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# Weed management in PEI potato production

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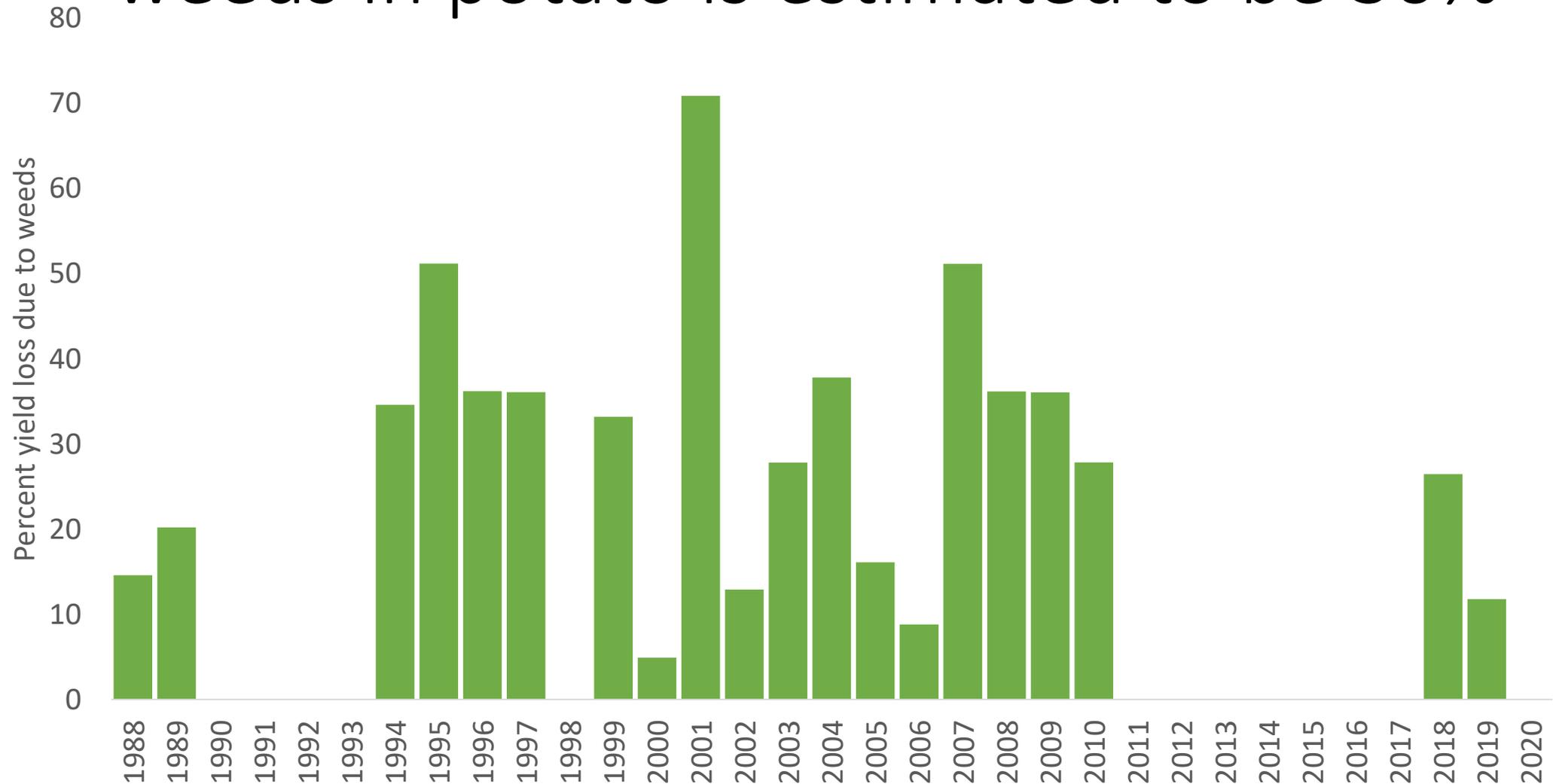
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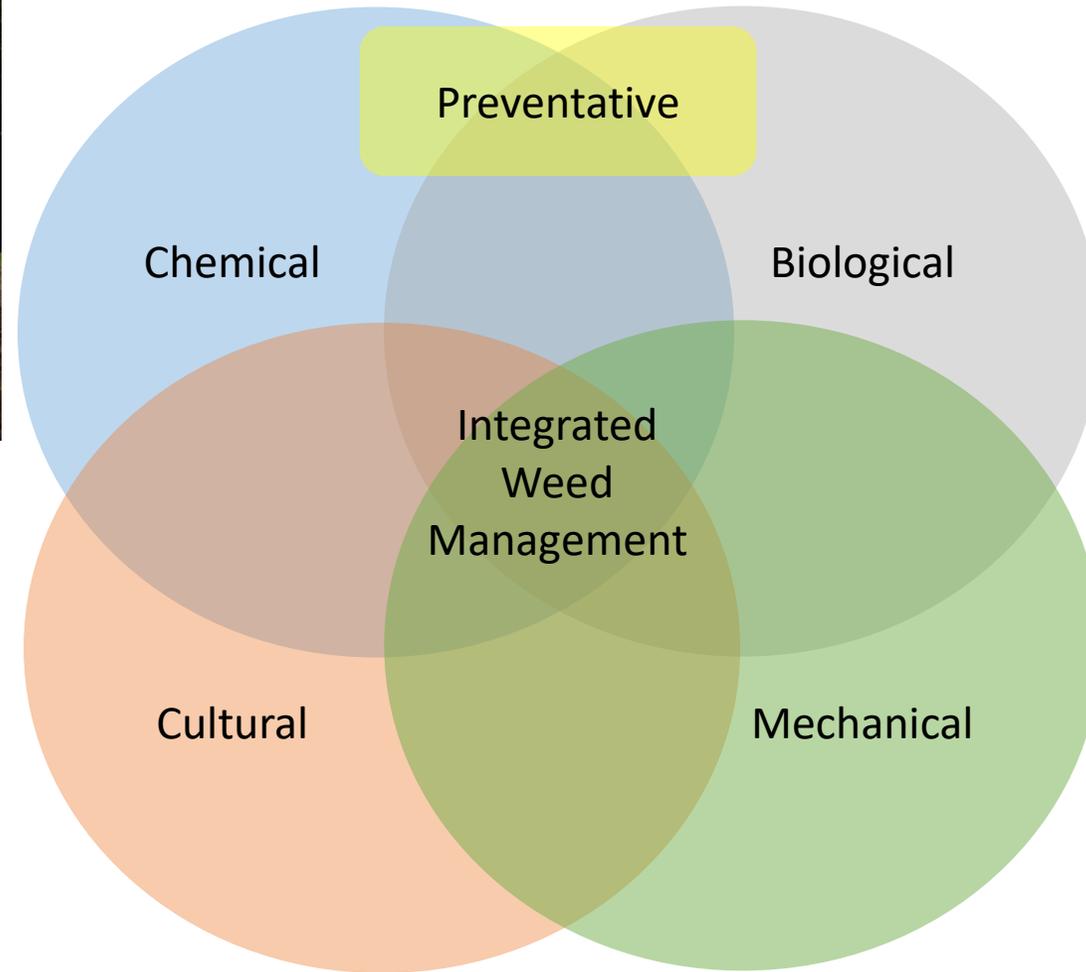
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# Marketable yield loss due to uncontrolled weeds in potato is estimated to be 30%



n = 37

# Integrated Weed Management



# Know your weeds!

Proper weed identification is the first step in integrated weed management programs

