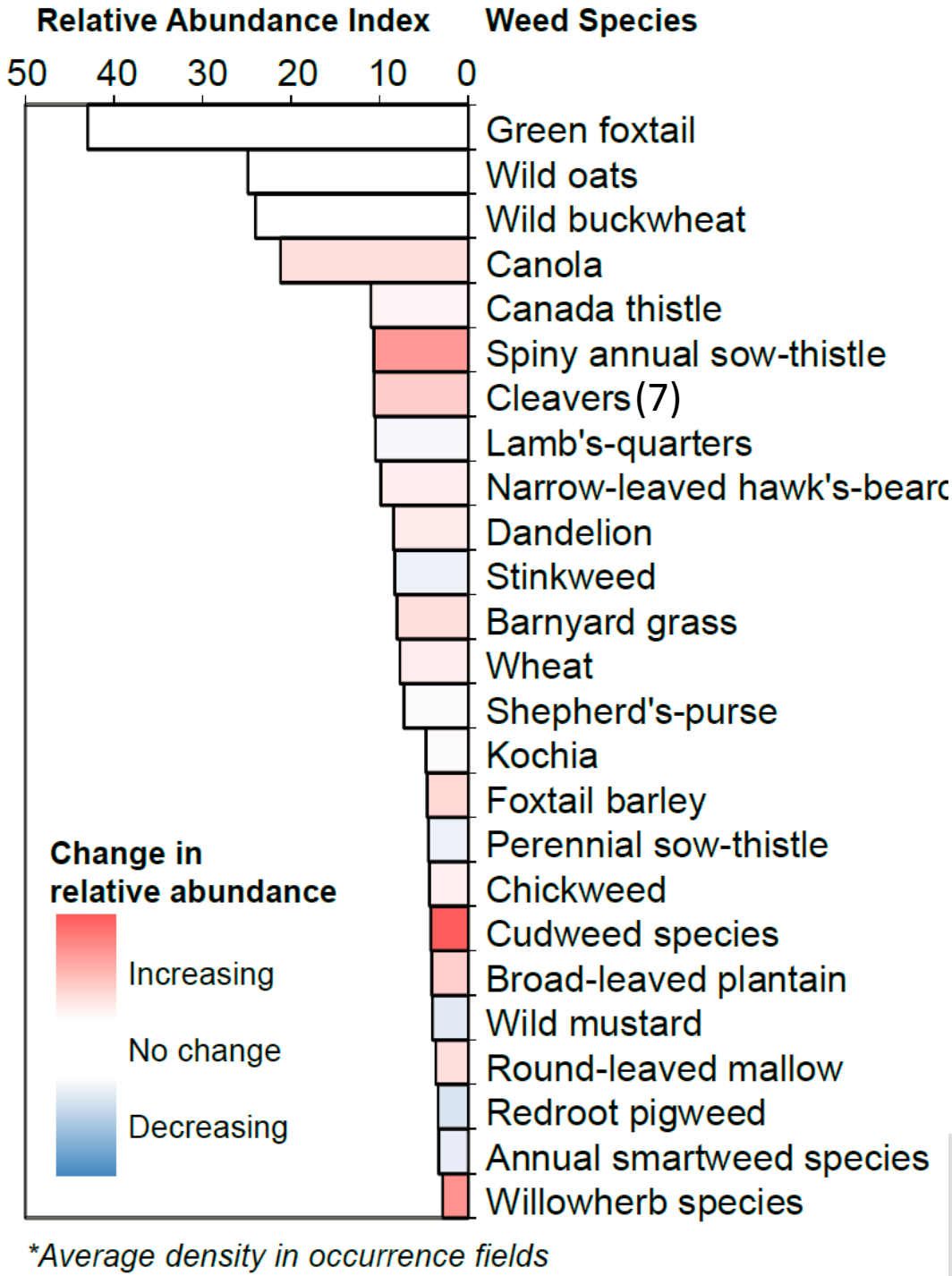



UNIVERSITY OF SASKATCHEWAN

Multiple Mechanisms of Action for Managing Cleavers (*Galium spp.*) in Canola Systems And Field Peas

Eric Johnson, Ian Epp & Chris Willenborg
Department of Plant Sciences
University of Saskatchewan



University of Saskatchewan

Top 25 Weed Species 2014-15 Weed Survey Leeson, 2015

Species Shifts

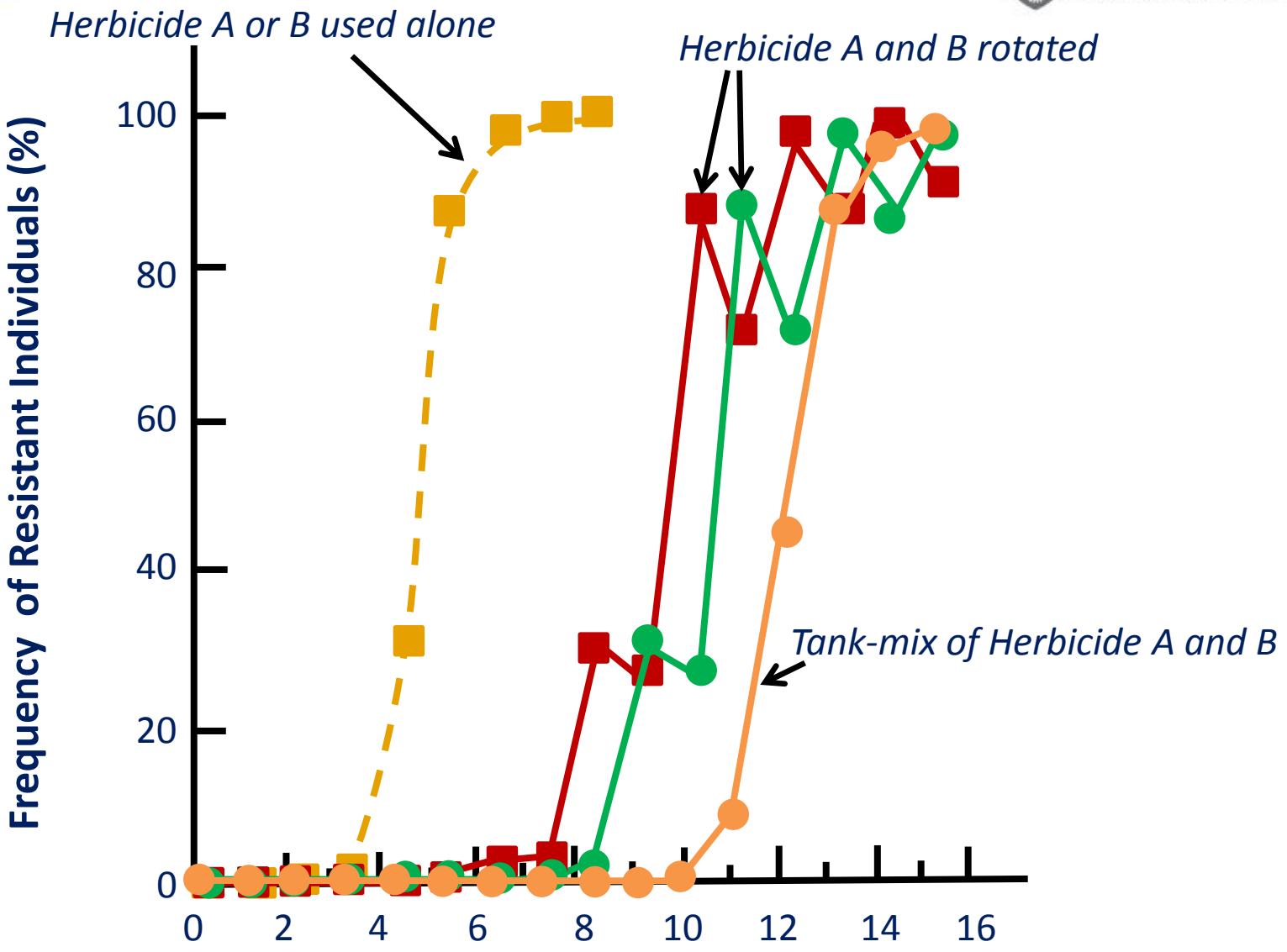
	Change in Relative Abundance Rank				
	1970s to 1986	1986 to 1995	1995 to 2003	2003 to 2010s	1970s to 2010s
Cudweed species			37	67	*104*
Willowherb species	1	-30		101	72
Spiny annual sow-thistle		23	16	28	*67*
Cleavers	15	10	2	6	33
Broad-leaved plantain	-4	-4	-7	47	32
Foxtail barley	-26	28	14	10	26
Round-leaved mallow	7	-1	7	9	22
Barnyard grass	1	5	16	0	22
Canola	3	11	-3	10	21
Dandelion	-13	22	3	1	13
Flax	22	-8	5	-7	12
Narrow-leaved hawk's-beard	-11	2	9	11	11
Wheat	-2	6	11	-4	11
Chickweed	7	-5	-3	11	10
Canada thistle	1	5	1	-1	6
Shepherd's-purse	7	-3	-6	4	2
Kochia	-12	16	5	-7	2

