UNIVERSITY OF SASKATCHEWAN

Tools for Managing Resistance and Weed Control – Pulse Crop Herbicide Options

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Disclaimer

- The information presented in this talk is from publicly funded research. It involves information on herbicides not currently registered in some pulse crops. Please consult herbicide labels before applying any herbicides listed in this presentation.

Weed Science Program, University of Saskatchewan

FEWER NEW SOLUTIONS BEING DEVELOPED

The declining rate of patent applications for new herbicides since 1990

Over a twenty year period there was a significant reduction in output of herbicide patents which stabilised in 2008, but at a very low level.

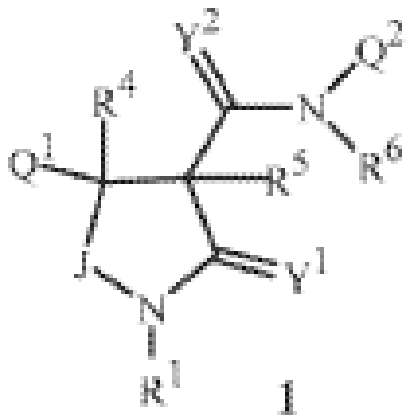
Source: Bayer CropScience

DuPont Crop Protection and Syngenta Announce Publication of a New Joint Patent for Herbicide Development

12.19.16

New chemistry class for weed management expected to be launched in 2023

WILMINGTON, Del., and BASEL, Switzerland, Dec. 19, 2016 – DuPont Crop Protection (DuPont) and Syngenta announced today the publication of a joint patent, focused on the development of a new herbicide chemistry class. Collaboration on the project started in 2015 and has resulted in the joint patent entitled "Substituted cyclic amides and their use as herbicides." The new herbicide has entered into the pre-development stage and is expected to be launched in 2023.



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Patents English French

Find prior art Discuss this application

Substituted cyclic amides as herbicides

WO 2016164201 A1

ABSTRACT

Disclosed are compounds of Formula I, including all stereoisomers, *N-oxides*, and thereof. (I) wherein R^1, R^4, R^5, R^6, Q^1, Q^2, Y^1, and Y^2 are as defined in the disclosure; and T is j^1-A- and also as defined in the disclosure. Also disclosed are compositions containing the compounds of Formula I and methods for controlling undesired vegetation comprising contacting the undesired vegetation or its environment with an effective amount of a compound or a composition of the invention.

Publication number	WO2016164201 A1
Publication type	Application
Application number	PCT/US2016/024669
Publication date	Oct 13, 2016
Filing date	Mar 29, 2016
Priority date	Apr 10, 2015
Inventors	Andrew Duncan Satterfield, James Francis Bereznak, Andrew Edmund Taggi
Applicant	E I Du Pont De Nemours And Company
Export Citation	BiBTeX, EndNote, RefMan

Patent Citations (18), Non-Patent Citations (43), Classifications (31), Legal Events (3)

External Links: Patentscope, Espacenet

History of Pulse Broadleaf Weed Control

- Prior to Imi Chemistry (1970 – 1990)
  - Trifluralin, Ethafluralin (Group 3), Metribuzin (Group 5), MCPA amine / sodium salt (Group 4), Tropotox Plus (Group 4), Basagran (Group 6), Pea Pack (Sencor / MCPA) (Group 5 + 4).
- Imi Chemisty (Group 2's) 1990-
  - Pursuit, Odyssey, Solo, Ares
  - 2007 – Clearfield lentil Introduced

Pulse Herbicides 2000 -

- 2002 – Pesticide Minor Use Program introduced
  - Assisted in the introduction / registration of: Carfentrazone (AIM), Sulfentrazone (Authority), Flumioxazin (Valtera) – Group 14's; Pyroxasulfone (Focus, Zidua) – Group 15; and Clomazone (Command) – Group 13;
- BASF introduced saflufenacil (Heat) – Group 14; Viper (imazamox + bentazon – Group 2 + 6).
- NuFarm – pyraflufen + MCPA (Goldwing) – Group 14 + 4)

Group 2 (ALS) resistance

- Kochia
- Cleavers
- Wild Mustard
- Stinkweed

Characteristics of Recent Herbicides

- Quite a few are soil active
  - Soil active herbicides tend to be less consistent due to environmental interactions
  - Generally, not as broad spectrum of weed control
  - Not perfect tolerance, particularly in lentil
- One-shot weed control in pulses unlikely concept in future.

