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Canada

# Agronomy Update 2018

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## Glyphosate-resistant weeds in western Canada

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# Weed Ecology and Cropping Systems

Charles Geddes and Louis Molnar

- **Diverse and profitable crop rotations**
  - ✓ Cereals, oilseeds, pulses, winter annuals, forages
- **Competitive cropping strategies**
  - ✓ Higher seeding rates, row spacing, fertilizer placement
- **Weed resistance management**
  - ✓ Rotating herbicide groups, glyphosate-resistance, non-chemical weed management, seedbank persistence
- **Improved crop and soil health**
  - ✓ Organic matter, soil structure, cover-crops, intercrops
- **New crop opportunities**
  - ✓ Soybean, corn, *Brassica carinata*



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# Overview

- Glyphosate
- Status of glyphosate-resistance (GR)
- Selection for GR weeds
- How to reduce selection pressure

# Glyphosate

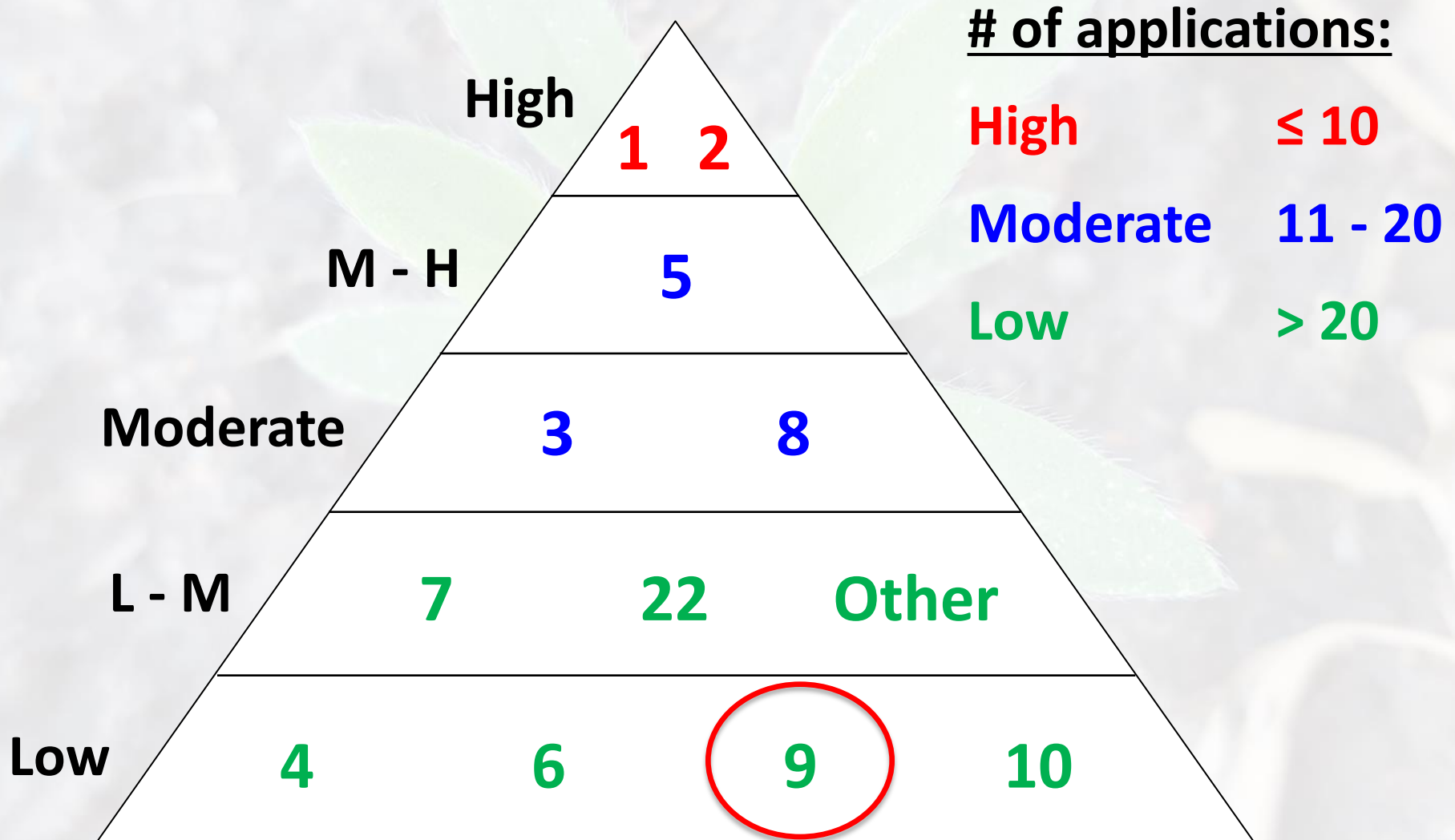
- Discovered in 1950's
- Herbicide released in 1974
- Patent expired in 2000
- “once-in-a-century herbicide” (Duke & Powles, 2008)
- “the world’s greatest herbicide” (Duke & Powles, 2008)