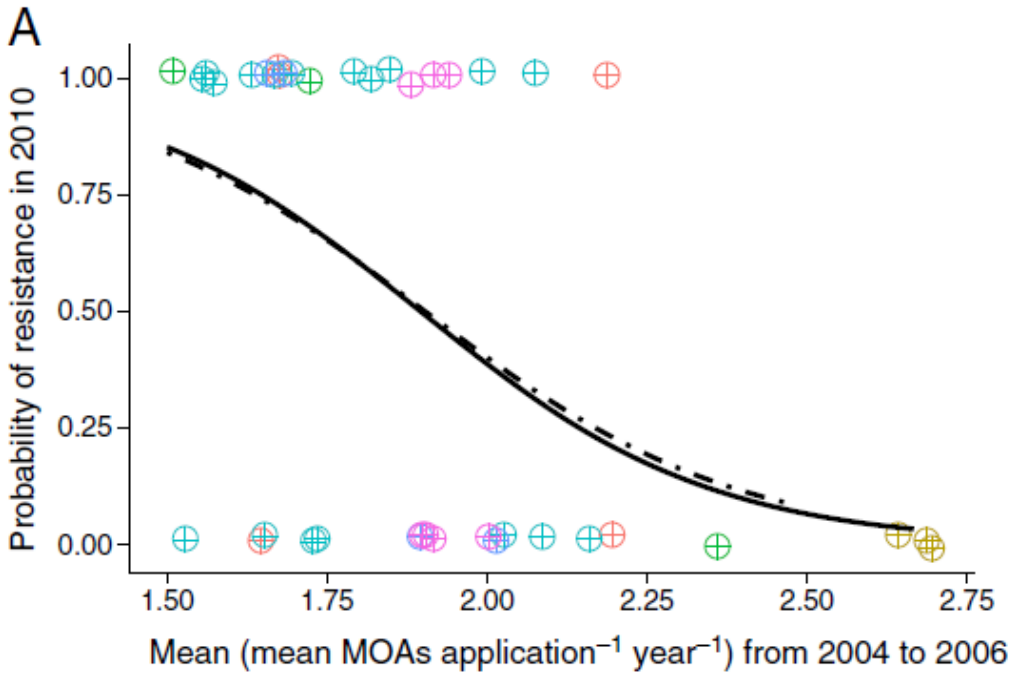
Cleavers in Canola

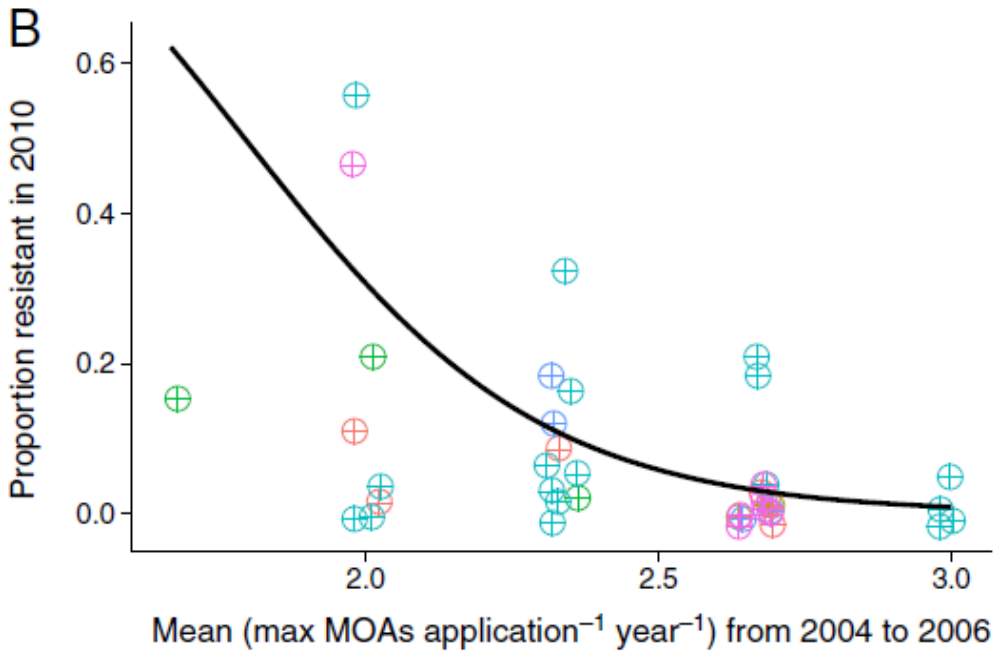
- Highly competitive at low densities
- Seed is difficult to remove from canola seed
- Significantly affect canola grading
- Increase harvest difficultly
- Predicted to be a high risk for glyphosate resistance

HT Herbicide Systems Used in Trials

- Glyphosate
  - Registered for cleavers control on plants up to 15cm
- Glufosinate ammonium
  - Variable Efficacy
- Imazamox + Imazapyr (Ares)
  - Group 2 resistance


Herbicide A or B used alone
Herbicide A and B rotated
Tank-mix of Herbicide A and B
Frequency of Resistant Individuals (%)
100
80
60
40
20
0
0
2
4
6
8
10
12
14
16
Generations





Effect of Number of MOA's used per year on probability of Glyphosate Resistant Waterhemp Illinois and Proportion of Glyphosate Resistant Seed

From: Evans et al. Pest Mgt. Sci. 2015

Potential Herbicides

- Quinclorac
  - Group 4
- Clomazone
  - Group 13
  - Preplant, soil activated

Clomazone

- Trade name: Command
- Bleaching herbicide (Group 13)
- Soybean, cotton, rice, tobacco, vegetables
  - Submission to PMRA for use prior to seeding canola, field pea (?)
- Typically soil applied – PRE
- Susceptible seedlings emerge but are bleached and after a few days become necrotic

Clomazone

- Highly volatile
  - Current formulation is micro-encapsulated to reduce vapor drift.
- Persistence
  - Short to moderate persistence / microbial degradation
  - Soil ½ life = 5 to 60 days
- No HR biotypes reported to date.

