

# Weed Control in Mustard

11 January 2018

SaskMustard Mustard Day

Matthew Bernard, AAg

# Agenda

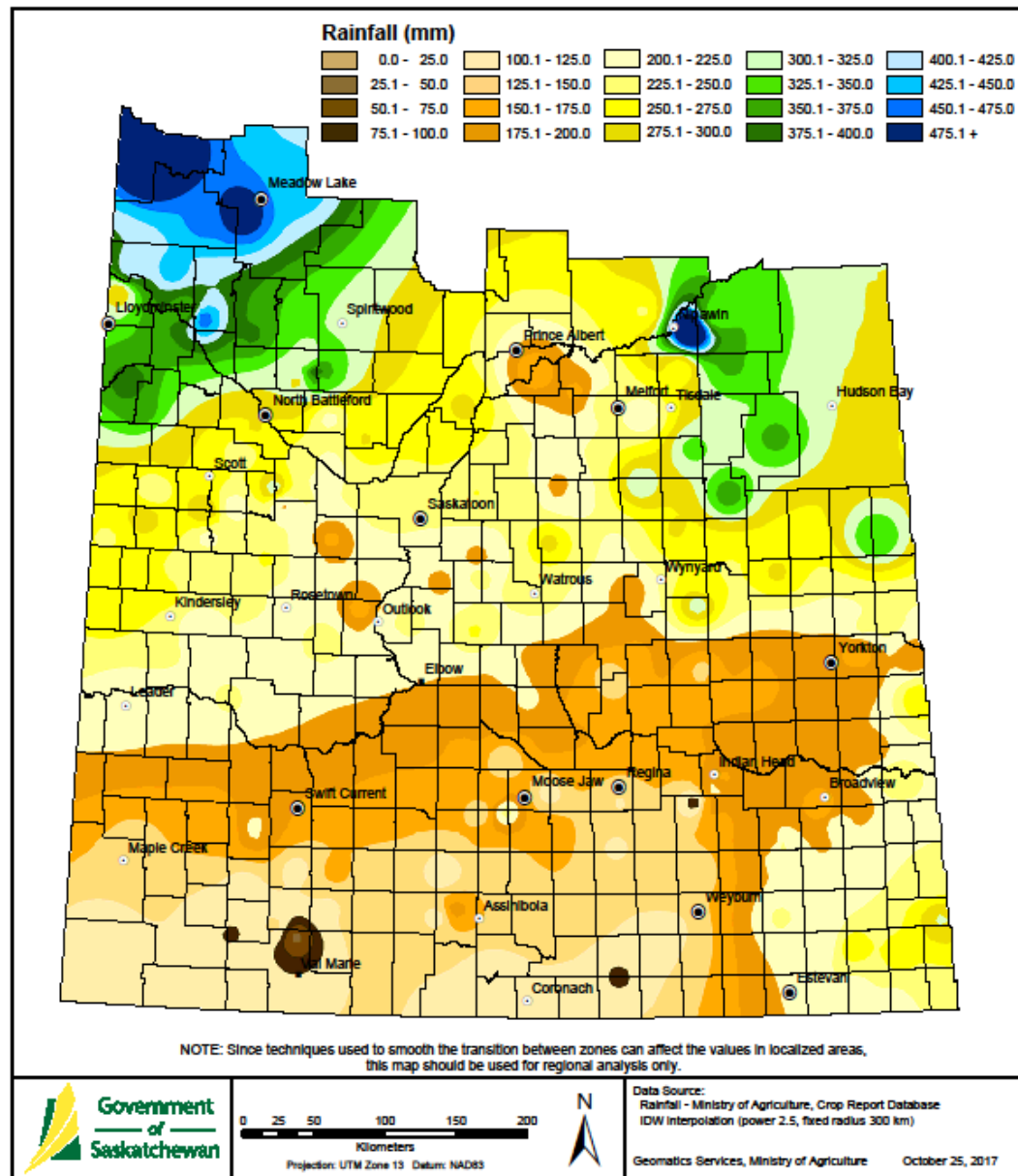
- Industry Overview
- Chemical Weed Control
  - Resistance
  - Current options
  - Layering
- Cultural Weed Control
- Mechanical/Alternative Weed Control

# Industry Overview for 2017

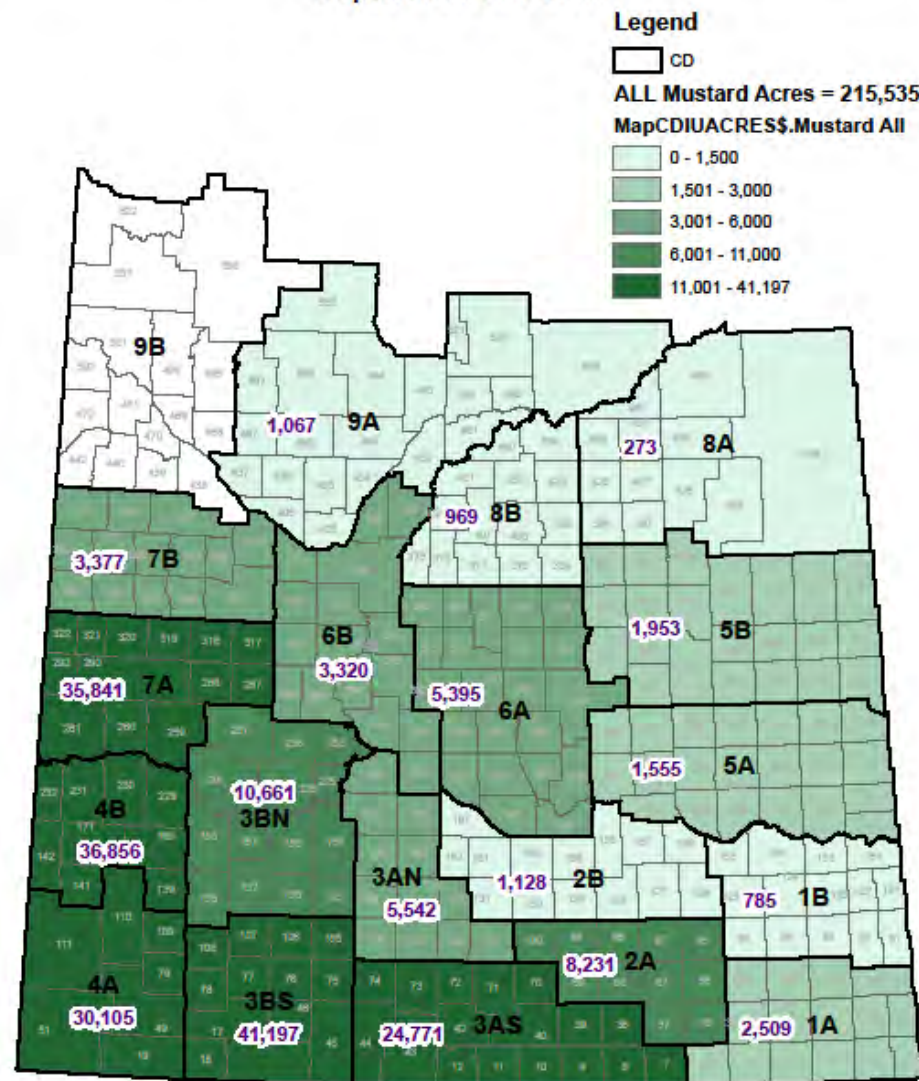
	2017		% change from 2016	% change from 5-yr average (2012-2016)
Total Seeded Acres	290,000		-26	-5
Seeded Acres by Type (percentage of total)	Yellow	138,000 (48%)	-43	No data
	Brown	72,000 (25%)	+44	No data
	Oriental	80,000 (27%)	-20	No data
Average Yield (lbs/ac)	730		-26	-17
Production (tonnes)	94,500		-42	-20

# Cumulative Rainfall

from April 1 to October 23, 2017



2017 SCIC Acres Seeded  
Includes Commercial, Pedigreed and Organic Acres  
As reported on Seeded Acreage Reports  
Minimum of 2 customers and 400 acres required per CD  
September 28, 2017



# Top 10 weeds in SK: 2014-15 surveys<sup>1</sup>

- 10: Dandelion ↑ (12<sup>th</sup> in 2003 survey)
- 9: Narrow-leaved hawk's-beard ↑ (20<sup>th</sup> in 2003 survey)
- 8: Lamb's-quarters ↓ (5<sup>th</sup> in 2003 survey)
- 7: Cleavers ↑ (14<sup>th</sup> in 2003 survey)
- 6: Spiny annual sow-thistle ↑ (34<sup>th</sup> in 2003 survey)
- 5: Canada thistle ↓ (4<sup>th</sup> in 2003 survey)
- 4: Volunteer canola ↑ (16<sup>th</sup> in 2003 survey)
- 3: Wild buckwheat (no change)
- 2: Wild oat (no change)
- 1: Green foxtail (no change)

# The Growing Problem of Herbicide-Resistant (HR) Weeds

*M ha / M ac*<sup>1</sup>

2001 - 2003 surveys: 4.4 / 10.9

2007 - 2009 surveys: 9.9 / 24.4

2014 - 2017 surveys: 15.4 / 38.0 (projected)

Weed Technology 2008 22:530-543

Education/Extension

## Weed Resistance Monitoring in the Canadian Prairies

Hugh J. Beckie, Julia Y. Leeson, A. Gordon Thomas, Clark A. Brenzil, Linda M. Hall, Grant Holzgang, Chris Lozinski, and Scott Shirriff\*

