An innovative approach to managing weeds in oats

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Rationale

- Weed management is a challenge for oat producers
  - Reduced plant stands
  - Reductions in yield and quality
  - Downgrading of sample

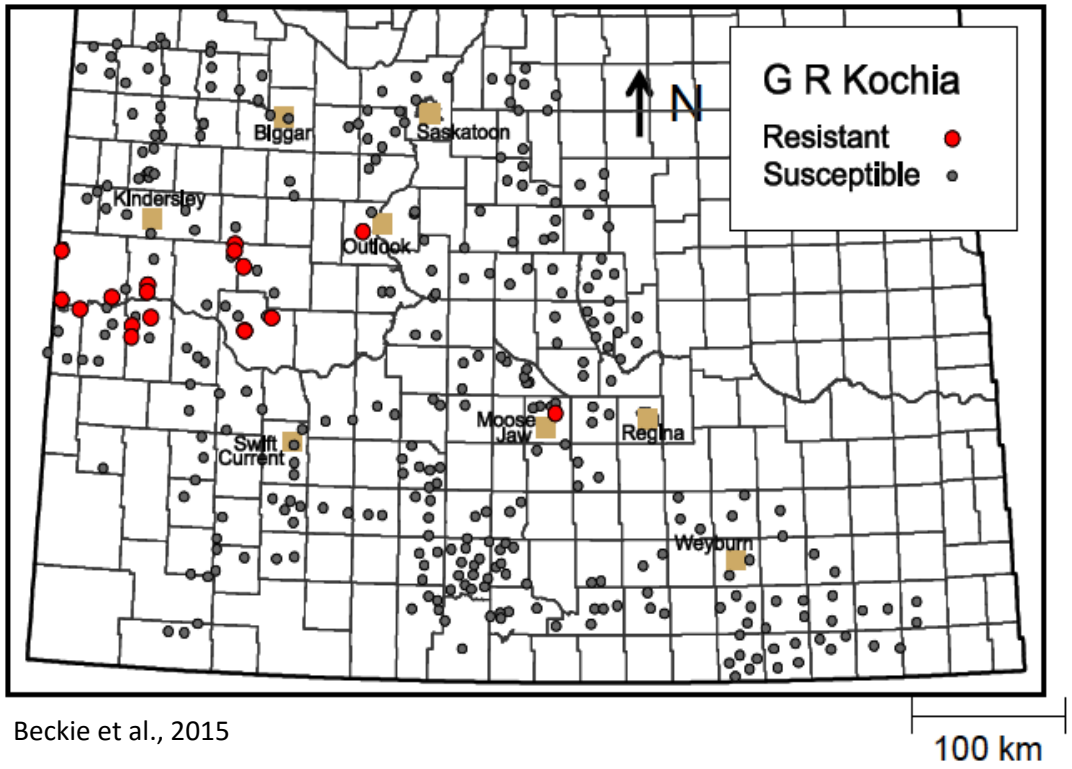
Rationale

- Wild Oat
  - Most problematic weed in oat production
  - #2 most abundant on Prairies
  - Cannot be selectively removed from oat

Rationale

- Kochia
  - Highly competitive
  - Spreading rapidly
  - #10 most abundant on Prairies
  - Herbicide resistance
    - Group 4 resistance in USA

Glyphosate-resistant Kochia



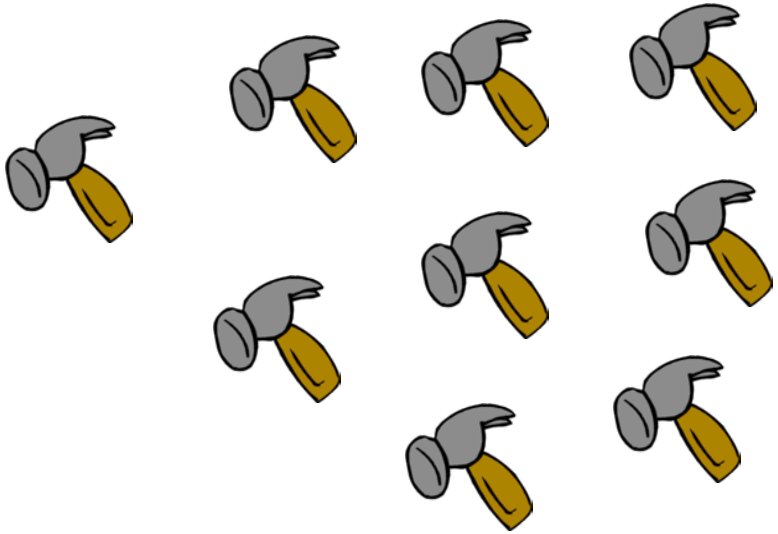
Beckie et al., 2015

- 17 GR kochia populations confirmed in SK
- 2 in MB
- Multiple resistant
  - Gr 2 – SU's

Rationale

- Increasing multiple herbicide resistance in kochia and wild oat
- Limited herbicide options in oat
  - Kochia – can use Group 4's but:
    - Dicamba and fluroxypyr resistance in MT and ND
- Integrated weed management is necessary
  - Few control options for both species

"MANY LITTLE HAMMERS"



- Using multiple tactics to manage weeds
- None of individual control measures provide acceptable control on their own

