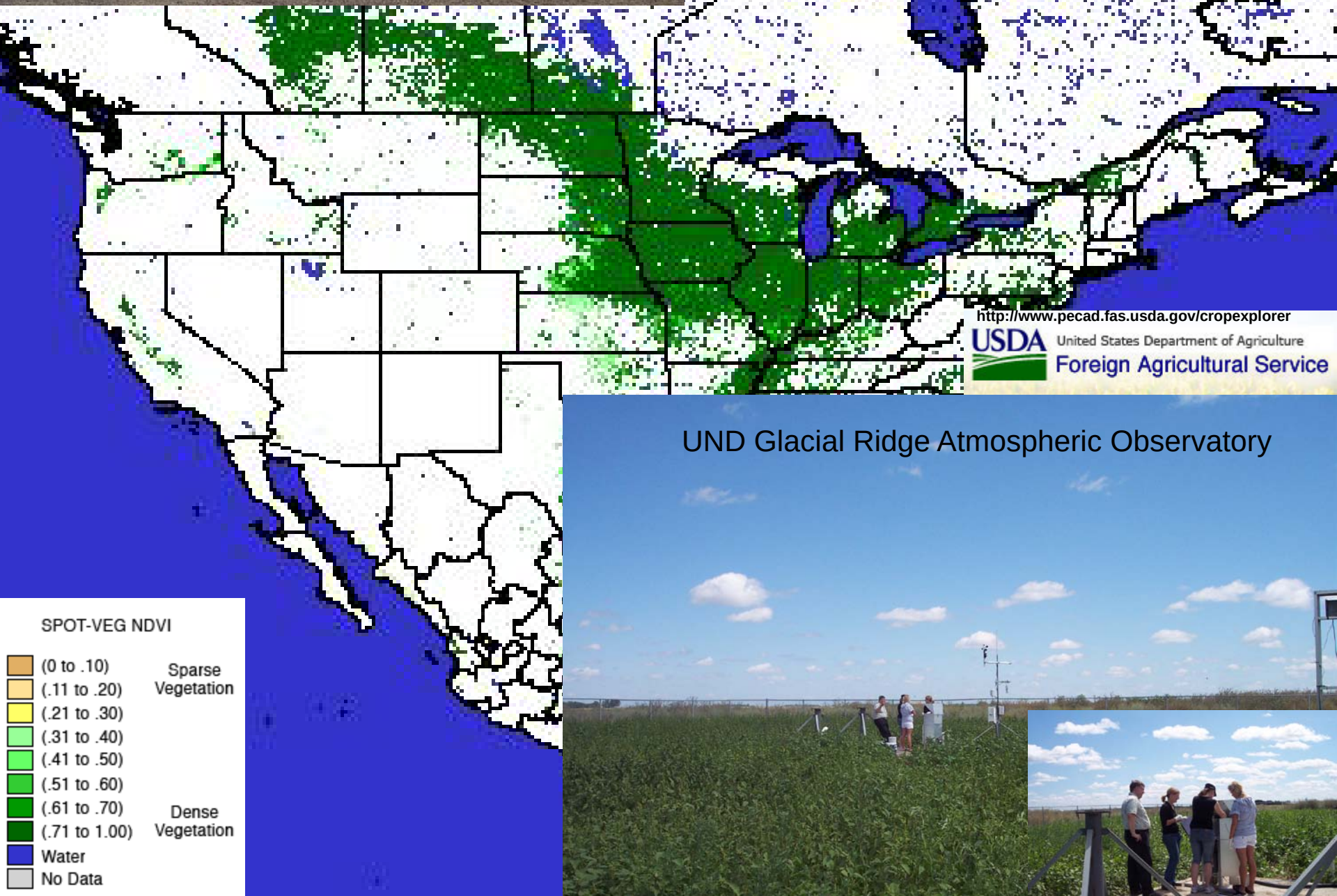
Where We Began!





Mapdata©2012 Google, INEGI Imagery ©2012TerraMetrics
97
Summerland
Penticton
5
Hope
3
Mission
Chilliwack
Sardis
Abbotsford
97
Oliver
EC Manning
Provincial Park
Cathedral
Provincial Park and
Protected Area
3
Osoyoos
Okanogan
National Forest
Ross Lake
National
Recreation Area
Omak
Lake Chelan
National
Recreation Area
Mt Baker
National Forest
97
Peace-Omineca
7
Skeena
6
Cariboo
5
Southern Interior
3
Kootenay
4
Vancouver
Island
1
Lower
Mainland
2

EC Bratt's Lake, SK


http://www.pecad.fas.usda.gov/cropexplorer
USDA
United States Department of Agriculture
Foreign Agricultural Service
SPOT-VEG NDVI
(0 to .10)
(.11 to .20)
(.21 to .30)
(.31 to .40)
(.41 to .50)
(.51 to .60)
(.61 to .70)
(.71 to 1.00)
Sparse Vegetation
Dense Vegetation
Water
No Data