Chickpea Developments

- Imi-tolerant: CDC Alma (kabuli) and CDC Cory (desi).
- Prairie Pesticide Minor Use Consortium prepared Minor Use submission for Solo to PMRA. Registration hoped for this year
- All new varieties will be imi-tolerant
- Tolerant to pyroxasulfone

Potential Herbicide in Chickpea

- Pyridate
  - Trade Name: Tough or Lentagran
  - Group 6 (same mode of action as bromoxynil, Basagran)
  - Post-emergence, contact, no residual
  - Old chemistry – Used to be Sygenta product, now belongs to Engage Agro of the Belchim group; working on new formulation

- Pyridate
  - Chickpea tolerance very good, works on a number of broadleaf weeds – strong on kochia, pigweeds, lambs-quarters, shepherd's purse, not as strong on wild mustard.
  - Contact – coverage important, works best on small weeds
  - Very smelly
  - Company working on submission for registration

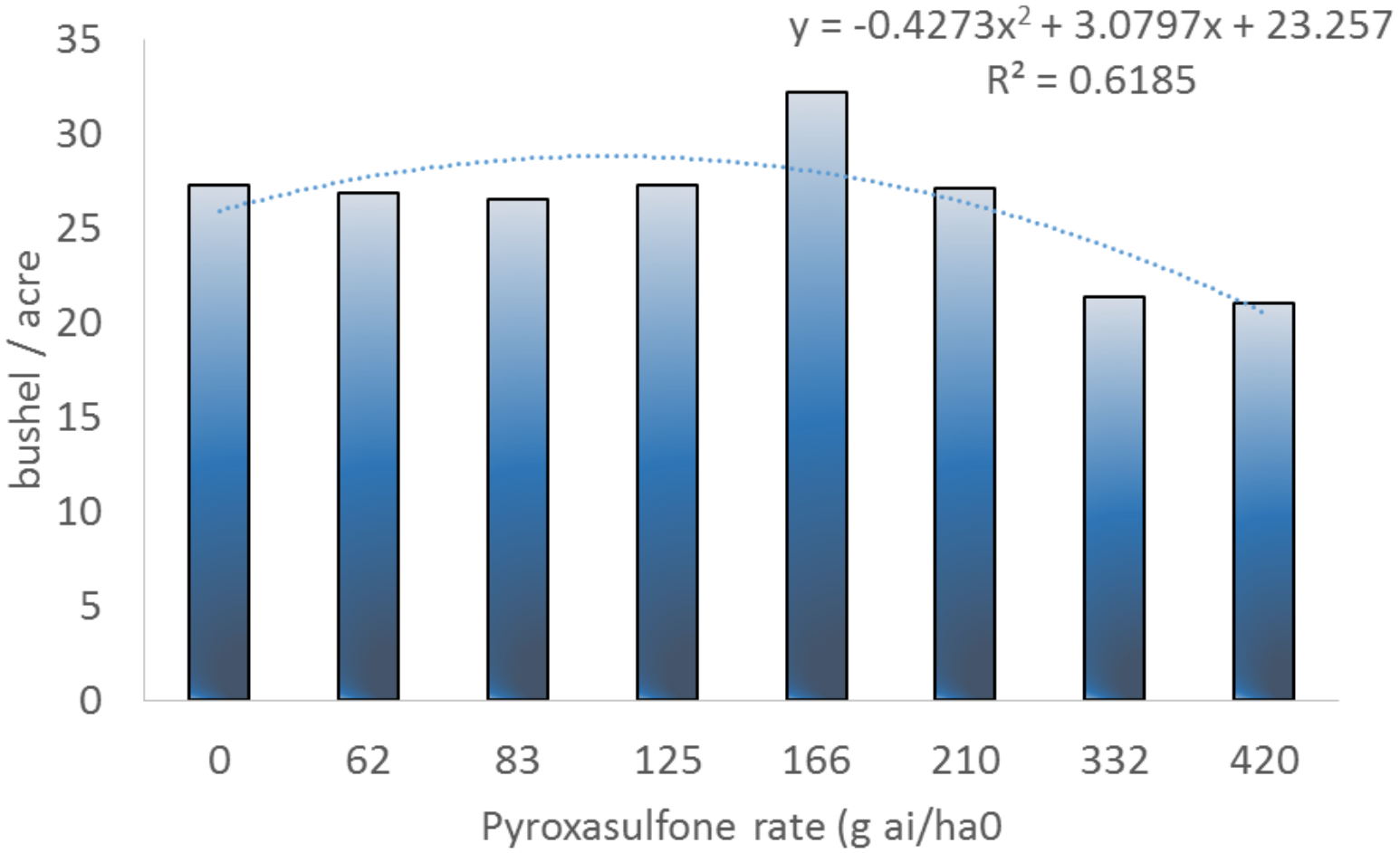
TOUGH® 5EC

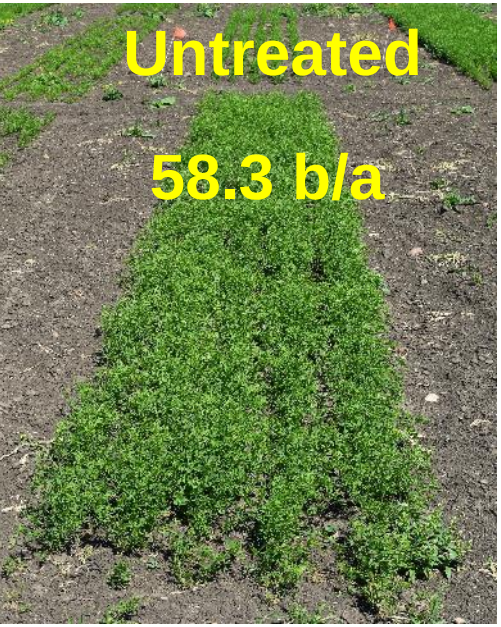
Lentil

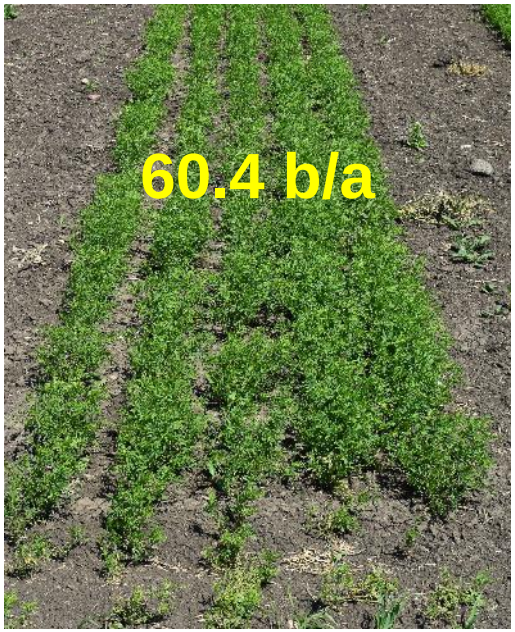
- Pyroxasulfone (Focus, Zidua)
- Flumioxazin (Valtera)
- Pyroxasulfone + Heat
- Amicarbazone

Pyroxasulfone injury in lentil

Effect of pyroxasulfone rate on lentil yield. Scott. 2010.