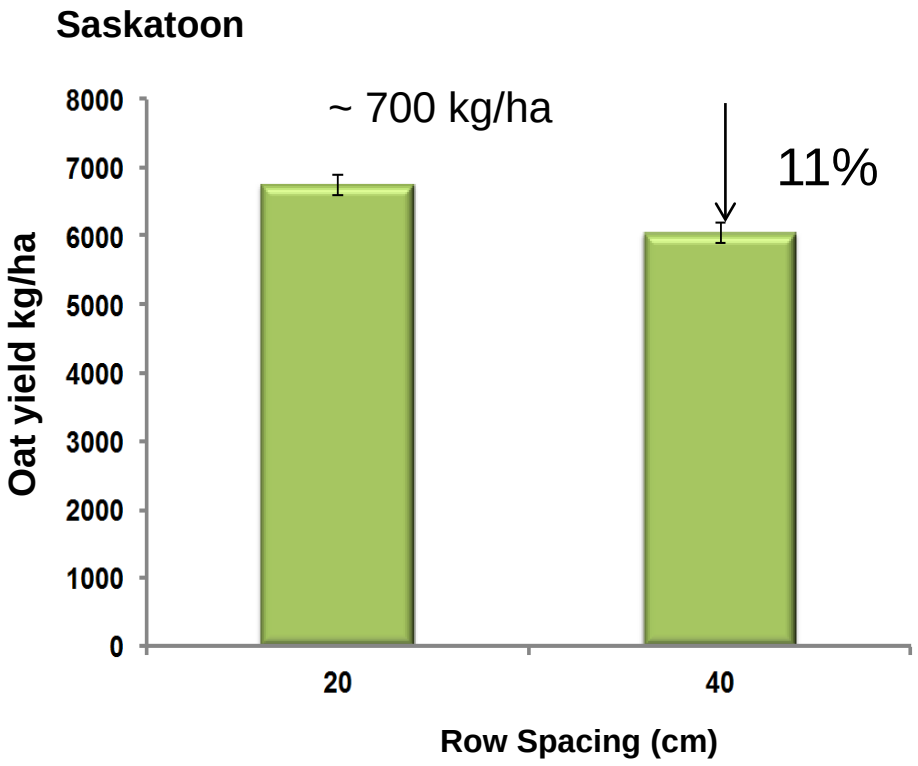
Treatments – IWM in oat

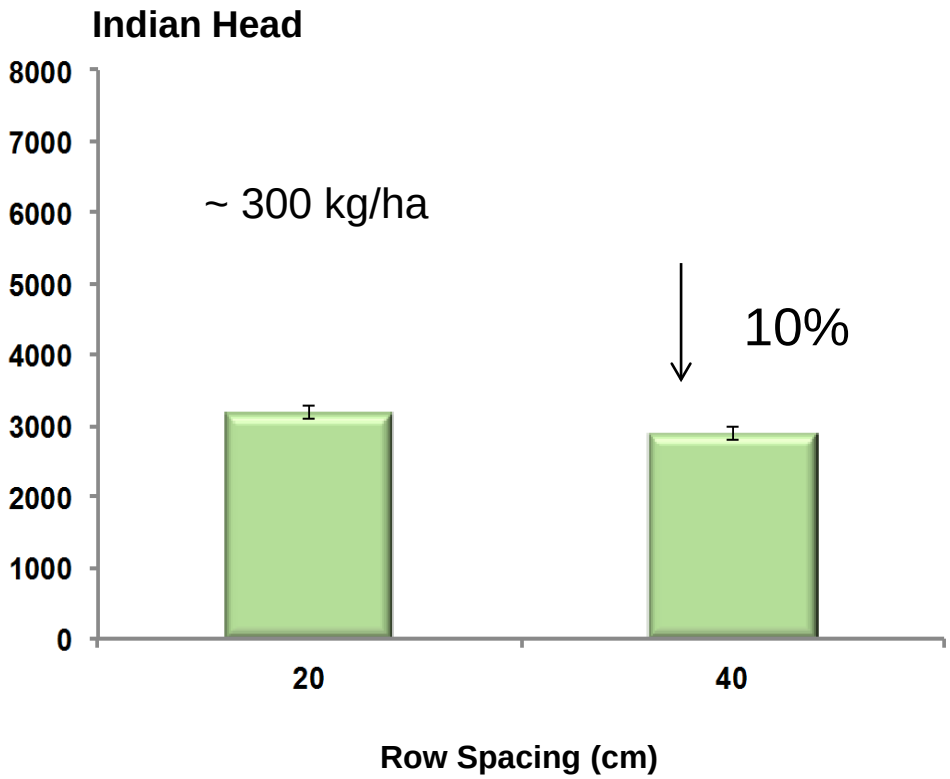
- Rotation – O-O-O-O-O; O-C-O-P-O; O-C-B-P-O
- Oat Cultivar: Short ('Summit'); Tall ('CDC Seabiscuit')
- Seeding Rate (oat only) – 1X or 2X (200 or 400 seeds m^{-2})
  - Summit – 1.5 and 3.0 bu/ac; Seabiscuit – 2.0 and 4.0 bu/ac
- Row Spacing – narrow (20 cm) or wide (40 cm)
  - All crops in all years
- Treatments applied to same plots year after year – cumulative treatment effects (5 year)

Experimental Procedures

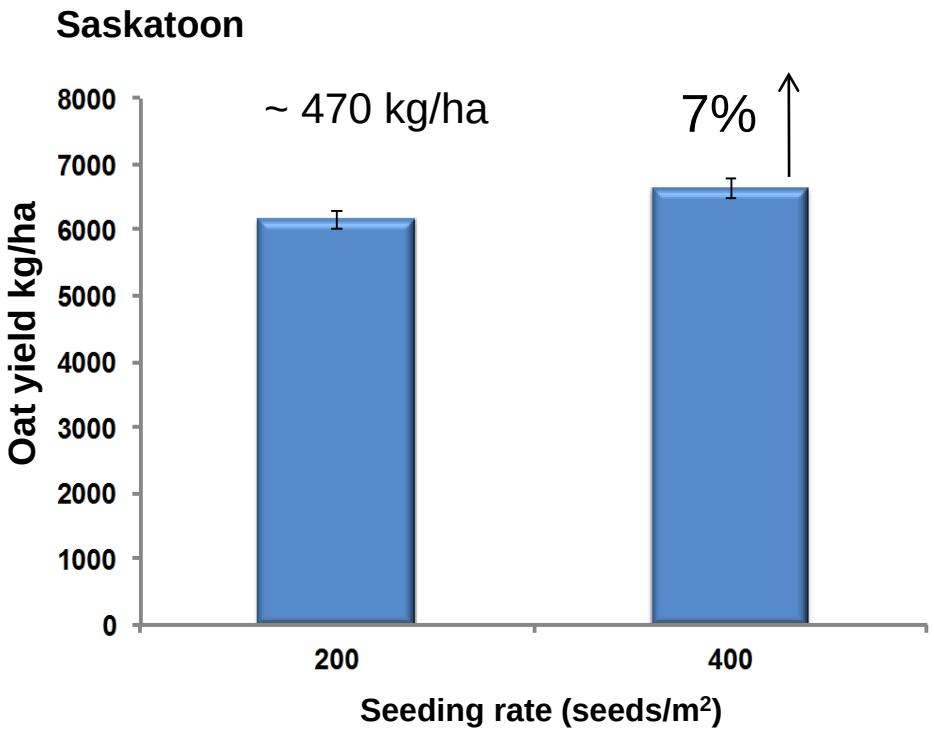
- Kernen Crop Research Farm (Saskatoon) and AAFC Indian Head, 2013-2018
- Wild oat and kochia planted at 100 seeds/m2
- Split-plot, 4 reps/site
- Fertilizer applied @ 100% soil test recommendations
- Herbicides specific to each crop
  - Minimal effects on kochia and wild oat