# Tolerance vs. Resistance

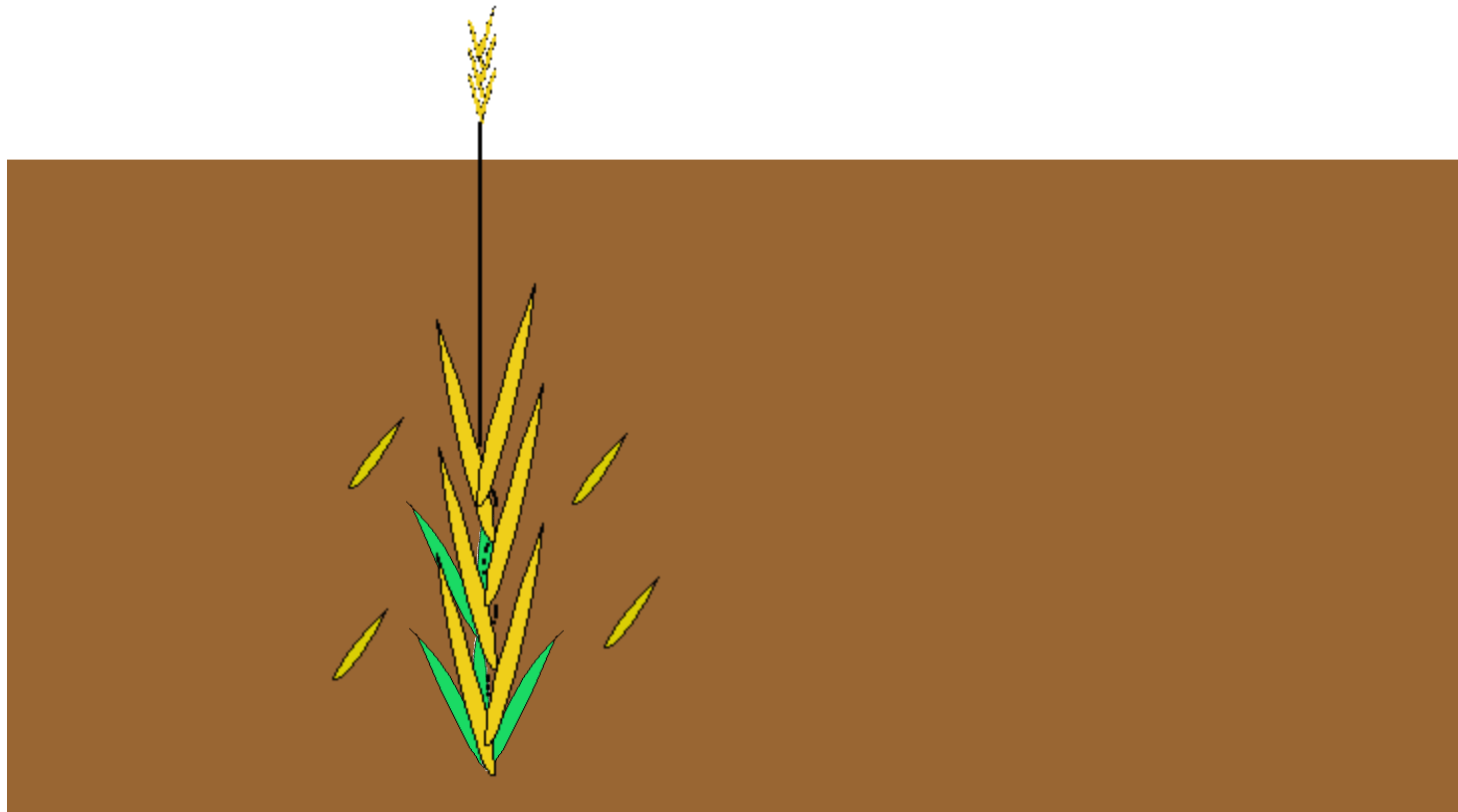
## Mode of Action (MOA) vs. Chemistry



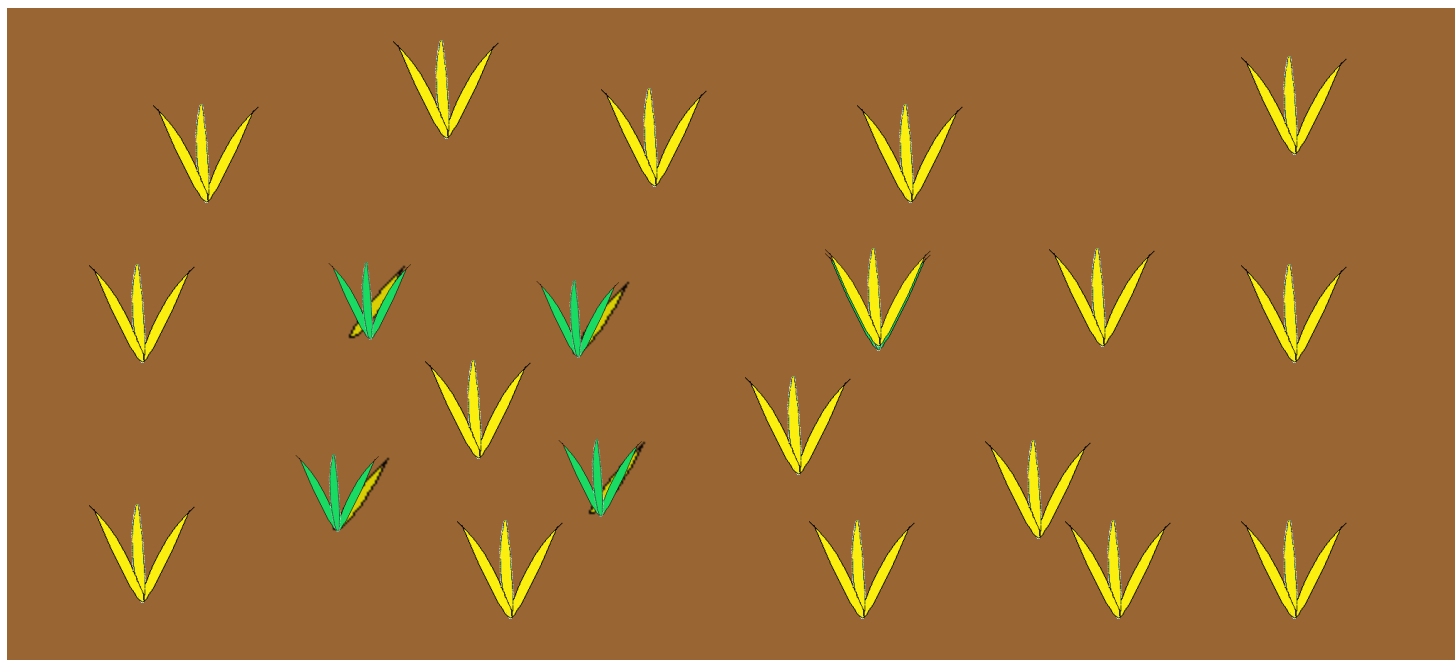
# How it develops



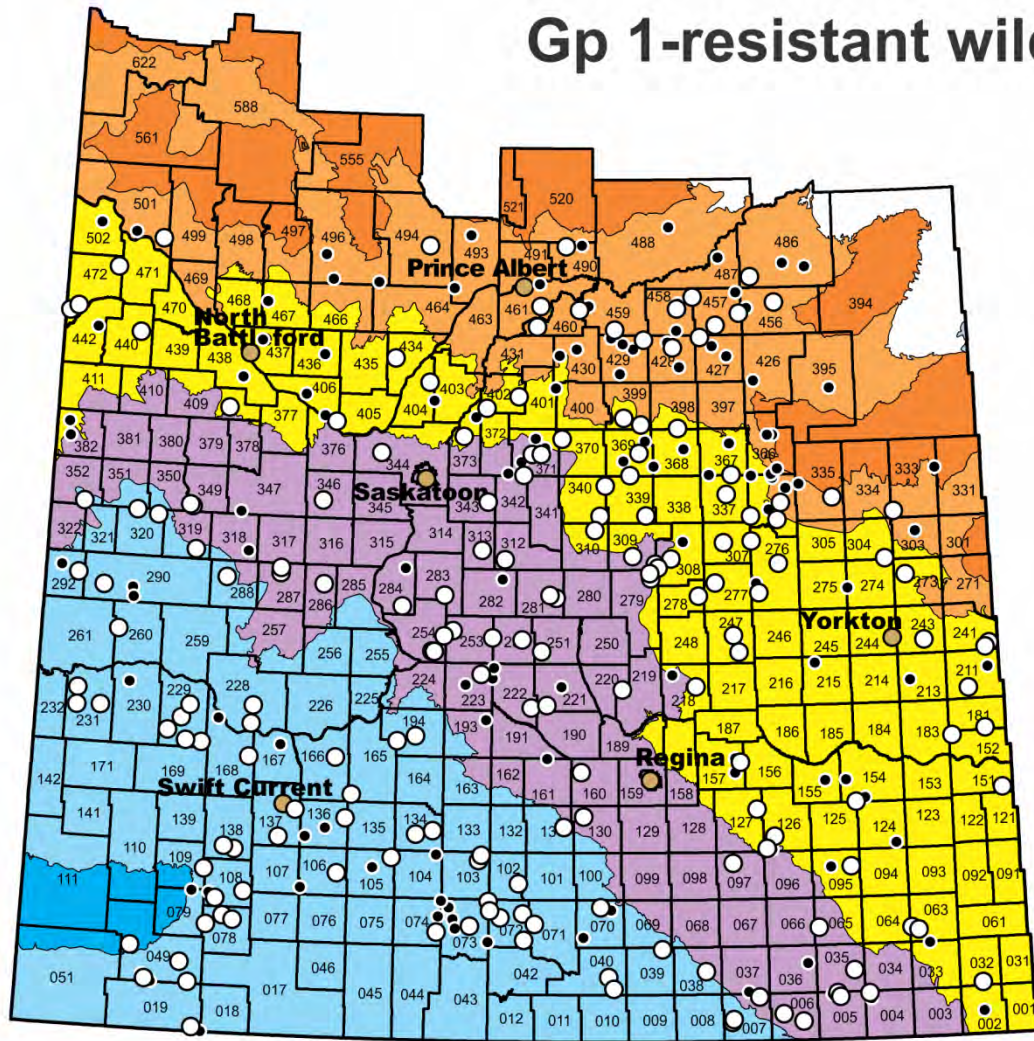
# How it develops



# How it develops



# Gp 1-resistant wild oat



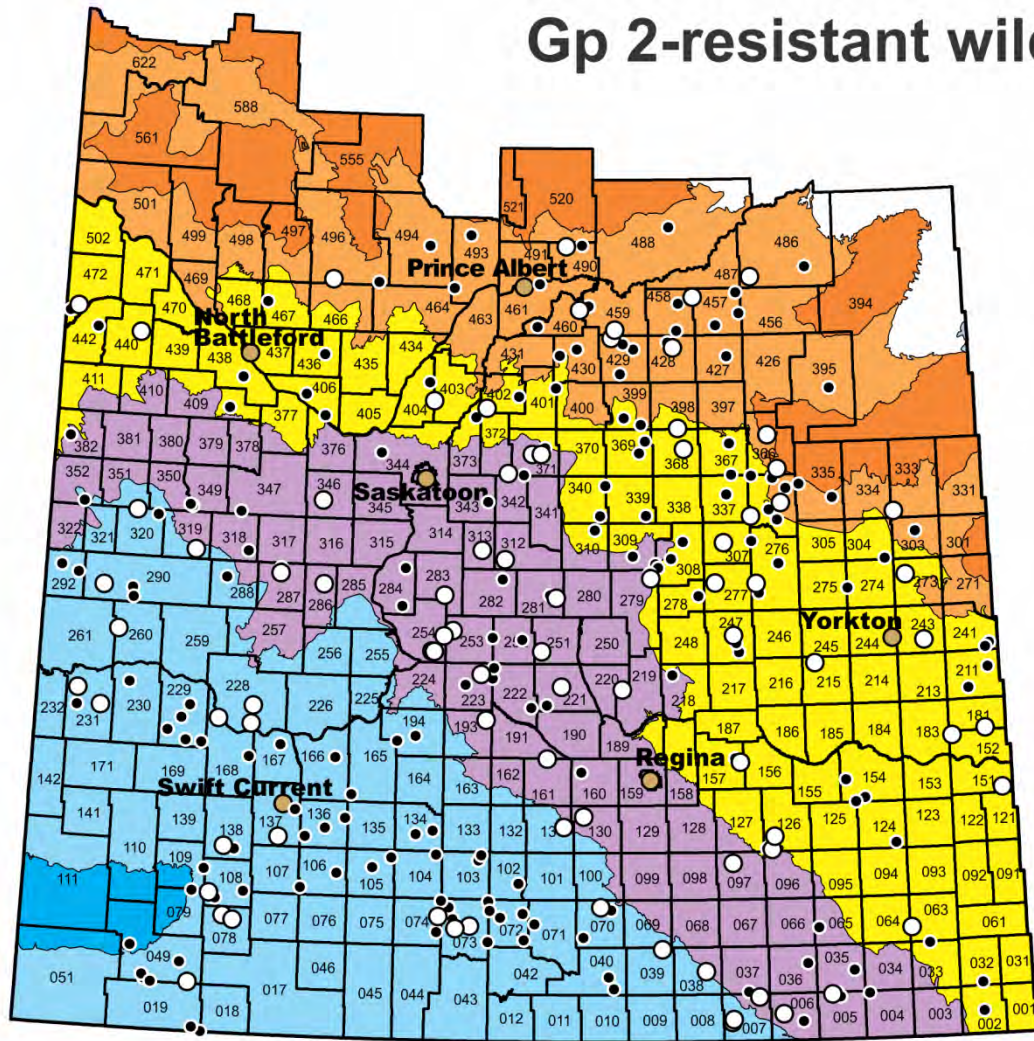
Resistant ○  
Not resistant •

## Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland



## Gp 2-resistant wild oat

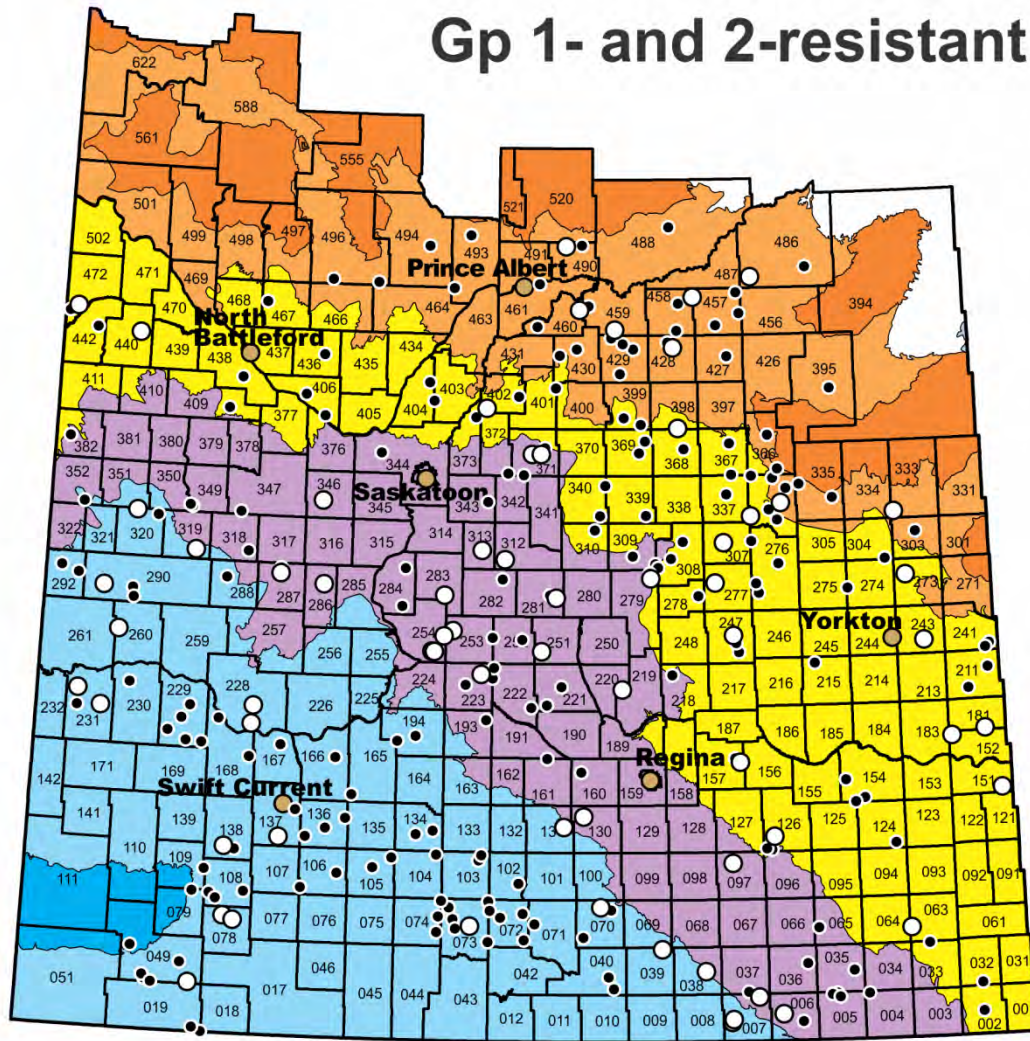


Resistant ○  
Not resistant •

### Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland

# Gp 1- and 2-resistant wild oat



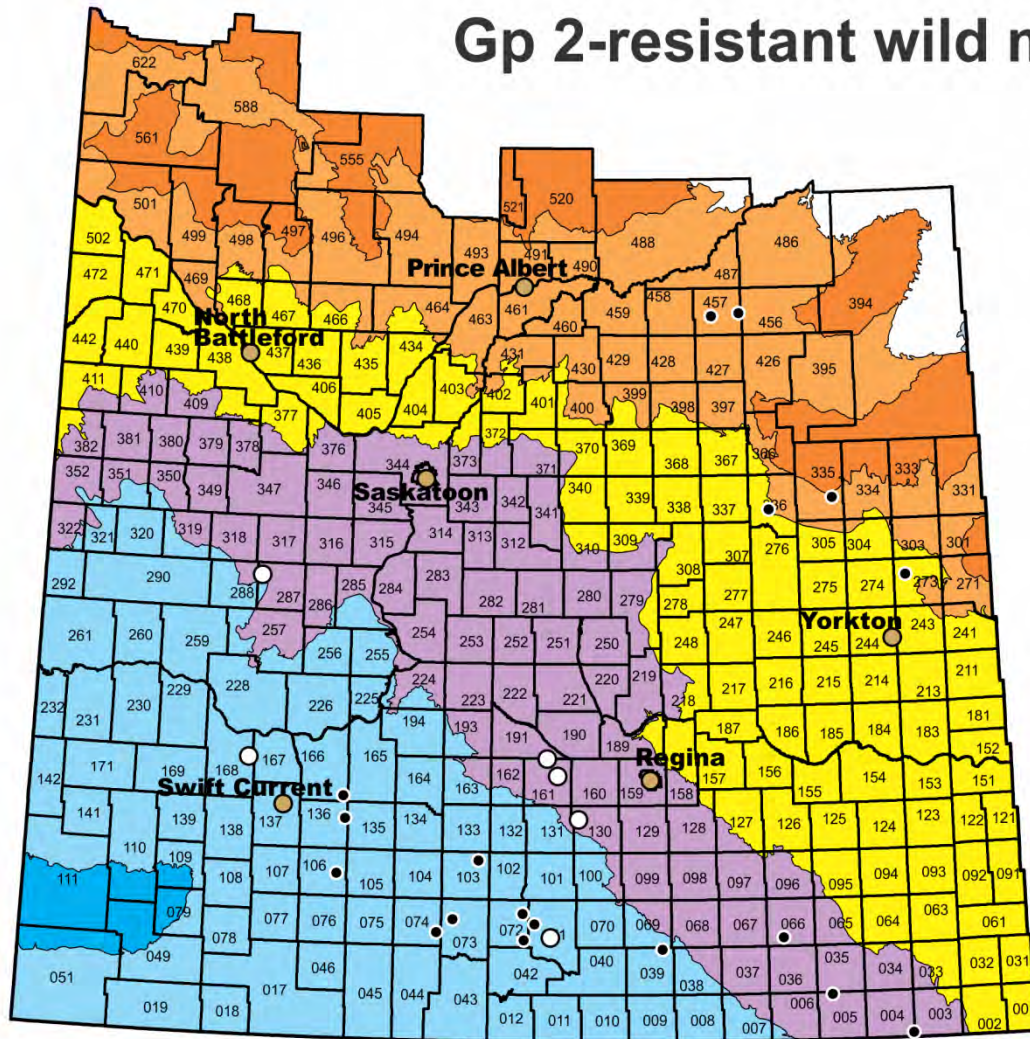
Resistant ○  
Not resistant •

## Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland



# Gp 2-resistant wild mustard



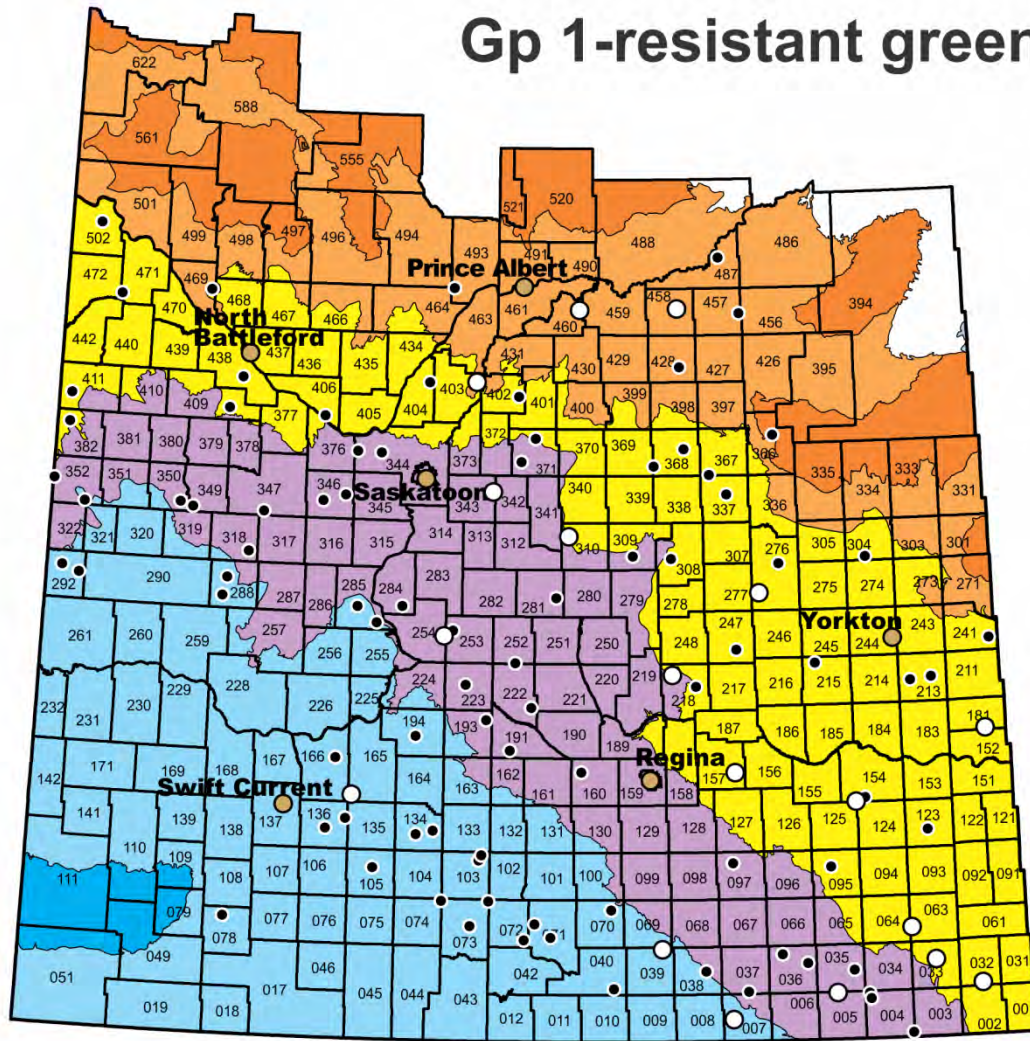
Resistant ○