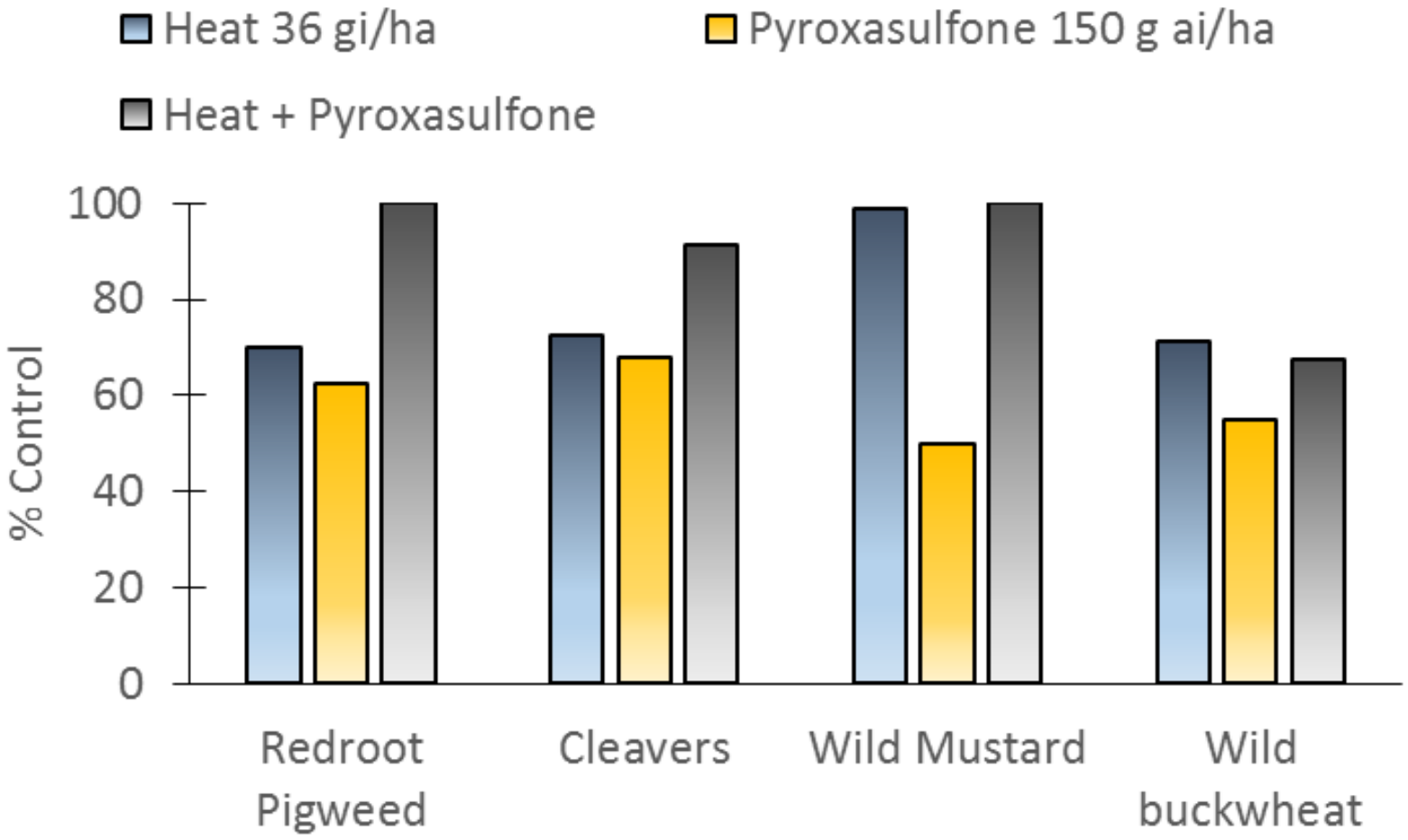




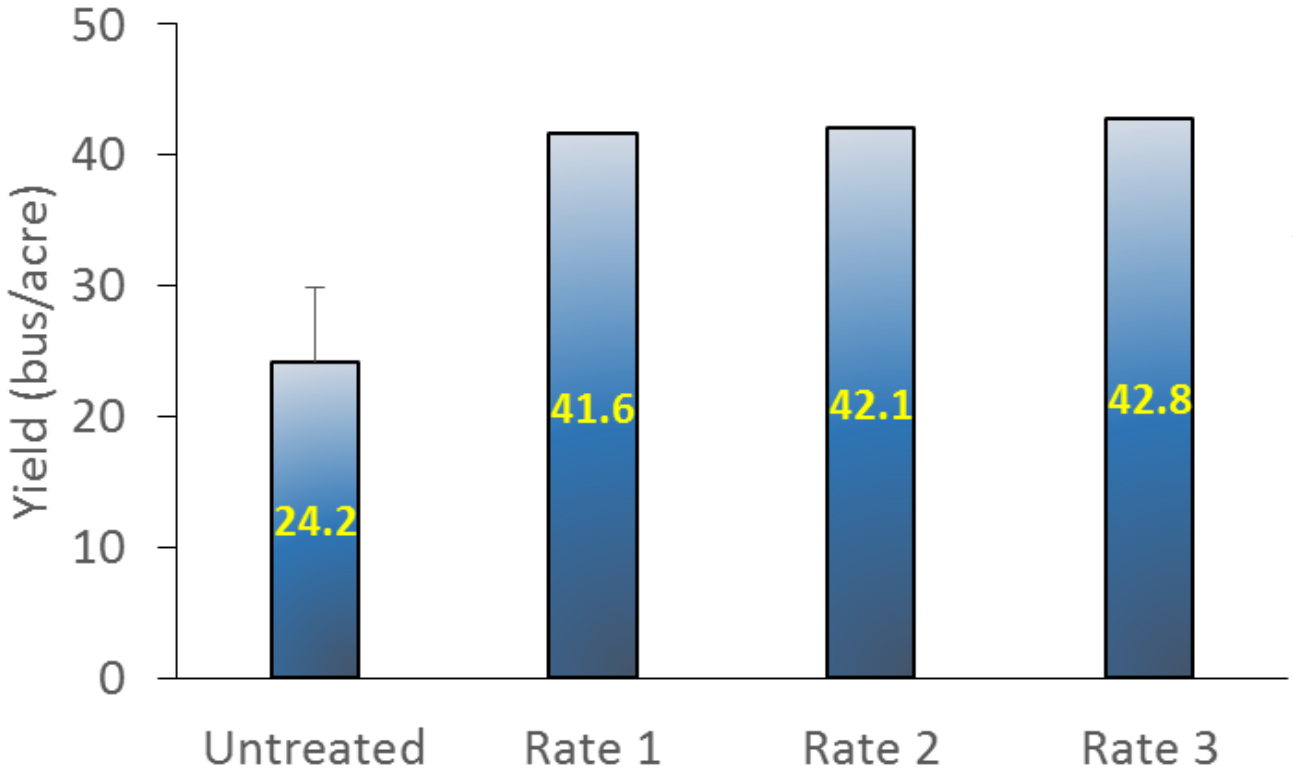


Maxim Lentil Injuries from Fluthiacet-Methyl And Sulfentrazone
Photo taken June 28, 2016

Heat and Pyroxasulfone May be Additive – Results in **Fababean**, Saskatoon, 2017



Effect of Heat and Pyroxasulfone on Yield of Lentil – Weeds Present – Saskatoon 2017



Highest injury rating ~ 10%
Wild mustard control - 50 to 60%
Kochia control - 70-80%

Valtera and Focus are not Edge substitutes for lentil

- **Valtera** fall-applied: provides good control of winter-annual weeds (including narrow-leaved hawksbeard), and the first, major flush of kochia. Not residual enough to provide season-long control of kochia flushes.
- **Focus** can be very effective on cleavers if soil organic matter is <6%. Very good on downy and Japanese brome. Other weed efficacy – environment dependent

Caution for lentil growers!

- Be careful not to overuse Group 14's!!
  - Valtera in fall followed by Heat in spring probably not a good idea! (haven't researched it)
  - Don't want to lose this group due to resistance development!

Lentil

- Amicarbazone – Group 5 herbicide (triazine)
  - Arysta product
  - Registered in corn and turfgrass in USA
  - Also registered in sugarcane in Australia
  - Mostly root uptake, very soluble herbicide.

- Preliminary results: Lentil / wild mustard selectivity ratio was 15:1 in growth chamber.