UND Glacial Ridge Atmospheric Observatory

Gravimetric analysis for particle loading on filter ± 3 μg

Load PUF/sorbents into a 100-mL ASE cell

↓

Fill the cell with extraction solvent eg EA

↓

Heat to 100ºC, pressure to 1500 psi

↓

Static 30 min 2 cycles

← Flush with 60% Solvent after the First Cycle

↓

Purge solvent with N_2 for 300 sec to a 250-mL collection bottle

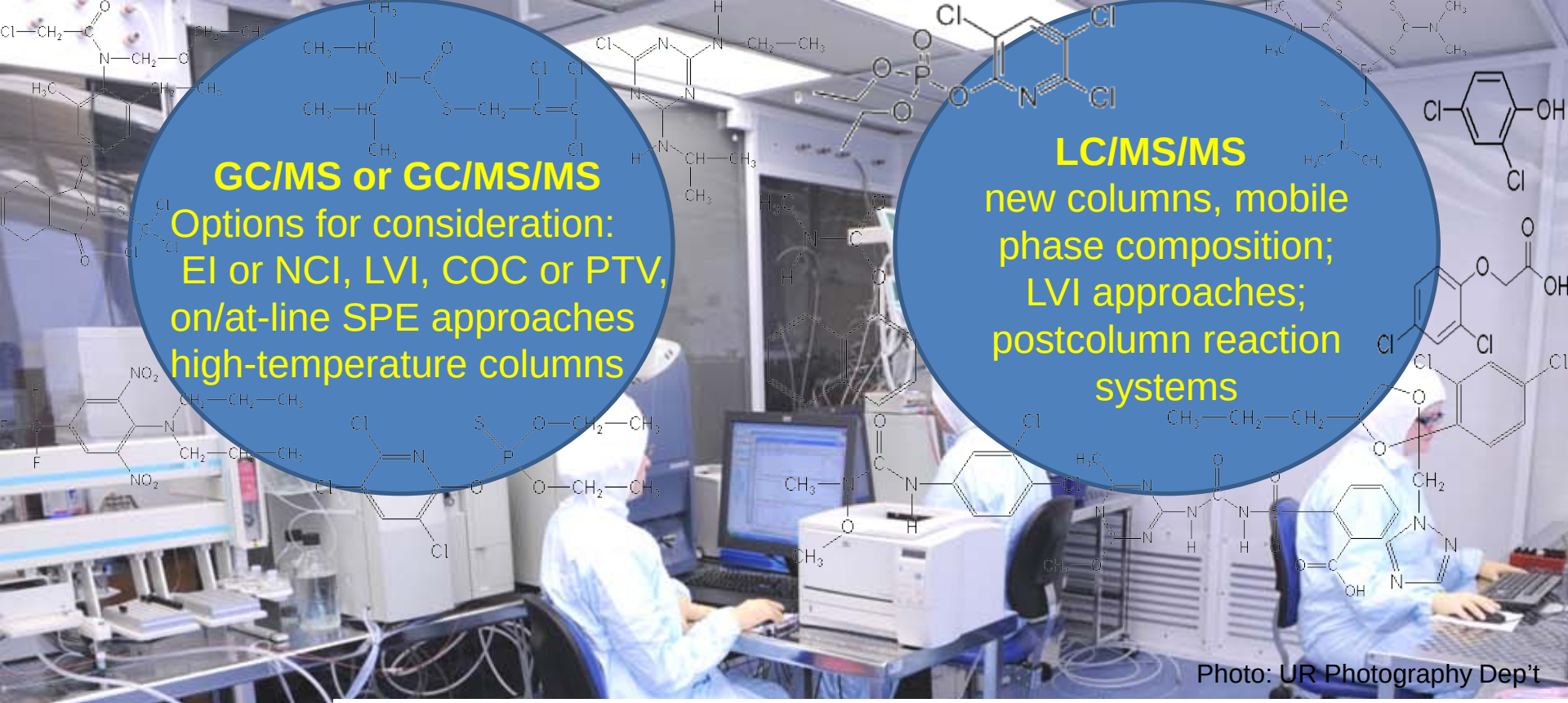
ASE extract

Dried to near dryness and dissolved in solvent suitable for SPE

Fraction taken for SPE clean-up, surrogate added for recovery check SPE clean-up for chemical class or target list

↓

SPE F1 fraction Dried to desired Volume, IS added, solvent selection for GC/MS or LC/MS/MS



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R. Raina, in Pesticides, Strategies for Pesticide Analysis, INTECH, 2011.
R. Raina, L. Sun, J. Environmental Science and Health B, 2008:43, 323-333.
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J. Environmental Science and Health B, 2010:45, 11-24.
R. Raina, E. Smith, J. AOAC Int., 2012, 95 (5), 1350-1356.

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Pesticide or Degradation Product	Bratt's Lake, SK (Prairies)[2005] (>MDL) pg m^{-3}	Detection %	Abbotsford, BC (LFV)[2005] (>MDL) pg m^{-3}	Detection %
Chlorpyrifos Chlorpyrifos oxon	0.6-1380 0.3-3900	100 96	3.9-86.7 3.2-186.0	100 100
Diazinon Diazinon oxon IMP DEP	0.3-6.6 <MDL <MDL <MDL	42	4.0-25000 371-32400 1.4-3810 40.2-2730	100 81 94 25
Malathion Malathion oxon	0.7-69.9 0.2-13.0	53 44	0.6-12900 1.1-1340	100 75
Azinphos methyl	<MDL		3.9-97.1	16
Dimethoate	<MDL		8.5-75.2	6
Trifluralin	5.0-1520[2003] 2.2-2430[2010]	96 91	5.8-429	90
Ethalfluralin	3.0-1330[2003] 8.5-1860[2010]	100 96	0.2-5.4	67
Triallate	2.0-27300[2003] 1.6-10140[2010]	100 100	0.3-6.3	85
α-Endosulfan β-Endosulfan	0.2-86.3[2010] 0.2-250[2010]	40 64	12.4-288[1] <MDL-38.0[1]	
Captan			55-3134[2004] 30-9287[2005] 99-13205[2006]	65 76 91
Folpet			22-1723[2004] 35-1064[2005] 86-923[2006]	69 70 54

[1]Y. Yao et al., ES&T, 2008, 42, 5931-5937

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	Vapour Pressure (Pa)	Water Solubility (mg/L)
Herbicides		
Triallate	0.016	4
2,4-D acid	0.00002	920
Organophosphorus Pesticides		
Chlorpyrifos	0.0010	0.3
Malathion	0.0053	145
Diazinon	0.0080	38
Trihalomethylthio fungicides		
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Folpet	0.0013	1.0
Azole Fungicides		
Propiconazole	0.00013	110
Prothioconazole	0.00000040	300-5000 (pH dependent)