Identify your weeds and adapt weed management strategies

# Grasses vs Broadleaves

Weeds can be divided into two large groups



Monocots  
Grasses



Dicots  
Broadleaves

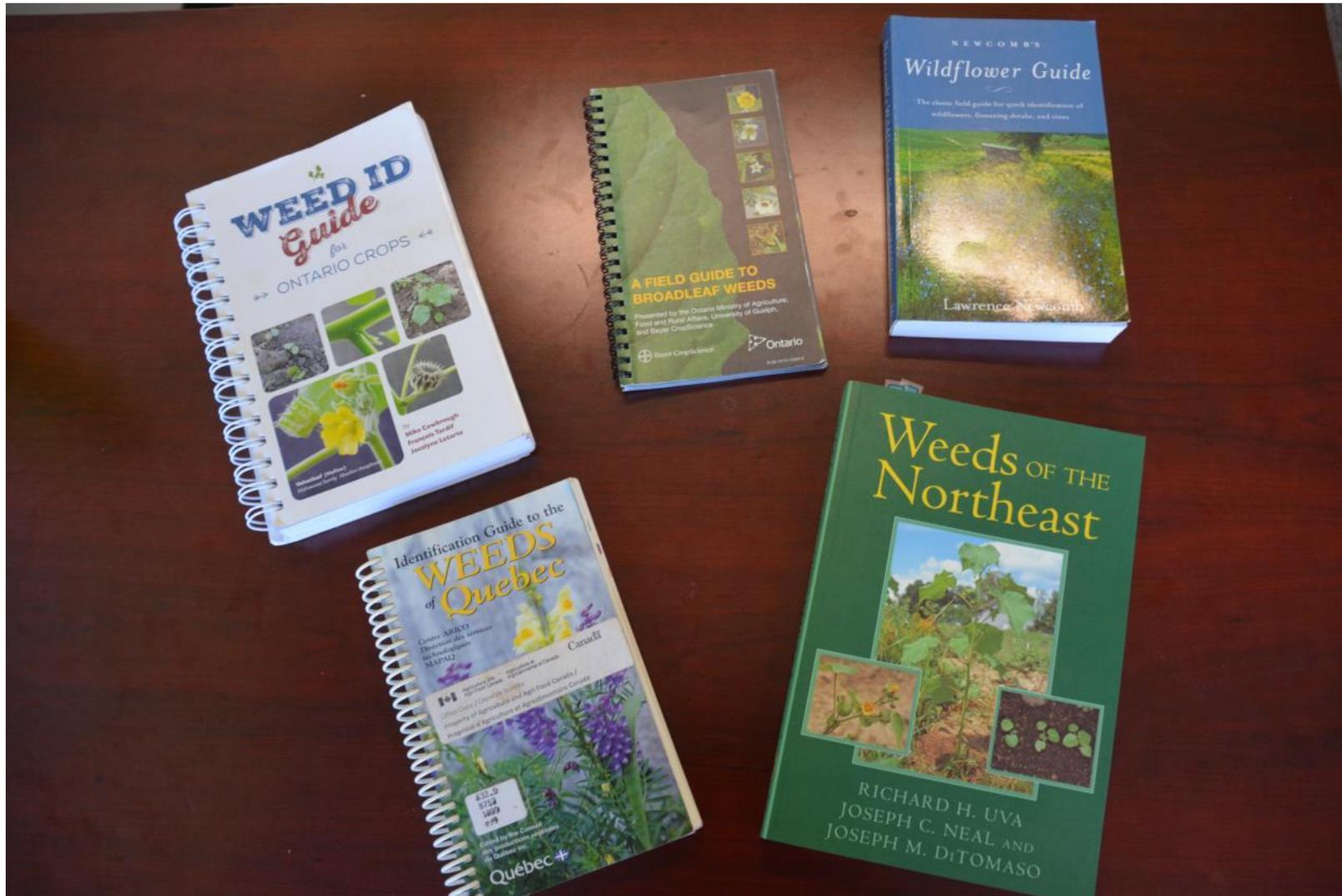
# Problem weeds of PEI



# Problem weeds of PEI



# Weed ID resources



# Terminology

Mode of action – sequence of events from herbicide uptake to plant death “how a herbicide works”

Residual – length of time a herbicide is effective in the environment

Selective herbicides – Herbicides which control different species

# Herbicide use pattern terminology

Pre-plant – products applied prior to planting “burn down”

Pre-emergence – applied post-planting but pre-potato emergence

Post-emergence – products applied post-potato emergence

Use of a product name does not constitute endorsement of that product

# Before planting “burn down” herbicides

If perennial weeds are a known issue in a field, a pre-plant burn down can help to control those weeds and prevent them from establishing

- Eptam 8E
- Glyphosate (Roundup)

# Eptam (EPTC)

- Group 8 – Inhibition of lipid synthesis (not via ACCase inhibition)
- Use rates between 4.25 and 8.5 L ha<sup>-1</sup> – use higher rates for dense stands
- Uptake via underground plant organs (roots, seeds, etc...)
- ***Has to be soil incorporated*** (disks, cultivator or with irrigation)
- ***Does not need*** rainfall for activation
- Susceptible to ***leaching*** with heavy rainfall
- Primarily targets grasses
- Moderate activity on corn spurry, lamb's quarters, nightshades, pigweed and chickweed
- Provides season-long weed control
- Can be tank-mixed with Sencor
  - ***Do not*** use higher than 0.75 kg ha<sup>-1</sup> of Sencor 75 DF in a tank-mix

# Pre-emergent herbicides

Probably what producers are most familiar and where there are the most options for chemical weed management

Several products can be applied at planting/ hilling all the way up to ground crack with no adverse affects on potato yield or quality

- Sencor
- Lorox
- Dual II Magnum
- Boundary LQD

- Glufosinate
- Glyphosate
- Frontier Max (Outlook)
- Reflex
- Sencor STZ

# Sencor 75DF (metribuzin)

- Group 5 – PSII inhibitor
- Use rates between 0.55 and 1.5 kg ha<sup>-1</sup> (Sencor 75DF)
- Can apply from planting up to emergence
- Pre- and post-emergent weed control
- ***Uptake is primarily by roots***, some uptake via foliage
- ***Rainfall is needed for full activation*** and to prevent crop injury on some varieties
- Need heat and sunlight to maximise efficacy
- Has a variety of registered tank-mix partners
- Controls a broad spectrum of broadleaves and annual grasses
- Lamb's quarters populations resistant to Sencor have been documented in PEI & NB

# Lorox L (linuron)

- Group 7 – PSII inhibitor
- Use rates between 2.3 and 4.6 L ha<sup>-1</sup>
- Can apply from planting to emergence
- Pre- and post-emergent weed control
- ***Primarily absorbed by roots***, less so by foliage
- ***Rainfall is required*** to move product to root zone
- Good control of annual grasses & broadleaf weeds
- May cause injury on low OM soils
- Can be tank-mixed with s-metolachlor for improved grass control
  - ***Do not*** use on coarse textured, low OM soil or high OM
- Ragweed populations resistant to linuron have been identified in NS
- Currently investigating suspected incidence of resistance in lamb's quarters

# Dual II Magnum (s-metolachlor)

- Group 15 – Inhibition of cell division
- Use rates between 1.25 and 1.75 L ha<sup>-1</sup>
- Can apply from pre-planting all the way up to ground crack
- **Has variety issues** - potato variety responses not well studied
- Pre-emergent weed control
- Uptake in grasses through **germinating shoot**, absorbed in **shoots and roots of germinating broadleaves**
- Controls annual grasses and some broadleaf weeds (nightshade, suppression of pigweed)
- **Rainfall within 10 days is required** for maximum pre-emergence activity
- Can be soil incorporated to improve pre-emergent activity
- Provides 10-14 weeks of residual control
- Winter cereals can be planted 4-5 months post-application

# Boundary LQD (s-metolachlor + metribuzin)

- Group 5 + Group 15
- Use rates of Boundary LQD between 1.85 and 2.5 L ha<sup>-1</sup>
- Refer to label of Sencor and Dual if tank-mixing
- Broad spectrum of annual grass and broadleaf control
- ***Will not*** control PSII-inhibitor resistant weeds
- Resistance to s-metolachlor documented in pigweed species in the US