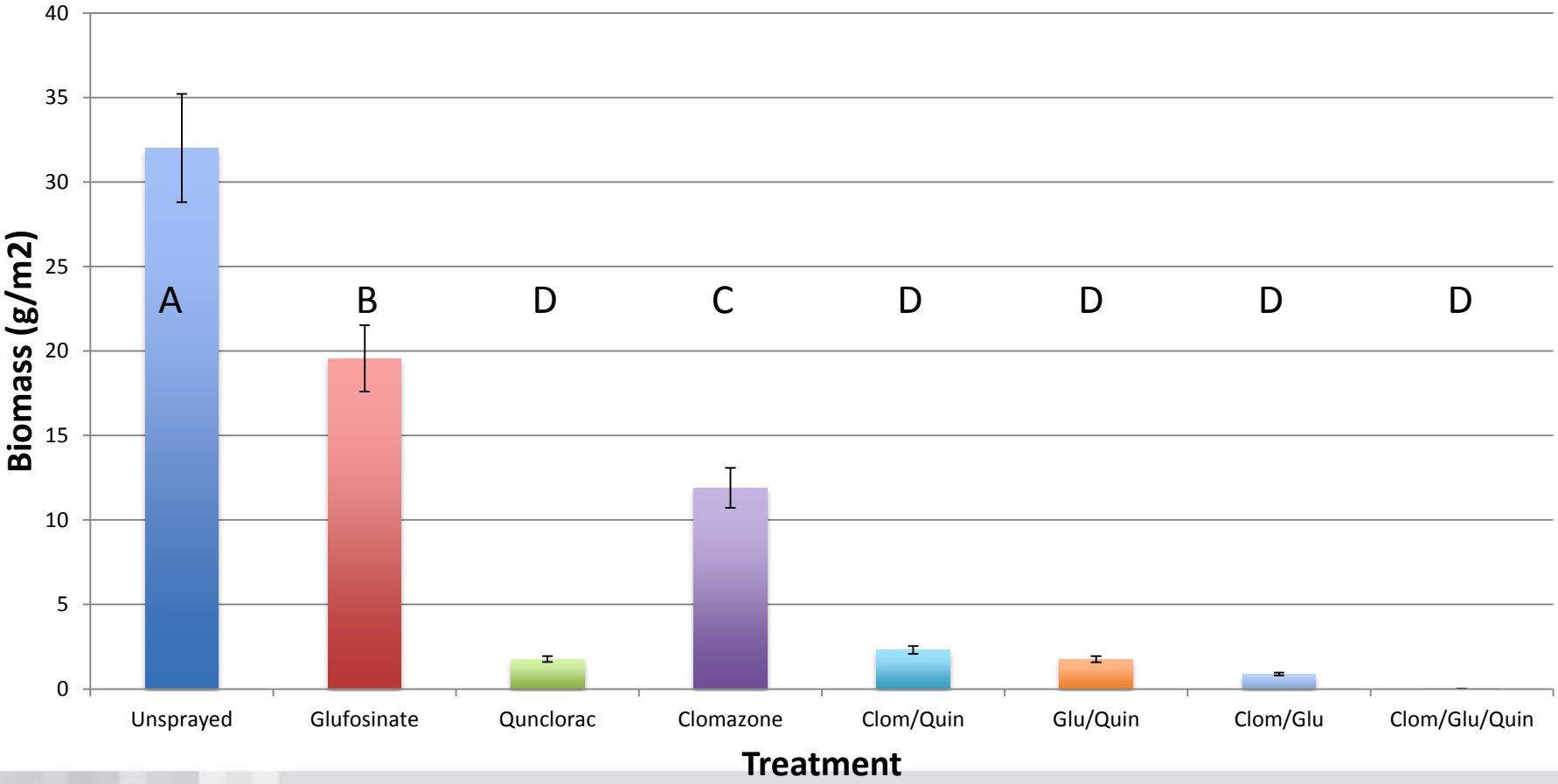
Field Trial Methodology

- Separate trials for each herbicide system
  (Liberty-link, Roundup-Ready, Clearfield)
- RCBD with 8 treatments
- Four reps
- 5 site-years (Scott, Saskatoon, and Rosthern)

Field Trial – Treatment List

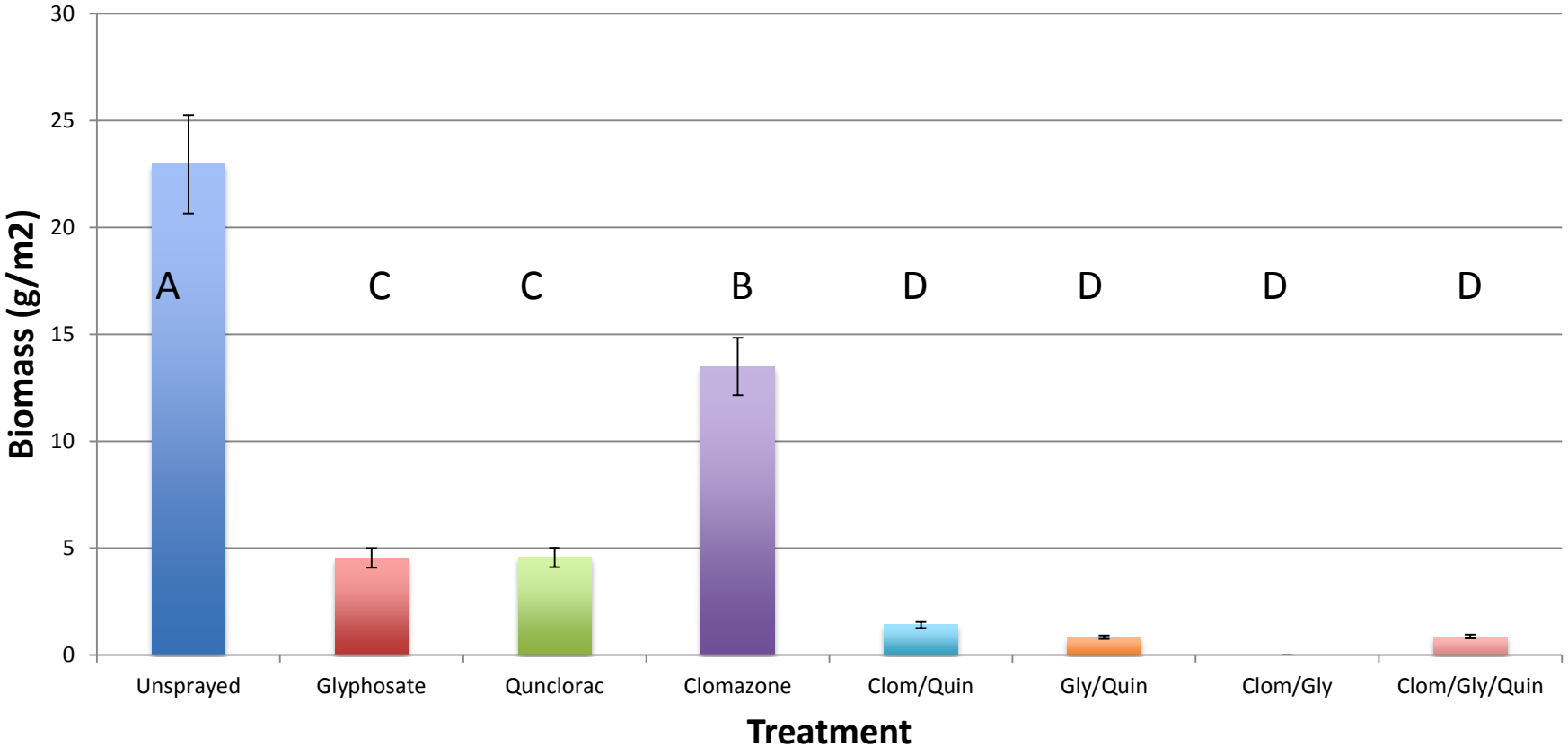
	*FB = followed by
1	Control (untreated check)
2	HT Standard
3	Quinclorac alone (100g ai/ha) + Merge Adjuvant (0.5v/v)
4	Clomoaone Alone (120g ai/ha)
5	Clomoazone (120g ai/ha) FB quinclorac (100g ai/ha) + Merge Adjevant (0.5 v/v)
6	HT Standard (as above) FB quinclorac (50g ai/ha) + Merge Adjevant (0.5 v/v)
7	Clomoazone (120g ai/ha) HT Standard (as above)
8	Clomoazone (120g ai/ha) FB HT STandard (as above) + quinclorac (50g ai/ha) + Merge Adjuvant (0.5 v/v)

Cleavers biomass in glufosinate tolerant canola (2013 & 2014)