Not resistant •

## Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland

# Gp 1-resistant green foxtail



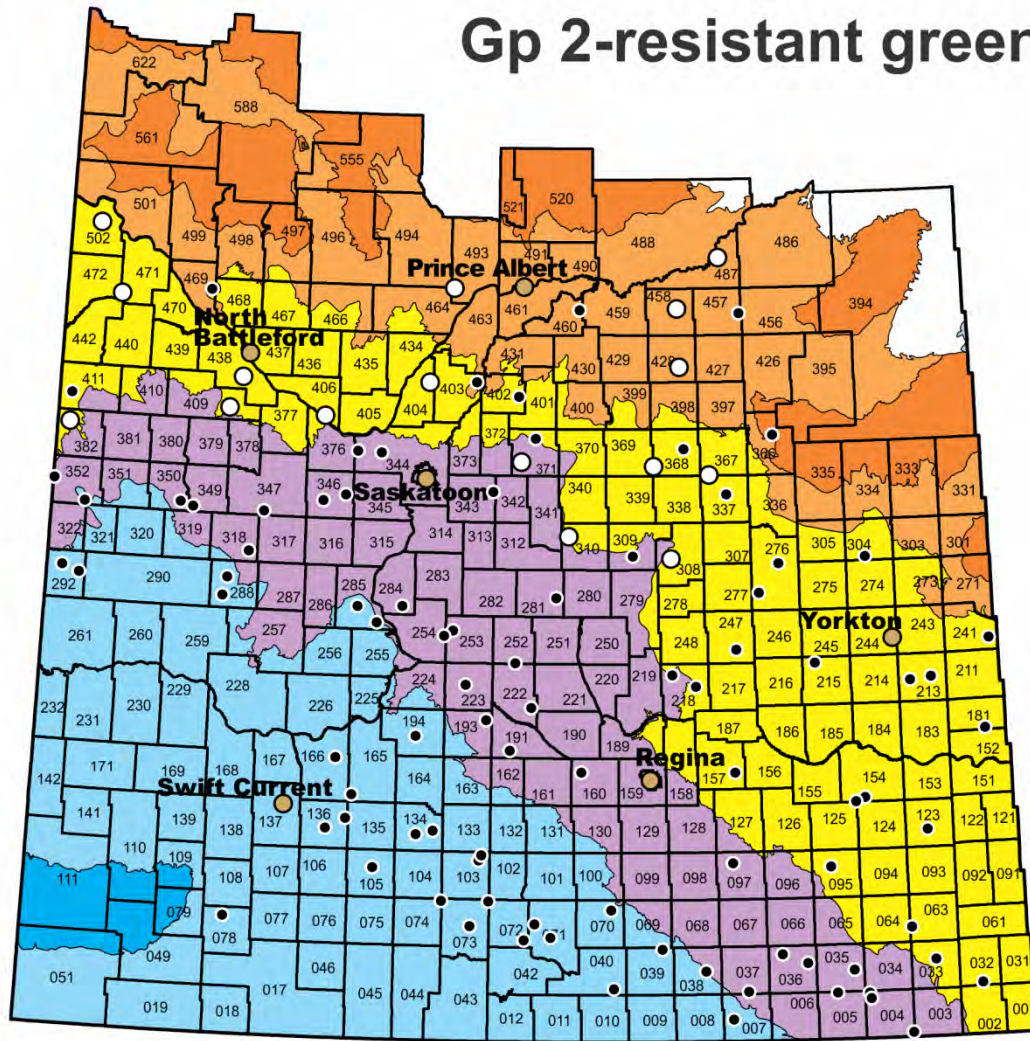
Resistant ○  
Not resistant •

## Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland



# Gp 2-resistant green foxtail



Resistant ○  
Not resistant •

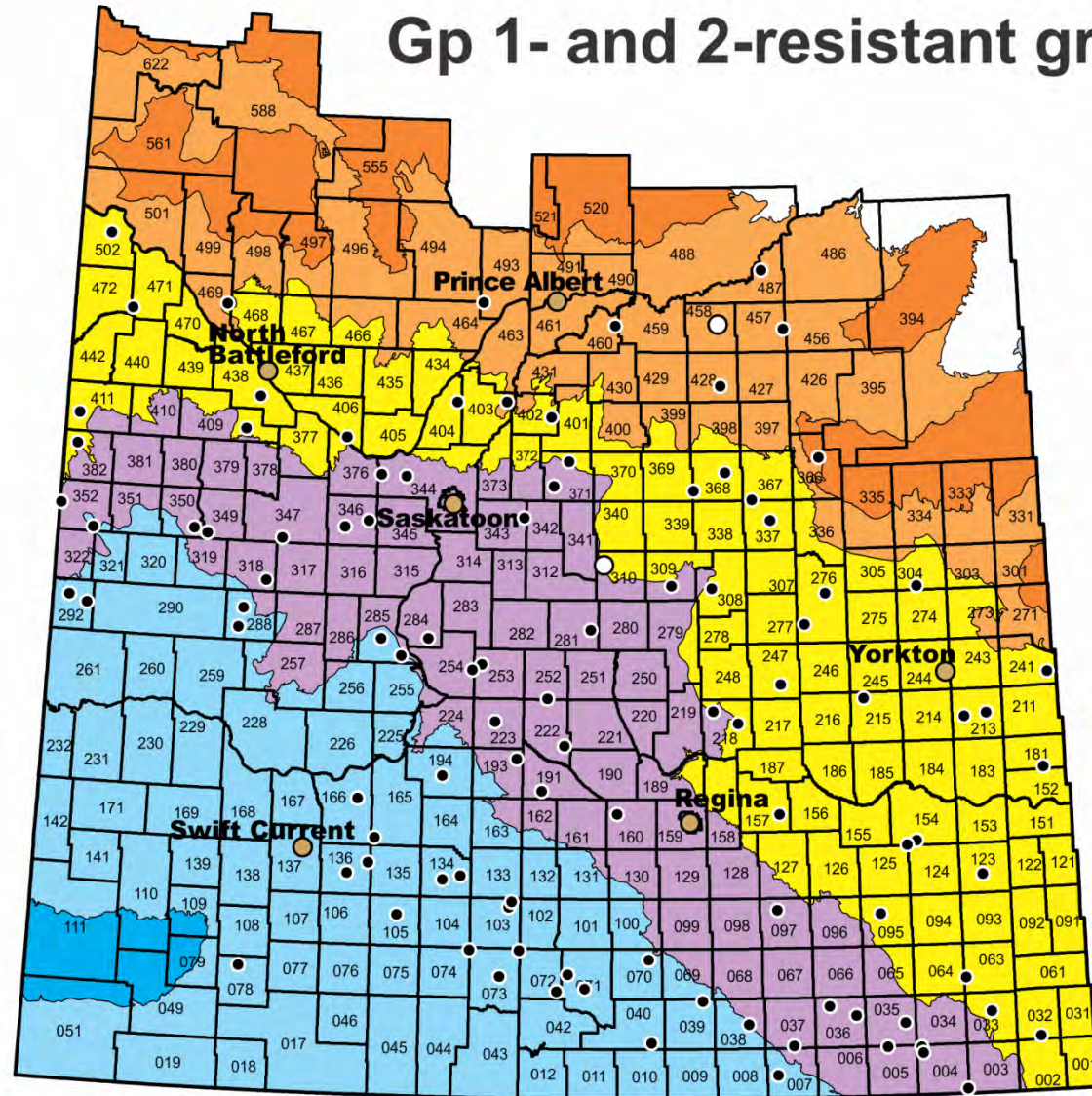
## Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland



# Gp 1- and 2-resistant green foxtail

Resistant ○  
Not resistant •

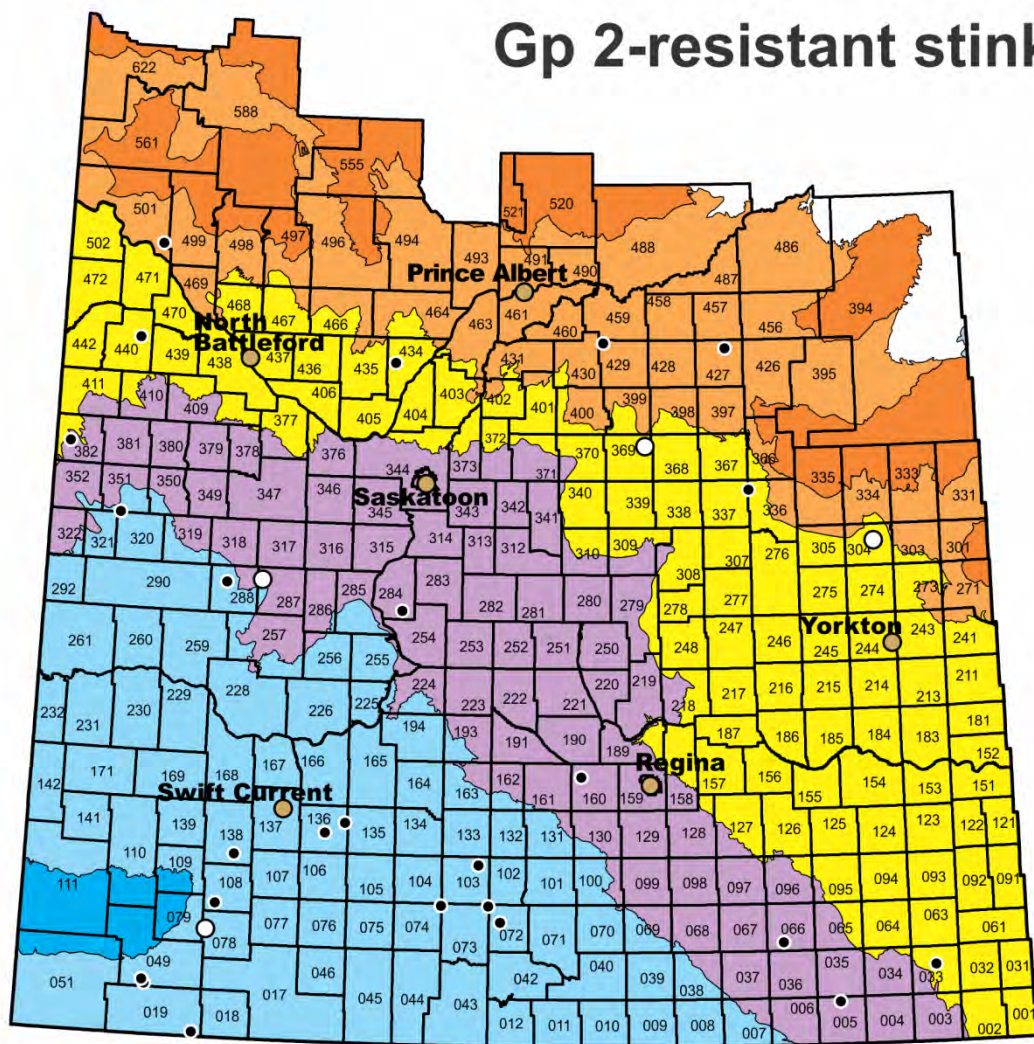


## Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland



# Gp 2-resistant stinkweed



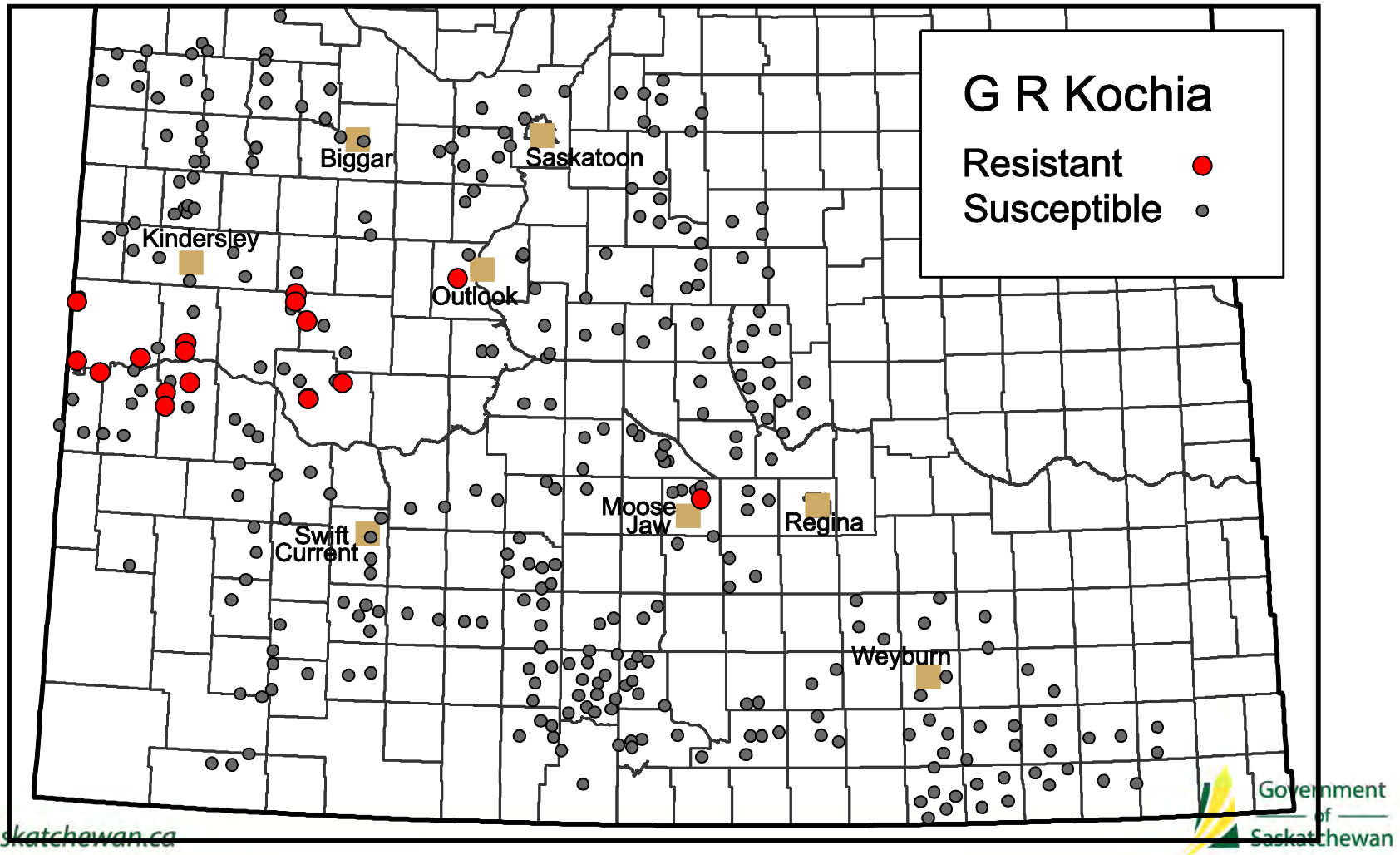
Resistant ○

Not resistant •

## Ecoregions

- Mid-Boreal Uplands
- Boreal Transition
- Aspen Parkland
- Moist Mixed Grassland
- Mixed Grassland
- Cypress Upland

# Baseline GR kochia survey in Saskatchewan in 2013: 17 of 342 sites (5%)



# Herbicide-Resistant (HR) Weeds (2012-2016)

- Gp 1 Persian dandel: Radville, Swift Current
- Gp 2 chickweed: Spiritwood
- Gp 2 redroot pigweed: 10% of surveyed fields in 2014-15 survey
- Gp 9 kochia: Assiniboia