# Results from our trials (Dual II Magnum)

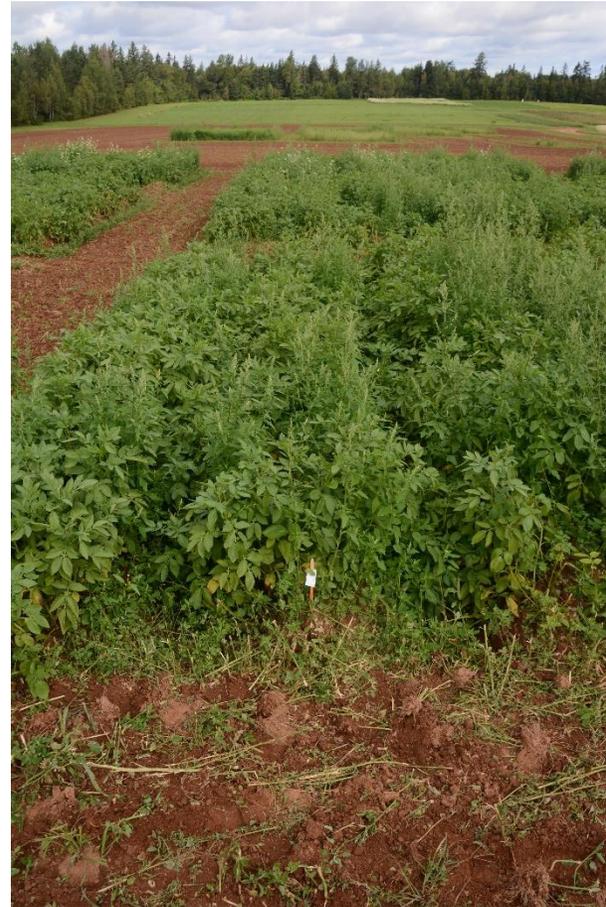
Poor control of

- Lamb's quarters

Moderate control of

- Shepard's purse
- Wild buckwheat & smartweeds
- Smooth crabgrass

Marketable yield equivalent to weed-free



# Results from our trials (Boundary LQD)

Great control of PSII-susceptible  
lamb's quarters

Excellent control of all other species

We noted some smooth crabgrass

Marketable yield equivalent to weed-free



# Roundup/ various (glyphosate)

- Group 9 – Inhibition of EPSP synthase
- Use rates vary based on product concentration
- Use higher rates for perennials and larger weeds (>15cm tall)
- Can be applied pre-plant and pre-emerge up to potato ground crack
- Post-emergent control
- Absorbed through foliage and translocated throughout the plant
- Should be applied to actively growing tissue for maximum efficacy
- ***No residual activity*** – potatoes can be seeded after application
- ***No selectivity*** – with enough of it, glyphosate will pretty much kill anything not resistant
- Worldwide resistance issues

# Ignite/ various (glufosinate)

- Group 10 – Inhibition of glutamine synthetase
- Use rates vary from 2.7 to 5.0 L ha<sup>-1</sup>
- Can be applied up to ground crack
- Post-emergent control
- Absorbed by the foliage and minimally translocated
- ***No residual activity*** and no cropping restrictions
- ***Non-selective***, perennials may regrow
- Limited incidence of resistance, mostly perennial ryegrass in New Zealand orchards

# Frontier Max/ Outlook (dimethenamid-P)

- Group 15 – Inhibition of cell division
- Use lower rates with reduced OM (OM~3% use 756 g ha<sup>-1</sup>, consult label)
- Applied anytime after planting as long as **potatoes have not emerged**
- **Pre-emergent** control
- **Uptake via shoots and roots** but primarily through developing **coleoptile**
- Effective on annual grasses and some broadleaf weeds (pigweed, nightshade)
- Provides **season-long** weed control
- **Rainfall is required** within 7-10 days
- Can use shallow cultivation in absence of rainfall to move product to moist soil zone

# Frontier Max/ Outlook (dimethenamid-P)

- In cold, wet conditions, potato emergence may be delayed or stunted
- If crop fails, **do not** re-plant potato – plant corn, soybean or dry bean
- Only **a single application** may be made per year
- Do not apply within 40 days of harvest
- Re-cropping intervals –
  - 100 days for cereals
  - Next spring for potato, corn, soybean, dry bean, cabbage
  - 11 months for all other crops
- 2016 resistance documented in pigweed species in Illinois
- Consult the label before using

# Results from our trials

## Poor control of

- Lamb's quarters
- Shepard's purse
- Wild buckwheat & smartweeds
- Smooth crabgrass

Small marketable yield boost over weed-free (~10%)



# Reflex (fomesafen)

- Group 14 – Inhibition of protoporphyrinogen oxidase (PPO)
- Use 1.0 L ha<sup>-1</sup>, if weeds are emerged add Agral 90 @ 0.1% v/v
- Can be applied at planting up to potato emergence
- Provides **pre-** and **post-**emergent control of pigweed and suppression of lamb's quarters
- **Post-emergent** control of ragweed, wild mustard, lady's-thumb, Eastern black nightshade, canola
- For post-emergent control – max of 4 leaves for most weeds, 3 for lamb's quarters

# Reflex (fomesafen)

- ***Do not*** cultivate within 7 days after application
- ***Do not*** apply to soils >5% OM or fine textured soils
- ***Do not*** apply Reflex to a field more than once every two years
- ***Do not*** harvest potatoes within 70 days of application
- Resistance documented in pigweed species across the soybean/ corn belt of US
- Consult the label for using

# Results from our trials

Good control of early emerging weeds  
but doesn't get that second flush

We noted,

- Lamb's quarters
- Smooth crabgrass
- Field mint
- Common chickweed

Marketable yield equivalent to weed-free



# Sencor STZ (metribuzin + sulfentrazone)

- Group 5 + 14 – Inhibition of protoporphyrinogen oxidase (PPO)
- STZ can have many interesting interactions in the soil
  - Degradation via microbial activity
- Use rates between 157 – 219 mL ha<sup>-1</sup>
  - Higher rates for longer season varieties or heavy weed pressure
- Uptake of STZ is primarily ***via roots***
  - STZ ***will not control*** emerged weeds including PSII-inhibitor resistant species
- Controls all weeds on the Sencor label including
  - ***PSII-inhibitor resistant species*** (lamb's quarters & pigweeds)
  - Wild buckwheat

# Sencor STZ (metribuzin + sulfentrazone)

- Can be applied anytime after planting providing:
  - A ***minimum of 1"*** of soil is covering potatoes
  - Soil is settled after hilling
- ***Do not*** soil incorporate
- ***Do not*** apply to fine textured soils with OM <1.5%
- ***Do not*** apply to any soil with OM >6%
- ***Do not*** apply to soil with pH of 7.8 or greater
- ***Requires rain or irrigation*** for maximum effectiveness

# Sencor STZ (metribuzin + sulfentrazone)

- Sulfentrazone is persistent and can last in the soil for **years**
- Wait **24 months** after applying STZ to a field before re-applying
- If drought occurs in **any** of those years, **delay** use of STZ by **further years** equal to number of drought years
- Resistance to STZ documented in wild oat in Manitoba & ragweed in Delaware
- Consult the label prior to use

# Results from our trials

Good control of PSII-inhibitor resistant lamb's quarters

We noted

- Low cudweed
- Smooth crabgrass

Marketable yield equivalent to weed-free



# Post-emergent herbicides

Very limited options, mostly limited to grass herbicides

- Clethodim
- Excel
- Venture
- Poast

- Prism
- Titus Pro

# Grass Herbicides

- Group 1 – ACCase inhibitor
- Post-emergent control
- Use rates vary
- Widespread resistance has been documented Worldwide
- Consult the label

Herbicide	Grasses Controlled
Clethodim	Annual grasses
Excel	Annual grasses including crabgrass
Venture	Annual grasses including crabgrass Quackgrass
Poast	Annual grasses including crabgrass Quackgrass

# Prism (rimsulfuron)

- Group 2 – ALS inhibitor
- Use rate of 60 g ha<sup>-1</sup> - use a surfactant
- Can apply from emergence up to prior to initiation of flowering
- Provides post-emergent weed control of annual grasses and some broadleaves
  - Pigweed & lamb's quarters need to be at maximum 2-3 leaf stage
  - Controls PSII-inhibitor resistant biotypes
  - Controls hairy nightshade
- Absorbed through the leaves and translocated throughout the plant
- Provides control of weeds until canopy closure