**Extoxnet PIP

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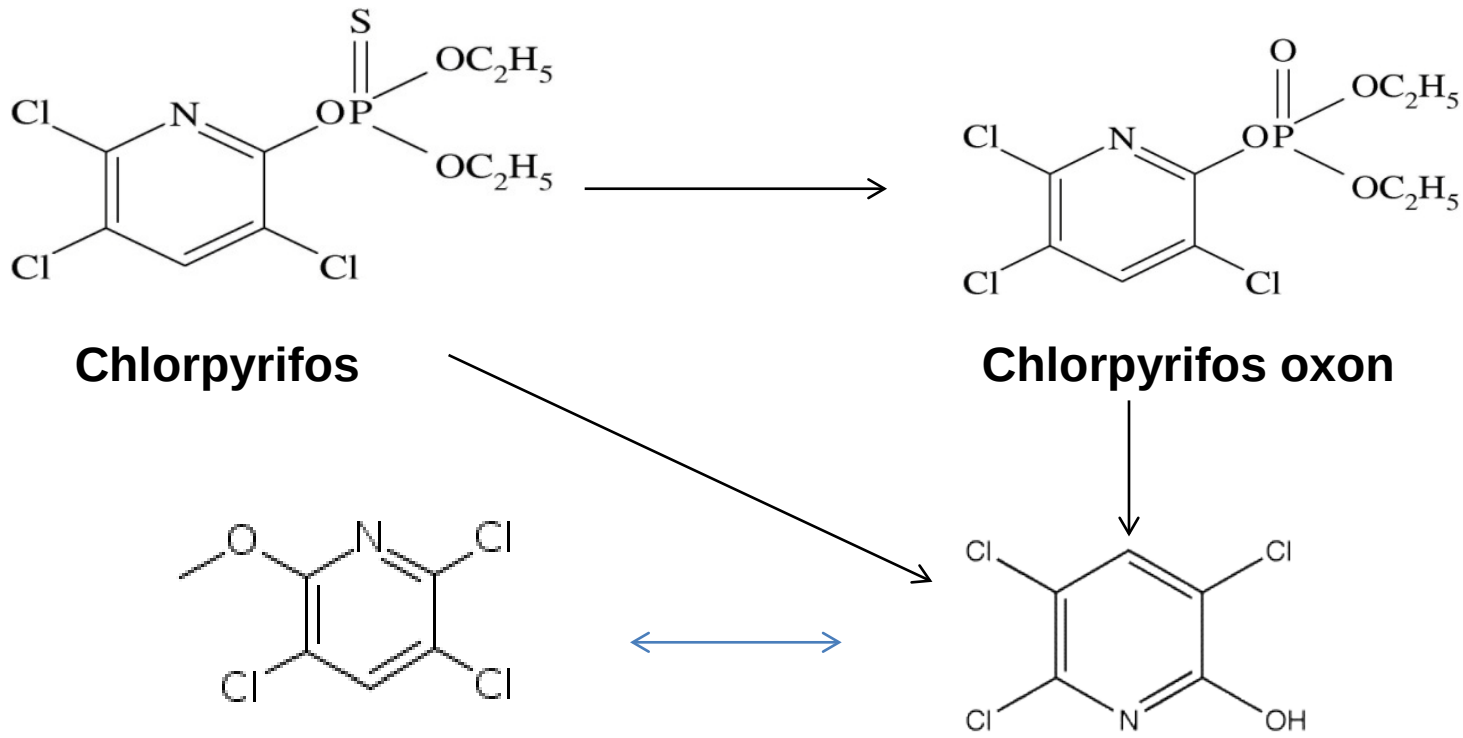


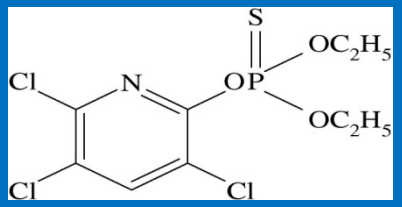
Chlorpyrifos

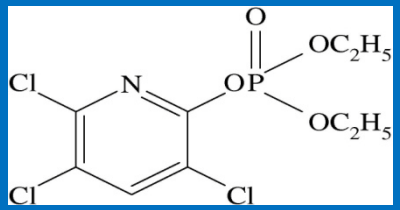
Chlorpyrifos oxon

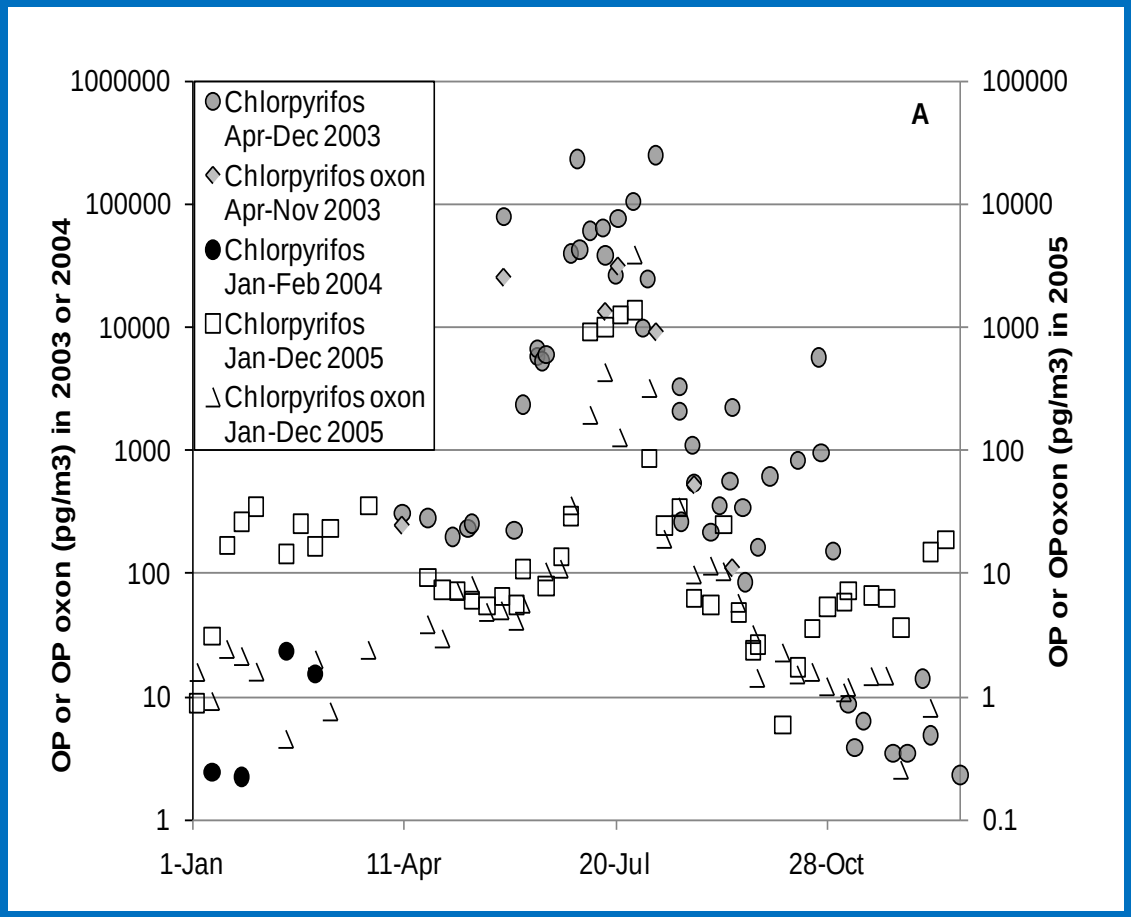
Trichloro methoxypyridine (TMP)