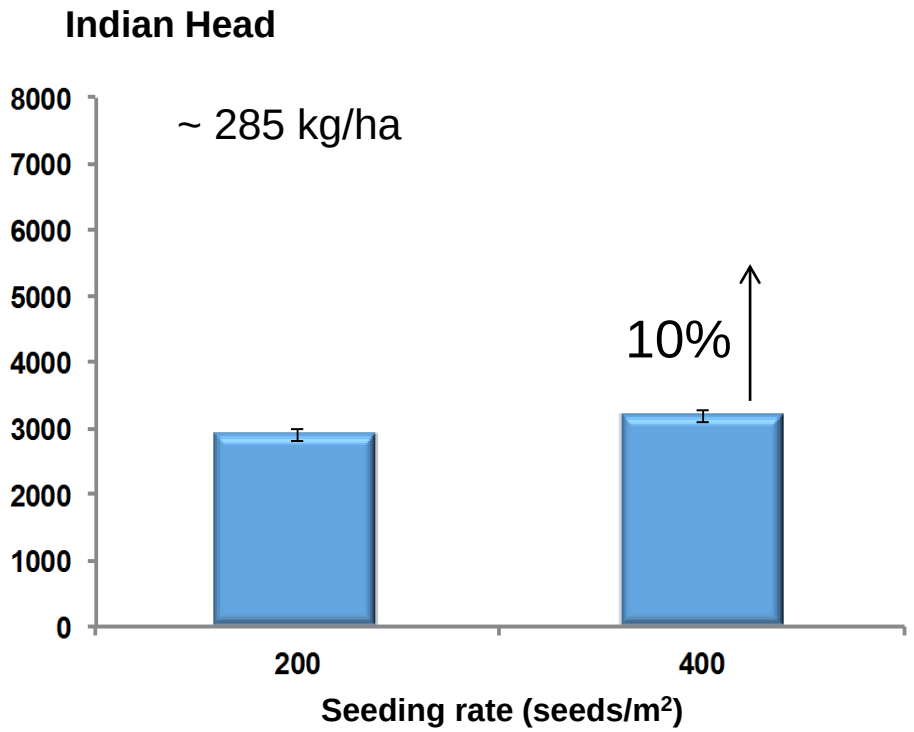
Oat Yield – Row Spacing



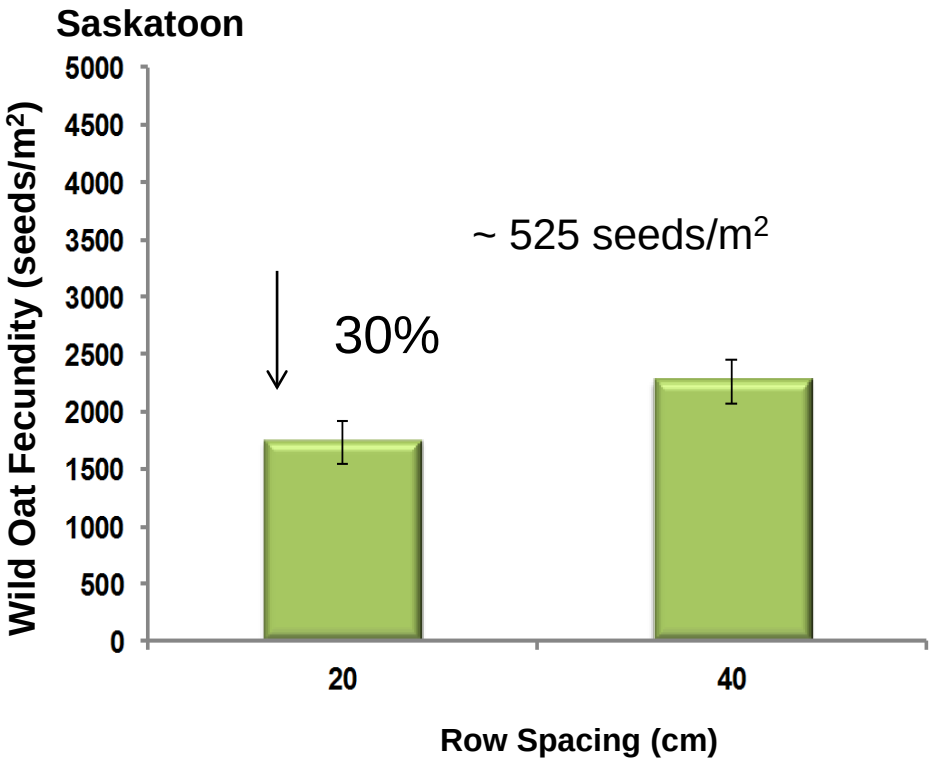


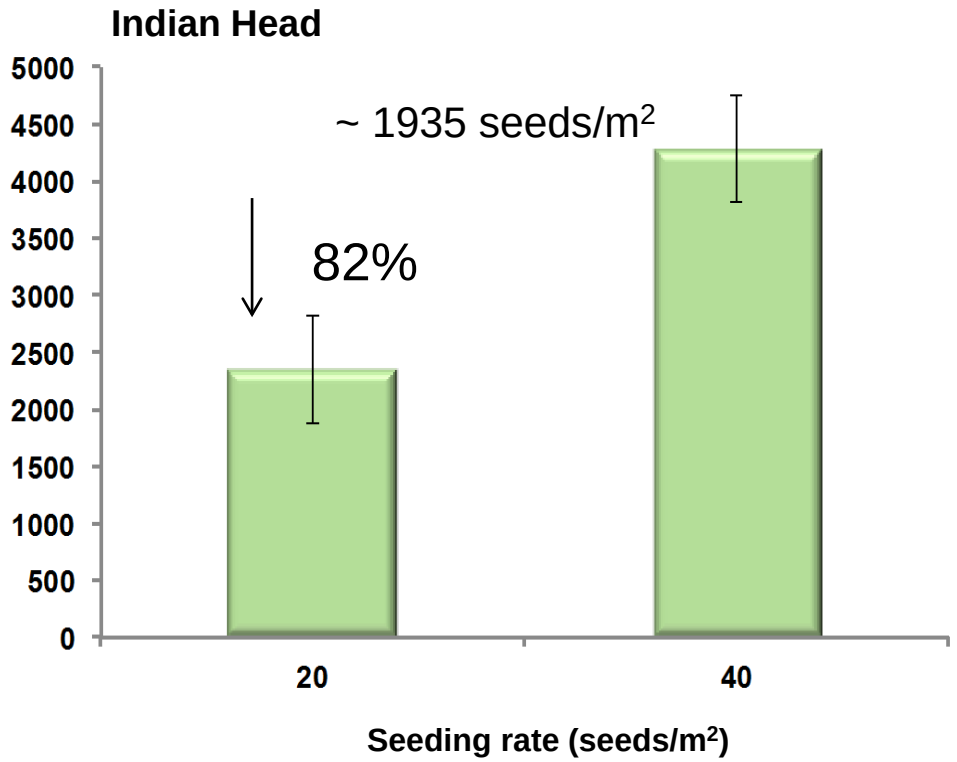
Oat Yield – Seeding Rate



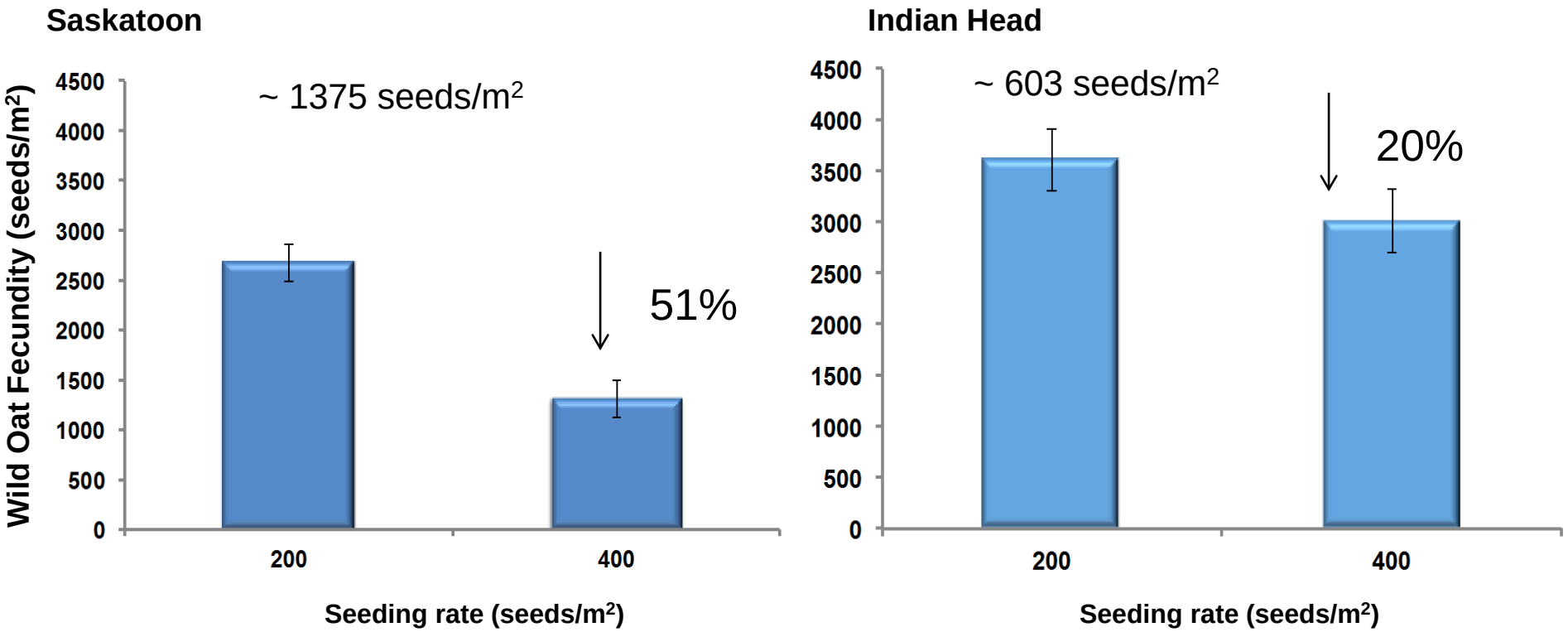


Wild Oat Fecundity- Row Spacing

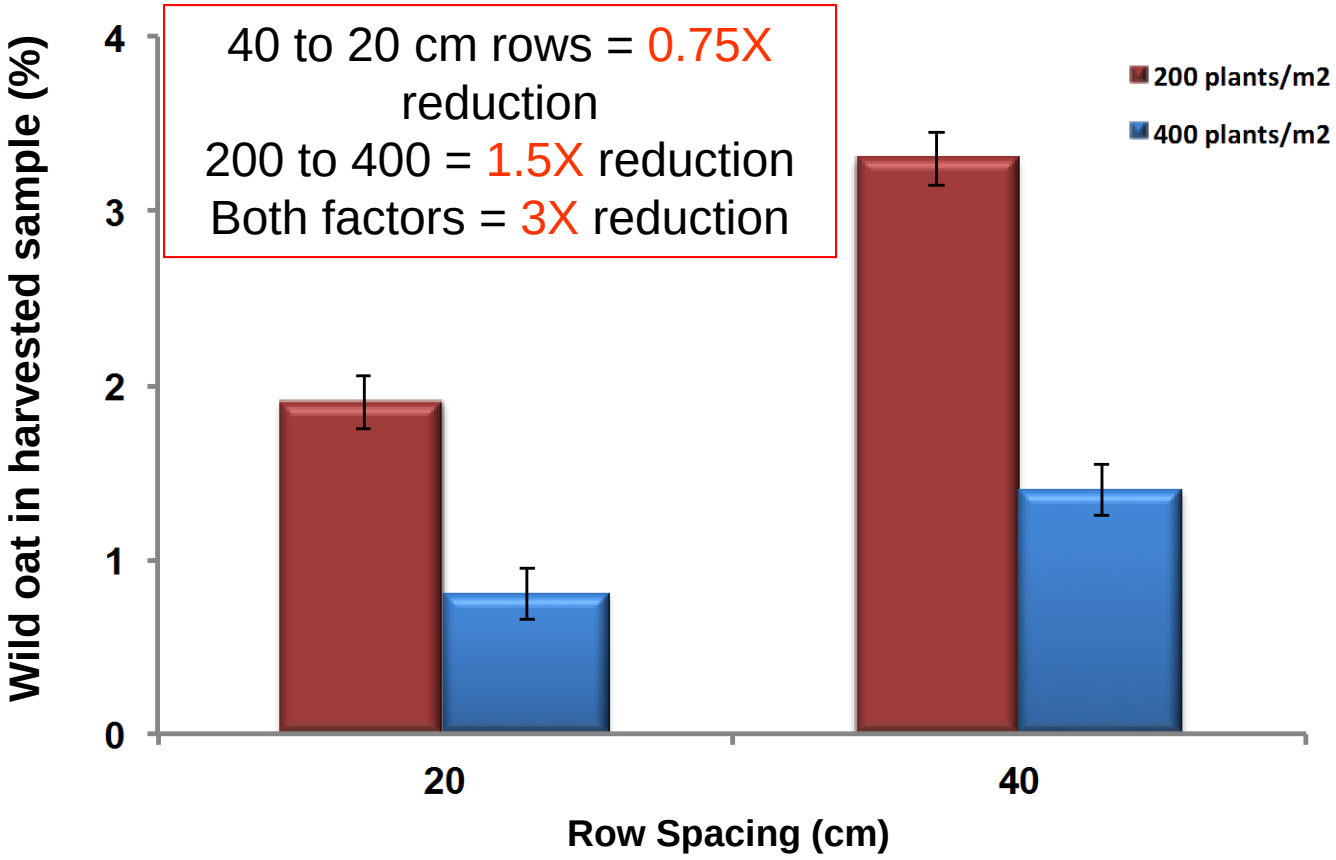




Wild Oat Fecundity- Seeding Rate



Wild Oat Contamination- Saskatoon



But sometimes you neec
a big hammer!

Screening for new herbicide options in oat

Drew Weibel

Experimental Procedure

2 Sites- 4 Site Years

- Scott, Saskatoon

RCBD- 4 replications

I. Kochia Control

- Kochia density: 100 plants m^{-2}