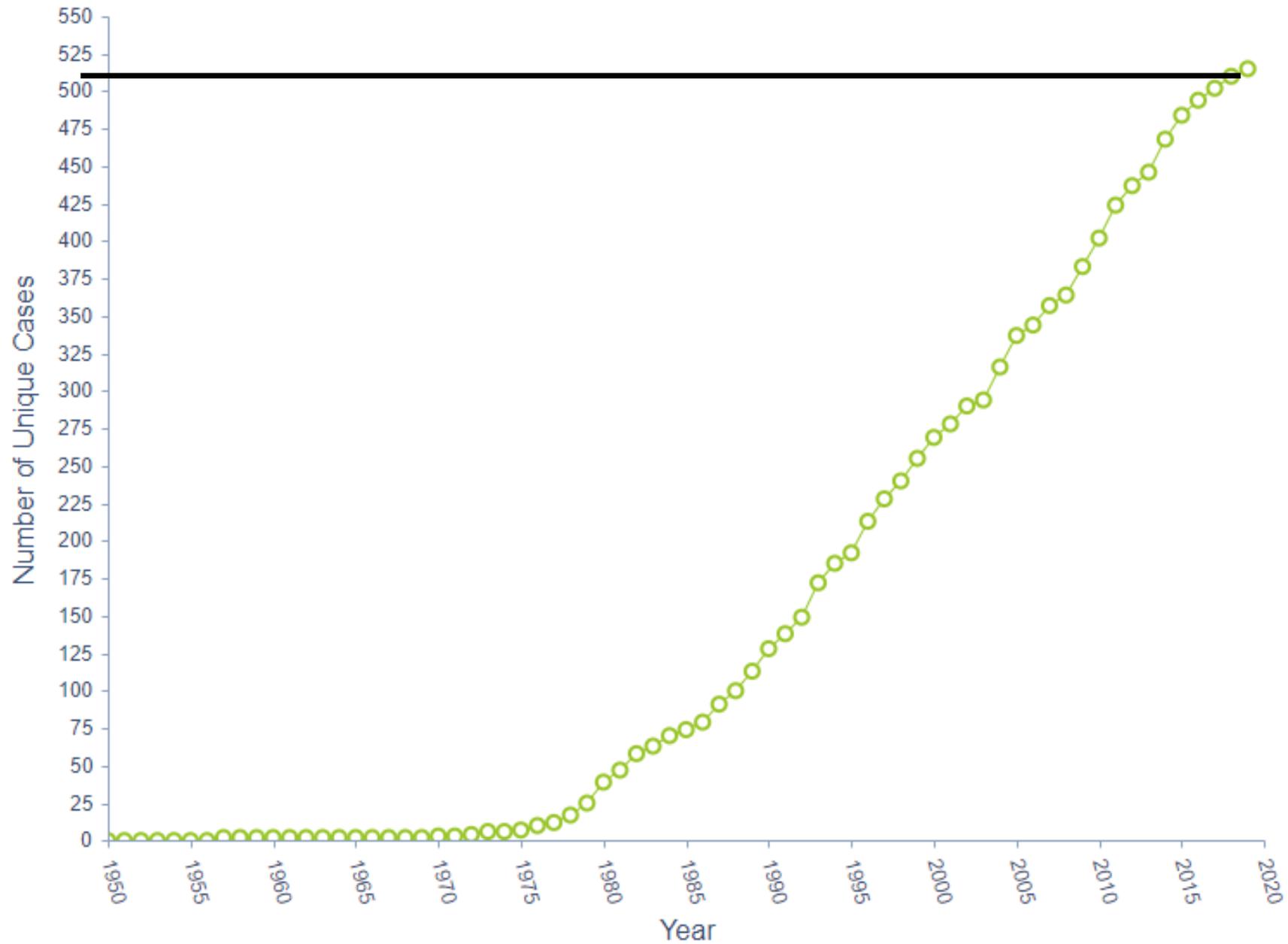
# Prism (rimsulfuron)

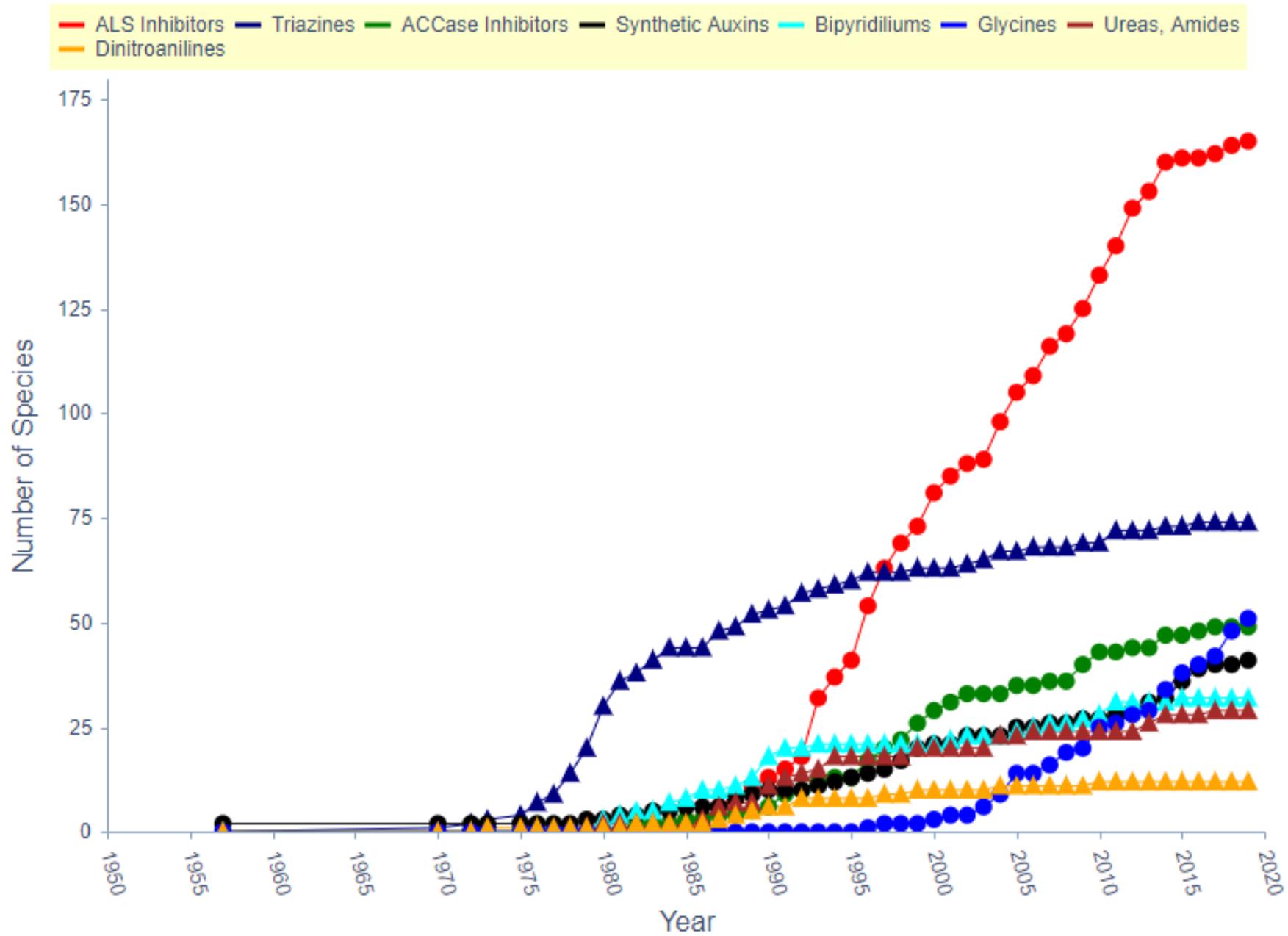
- Injury to potatoes may occur if previously stressed
- Can be tank-mixed with Sencor to improve control (Titus Pro)
  - This will not improve control of PSII-inhibitor resistant lamb's quarters
- Susceptible to **leaching** in sandy soils
- May **contaminant groundwater** if water table is shallow
- **Do not** apply if heavy rain is forecast
- Widespread resistance to group 2 herbicides reported Worldwide