ED_{50}

Lentil – 897 g ai ha^{-1}

Wild mustard - 61 g ai ha^{-1}

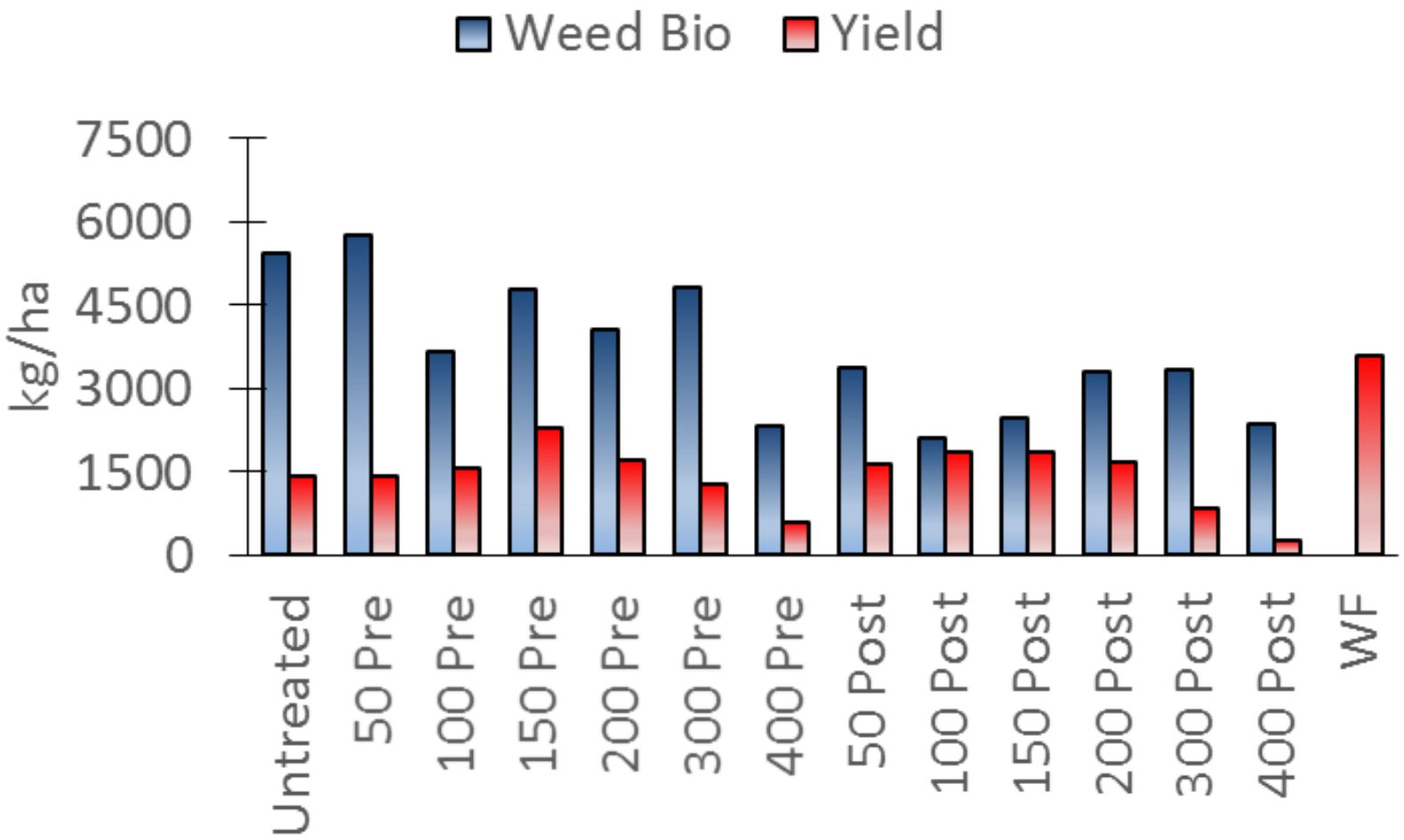
Amicarbazone

- Field tested at Saskatoon (clay-loam) and Scott (loam) in 2017.
- PRE- and POST- application at rates of 50 to 400 g ai/ha.
- Also, tested PRE- for volunteer RR control in corn
- Lentil exhibited better tolerance at Saskatoon than Scott.

Amicarbazone – Preliminary Results

- Scott
  - None of the PRE- or POST- treatments provided season-long control of kochia.
  - Pre-applications provided >70% suppression / control of wild mustard until early July, but final ratings in August were <70%.
  - Post applications > 150 g ai/ha provided season-long suppression / control of wild mustard >75%. Rates >200 g ai/ha: 86 to 97% control
  - Rates >300 g ai/ha applied either PRE- or POST- unacceptable injury in lentil