# Advantages

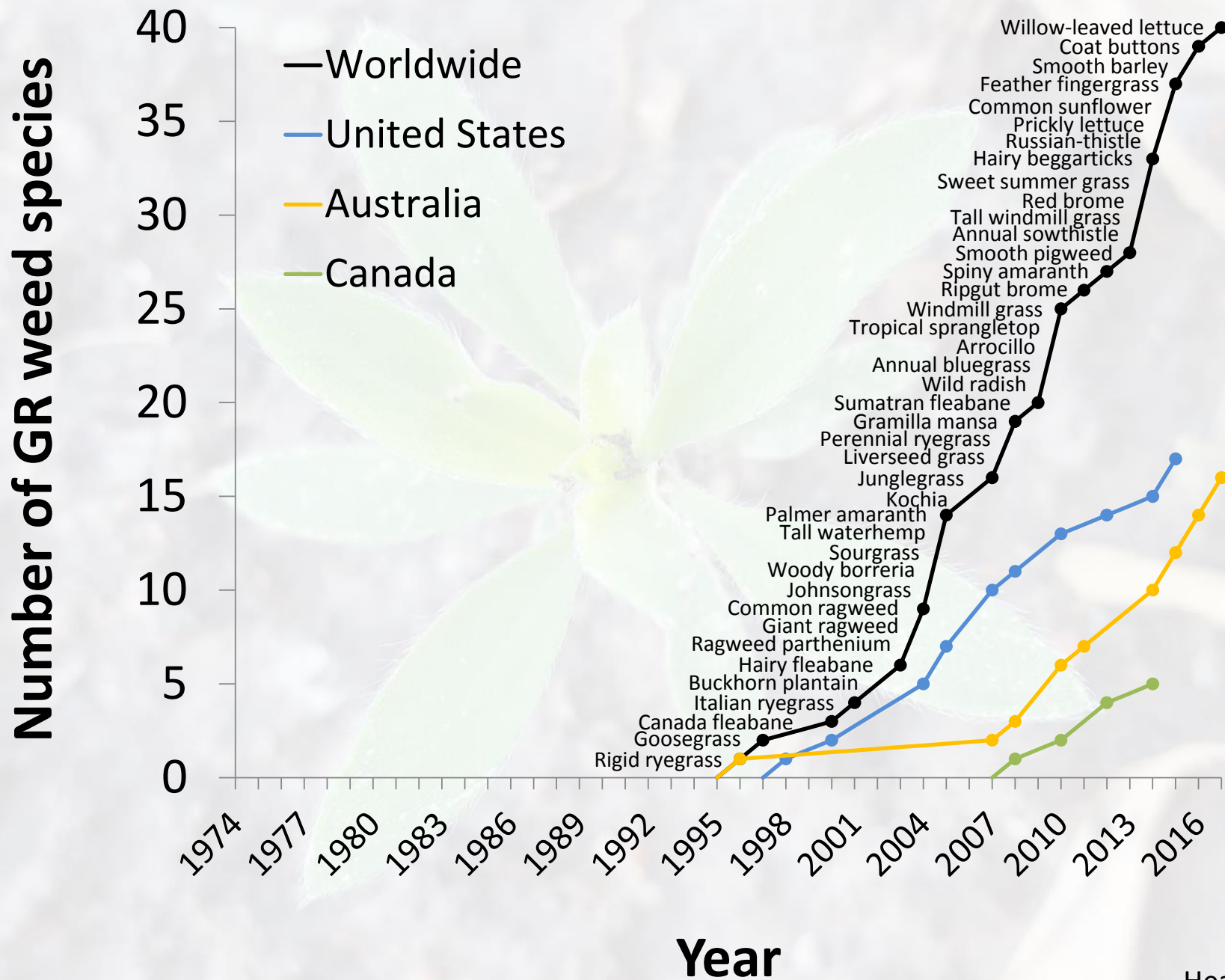
- Control of numerous weed species
- Adoption of conservation tillage
  - Reduced soil erosion
  - Conservation of soil moisture
  - Time
- Low cost
- Low toxicity
- No residual soil activity (cropping flexibility)