Trichloropyridinol (TCP)

and ethylthiophosphate, diethylthiophosphate, **diethylphosphate (DEP)**







Bratt's Lake, SK

R. Raina, P. Hall, L. Sun, ES&T, 2010

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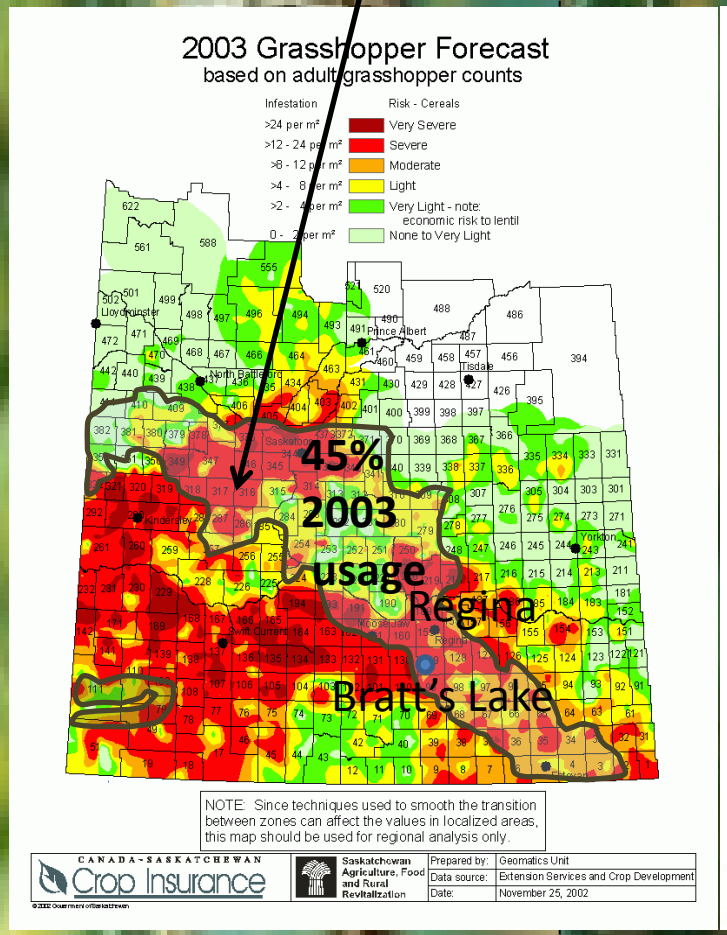
Chlorpyrifos SK Usage

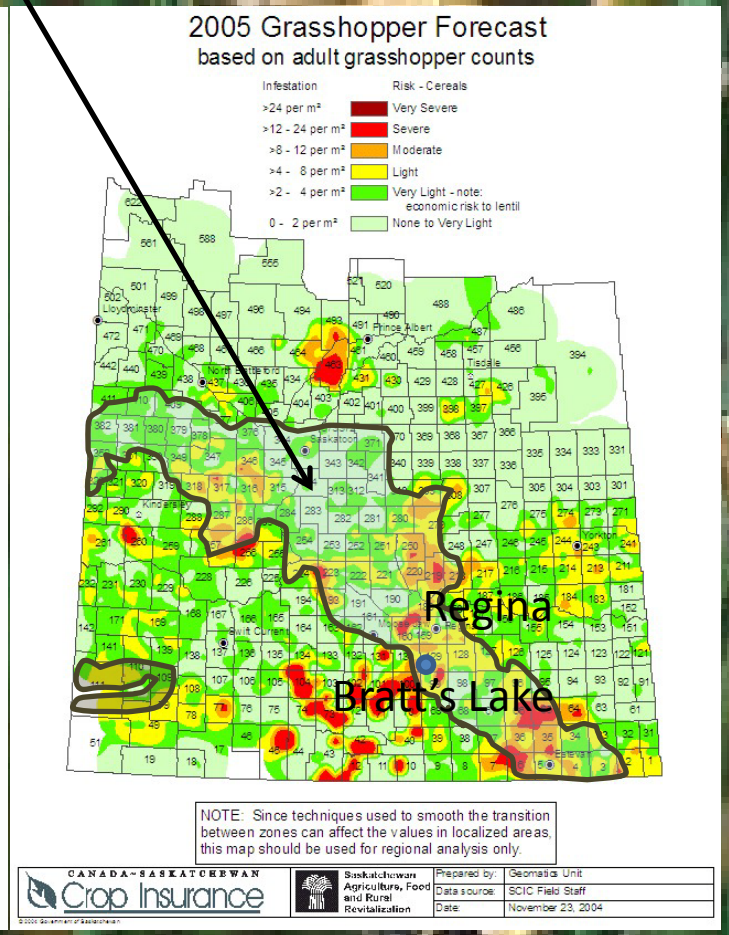
2001: 7300 kg

2002:122000 kg

2003: 206000 kg

Dark Brown Soil Zone





Dan L. Johnson
Lethbridge

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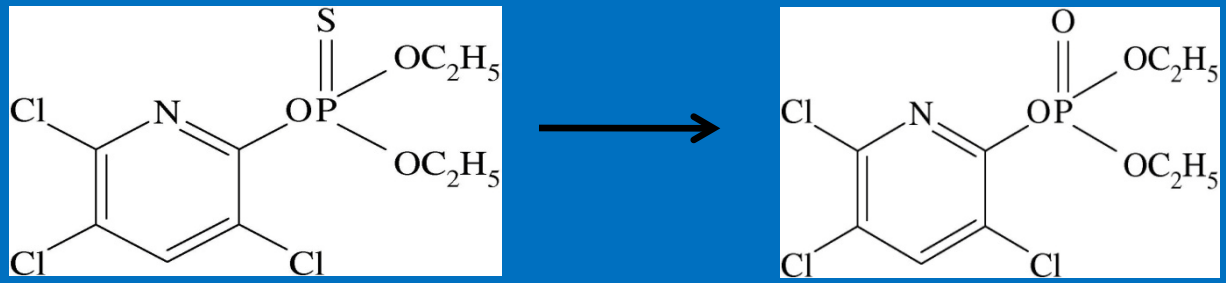