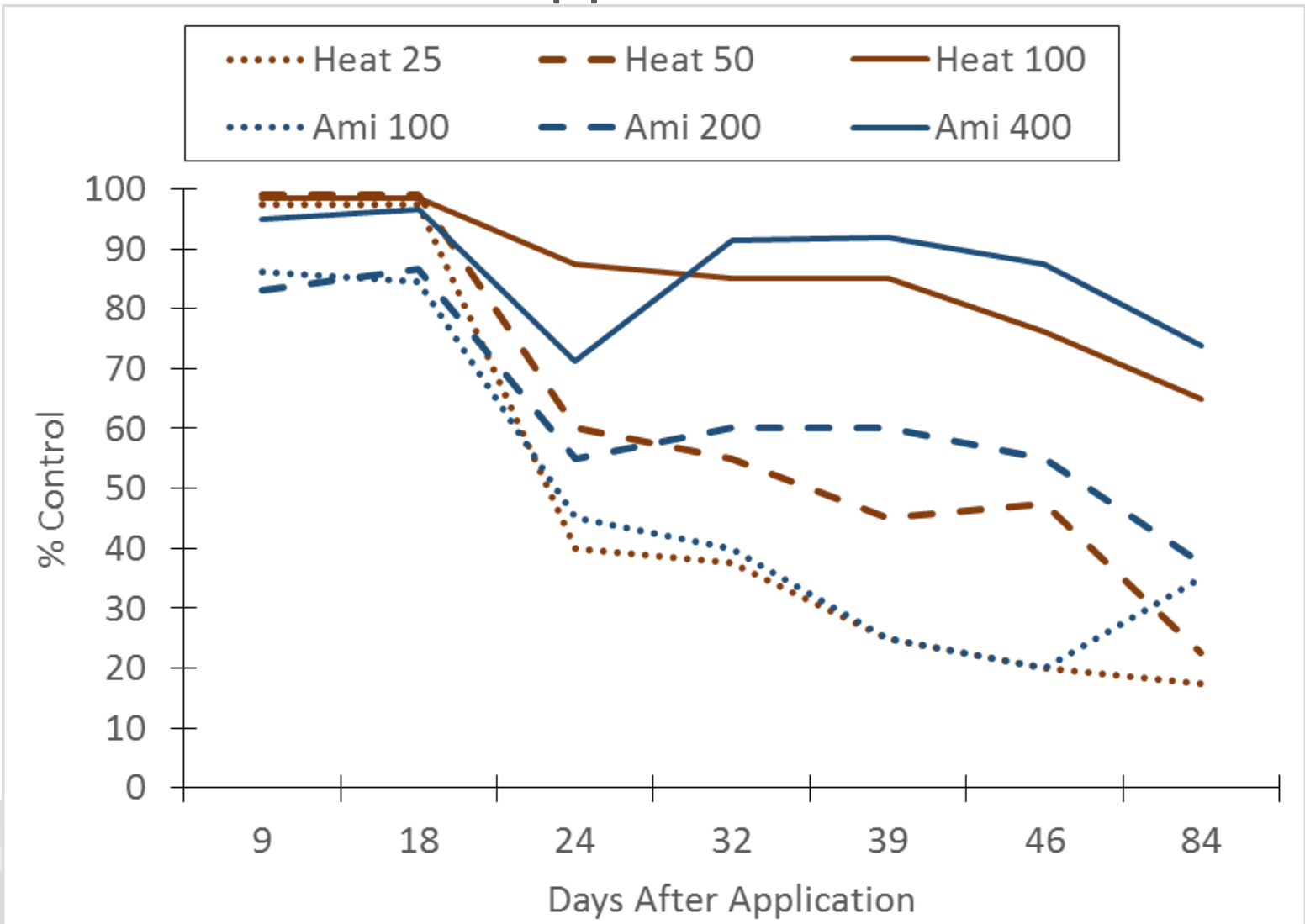
Amicarbazone in lentil – Scott 2017



Amicarbazone – Preliminary Results

- Saskatoon
  - Rates >300 g ai/ha applied either PRE- or = 400 g ai/ha POST- unacceptable injury in lentil
  - Similar results on wild mustard as at Scott
  - Rates > 150 g ai/ha PRE- or POST- provided > 70% control of stinkweed

Volunteer RR canola control in corn – RRE applications



Future of Amicarbazone

- Arysta interested in pursuing in pulses
- Lots of research required before it will be available to growers
  - Tolerance of other pulses?
  - Split-timing – pre and post?
  - Is it any better than Sencor?