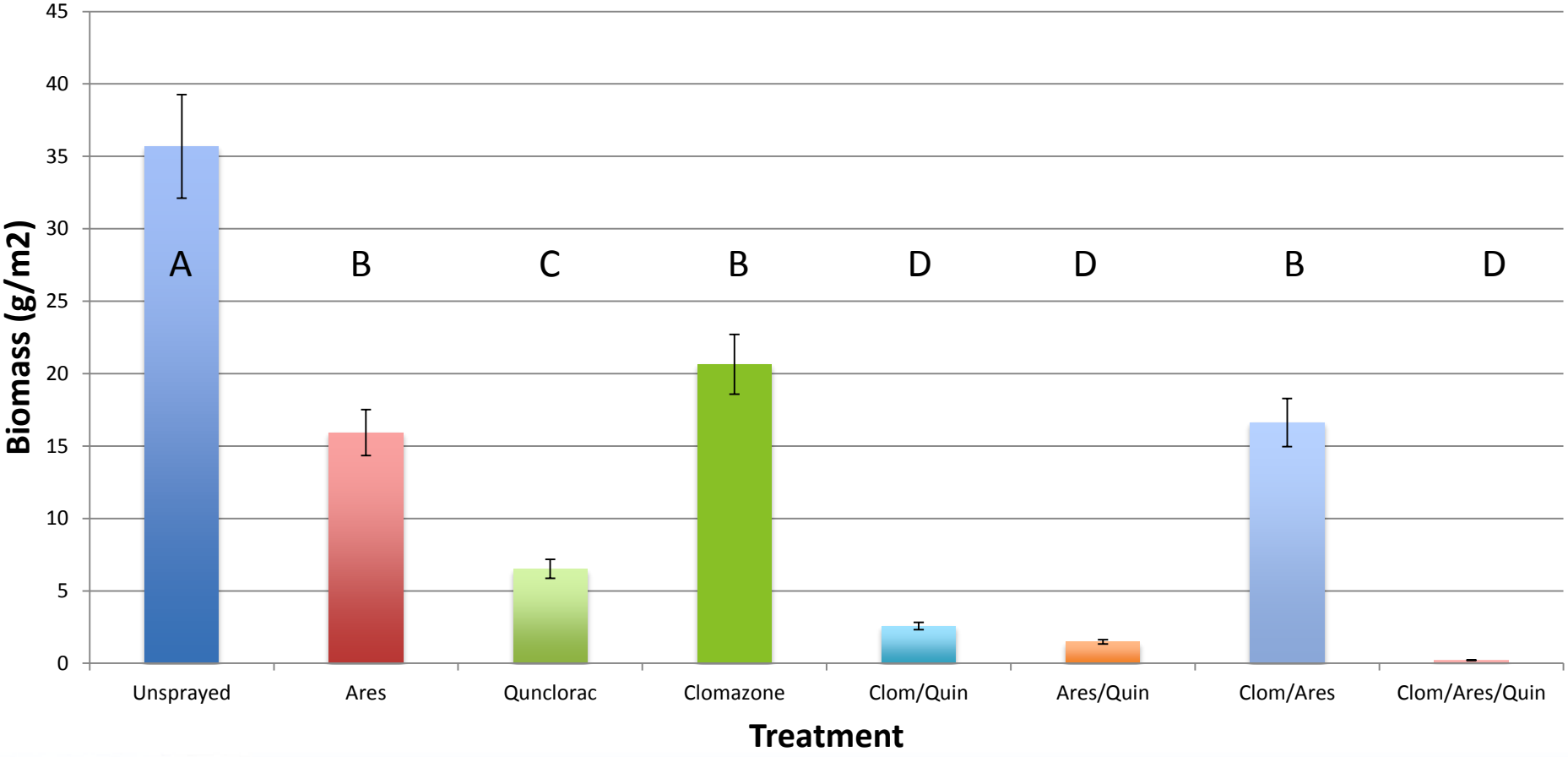
Note: Means with the same letter in the same row are not significantly different (P>0.05). The multi-treatment comparisons using Tukey method. SEM = standard error of mean.

Cleavers biomass in glyphosate tolerant canola (2013 & 2014)



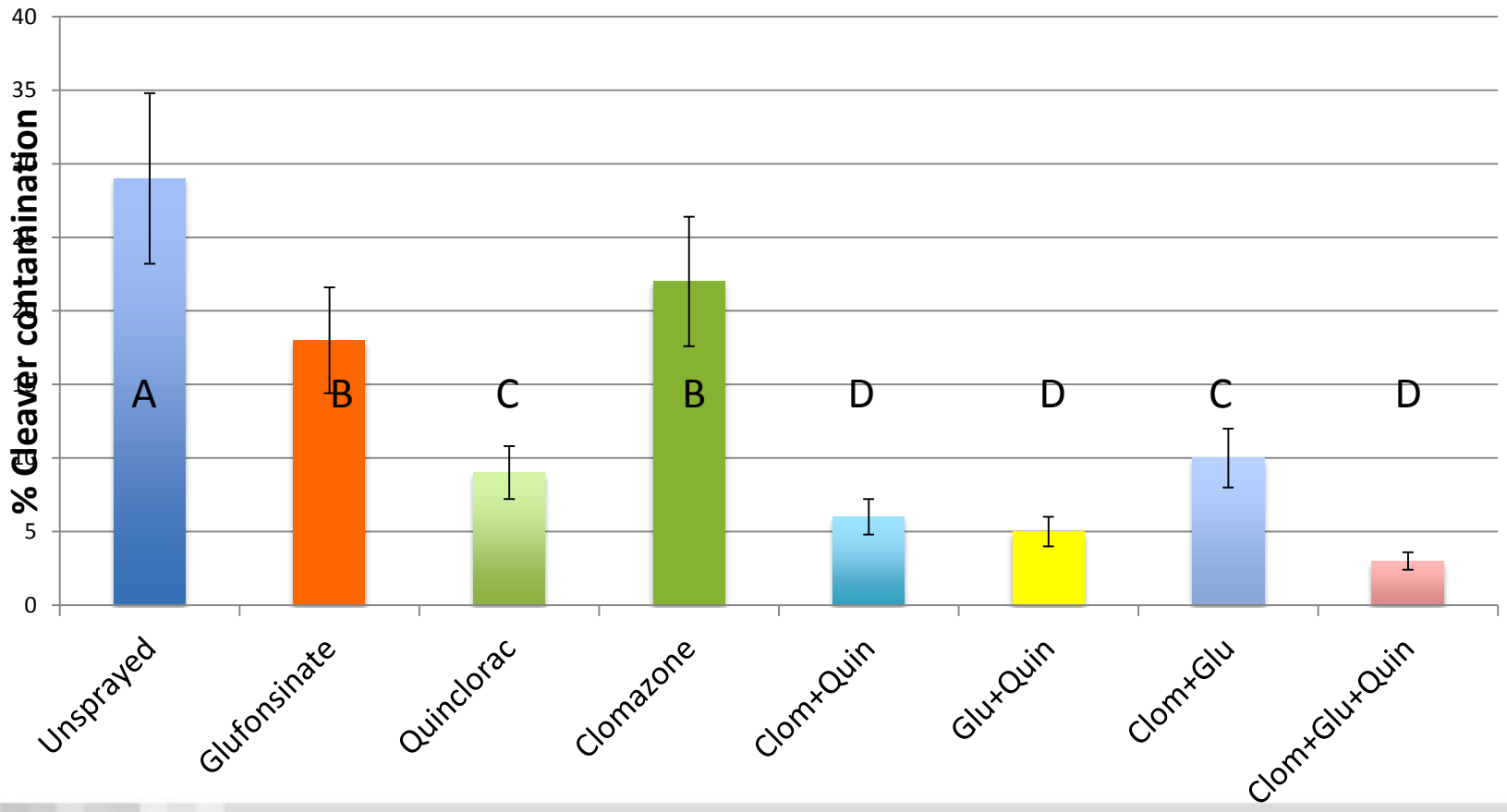
Note: Means with the same letter in the same row are not significantly different (P>0.05). The multi-treatment comparisons using Tukey method. SEM = standard error of mean.