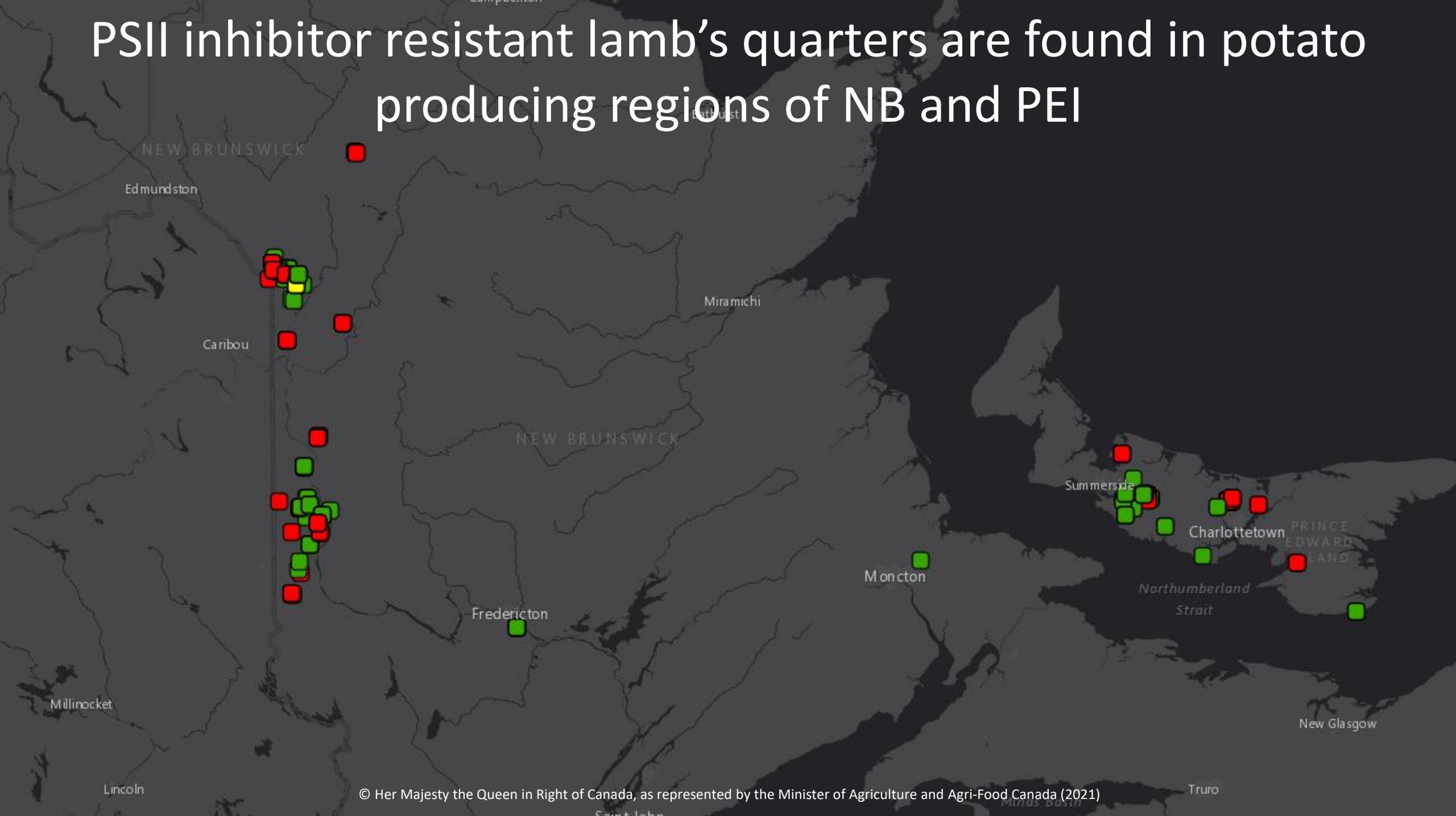


# Chronological Increase in Resistant Weeds Globally





# PSII inhibitor resistant lamb's quarters are found in potato producing regions of NB and PEI





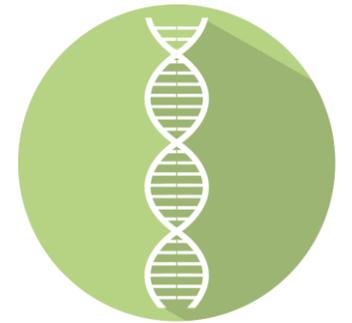
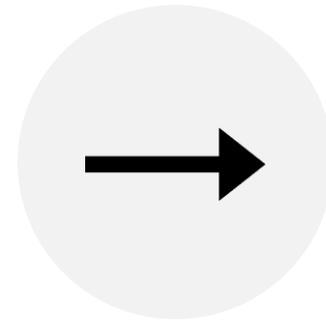
Reduced  
cultivation



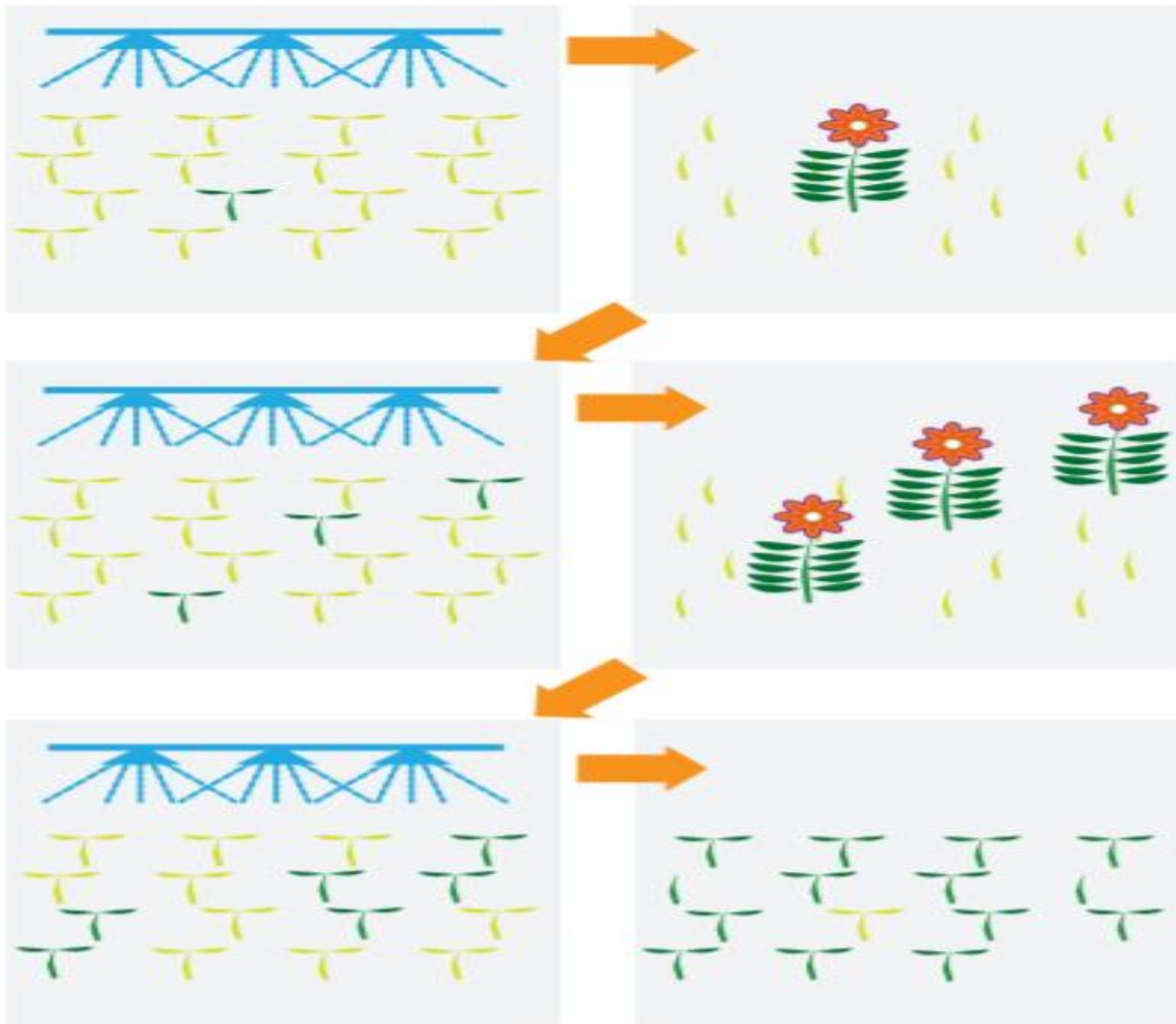
Shorter crop  
rotations



Reliance on  
single modes of  
action



Herbicide  
Resistance



# Scouting for Herbicide Resistance

Has the same herbicide mode of action been used repeatedly on this field?