# Chemical Weed Control

62

Table 13. Weed Control in Special Crops

HERBICIDE	Page	CROP							ANNUAL WEEDS																		PERENNIALS								
		Canaryseed	Safflower	Caraway	Coriander	Buckwheat	Mustard	Oilseed mustard (Brassica juncea)	Barnyard Grass	Foxtail, Green	Foxtail, Yellow	Volunteer Barley	Volunteer Wheat	Wild Oat	Buckwheat, Wild	Catchfly, night-flowering	Chickweed	Cleavers	Cocklebur	Flixweed	Hemp-nettle	Kochia	Lamb's-quarters	Mustard, Wild	Pigweed, Redroot	Russian Thistle	Shepherd's Purse	Smartweed, Annual Species	Stinkweed	Volunteer Flax	Volunteer Mustard, Canada	Canada Thistle	Dandelion	Perennial Sow-thistle	Quackgrass
Ares	101						✓ <sup>6</sup>	•	•	•	•	• <sup>8</sup>	•				•				•	•	•	•	•	•	•	•		•					
Authority/ Authority Charge	103						✓	✓														•													
Avadex	106	✓ <sup>1</sup>					✓						•									•	•	•	•	•	•	•	•						
Bromoxynil	128	✓												•					•			•	•	•	•	•		•	•						
Bromoxynil/MCPA	134	✓													•	•			•	•		•	•	•	•	•	•	•	•		•	•	•		
Clethodim	146		✓	✓	✓		✓	✓	•	•	•	•	•	•																				•	
Curtail M	158	✓													•				•	•		S	•	•	•		•	•	•		•	•	• <sup>4</sup>	•	
Dicamba + MCPA	161	✓													•	•		•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	
Dicamba/Mecoprop/ MCPA	165	✓													•	•		•	•	•	•	•	•	•	•	•	•	•	•		•	•	•		
Edge Granular	184		✓	✓	✓		✓ <sup>2</sup>		•	•	•	S	S	S	•		•	S			S	•	•		•	S		S							
Enforcer M (see bromoxynil+ MCPA+fluroxypyr)	138	✓													<sup>10</sup>	<sup>10</sup>	<sup>10</sup>		<sup>10</sup>	<sup>10</sup>	<sup>10</sup>	•	•	•	S	<sup>10</sup>	<sup>10</sup>		<sup>10</sup>	<sup>10</sup>					
Fluroxypyr + MCPA	221	✓													S		•	•	•	•	•	•	•	•		•	S	•	•	•					
Fortress MicroActiv	226						✓			•	•			•	•							•	•		•	•									
Linuron	281			✓	✓																		•												
Muster Toss-n-Go	304						✓ <sup>3,8</sup>	✓											•	•			•	•			•	•							
Odyssey NXT	309							✓ <sup>6</sup>	•	•	•	•	• <sup>8</sup>	•	•		•	•	•	•	•	•	•	•	•	•	•	•	•		• <sup>8</sup>				
Poast Ultra	330		✓	✓	✓	✓	✓		•	•	•	•	•	•																				•	
Prestige XC	335	✓													•		S	•	•	S	•	•	•	•	•		•	•	•	•	•	•	• <sup>4</sup>	•	
Quinclorac	343						✓		•	•								•																S	
Quizalofop	345						✓ <sup>9</sup>	✓	•	•	•	•	•	•																•					
Solo ADV	370						✓ <sup>6</sup>		•	•	•	•	• <sup>8</sup>	•	S			S					•	•	•		•	•	•		• <sup>8</sup>				
Solo Ultra	372						✓ <sup>6</sup>		•	•	•	•	•	•	S			S					•	•	•		•	•	•		• <sup>8</sup>			S	
Trifluralin	401		✓				✓		•	•	•			•	•		•					•	•	•	•										

• Control. S - Suppression. TG - Top growth control.

<sup>1</sup> Granular formulation only. <sup>2</sup> Yellow mustard only. <sup>3</sup> Brown and oriental mustards only. <sup>4</sup> Spring seedlings only. <sup>5</sup> Oriental mustard only. <sup>6</sup> For use in CLEARFILED varieties only. <sup>8</sup> CLEARFIELD varieties not controlled <sup>9</sup> Including Ethiopian mustard (Brassica carinata) <sup>10</sup> Controlled at the higher rates.



# Chemical Weed Control\*

In-crop (herbicide group) [product name]				Pre-harvest
Soil-active (group) [brand names]	Considerations	Foliar (group) [brand names]	Considerations	
Sulfentrazone (14) [Authority]	0.25 to 0.5 inch rainfall to incorporate into germination zone	Ethametsulfuron- methyl (2) [Muster Toss-N-Go]	4-leaf stage up to bud formation	Glyphosate (9) [Roundup WeatherMax only]
Sulfentrazone (14) + carfentrazone (14) [Authority Charge]	For already-emerged, glyphosate-resistant weeds	Quinclorac (26) [Clever, MasterLine]	Caution: MRL issues	
Triallate (8) [Avadex]	Granular option for late fall: no immediate incorporation needed	Clethodim (1) [Select, Centurion, Arrow, Shadow, Patron]	Note pre-harvest intervals to avoid food residue / MRL issues	
Triallate (8) + trifluralin (3) [Fortress]	Granular option for late fall: no immediate incorporation needed	Sethoxydim (1) [Poast Ultra]		
Trifluralin (3) [Treflan, Bonanza, Rival]	Requires immediate incorporation; apply prior to Authority.	Quizalofop (1) [Assure II, Yuma GL]		
Ethalfuralin (3) [Edge]	Requires immediate incorporation			

\*read labels and the Guide to Crop Protection for  
complete instructions & considerations

# Top 10 HRWM Practices<sup>1</sup>

- 10: Maintaining a database: invaluable reference
- 9: Strategic tillage: if, where, or when needed
- 8: Field & site-specific weed mgmt: 1 size may not fit all
- 7: Weed sanitation: border control and slowing HR dispersal
- 6: In-crop wheat-selective herbicide rotation
- 5: Herb Grp rotation: avoid back-to-back in-crop Grp 1 or 2
- 4: Herbicide mixtures/sequences: better than rotations
- 3: Pre- and post-herbicide scouting: know your enemy
- 2: Competitive crops & practices that promote competitiveness: natural biological control
- 1: Crop diversity



# Chemical Weed Control: Herbicide Layering...What is it?

- **Preemptive** approach to weed control that uses different modes of action (MOAs) and different targets (soil, foliar) to control the same weed
- Herbicide (mode of action) **rotation**
  - Less frequent exposure to a mode of action
    - Prevents small HR populations from producing seed
    - Prevents soil seed banks of HR weeds from building
      - Minimize risk of HR populations becoming widespread
- Herbicide (mode of action) **mixture**
  - Unlikely a weed develops resistance to 2 or more simultaneously
- Must consider **multiple years** AND your specific crop rotation

# Herbicide Layering: Goals

**Yield Increase**

**IPM Tool Preservation**

**Weed Control**

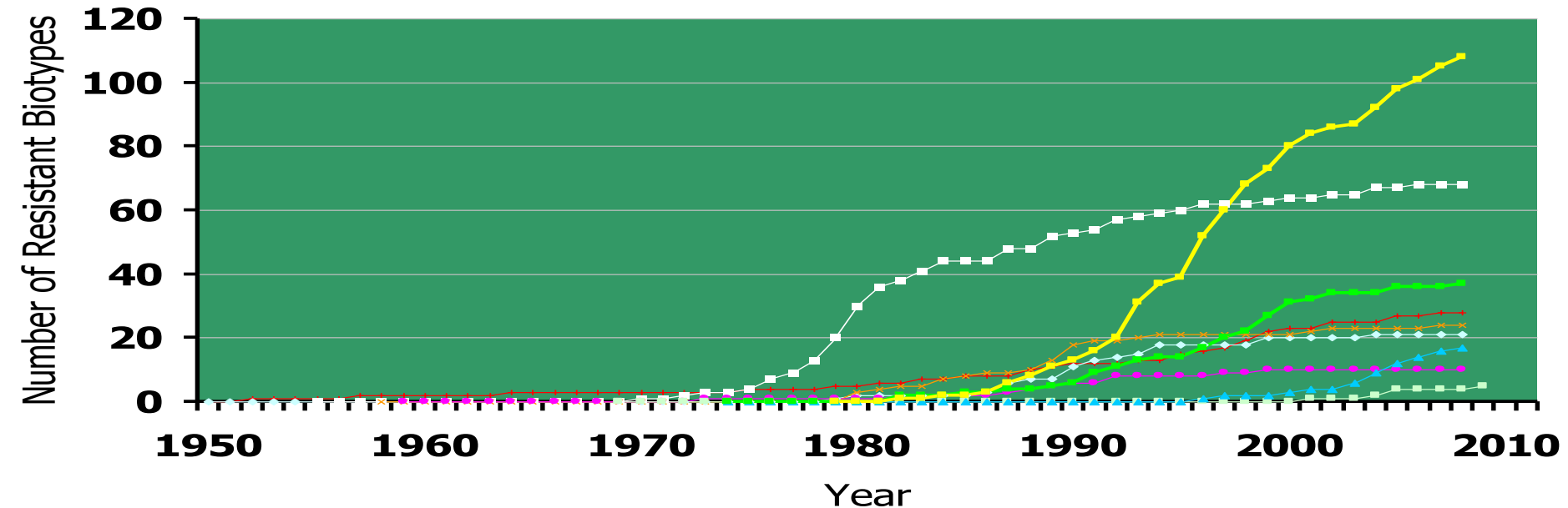
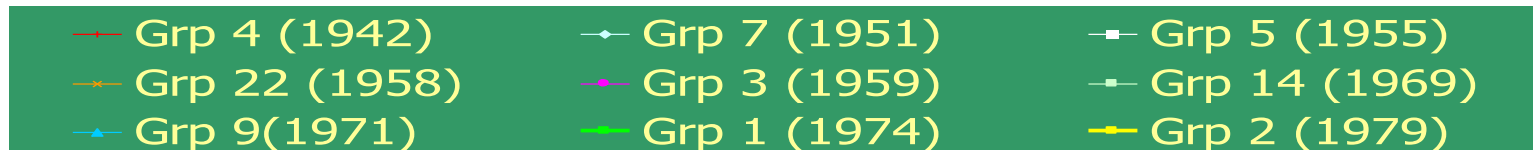
(and drive down the soil seed bank of the HR weed over time)