  - Broadcast and rolled, no crop

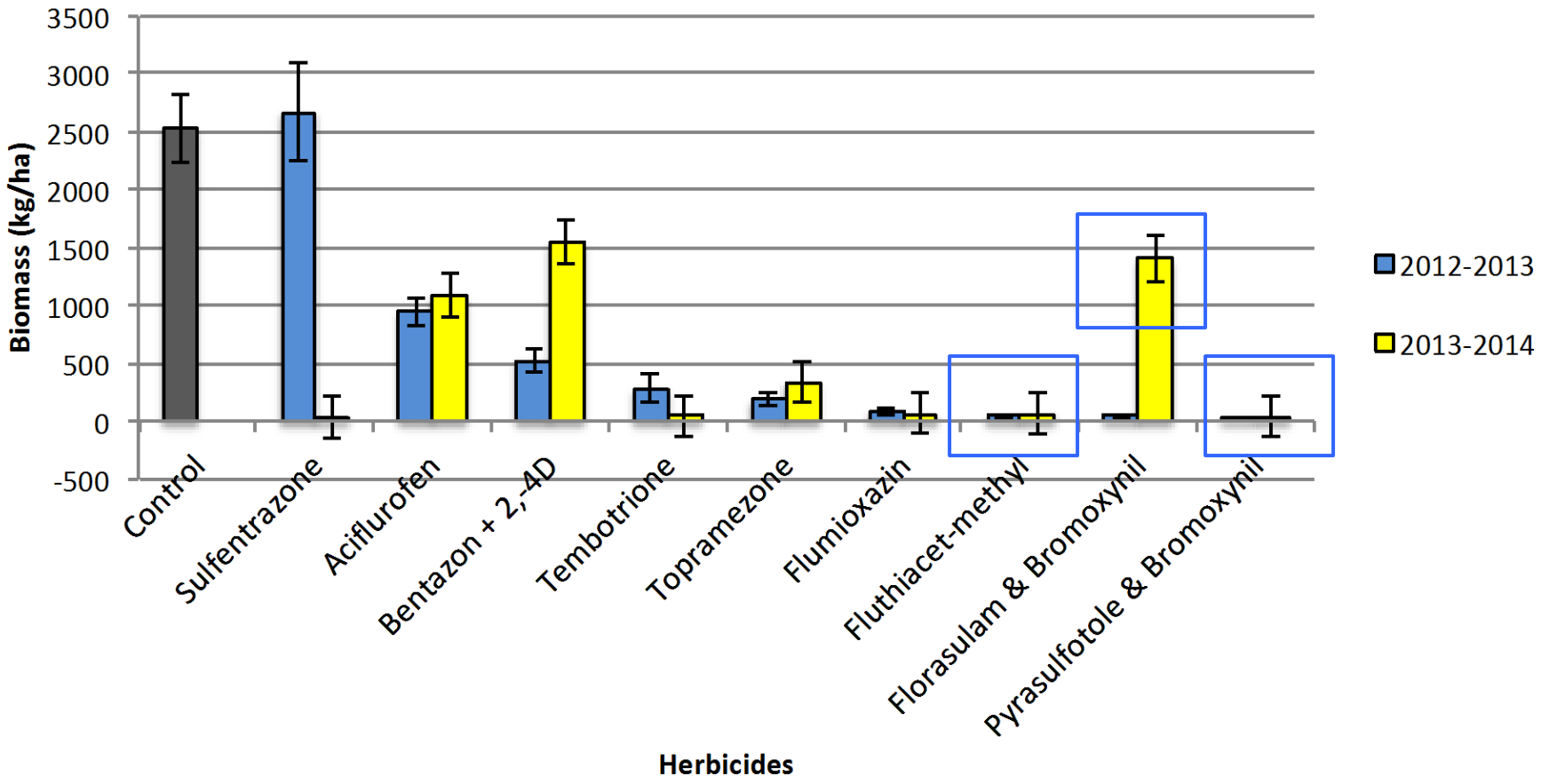
II. Crop Tolerance

CDC Seabiscuit : 300 plants m^{-2} 1x & 2x herbicide rates

Treatment Applications

Chemical Name	Trade Name	Rate (1x) (g a.i. ha^{-1})	Rate (2x) (g a.i. ha^{-1})	Group
Control	--	---	---	--
Sulfentrazone	Authority	150	300	14
Fluthiacet-methyl	Cadet	4	8	14
Flumioxazin	Valtera	110	220	14
Aciflurofen	Blazer	296	592	14
Bentazon + 2,4-D	Basagran + 2,4-D	475	950	6
Florasulam & Bromoxynil	Benchmark	5 + 280	10 + 560	(2,6)
Pyrasulfotole & Bromoxynil	Infinity	31+ 170	62 +340	27
Topramezone	Impact	12.5	25	27
Tembotrione	Laudis	90	180	27