Cleavers biomass in imidazolinone tolerant canola (2013 & 2014)

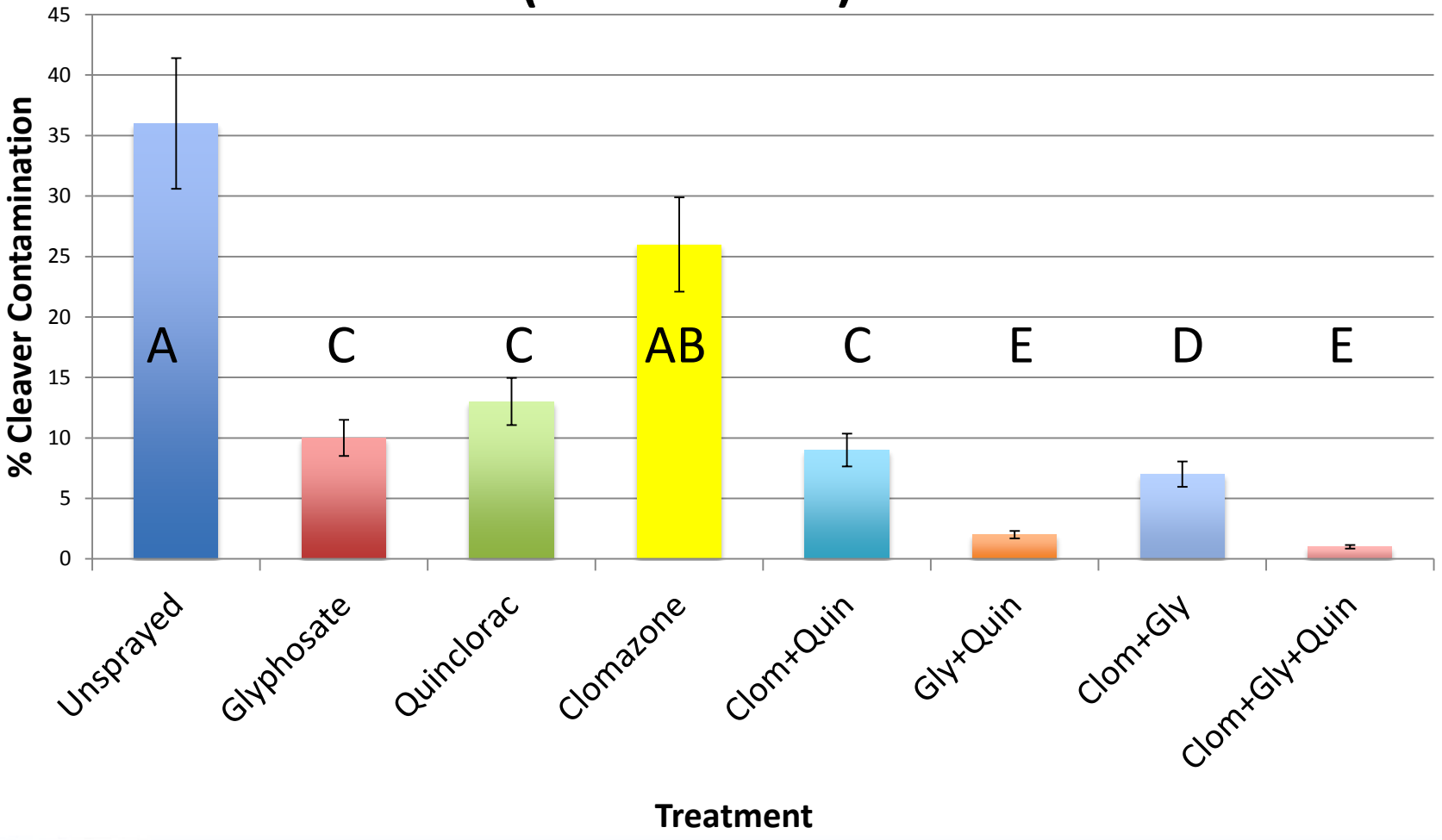


Note: Means with the same letter in the same row are not significantly different (P>0.05). The multi-treatment comparisons using Tukey method. SEM = standard error of mean.

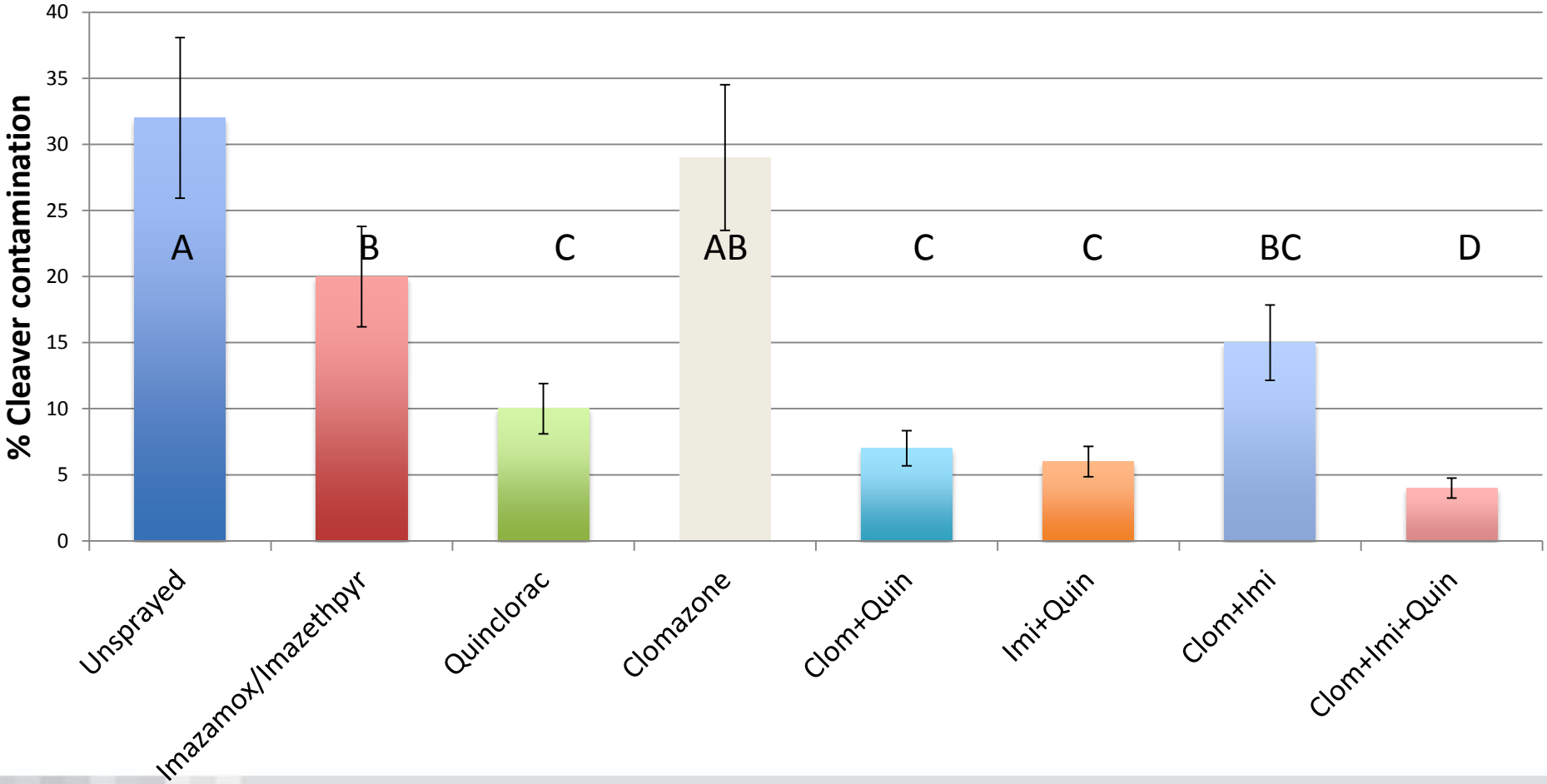
Cleaver contamination in glufosinate tolerant canola (2013 & 2014)