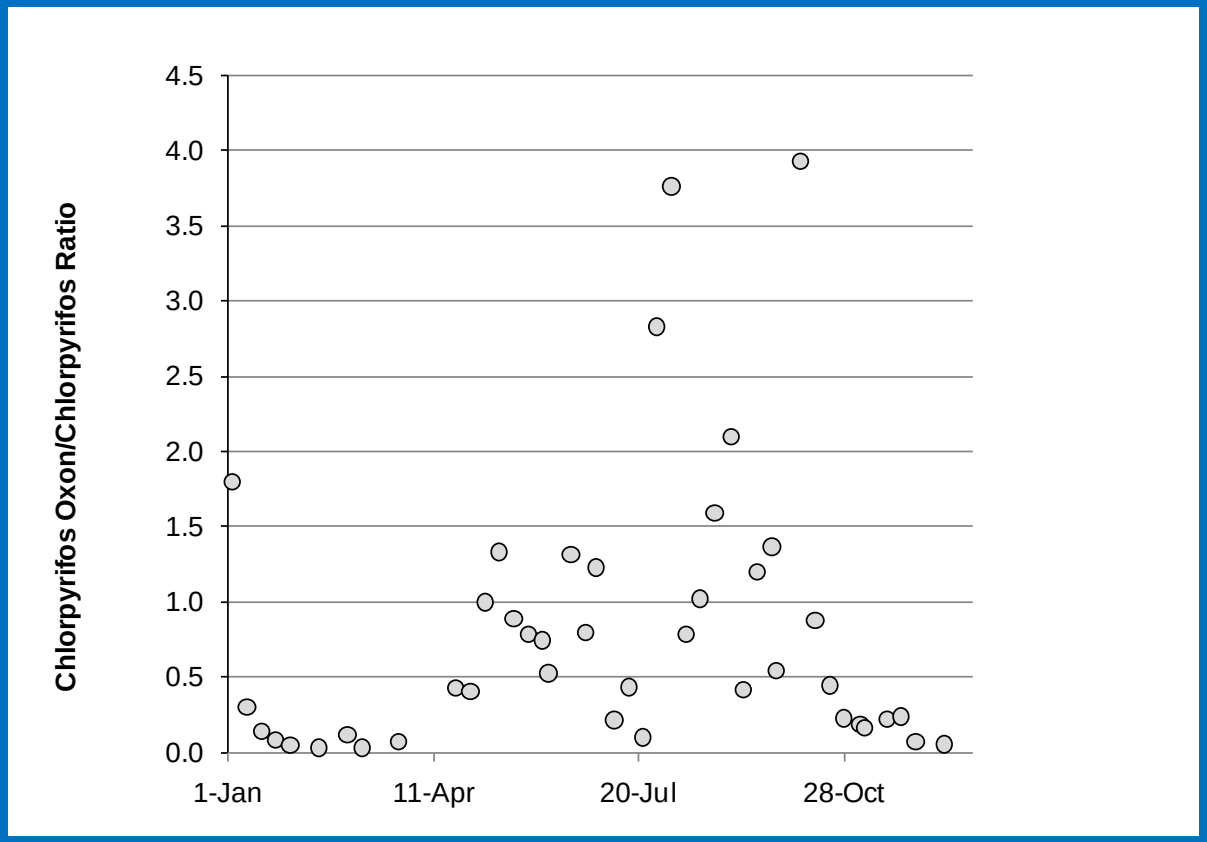

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R. Raina, P. Hall, L. Sun, ES&T, 2010

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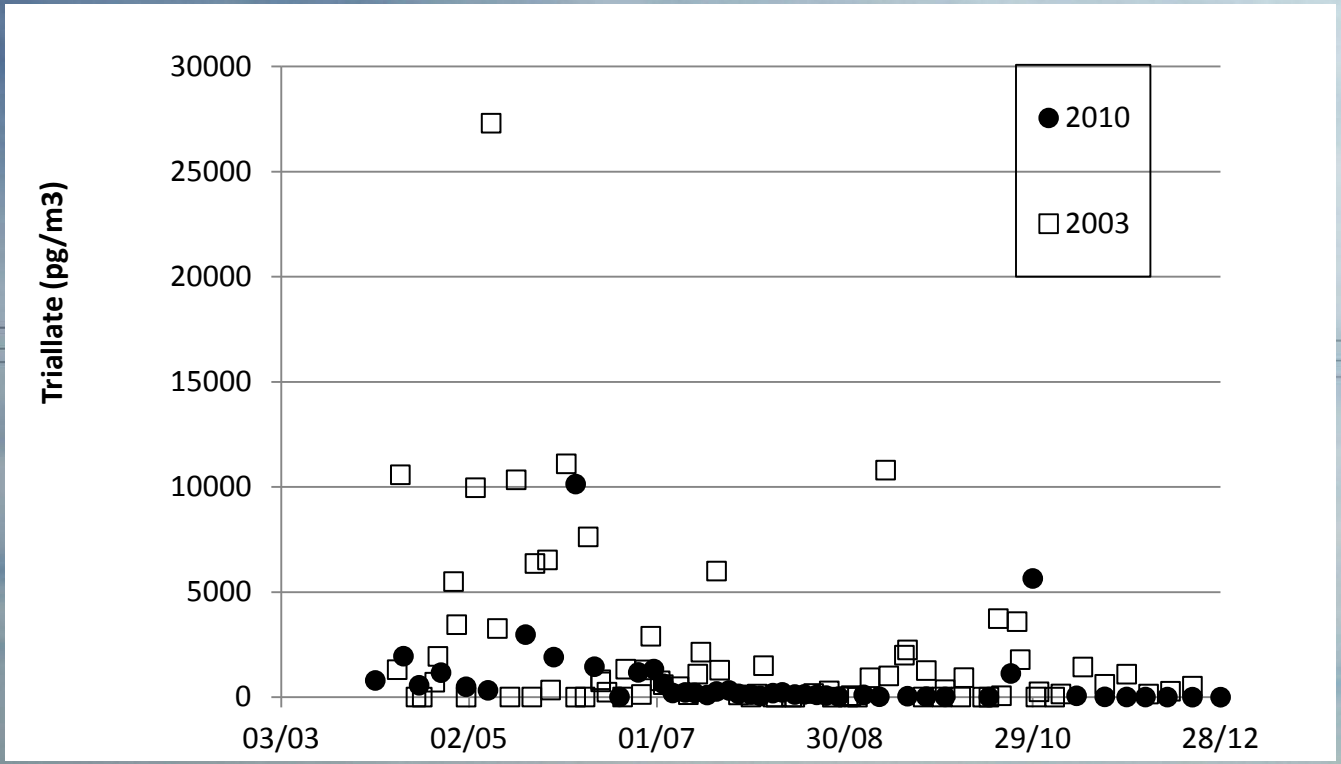

Crop (crop district 2B)	Acres Harvested in 2003	Production tonnes 2003	Acres Harvested in 2010	Production tonnes 2010
All wheat	839 993	628 968	478 729	488 563
Barley	159 005	138 088	88 750	94 824
Oats	51 555	32 932	12 684	12 220
Canola	148 922	56 243	465 054	344 697
Lentils	267 354	111 849	414 077	256 122
Dry Peas (or peas)	169 410	105 556	117 019	93 611
Chick Peas	11 869	4 901	18 521	17 643