Did the same rate previously control this weed?

Are there live and dead weeds following application?

Noticed a recent decline in control?

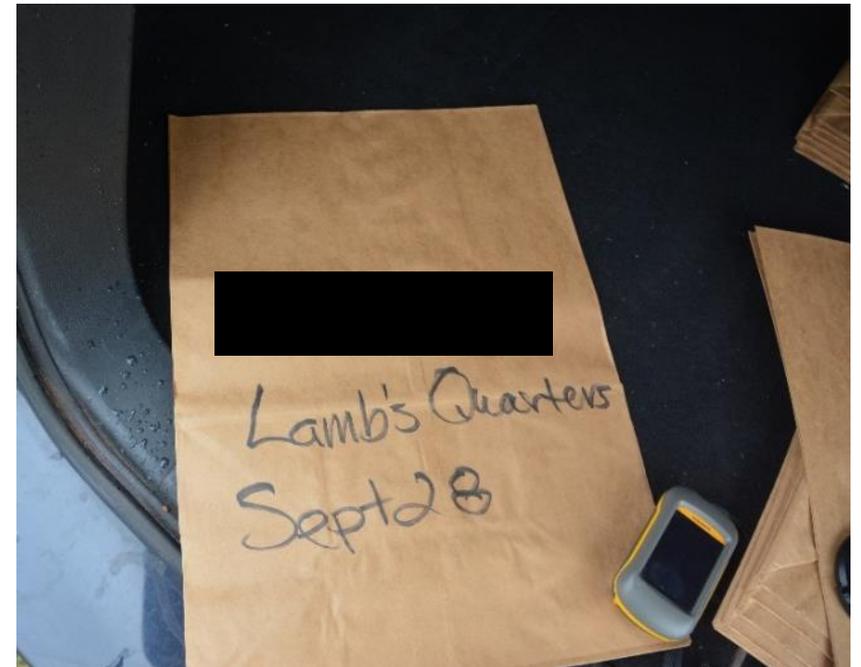
Are other weed species being controlled by this rate?

# Spotting signs of PSII-inhibitor resistance



# Initiated resistance testing in 2017

Collected seed samples from PEI producer fields and the AAFC Harrington experimental farm where poor control of lamb's quarters was observed following an application of metribuzin



# Response of lamb's quarter populations from PEI and NB to increasing doses of two herbicides

Metribuzin (Sencor 75 DF)

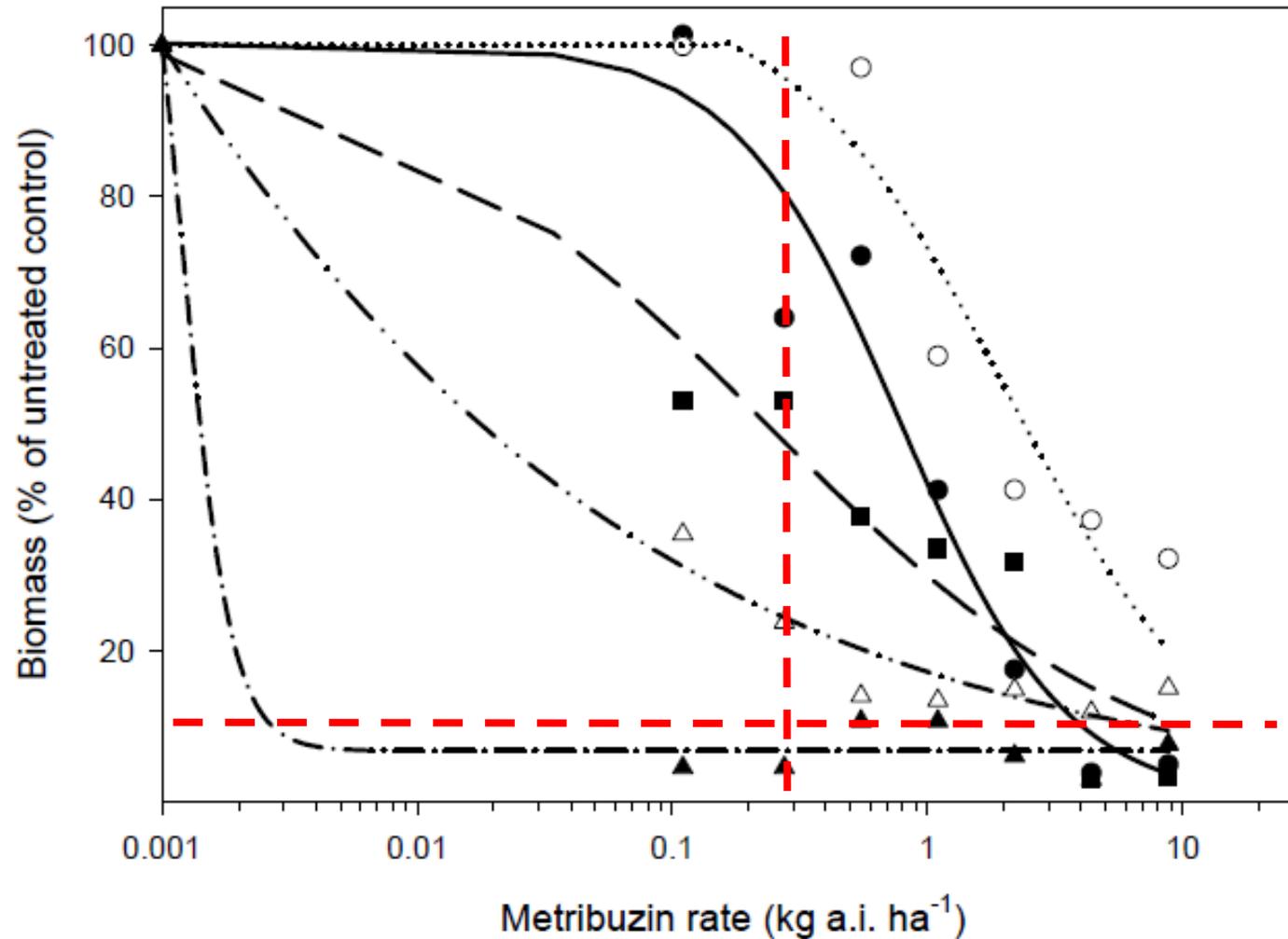
Group 5 – PSII inhibitor site A

Linuron (Lorox L)

Group 7 – PSII inhibitor site B



# Lamb's quarters populations from PEI and NB are resistant to metribuzin



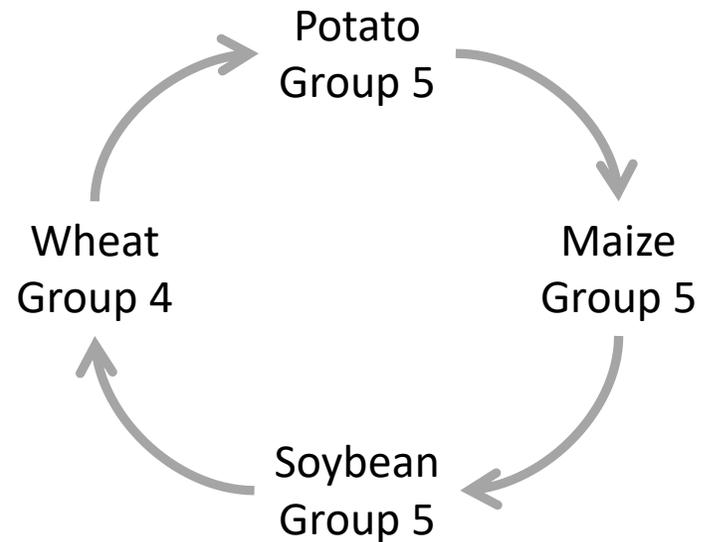
# PSII-resistance appears to be due to Ser<sub>264</sub>Gly mutation is *psbA*

Target-site (*psbA* gene) herbicide resistance to photosystem-II inhibitors.