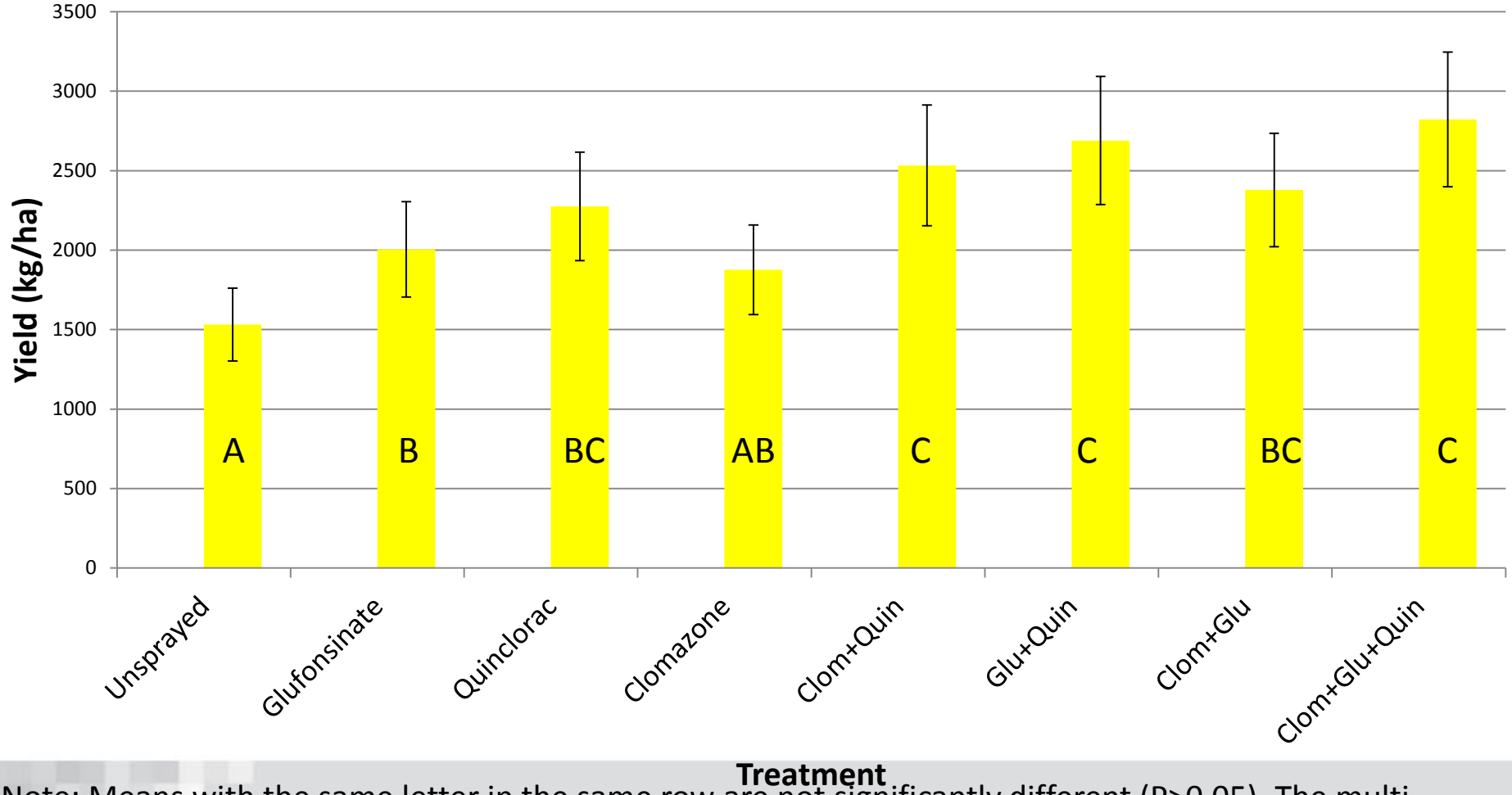
Cleaver contamination in glyphosate tolerant canola (2013 & 2014)



Cleaver contamination in imidazolinone tolerant canola (2013 & 2014)

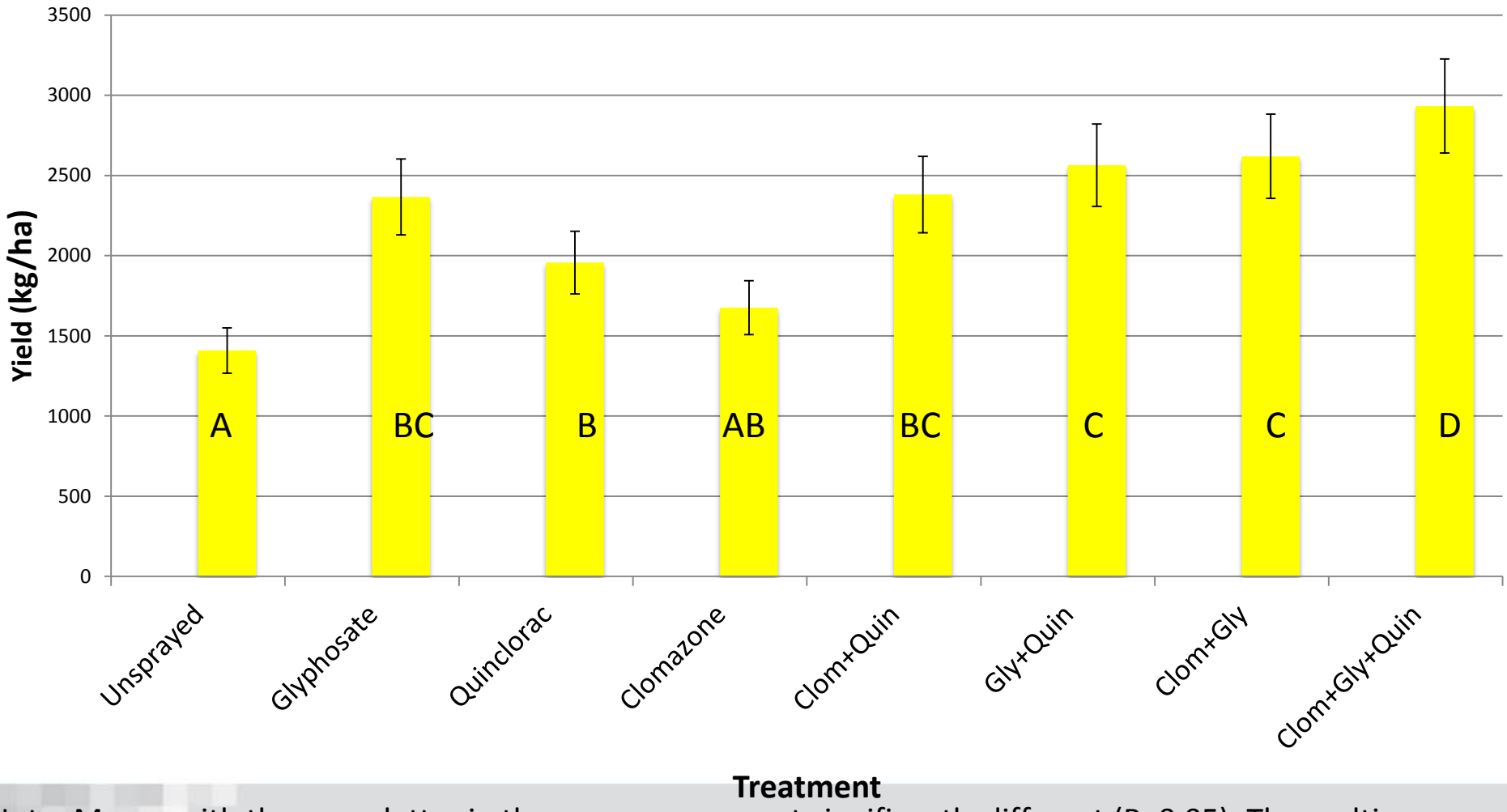


Effects of herbicide treatment on yield in glufonsiate tolerant canola 2013 & 2014