Kochia Control



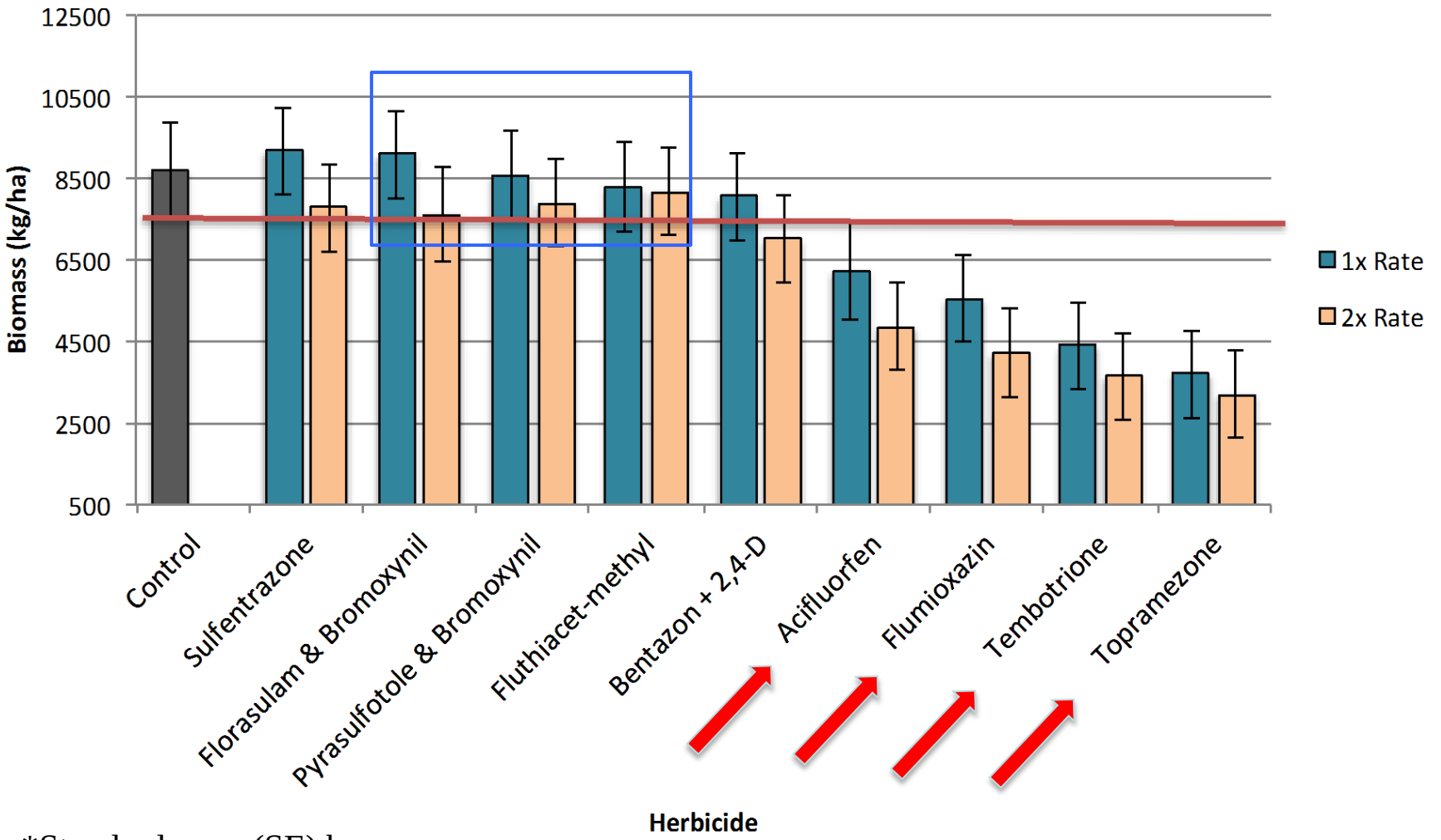
Florasulam & Bromoxynil

Control

Fluthiacet-methyl

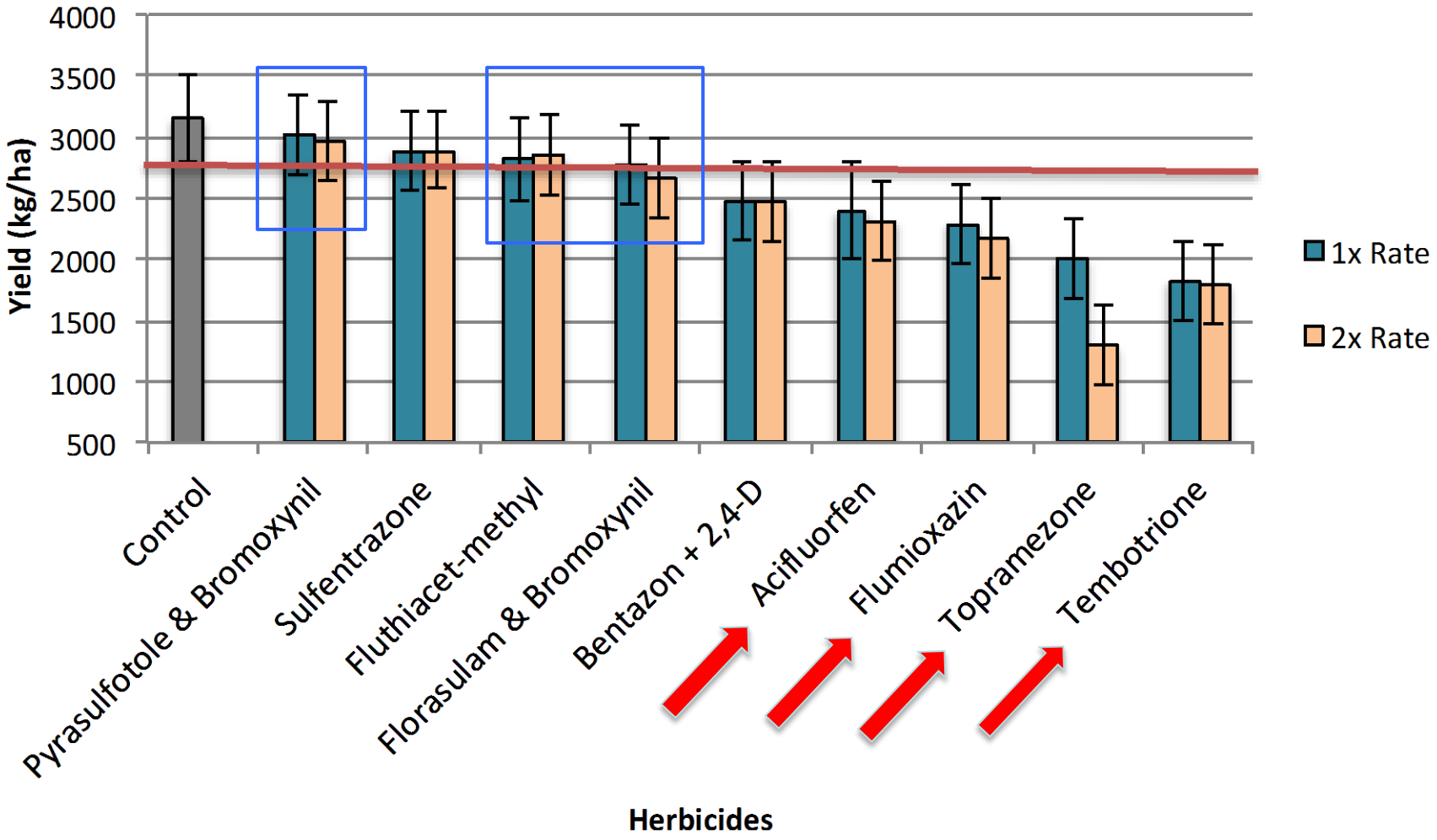
Pyrasulfotole & Bromoxynil

2014 Oat Biomass



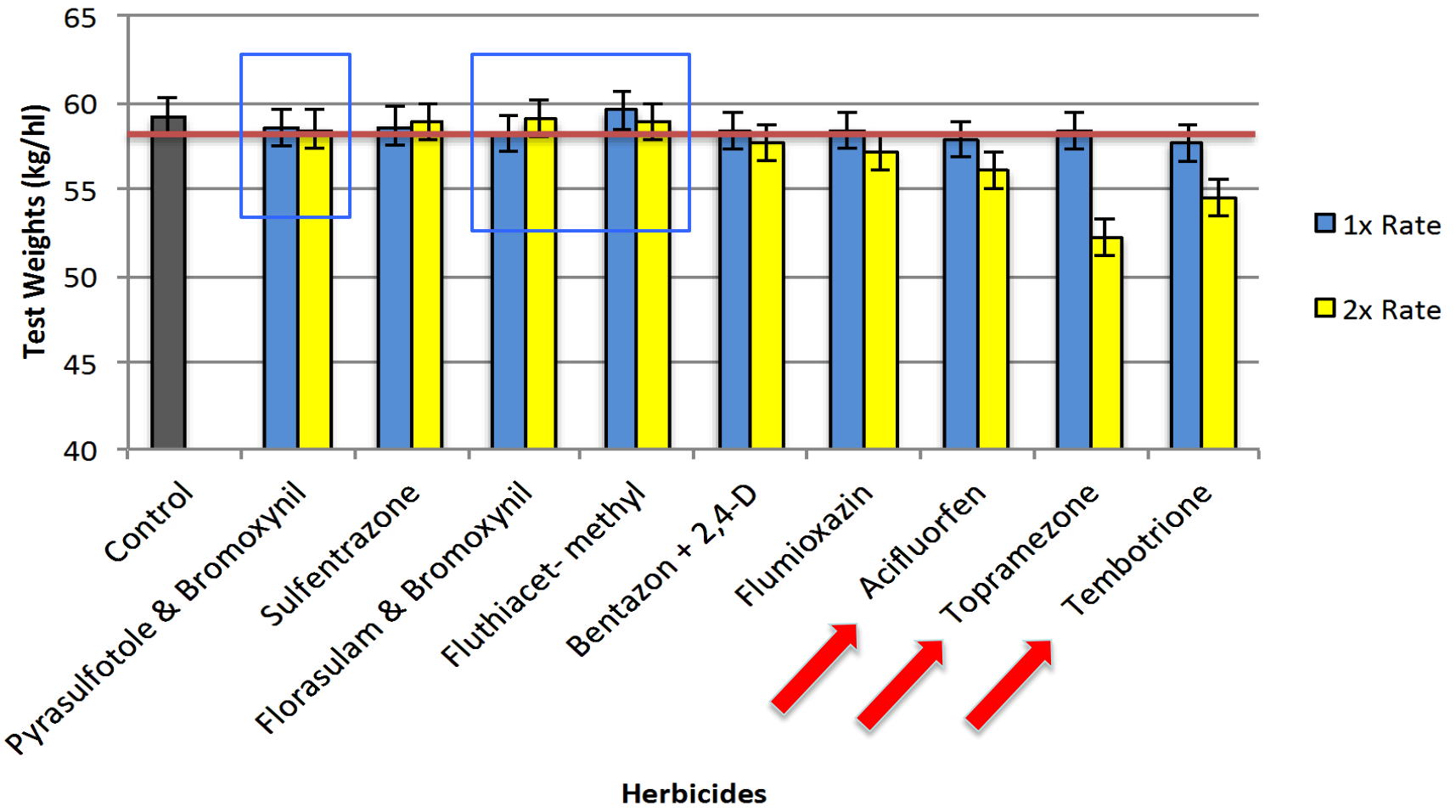