# Selection for HR by group

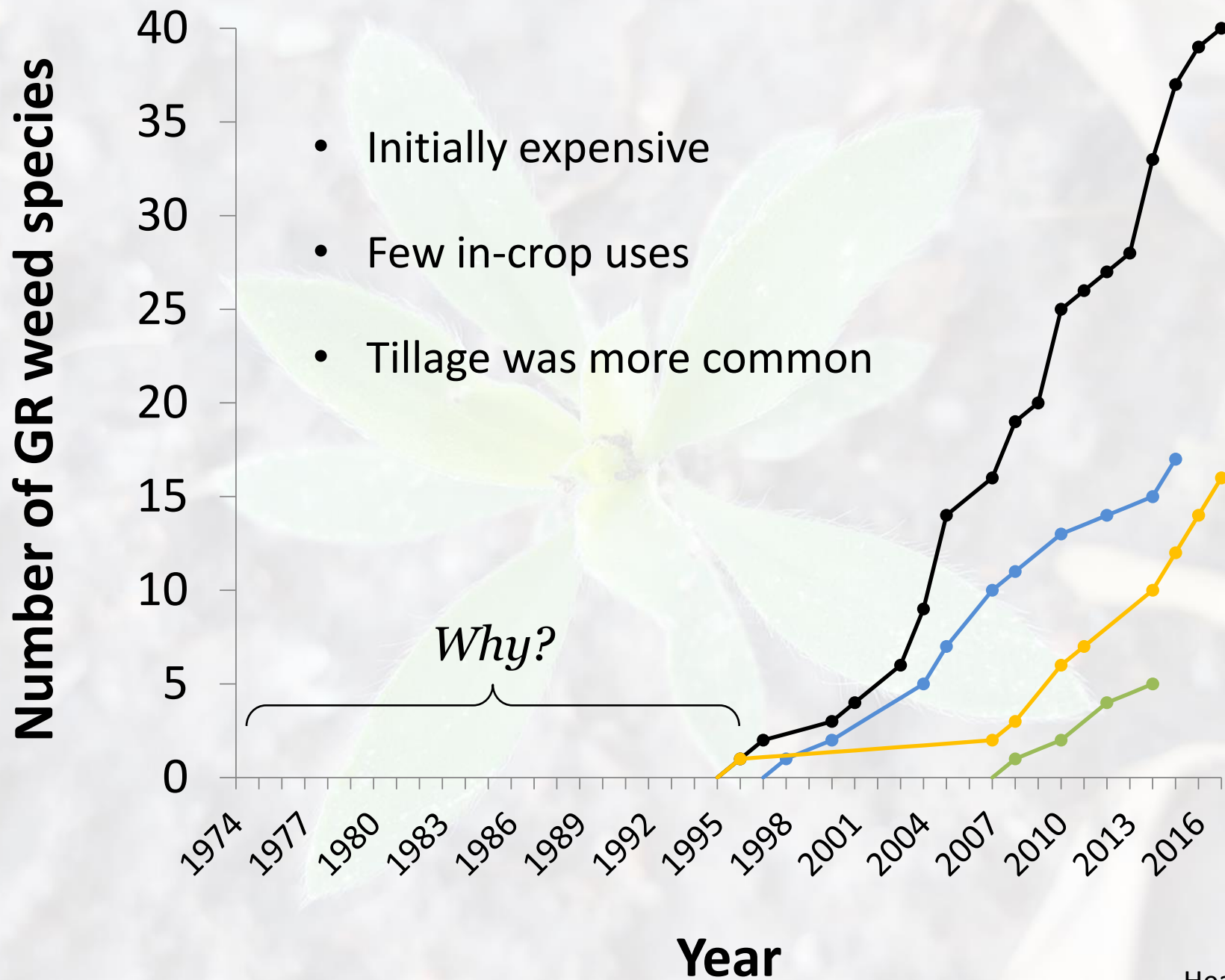


# Disadvantages

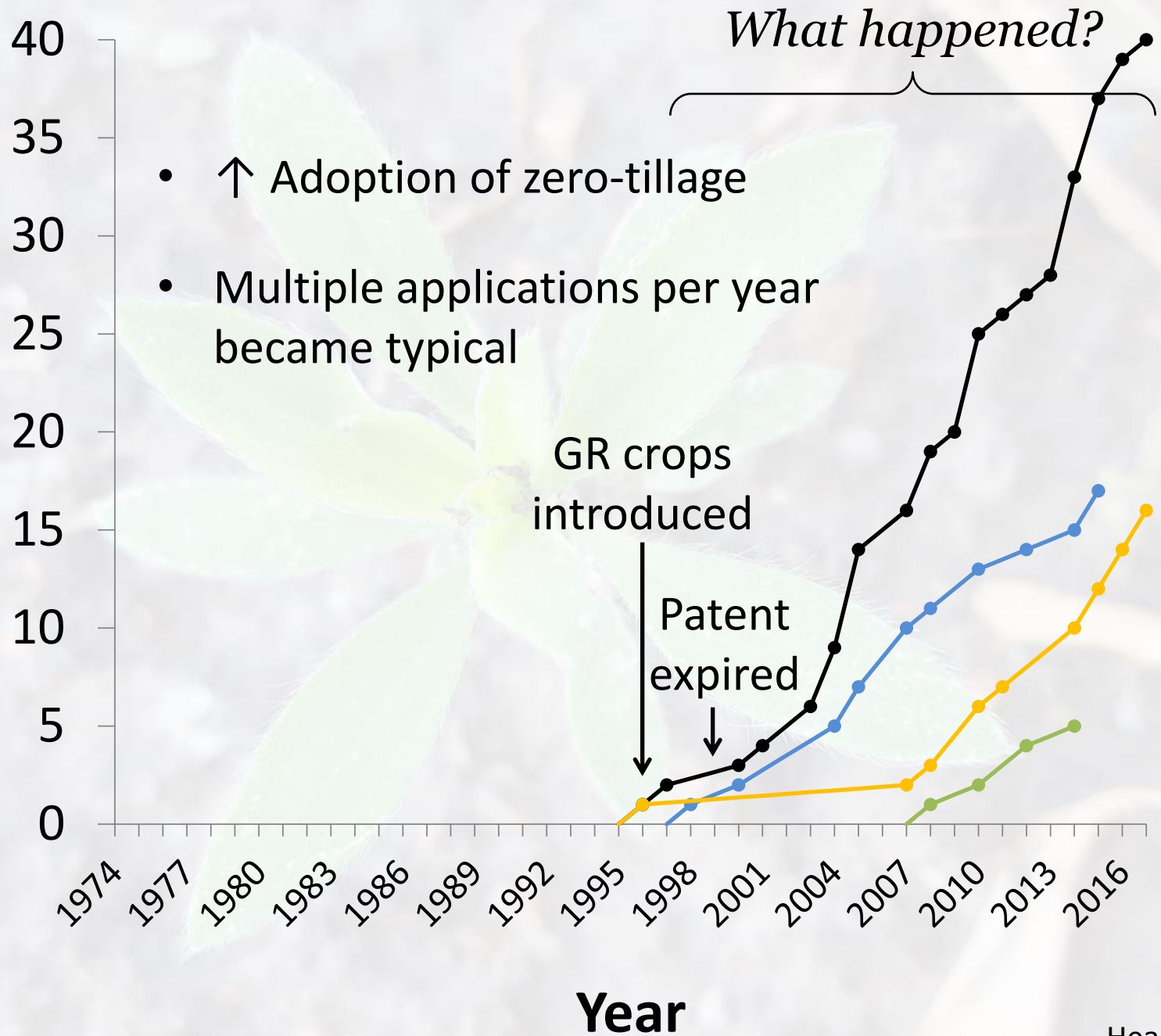
- Nonselective (limited use POST)
- No residual soil activity
- Drift on non-targets
- Devalued market for new herbicides







# Number of GR weed species



# Options for glyphosate use

- 1974 – 1995
  - PRE-emerge
  - PRE-harvest
  - POST-harvest
    - to a lesser extent
- 1996 – onward
  - PRE-emerge
  - POST-emerge
    - Greatest selection pressure
  - PRE-harvest
  - POST-harvest

# First cases of GR weeds...

## 1. Rigid ryegrass

**Where?** Annual crops in Victoria, Australia

**When?** 1996

**Why?** 15 years of annual PRE glyphosate use



[https://en.wikipedia.org/wiki/Lolium\\_rigidum](https://en.wikipedia.org/wiki/Lolium_rigidum)