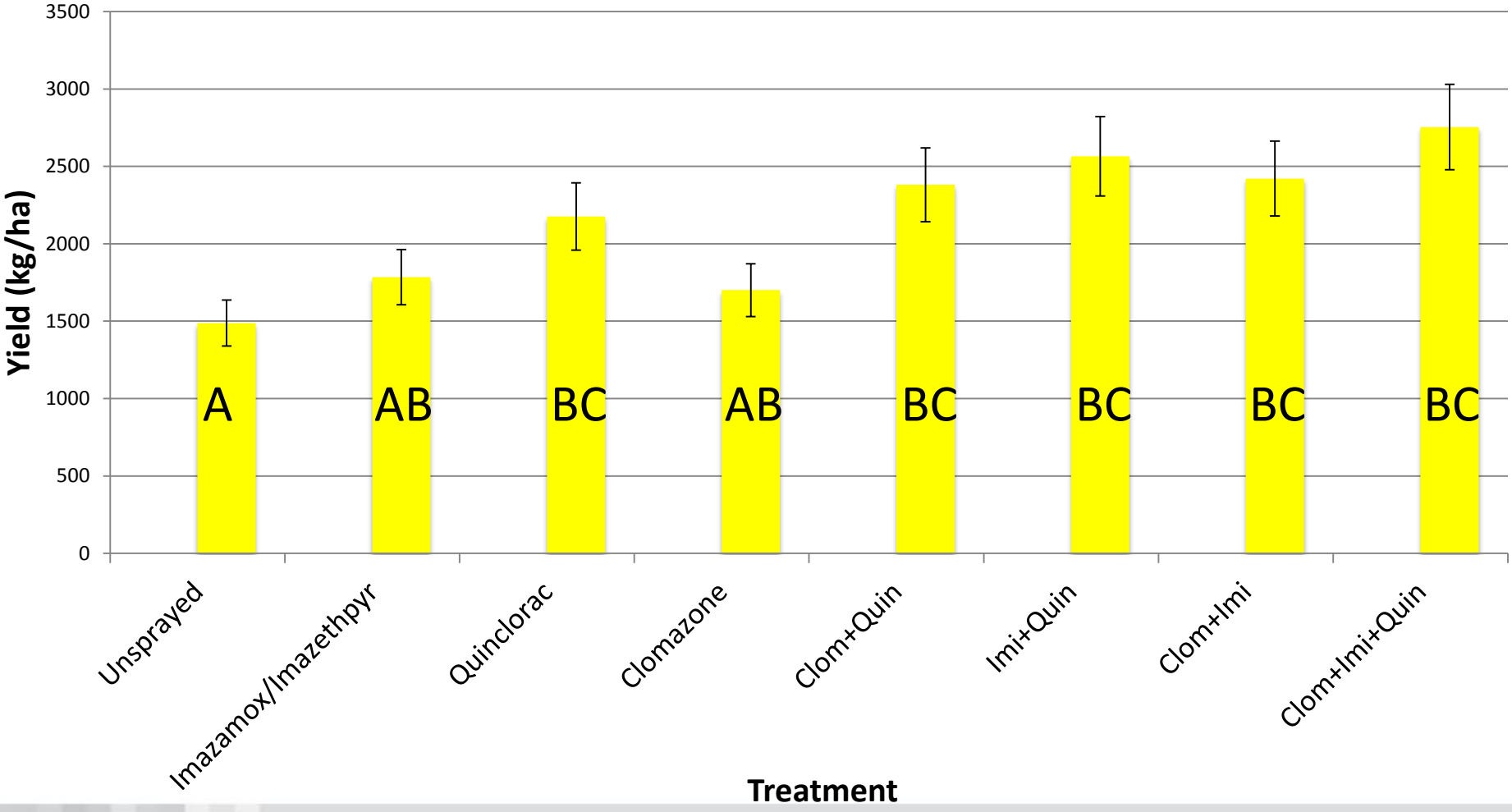
Note: Means with the same letter in the same row are not significantly different (P>0.05). The multi-treatment comparisons using Tukey method. SEM = standard error of mean.

Effects of herbicide treatment on yield in glyphosate tolerant canola 2013 & 2014



Note: Means with the same letter in the same row are not significantly different (P>0.05). The multi-treatment comparisons using Tukey method. SEM = standard error of mean.

Effects of herbicide treatment on yield in imidazolinone tolerant canola 2013 & 2014



Note: Means with the same letter in the same row are not significantly different (P>0.05). The multi-treatment comparisons using Tukey method. SEM = standard error of mean.

Clomazone on Cleavers

Symptoms from clomazone (Command) on *Brassica* – Group 13

Symptoms from clomazone (Command) on *Brassica* – generally transient

Clomazone Symptoms


Command 200 g

Herbicide Layering in Pulses

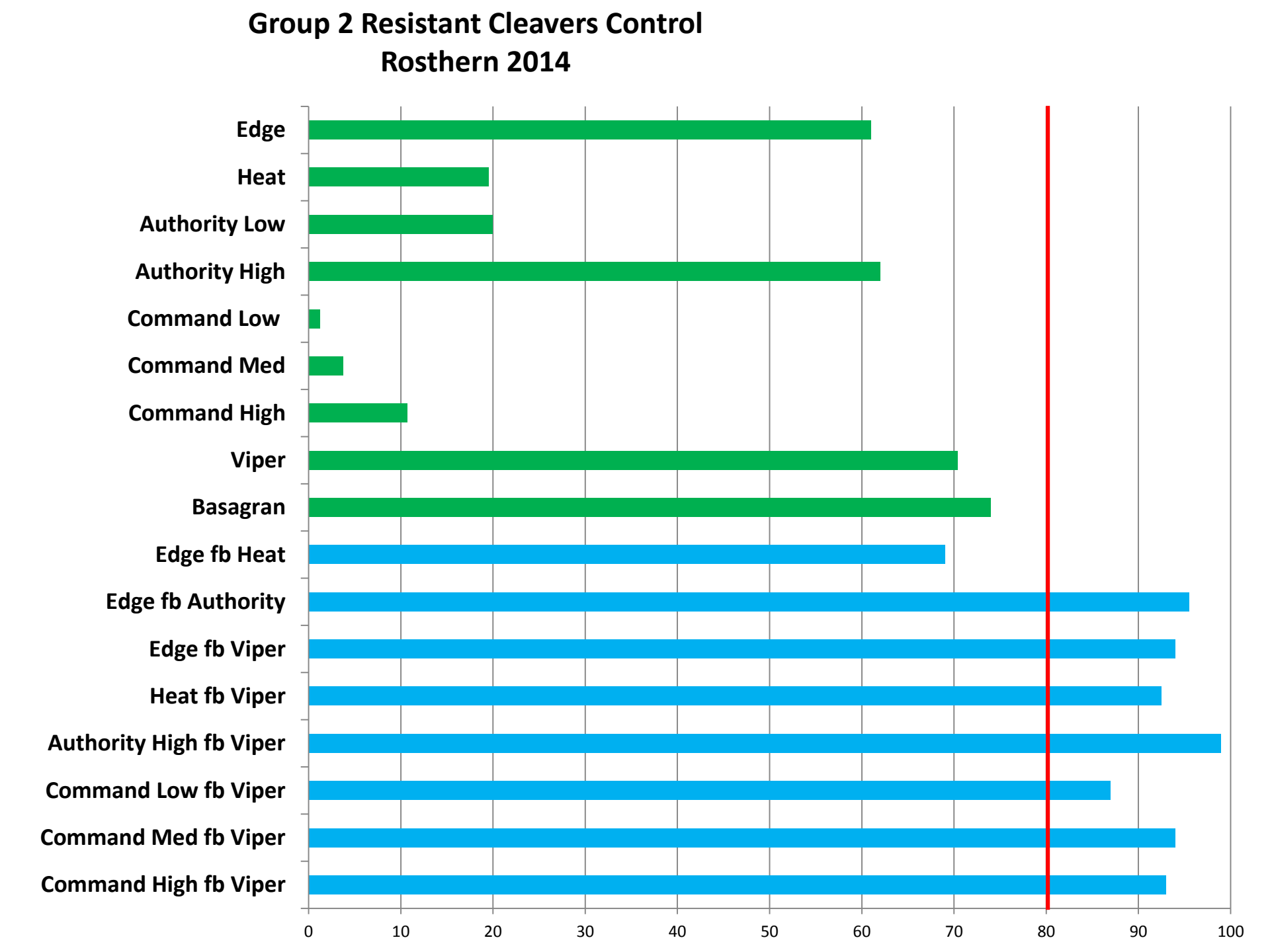
- Using both pre- and post-emergent herbicides of different modes of action to reduce risk of weed resistance and improve overall weed control.
- Have focused on controlling Group 2 resistant cleavers on soils with organic matter > 5%