*Standard error (SE) bars

2014 Oat Grain Yield



*Standard error (SE) bars

2014 Oat Test Weights



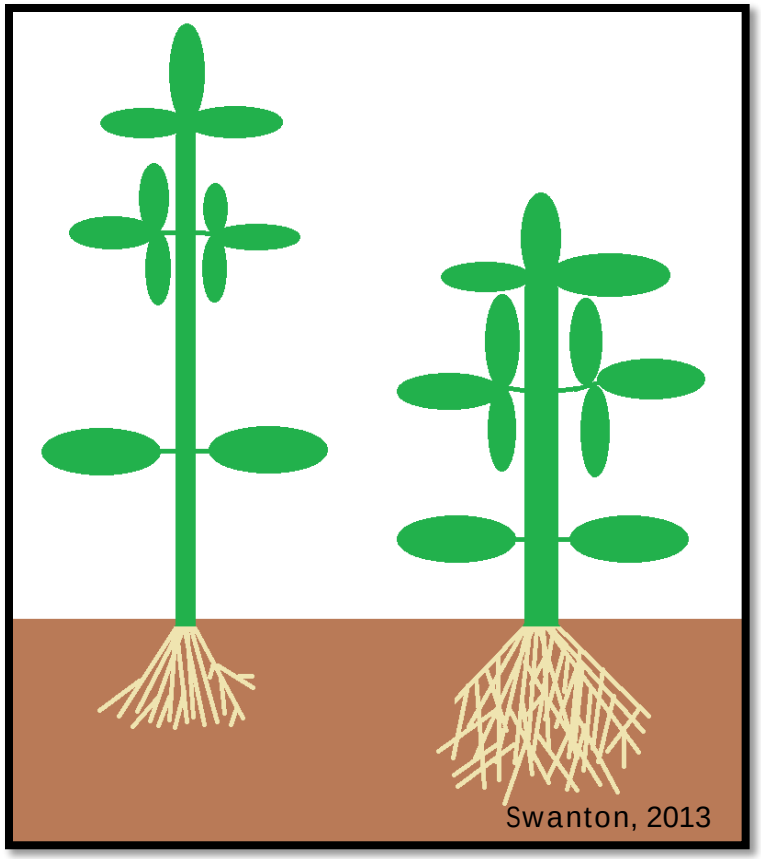
*Standard error (SE) bars

And sometimes you need a new hammer!