# Chemical Weed Control\*

In-crop (herbicide group) [product name]				Pre-harvest
Soil-active (group) [brand names]	Considerations	Foliar (group) [brand names]	Considerations	
Sulfentrazone (14) [Authority]	0.25 to 0.5 inch rainfall to incorporate into germination zone	Ethametsulfuron- methyl (2) [Muster Toss-N-Go]	4-leaf stage up to bud formation	Glyphosate (9) [Roundup WeatherMax only]
Sulfentrazone (14) + carfentrazone (14) [Authority Charge]	For already-emerged, glyphosate-resistant weeds	Quinclorac (26) [Clever, MasterLine]	Caution: MRL issues	
Triallate (8) [Avadex]	Granular option for late fall: no immediate incorporation needed	Clethodim (1) [Select, Centurion, Arrow, Shadow, Patron]	Note pre-harvest intervals to avoid food residue / MRL issues	
Triallate (8) + trifluralin (3) [Fortress]	Granular option for late fall: no immediate incorporation needed	Sethoxydim (1) [Poast Ultra]		
Trifluralin (3) [Treflan, Bonanza, Rival]	Requires immediate incorporation; apply prior to Authority.	Quizalofop (1) [Assure II, Yuma GL]		
Ethalfuralin (3) [Edge]	Requires immediate incorporation			
One of these is a 'layer'		One of these is a 'layer'		Another 'layer'

\*read labels and the Guide to Crop Protection for  
complete instructions & considerations

# Chemical Weed Control: Herbicide Layering...Why?



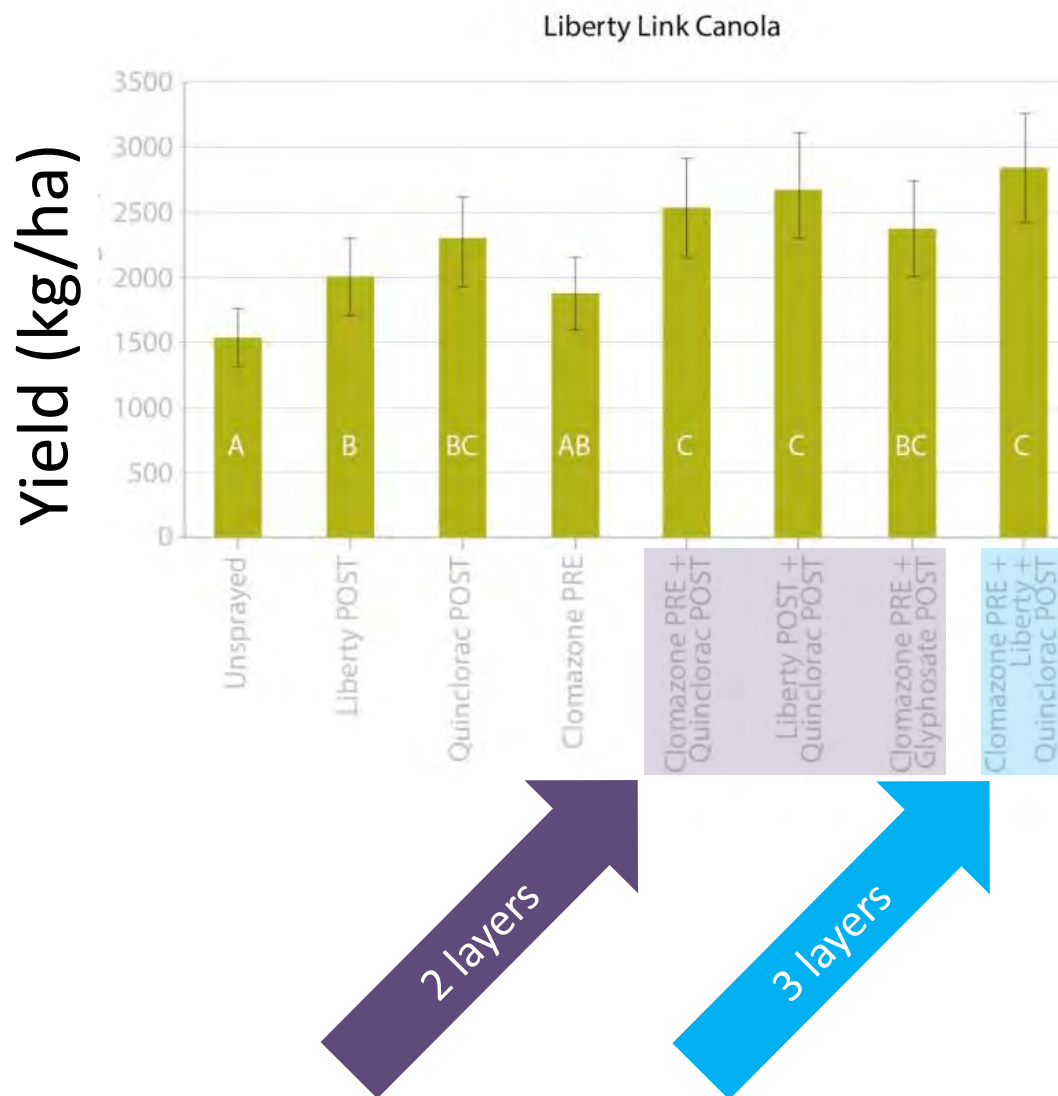
...To drive down the seed bank of HR weeds over time

# Cost of HR Weeds

	<u>% of respondents (250-SK) <sup>1</sup></u>
No additional cost	7
\$10/ac or less	41
\$11 - \$20/ac	23
\$21 - \$30/ac	11
\$31 - \$40/ac	6
\$41 – 50 /ac	4
Unknown cost	8

**Mean cost = \$12 per acre (\$30 per hectare)**

# Herbicide Layering: Yield (canola)<sup>2</sup>



\*note today's MRL issues with quinclorac; emphasis here is the benefits of layering, not a specific product

# Herbicide Layering: Cleaver Control (field pea)<sup>2</sup>

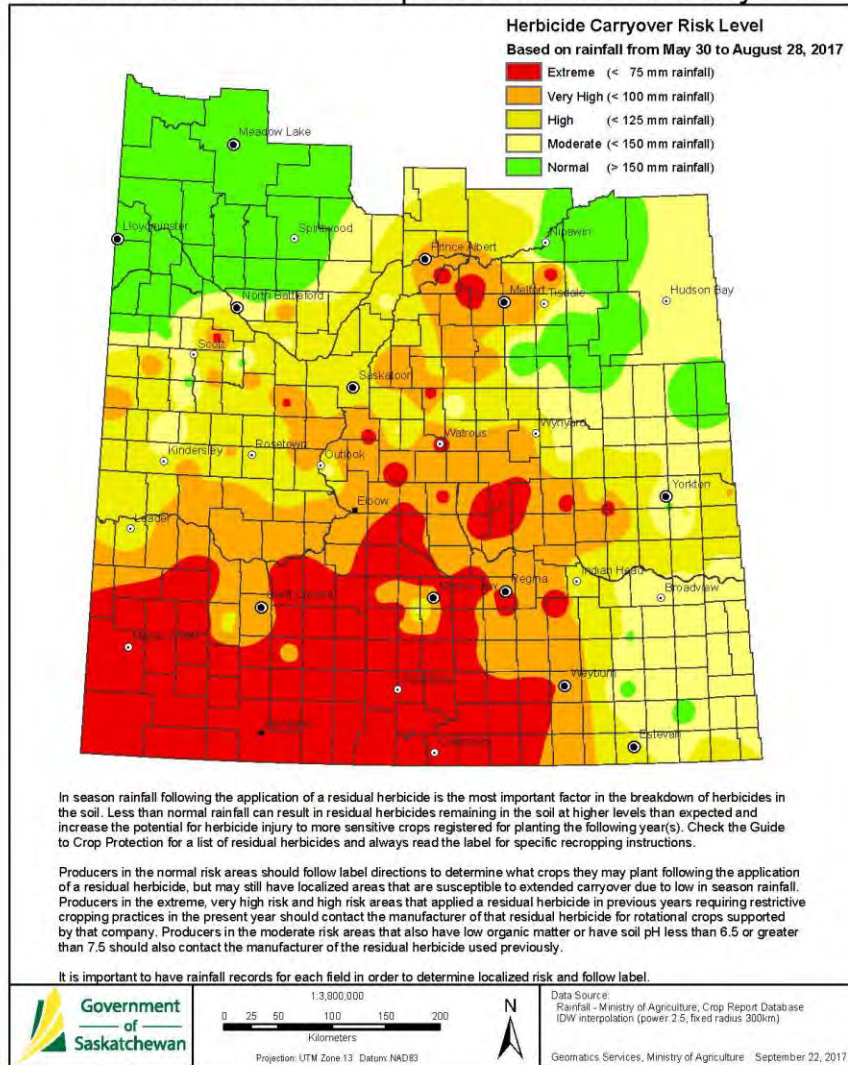


\*note today's MRL issues with quinclorac; emphasis here is the benefits of layering, not a specific product