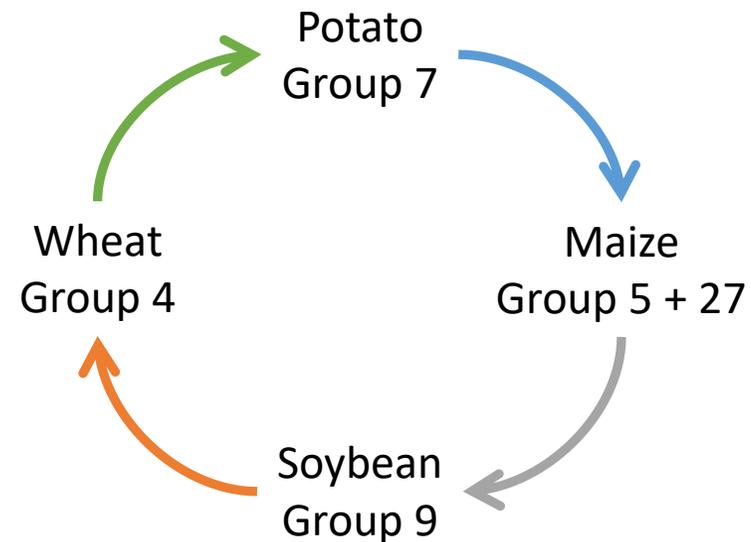
Mutation	Substitution	Species	Atrazine	Sencor e	Lorox	Bromotril
			Resistance index <sup>a</sup>			
Val219	Ile	<i>Amaranthus powellii</i> S. Wats. <i>Kochia scoparia</i> (L.) Schrad. <i>Poa annua</i> L.	L	L-M	M-H	S
Ser264	Gly	Numerous species	H-VH	M	S-L	S
	Thr	<i>Portulaca oleracea</i> L.	VH	S	VH	S
Asn266	Thr	<i>Senecio vulgaris</i> L.	S	L	S	H
Phe 255	Ile	<i>Capsella bursa-pastoris</i> (L.) Medik	S	L-H	L	nd
Ala 251	Val	<i>Chenopodium album</i> L. <i>Amaranthus retroflexus</i> L.	S	H	S	S

# Practice crop and herbicide rotation

## Crop Rotation



## Herbicide Rotation



# Managing PSII-resistant lamb's quarters in potato year

Focus on preventing weeds from setting seed

Use multiple modes of action with the  
correct herbicide rate and the correct time

Use mechanical management if possible

# Managing PSII-resistant lamb's quarters in rotation years

Use competitive cover crops to suppress lamb's quarters germination and seed shed

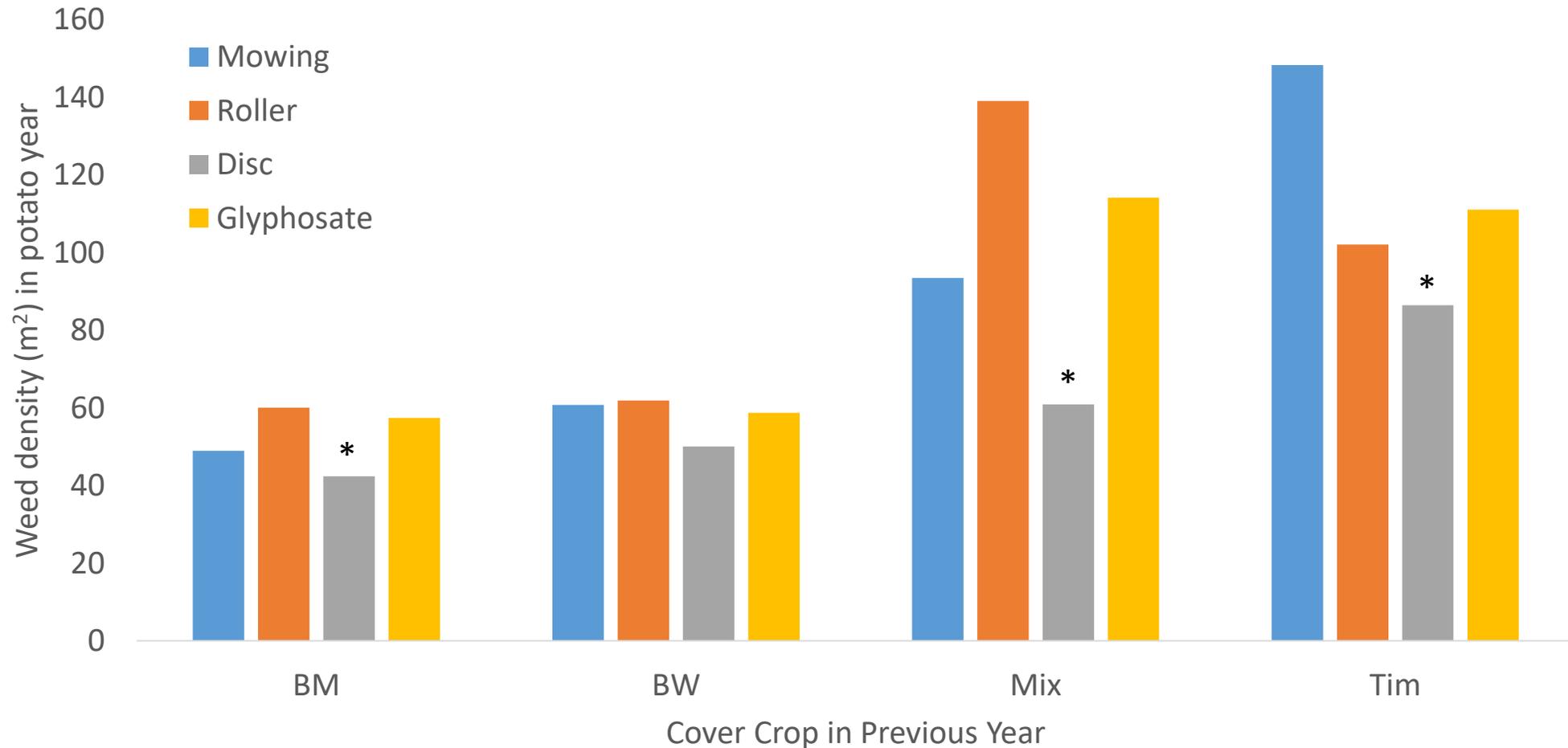
Use multiple modes of action with the correct herbicide rate and the correct time