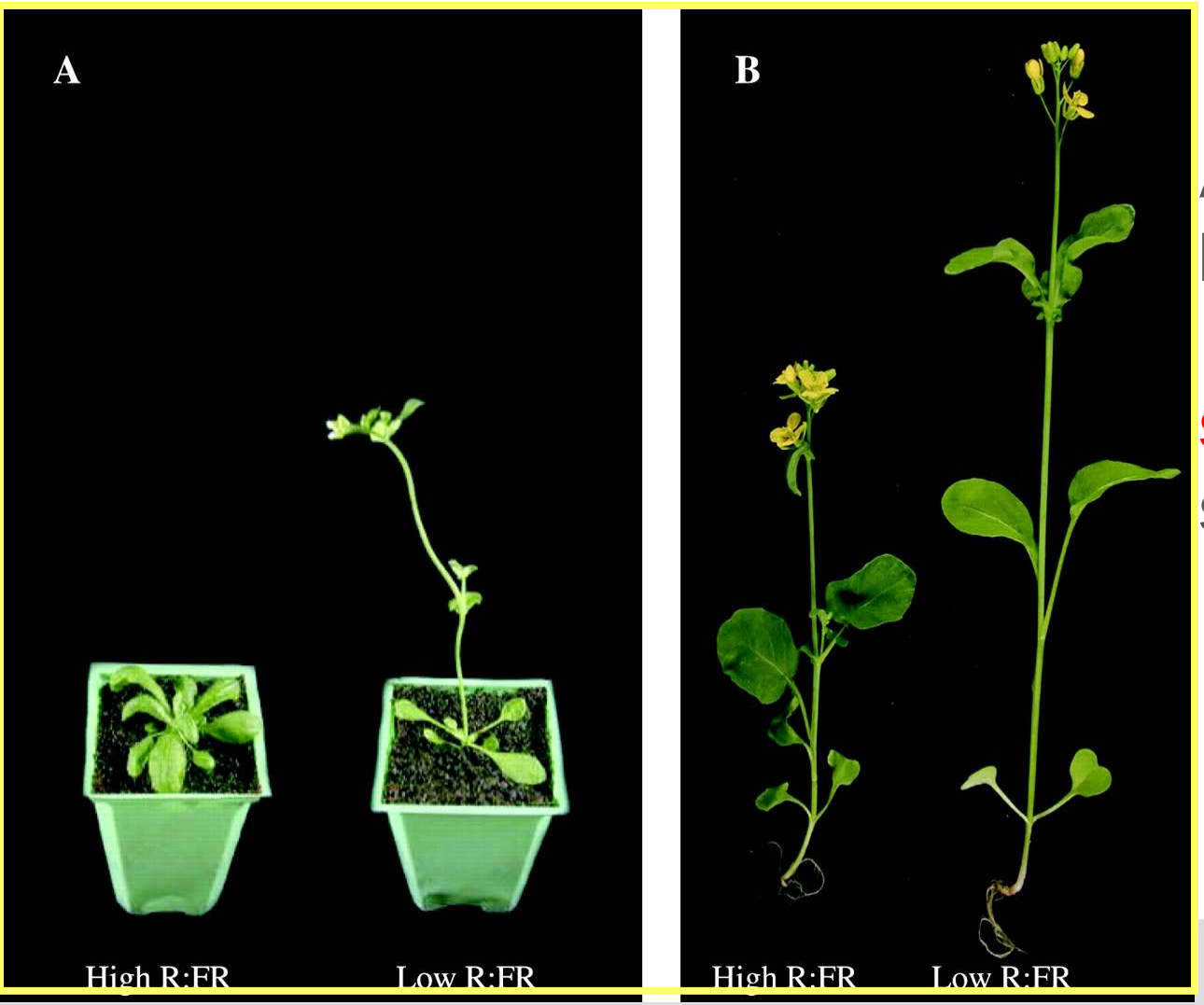
Can seed treatment enhance competitive ability?

Shade Avoidance

- Seeds and seedlings can detect their neighbours
  - **Red:Far-red light ratio**
- Adjust morphology as a result
  - **Shade avoidance**
    - apical dominance
    - increased branching
    - reduced root:shoot
    - lost yield



R:FR effects (shading)



Arabidopsis (a)
Brassica rapa (b)

shade avoiding species

Franklin and Whitelam, 2005

Seed treatments may alter the view

- Thiamethoxam treated corn (Afifi et al., 2014)
  - Enhanced corn germination
  - Negated anticipated morphological shade avoidance response

- **Can we use seed treatments to mitigate competition between oat and wild oat?**

2 sets of experiments

Greenhouse

- Plants grown to
  - three leaf stage
  - full maturity

- 22/16 ° C
- Turf-face
- RCBD- 6 reps

Phytotron

- early competition under cool temperatures
- Plants harvested at three leaf Stage

- 12/10° C
- Turf-Face
- RCBD-6 reps

Treatments

Seed Size

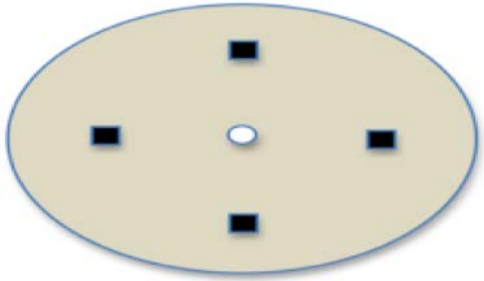
- Small (15-23 mg)
- Large (24-32 mg)

Seed Treatment - 1.5x rate

- Thiamethoxam (Cruiser 5SF)
- Pyraclostrobin (Xenium 700)
- Combination of both treatments
- Uncoated control