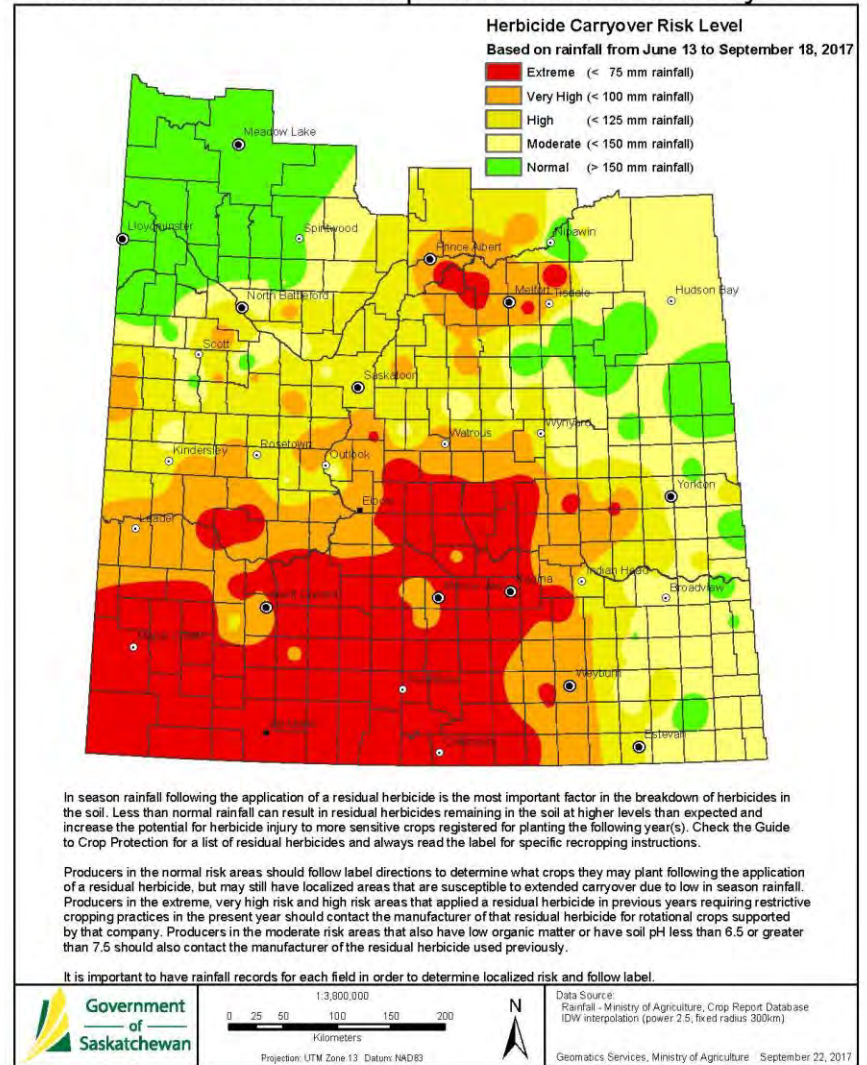


# Chemical Considerations

## Risk of Greater than Expected Herbicide Carryover



## Risk of Greater than Expected Herbicide Carryover



Be aware of re-cropping restrictions of specific products under extremely dry conditions  
[saskatchewan.ca](http://saskatchewan.ca)



# Chemical Considerations: Re-cropping Restrictions

78

Injury symptoms from other causes can resemble herbicide carryover injury (i.e. cold weather, flooding, drought, insects, etc.). Consult with your local agronomist on potential causes before spending money on testing.

Herbicides that leave a soil residue and are of particular concern in Western Canada are found in the following chart.

## Re-cropping Restrictions for Residual Herbicides:

Figures listed are the number of cropping seasons before each crop can be grown ("1" means that the crop can be grown the year following application). For plant-back restrictions less than one season; the delay is indicated with a "d" for number of days or with "mths" for the number of months. A blank space means that there are no recommendations given on the product label and a field bioassay is recommended by many product manufacturers to determine if these crops are safe to plant. A field bioassay is a strip of a test crop that covers an area of the field that is representative of the field variation and should include an untreated area.

PRODUCT	Alfalfa	Barley	Canaryseed	Clearfield canola	Non-Clearfield canola	Faba beans	Field corn	Dry beans	Field peas	Flax	Forage grasses	Lentils	Mustard	Oats	Potatoes	Rye	Soybeans	Sunflowers	Wheat (durum)	Wheat (spring)	Wheat (winter)
2,4-D*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Accent	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths
Altitude FX/FX2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Amitrol 240	1d	1	1d	1d	10d*	10d*	5d*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
AAtrex, Primextra II Magnum	1	1	1	1	1*	1	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ares	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Authority / Authority Charge	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Avadex	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Barricade, Predicade, Retain, Signal FSU, TraxosTwo	2	1	2	1	1	2	2	2	1	1	1	1	1	1	2	1	2	2	1	1	1
Battalion	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Command 360 ME	2	2	2	1	1	2	1	1	2	2	2	2	2	2	1	2	1	2	2	1	16 mths
Curtail M, Prestige XC	2	1	2	1	1	2	1	2	1*	1	1	2	1	1	1	1	2	2	1	1	1
Dicamba*	1	1*	1*	1*	1	1*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dual II Magnum	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4.5 mths
Eclipse III, Clopyralid	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Edge	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1*
Flexstar GT	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4 mths
Florasulam/fluoroxypyr + MCPA	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Florasulam + glyphosate (prior to Aug 1)	0d	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0d
Flucarbazone, Everest GBX (Brown soils)	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Flucarbazone, Everest GBX (Dark Brown soils)	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*
Flucarbazone, Everest GBX (Black soils)	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*
Flucarbazone, Everest GBX (Grey-Wooded soils)	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*
Focus	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	4 mths
Valtera (Crop uses)	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	11 mths	4 mths

79

PRODUCT	Alfalfa	Barley	Canaryseed	Clearfield canola	Non-Clearfield canola	Faba beans	Field corn	Dry beans	Field peas	Flax	Forage grasses	Lentils	Mustard	Oats	Potatoes	Rye	Soybeans	Sunflowers	Wheat (durum)	Wheat (spring)	Wheat (winter)
Fortress MicroActiv	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Frontier Max, Outlook	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Florasulam + MCPA, flora-sulam + 2,4-D, florasulam + Curtail M ***	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Hat Trick	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Imazamethabenz (Black and Grey Wooded soils)	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Imazamethabenz (Brown and Dark Brown soils)	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Imazethapyr	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Infinity / Tundra / Velocity m <sup>2</sup>	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Kerb	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
Korrex	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Metribuzin	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Metsulfuron (pH less than 7, Brown and Dark Brown)	1	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Metsulfuron (pH less than 7, other soils)	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Metsulfuron (pH 7 to 7.9, Brown and Dark Brown soils)	1	4	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Metsulfuron (pH 7 to 7.9, other soils)	1	4	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Muster	2	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Odyssey*, Odyssey Ultra*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Option	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Paradigm	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Permit	2 mths	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Pixaro	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Prism	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Pulsar	2	1	2	1	1	2	2	2	1	1	1	1	1	1	2	2	1	2	2	1	1
Quinclorac	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Reflex*	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Solute	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Signal FSU	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Simplicity	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Solo, Viper ADV	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Tandem	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Travallas	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths	10 mths
Tribenuron/Metsulfuron	1d	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Trifluralin	0	1*	2	0	0	0	1*	0	0	1*	2	0	0	2	0	0	0	0	0	0	1*
Triton C*	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Ultim	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Varro	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10 mths

\* The minimum re-cropping intervals are listed. These intervals may be longer than those listed depending on the use rates, region, province, soil types, environment, time of application and crop variety. Refer to product page for more information.  
 \*\* Drought restrictions apply to drought conditions (80% of normal June to September rainfall) for high pH soils (greater than pH 7.5) and severe drought (less than 65% of normal June to Sept. rainfall) for all soils.  
 \*\*\* May not be supported for all products; see product page for details.  
 \* May not be valid for all varieties or crop types. See product page for details.  
 \*\* DO NOT grow dry beans the year following Everest GBX application.  
 0 - May be seeded or reseeded the year of application. No re-cropping restrictions. 1 - Next cropping season after application. 2 - Two cropping seasons after application.  
 NR - Not recommended.  
 Note: The re-cropping intervals listed may not be sufficient to prevent crop injury during periods of below average rainfall.

Weed Control

# Chemical Considerations

## Maximum Residue Limits (MRLs)

- In Canada
  - **Prior to** pesticide registration: Health Canada determines if consumption of maximum amount of residue (that is expected to remain on a food product after the pesticide is used as instructed) will pose a risk to **human health**
- Even products that are registered might have market concerns
- How to avoid MRL-related issues?
  - Read & follow labels
  - Discuss with your buyer
  - [keepingitclean.ca](http://keepingitclean.ca)
  - Guide to Crop Protection

# Cultural Weed Control

Practice (relative to recommended)*	Function	Effect on Weeds	Considerations
Diversify crop rotation	Suppress weed seed production; N; soil organic matter	Efficient use of herbicide MOAs	Mode of actions used in other crops
Increase seeding rate	Denser canopy, faster closure	Shade & outcompete	Cost of seed; row spacing; seed quality
Decrease seeding depth	Quicker emergence Stronger seedlings Uniformity	Outcompete	Real or forecast moisture; depth of moisture
Reduce row spacing	Quicker canopy closure	Shade & outcompete	Seeding rate; seed quality
Optimize fertility	Vigorous seedlings	Outcompete	Access to equipment; soil test (and cost); fertilizer cost
Seed quality & clean seed	minimize weed introduction; uniformity & vigour	Reduces # to deal with; outcompete	Cost; contamination between canola & mustard
Early seeding date	Access to early moisture	Shade & outcompete	Weather; rotation logistics

# Mechanical/Alternative Weed Control

To prevent weed seed production:

- Patch management
  - Tillage
  - Mowing
- “Topping”
- Wicking (systemic only)
- Intercropping



# Future Direction



Dr. Brianne Tideman,  
Agriculture and Agri-Food Canada, Lacombe Research Centre,

# Summary

- Herbicide Resistant (HR) weed populations are not going away
- No “silver bullets”
- Integrated Pest Management (IPM) via diversity (Chemical, Cultural, Mechanical) is key
- Consistent & informed Best Management Practices (BMPs) is best long-term strategy
- Implications of a herbicide used can change depending on environmental conditions & intended market

# Useful Resources

- **Mustard Production Manual (SaskMustard)**  
<https://saskmustard.com/production-manual/>
- **Guide to Crop Protection (Ministry of Agriculture)**  
<https://www.saskatchewan.ca/business/agriculture-natural-resources-and-industry/agribusiness-farmers-and-ranchers/crops-and-irrigation/crop-protection/guide-to-crop-protection>
- **MRL database (Health Canada)**  
<http://pr-rp.hc-sc.gc.ca/mrl-lrm/index-eng.php>

saskatchewan.ca