Saskatchewan Ministry of Environment FactSheet -Statistics

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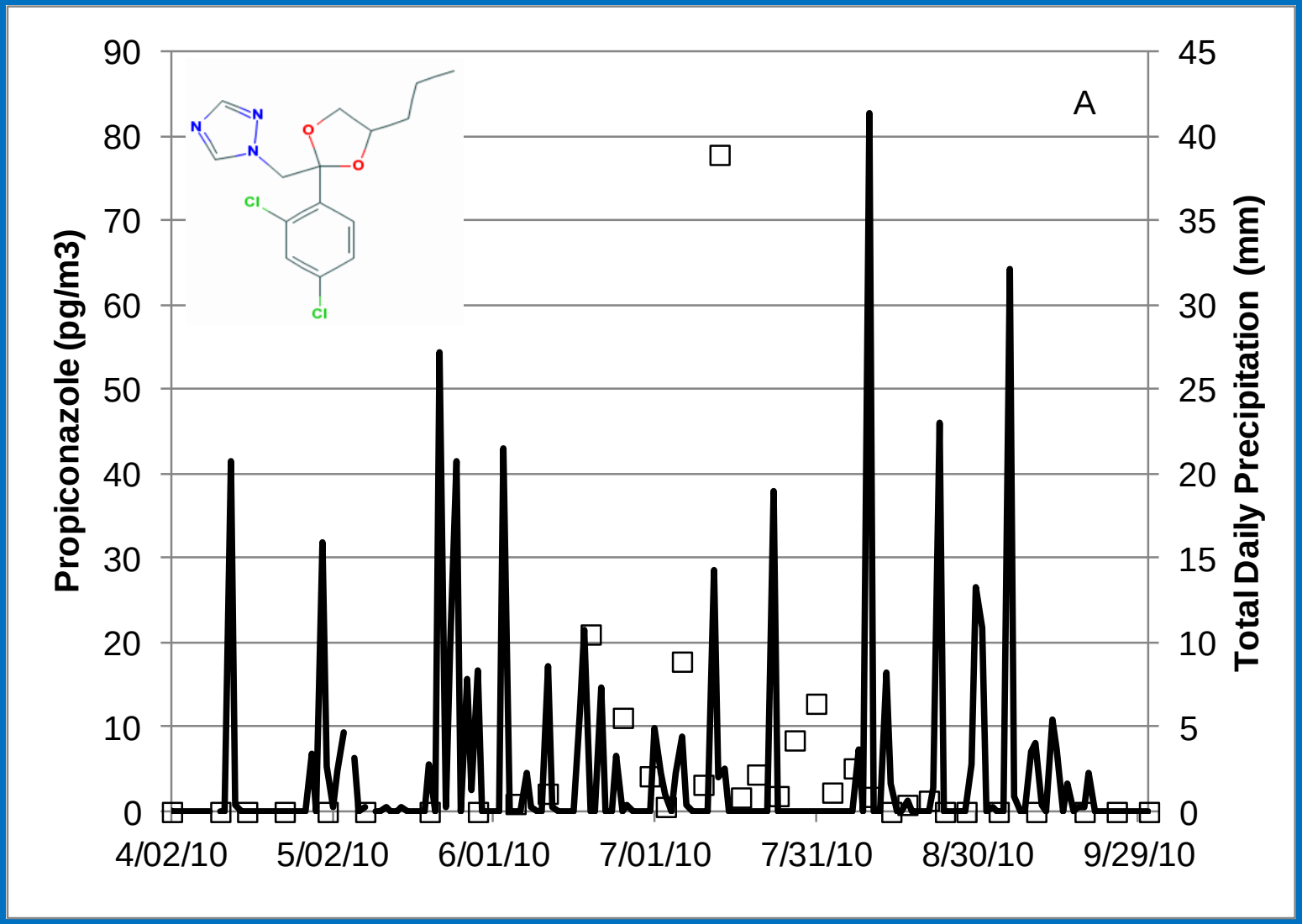

R. Raina, E. Smith, J AOAC International, 95(5), 1350-1356, 2012

Propiconazole SK 2001 626 kg, 2002 4910, 2003 1822 kg

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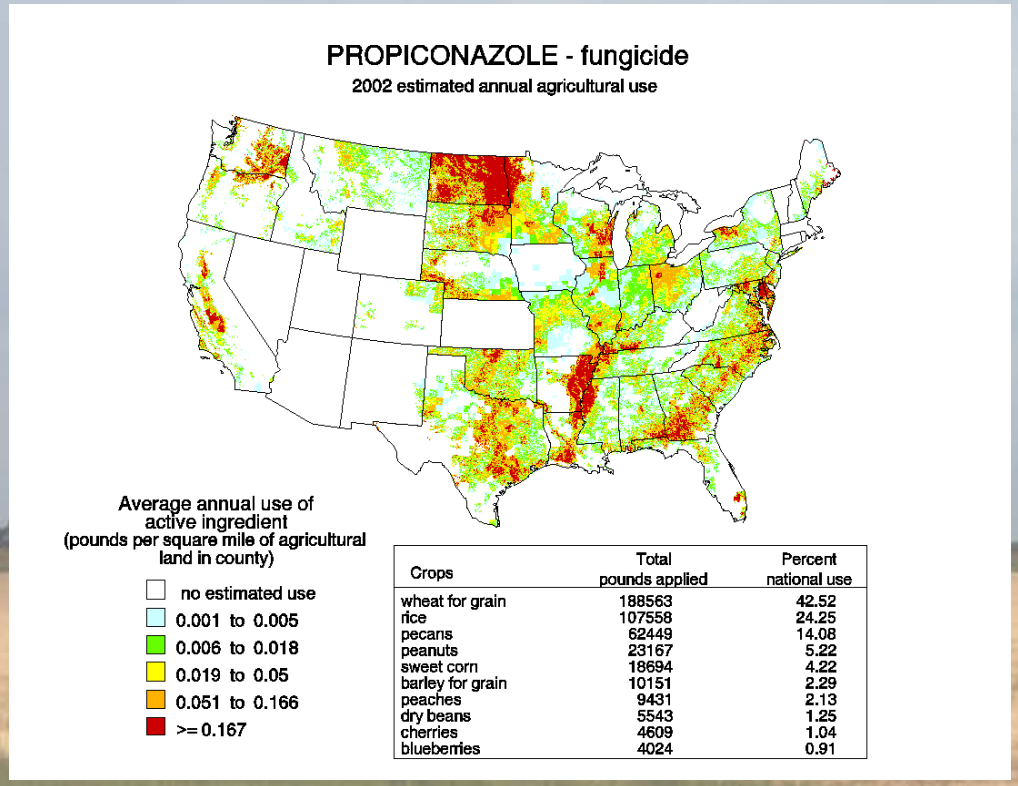
Do we have a candidate for regional & long-range atmospheric transport?