Competition

- Wild Oat present (4 plants/pot)
- Oat monoculture

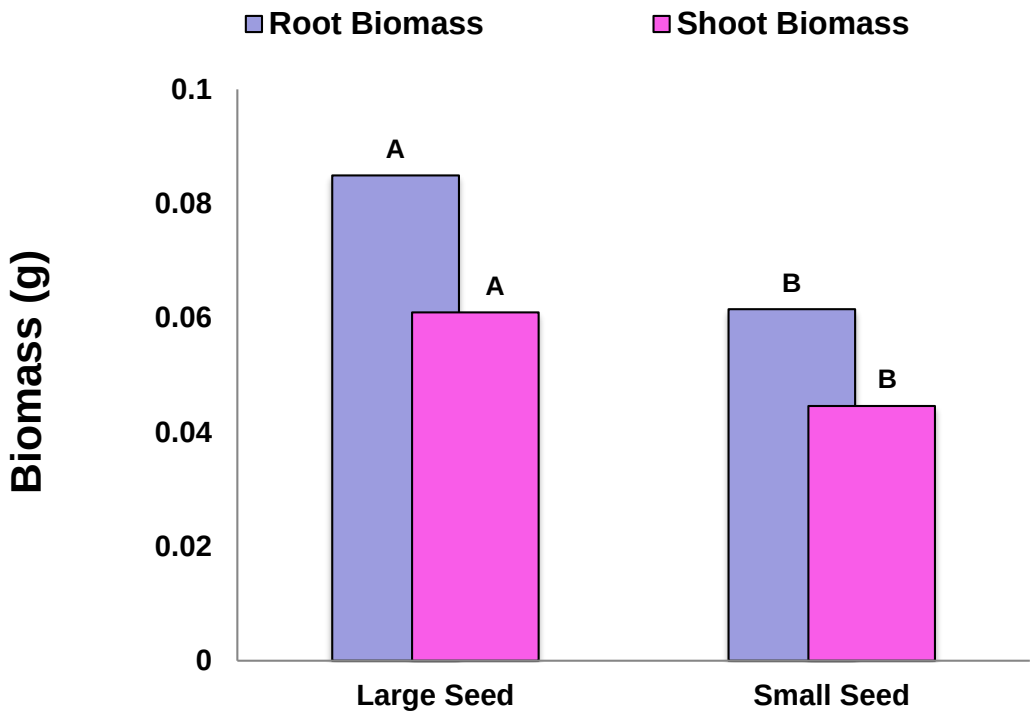


Results - Phytotron

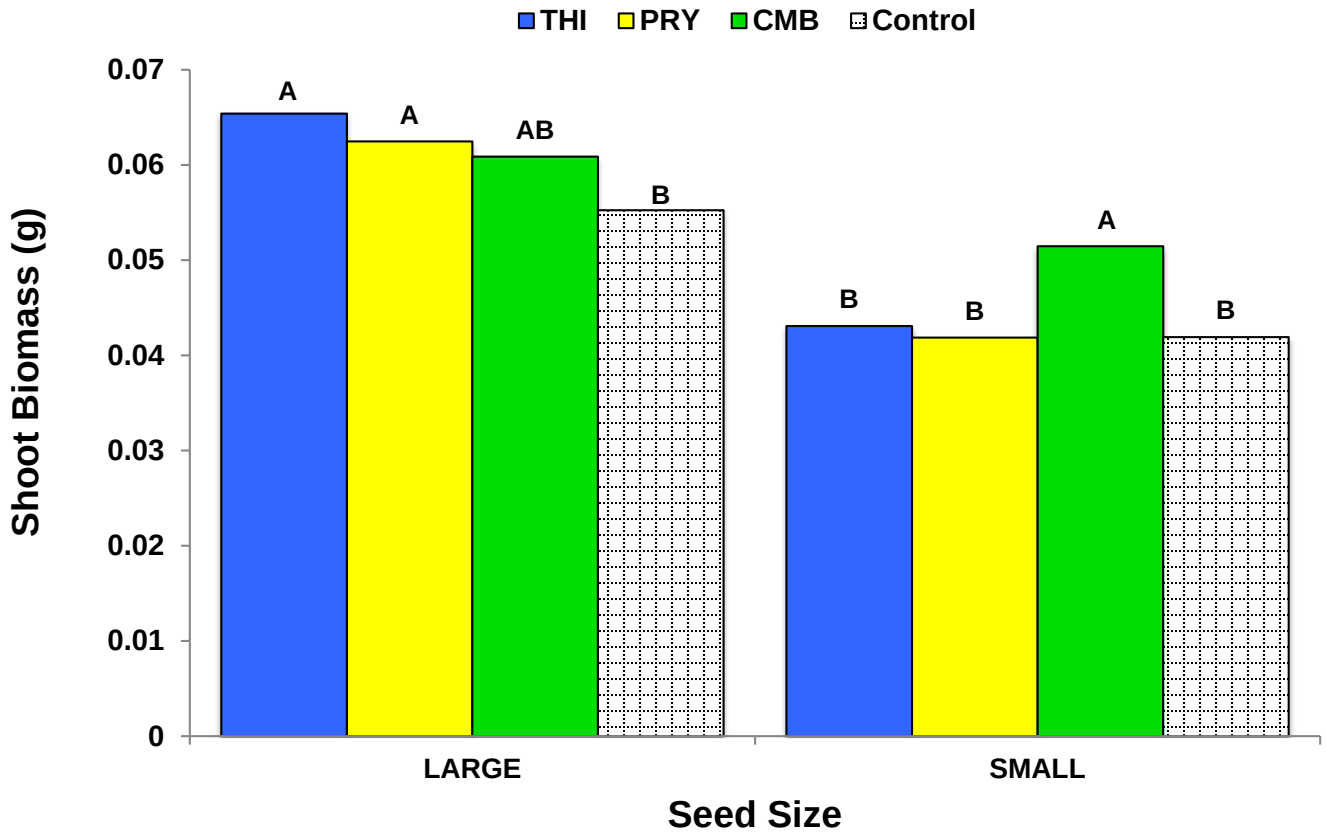
Source	DF	Root (g)	Shoot (g)	R: S (%)	Final Emergence (GDH)
Size (S)	1	<0.0001***	<0.0001***	0.5048	<0.0001***
Seed Treatment (ST)	3	.0709	0.0193**	0.8049	0.9967
Competition (C)	1	0.0113*	0.1009	0.0211*	0.6823
S X ST	3	0.1247	.0332*	0.452	0.9925
ST X C	3	0.6485	0.5725	0.6363	0.9979
S X C	1	0.7253	0.1109	0.0234*	0.8060
S X ST X C	3	0.9238	0.9980	0.4373	0.9925
Run (R)	1	0.2345	0.1434	0.5325	0.8923
R X S	1	0.3809	0.2764	0.8781	0.3438
R X ST	3	0.5431	0.8712	0.3757	0.6432
R X C	1	0.6245	0.1753	0.5793	0.9743

*,**,***, significant at the 0.05, 0.01, and 0.001 significant levels, respectively.

Biomass - Phytotron



Biomass - Phytotron

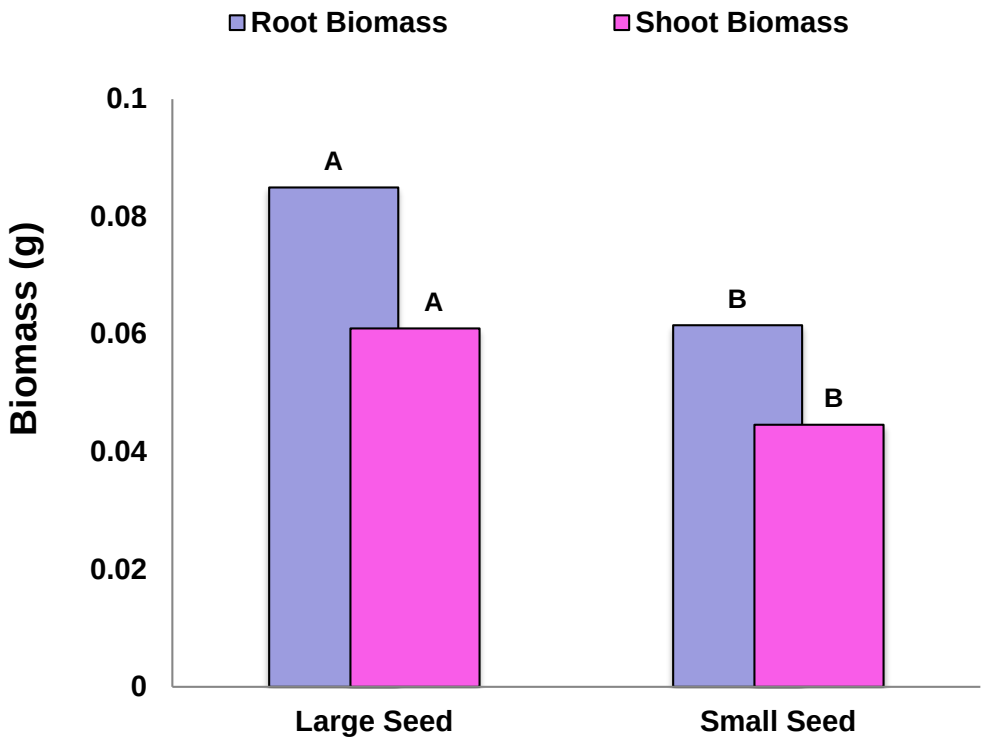


Results - Greenhouse

Source	DF	Root (g)	Shoot (g)	R: S (%)	Final Emergence (GDH)
S	1	<0.0001***	<0.0001***	0.7735	<0.0001***
ST	3	0.8547	0.6995	0.7147	0.7153
C	1	0.022*	0.0024*	0.8926	0.2488
S X ST	3	0.4431	0.3882	0.1239	0.8402
ST X C	3	0.8394	0.114	0.3968	0.9712
S X C	1	0.4022	0.6758	0.1442	0.1863
S X ST X C	3	0.2506	0.2640	0.9987	0.8902
Run (R)	1	0.3509	0.2345	0.3129	0.3012
R X S	1	0.3981	0.4297	0.3812	0.3660
R X ST	3	0.2815	0.9275	0.7252	0.4087
R X C	1	0.7251	0.4820	0.9761	0.1923

*,**,***, significant at the 0.05, 0.01, and 0.001 significant levels, respectively.

Results - Greenhouse



Preliminary Conclusions

- Lower seeding rates, wide row spacing exacerbate wild oat problems
  - Magnitude depends on wild oat density
- Effect of combining all practices?
  - Could be multiplicative (1+1=3), synergism
- Potential new herbicide options for kochia control?
  - Cadet® (Fluthiacet-methyl, (14))
  - Infinity® (pyrasulfotole (27) + bromoxynil (6))
- Potential for seed treatments to influence competitive ability

Use of glyphosate as a pre-harvest management tool in oat

Acknowledgements

Saskatchewan Oat Development Commission

Western Grains Research Foundation

Government of Saskatchewan
Ag Development Fund

NSERC CRSNG

Agriculture and Agri-Food Canada
Agriculture et Agroalimentaire Canada