## 2. Goosegrass

**Where?** Orchard in Malaysia

**When?** 1997

**Why?** 7 glyphosate applications over 3 years



<https://oak.ppws.vt.edu/~flesser/weedguide/elein.htm>

## 3. Canada fleabane

**Where?** Continuous soybean in Delaware, USA

**When?** 2000

**Why?** 3 years of glyphosate use PRE & POST



Peter Sikkema, UGuelph



# GR weeds in Canada



Giant ragweed



Canada fleabane



Common ragweed



Kochia



Tall waterhemp

# GR weeds in Eastern Canada

## 1. Giant ragweed

**Where?** Soybean in Essex County, ON

**When?** 2008

**1<sup>st</sup> report.** Following 2 applications of glyphosate





# Giant ragweed



Photo courtesy: Bill Johnson



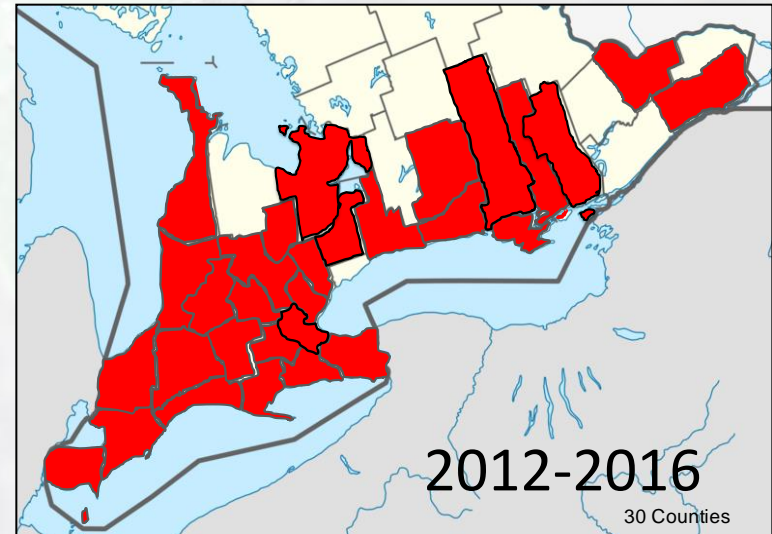
**Giant Ragweed**  
*Forrest M. Mims III*

[http://www.mysanantonio.com/life/columnists/forest\\_mims/article/In-search-of-the-giant-ragweed-655739.php](http://www.mysanantonio.com/life/columnists/forest_mims/article/In-search-of-the-giant-ragweed-655739.php)

# GR weeds in Eastern Canada

## 2. Canada fleabane

**Where?** Soybean in Essex County, ON  
**When?** 2010  
**1<sup>st</sup> report.** Following burndown @ 2X rate





# GR weeds in Eastern Canada

## 3. Common ragweed

**Where?** Soybean in Essex County, ON

**When?** 2011

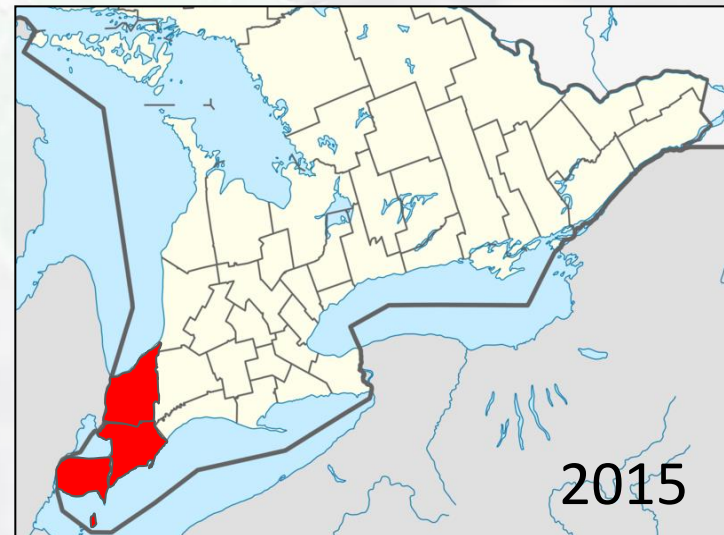
**1<sup>st</sup> report.** Following POST glyphosate



# GR weeds in Eastern Canada

## 4. Waterhemp

**Where?** Soybean in Lambton County, ON  
**When?** 2014  
**1<sup>st</sup> report.** Following 9 year continuous soybean