Crops	Total pounds applied	Percent national use
wheat for grain	188563	42.52
rice	107558	24.25
pecans	62449	14.08
peanuts	23167	5.22
sweet corn	18694	4.22
barley for grain	10151	2.29
peaches	9431	2.13
dry beans	5543	1.25
cherries	4609	1.04
blueberries	4024	0.91

USGS
National
Synthesis
Project
2002 usage maps
http://water.usgs.gov/nawqa/pnsp/

2002 196944 kg US mostly in North Dakota, South Dakota, Minnesota
Relative to SK 626-4910 kg during 2001-2003

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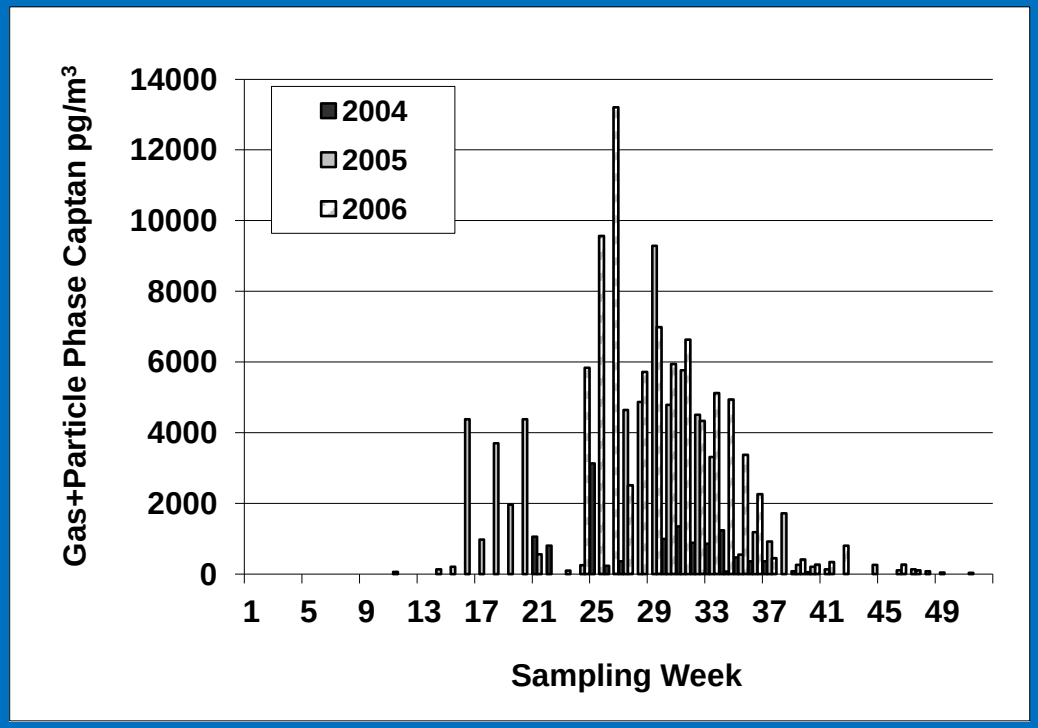
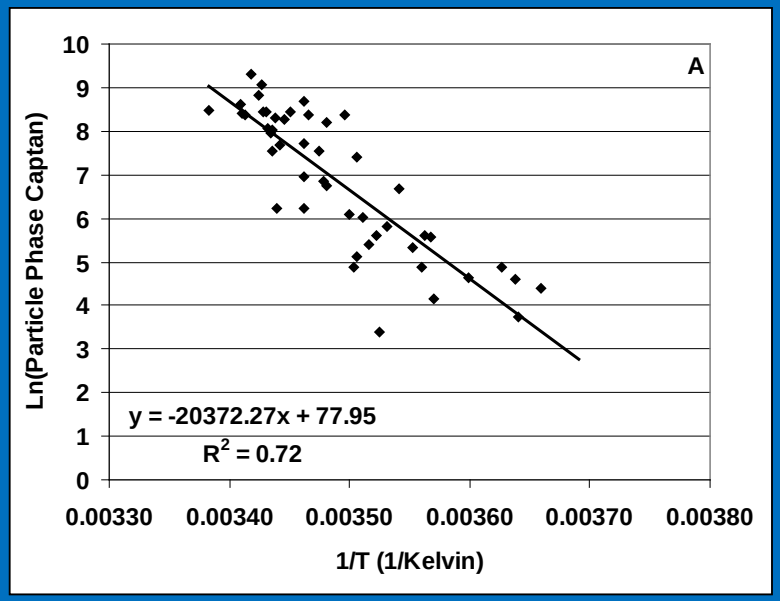
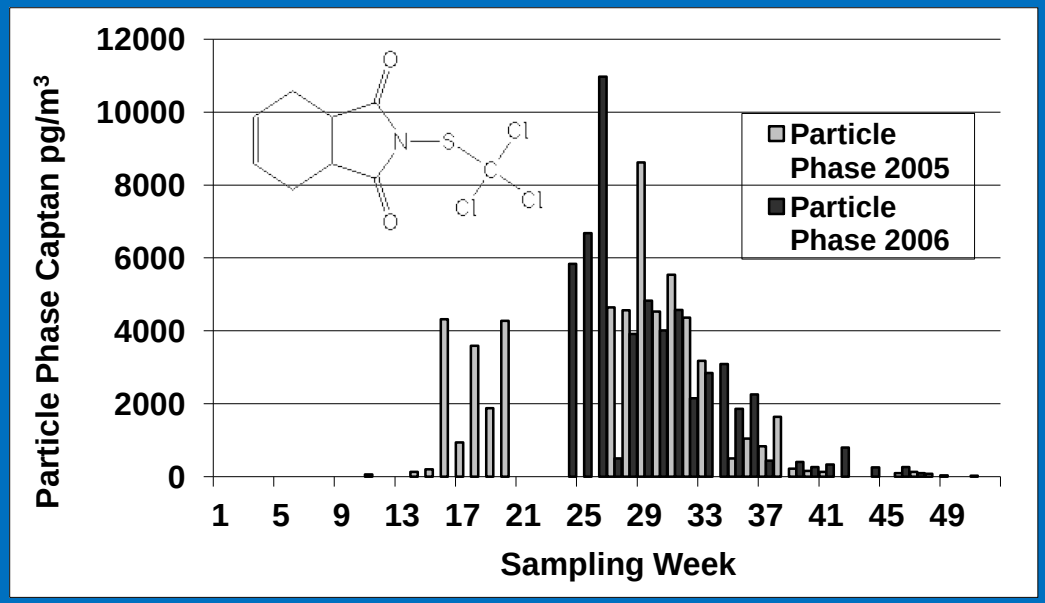


R. Bailey (Raina-Fulton), W. Belzer, K. Jones, Air, Soil, and Water Research 2009, 2, 41-49.

1991-2003 25,5000-29,160 kg
>75% BC acreage or crop in Lower Mainland Region 2





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Prothioconazole	0.00000040	300-5000 (pH dependent)
Methyl Carbamates		
Carbaryl	0.00018	40