Prevent new weed seed introductions

Use certified weed-free seed

Clean equipment

# Discing cover crops at the end of season reduces subsequent weed populations in the potato year



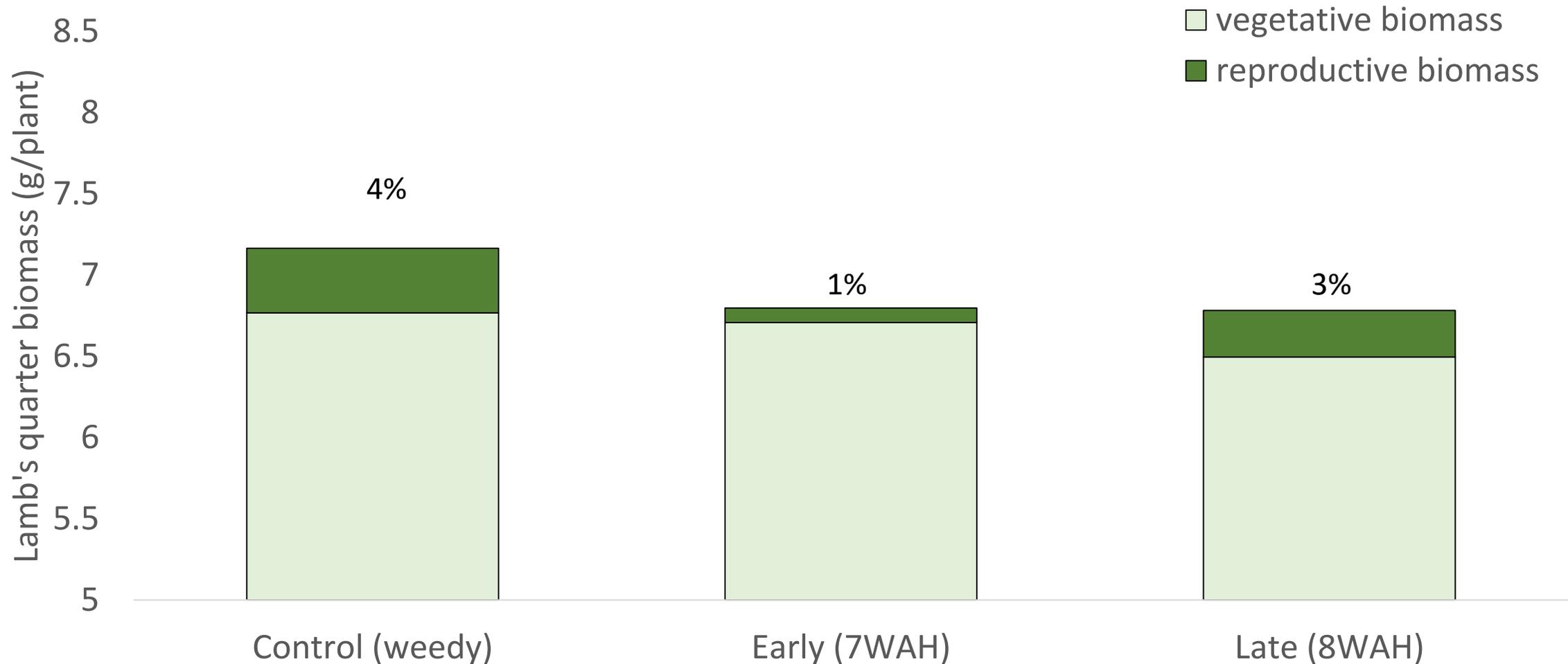
# Can we control lamb's quarters over-topping the potato canopy?



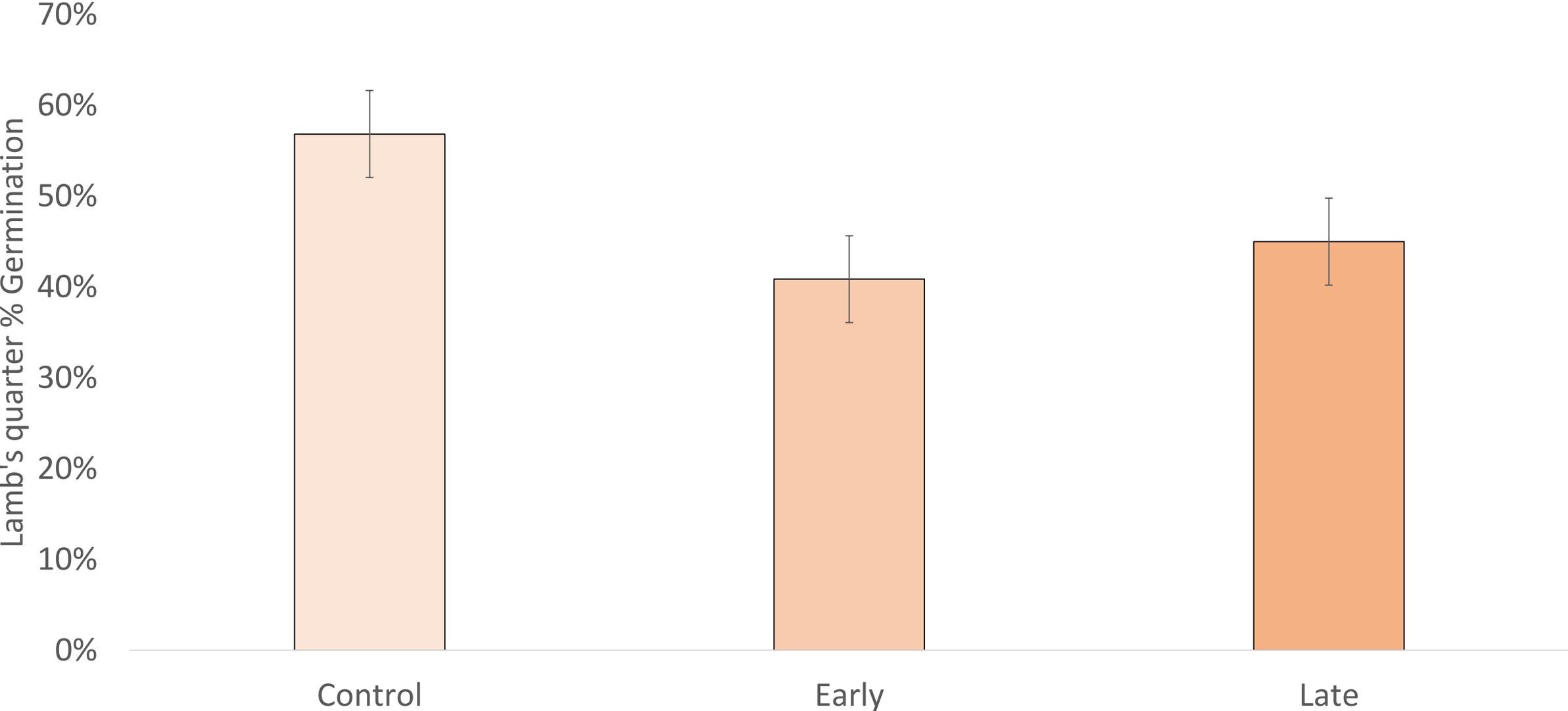




# Early wick weeding decreased the reproductive allocation of lamb's quarters by 74% vs. untreated weedy control



# Wick applications decreased lamb's quarter seed germination by 21-28% vs. the untreated control.



# Additional Resources



## Pest Control Guide

Publication 1300A

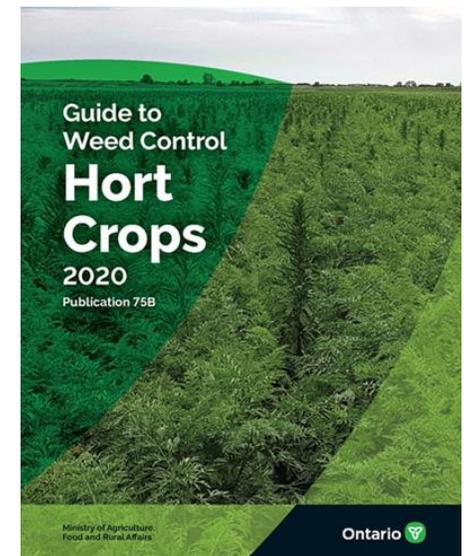


[Control of Herbicide Resistant Lambsquarters – AAFC Factsheet \(Oct 2020\)](#)

[Volunteer Potato Management – NBDAAF \(March 2019\)](#)

[Weeds in Potatoes – Guide to Available Chemistry \(NB Dept of Ag\)](#)

[Effect of Glyphosate on Potatoes \(NDSU\)](#)



### Management of PSII-Inhibitor Resistant Common Lambsquarters in Atlantic Canadian Potato Production

#### Potatoes and Herbicide-Resistant Common Lambsquarters

Atlantic Canadian potato producers have relied on PSII-inhibiting herbicides like metribuzin and linuron for weed management in potatoes. Producers in the region have recently reported poor control of common lambsquarters (*Chenopodium album* L.) following the use of metribuzin. Common lambsquarters are highly competitive with potato plants and can reduce yield and quality. Poor control of common lambsquarters after using PSII-inhibiting herbicides is a concern as resistance has been well documented in this species across Canada. Researchers from Agriculture and Agri-Food Canada studied whether poor common lambsquarters control was due to resistance in potato producing regions of New Brunswick (NB) and Prince Edward Island (PEI). They tested herbicides from different modes of action how they provided control of common lambsquarters in Atlantic Canadian potato production.





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# Questions?

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