# GR weeds in Western Canada

## 1. Kochia

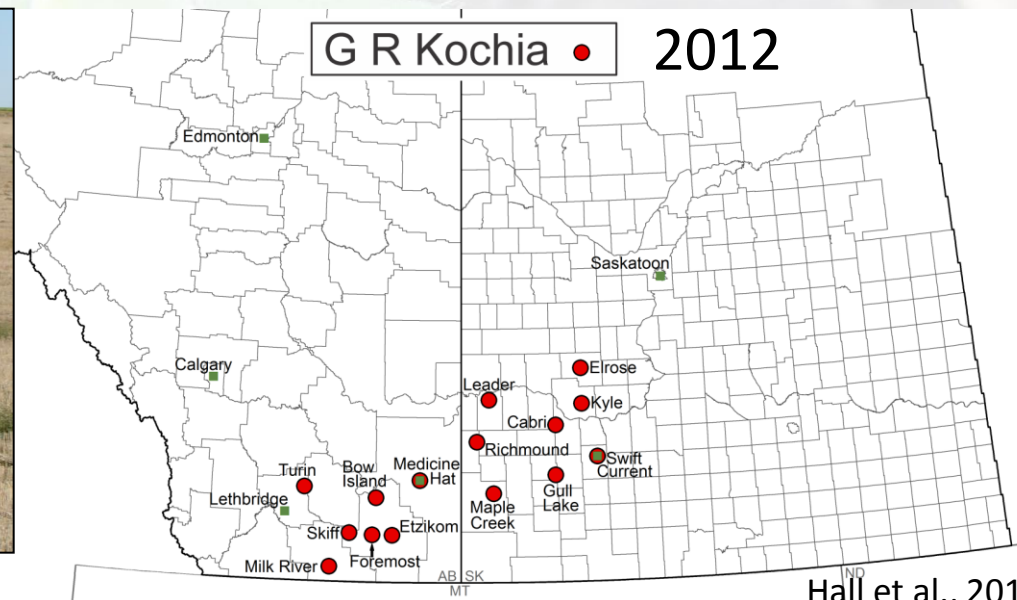
**Where?** Warner-Milk River Area, AB

**When?** 2011

**1<sup>st</sup> report.** 3 chem-fallow fields

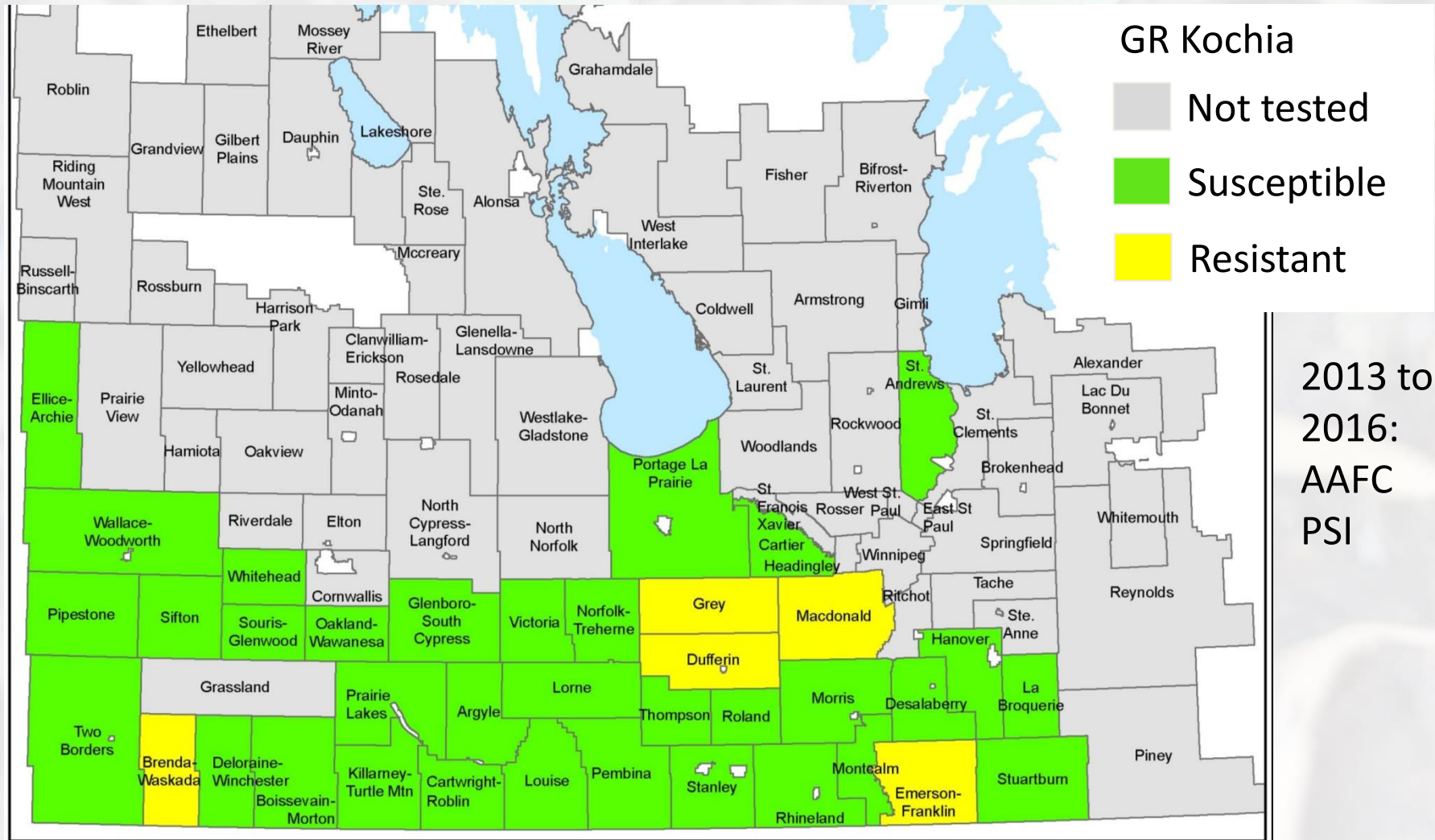


Photo courtesy: Bob Blackshaw, retired





# GR kochia in Manitoba 2016







**Chemical  
Fallow**

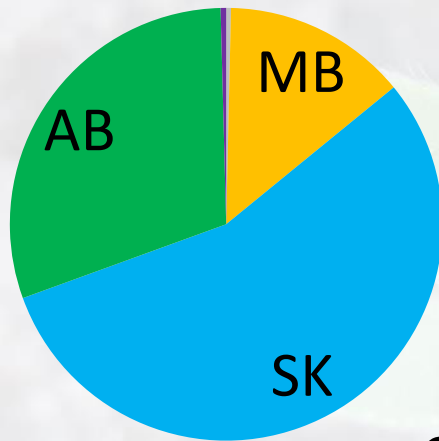