Herbicide Layering in Pulses

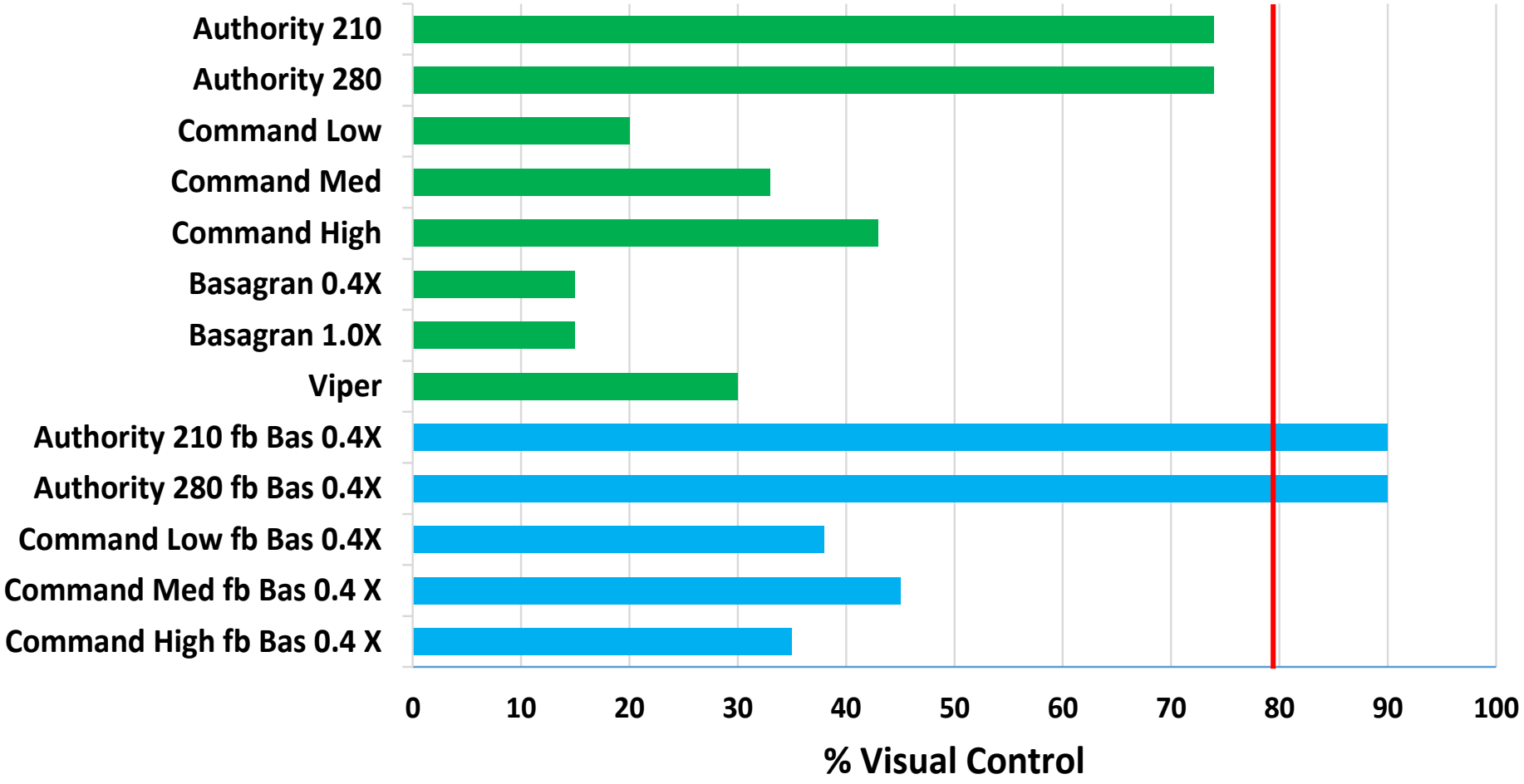
- Pre- is a short or medium-term residual product
  - Concept is to reduce weed population for in-crop application
  - Resistance is a numbers game, reduce the numbers, reduce selection pressure.
- Ideal is to use different herbicide groups, 3 to 4 MOA in the crop

Pulses

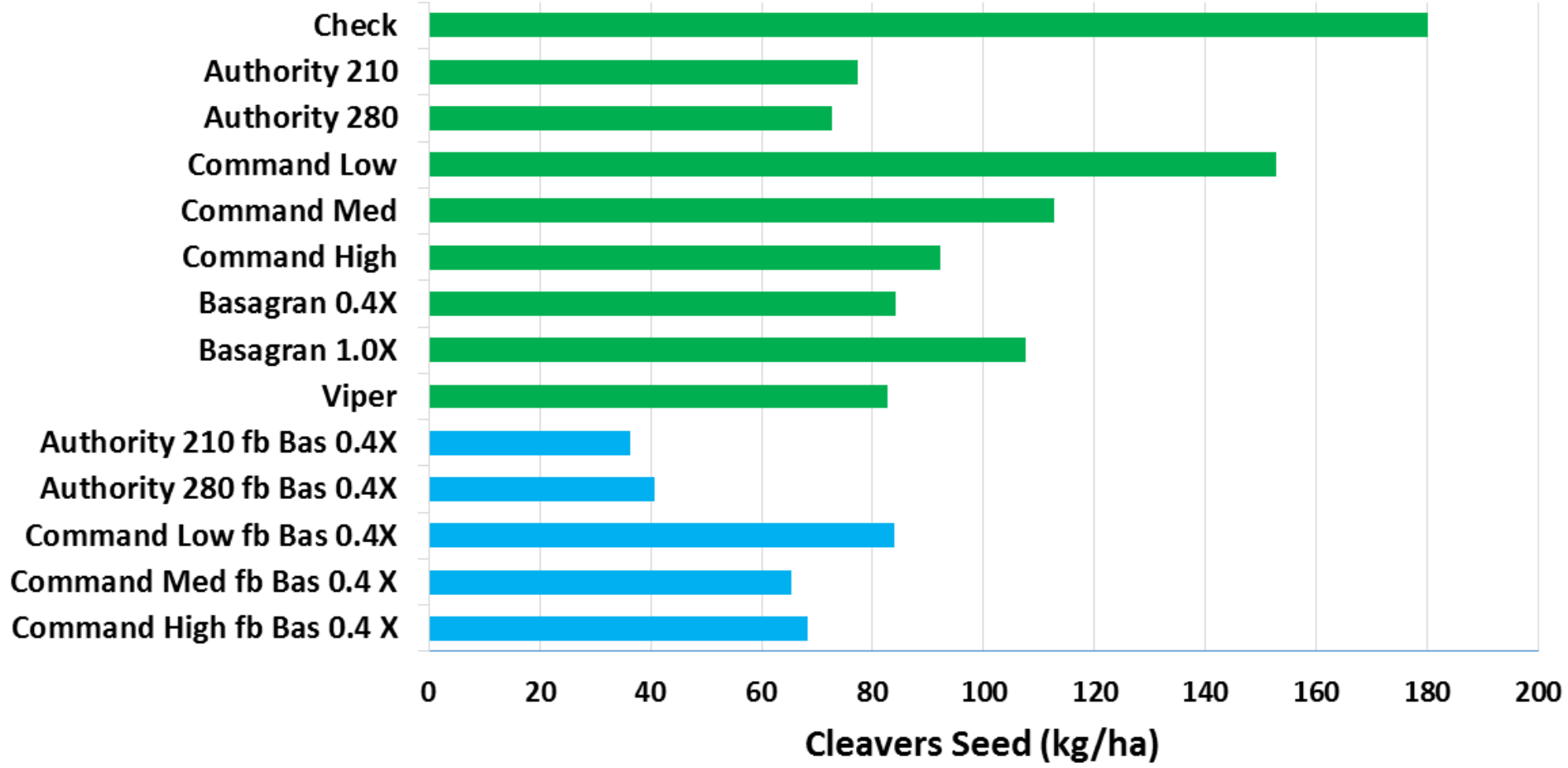
- Pre-
  - Edge – Group 3; Fortress – Group 3 & 8
  - Authority, Valterra, Heat – Group 14
  - Focus – Group 15
- Post-
  - Odyssey, Pursuit – Group 2
  - Viper – Group 2 & 6


Group 2 Resistant Cleavers Control
Rosthern 2014
Edge
Heat
Authority Low
Authority High
Command Low
Command Med
Command High
Viper
Basagran
Edge fb Heat
Edge fb Authority
Edge fb Viper
Heat fb Viper
Authority High fb Viper
Command Low fb Viper
Command Med fb Viper
Command High fb Viper
0
10
20
30
40
50
60
70
80
90
100

Group 2 Resistant cleavers control Rosthern 2015



Group 2 Resistant cleavers seed production Rosthern 2015



Conclusions

- Benefits to using Multiple Mechanisms of Action for managing cleavers in canola
  - Short-term economics?
  - Are farmers willing to spend more money on weed control to help prevent a future problem?
- Herbicide layering still in conceptual stage; more research required to quantify potential benefits.

NEWS

Russian thistle, Flickr.com

Glyphosate-resistant Russian thistle found in Montana

By **Montana State University** on Mar 4, 2016 at 3:46 p.m.

Acknowledgements
Weeds Crew 2015

Saskatchewan Pulse Growers

SaskCanola
Saskatchewan Canola Development Commission