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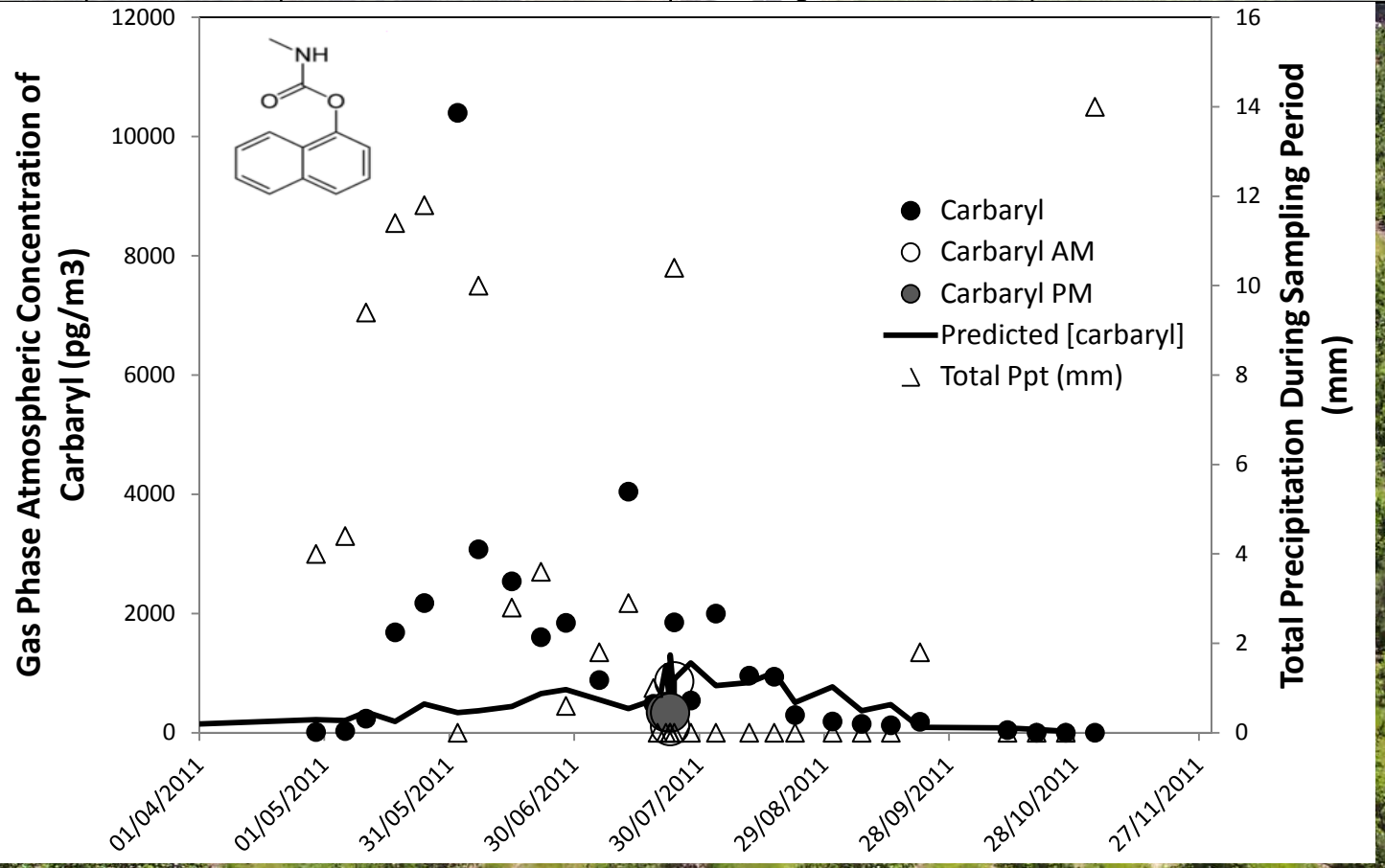
Pesticide	Trade Name	Recommended Application Method	Crop(s)	Pest(s) or Weed Control
carbaryl	Sevin XLR Plus	liquid suspension applied by spraying	grapes, apples, apricots, cherries, peaches, pears, and prunes	cherry fruit fly, Virginia creeper leafhopper, western grape leafhopper



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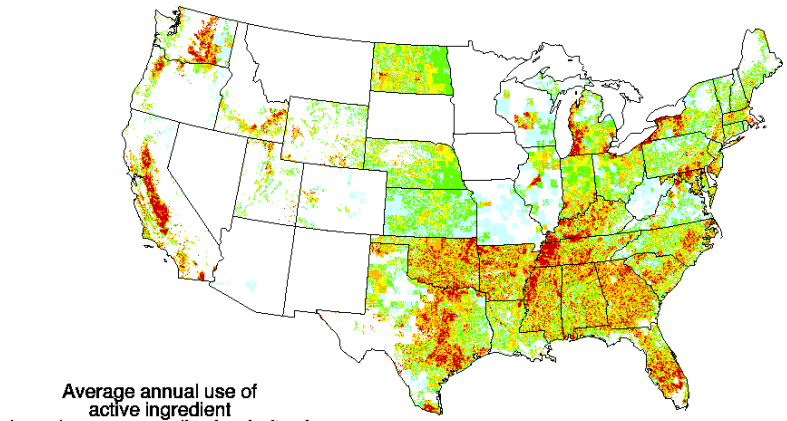
United States Geological Survey Usage Map for Carbaryl for 2002



Crops	Total pounds applied	Percent national use
other hay	646072	22.64
pecans	373494	13.09
apples	342293	11.99
citrus fruit	278504	9.76
soybeans	257502	9.02
corn	194981	6.83
grapes	112199	3.93
cherries	100890	3.54
peaches	70904	2.48
alfalfa hay	63449	2.22

Region 3 BC in 2003 carbaryl 10310 kg
Okanagan Valley 2011 carbaryl ~7860 kg[1]
[1]BC Ministry of Environment

carbaryl	
State	**Usage Quantity in 1997 (kg)**
Washington	94870
Oregon	22450

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Thanks to the Help of Many

Canadian Collaborators/Volunteers

- Environment Canada
- BC Ministry of Environment
- Metro Vancouver
- Agriculture and Agri-Food Canada
- Government of Saskatchewan, Department of Agriculture
- Health Canada

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UND Field Site at Glacial Ridge, MN
Kris Ray, Coville Tribe – Omak, WA

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- Canadian Foundation for Innovation for Trace Analysis Facility

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The Graduate Students

Photo: UR Photography Dep't