Photo courtesy: I. Kristjanson

Slide credit:  
Rob Gulden, UManitoba

# 2017 Canadian seeded acreage

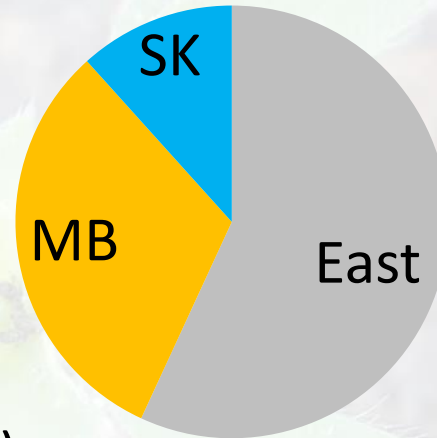
## Canola (47% GR in 2012)

~23.0 Million ac.



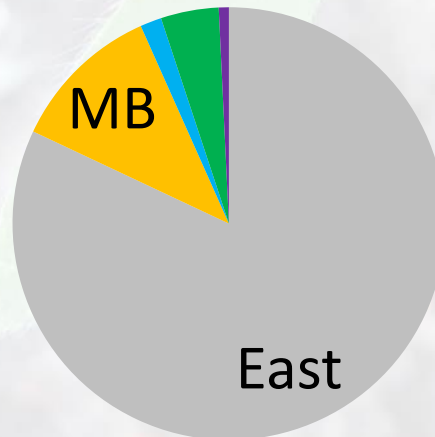
## Soybean (79% GR)

~7.3 Million ac.



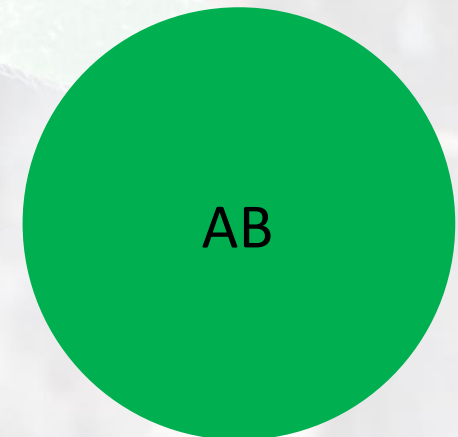
## Corn (90% GR)

~4.4 Million ac.



## Sugarbeet

~26 Thousand ac.





# MB seeded area

**Seeded acreage  
(Million ac.)**



**Year**



# Where is GR found?

- Eastern Canada
  - in areas with a high % of GR soybean
    - E.g., 1-4 years of soybean followed by winter wheat
  - Canada fleabane found in more complex rotations
    - E.g., corn-soybean-wheat-tomato-sweet corn
- Western Canada
  - Chemical Fallow
  - PRE burnoff
  - POST in GR crops



# Solutions

- ONLY ONE SOLUTION
  - Remove the selection pressure
- OPTIONS FOR DELAYED SELECTION
  - Reduced glyphosate use
  - Limit frequency of GR crops
  - Greater diversity
    - Chemical weed management
    - Non-chemical weed management



Giant ragweed



Canada fleabane



Common ragweed

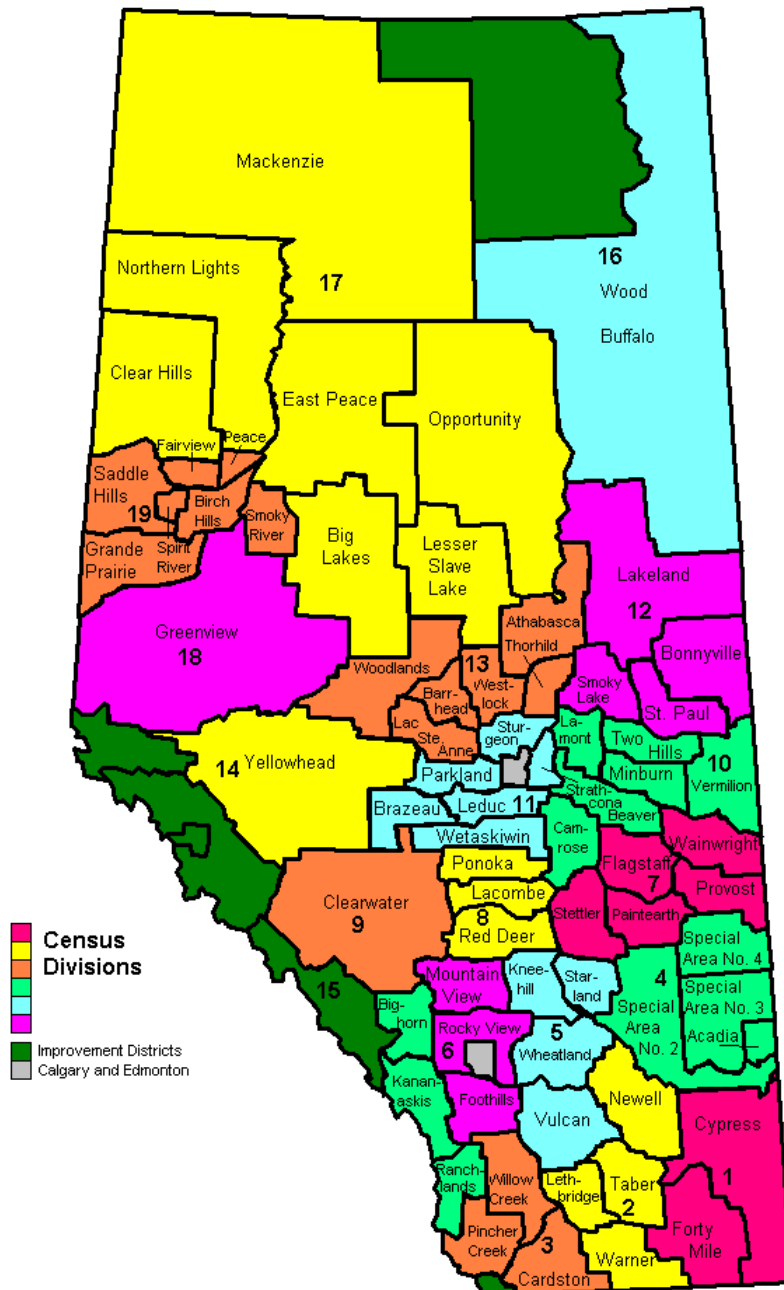


Kochia



Tall waterhemp

# 2017 Alberta kochia/ R. thistle (post-harvest) survey



Wheatland (36)  
 Foothills (15)  
 Vulcan (51)  
 Kneehill (9)  
 Starland (8)  
 Rocky View (8)  
 Lethbridge (27)  
 Cardston (18)  
 Pincher Creek (9)  
 Willow Creek (21)  
 Taber (18)  
 Acadia (5)  
 Cypress (21)  
 Forty Mile (39)  
 Warner (33)  
 Newell (12)

## Total: 330 sites

- Beckie, Shirriff, Hall
- Funded by ACIDF

# Conclusions

- 40 GR weed species worldwide
- 5 GR weed species in Canada
- Canada is a great example of delayed GR
- $\uparrow$  diversity =  $\downarrow$  selection pressure
- Go to [www.weedtool.com](http://www.weedtool.com)

# Thank you

- Research contributions
  - Bob Blackshaw
  - Hugh Beckie
  - Peter Sikkema
- Weed Ecology and Cropping Systems
  - Louis Molnar
  - Theo Taam
  - Maegen Poblacion



Questions or Comments?  
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