Field Pea

- Using both pre- and post-emergent herbicides of different modes of action to reduce risk of weed resistance and improve overall weed control.
- 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

Herbicide Layering

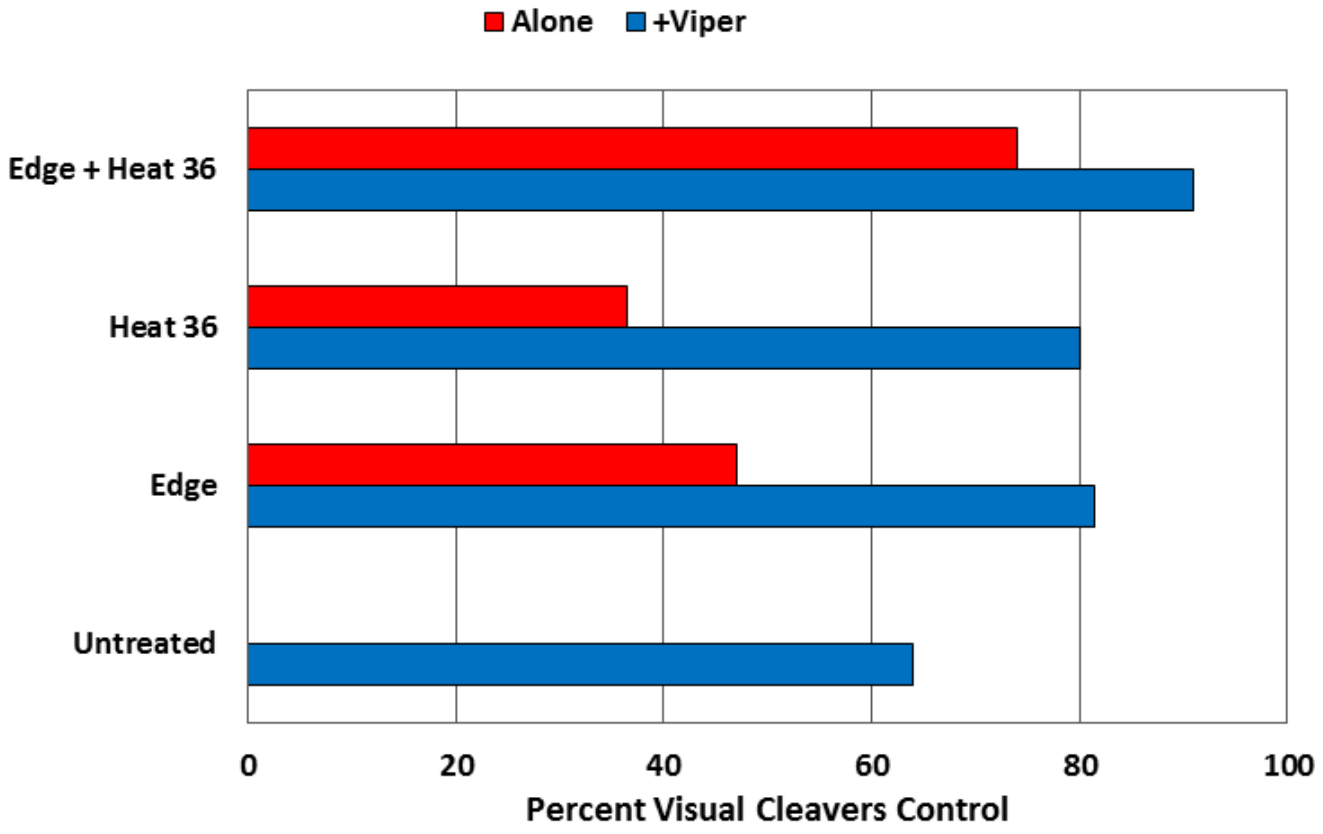
Layering Options for Group 2 R cleavers - Necessary in high organic matter soils

- PRE
  - Field pea – Edge (fall applied, helps to incorporate with heavy harrow), Authority, Heat, Command*, Focus*
- POST
  - Field pea – Viper, Basagran

*Not yet registered

Group 2 Resistant cleavers control
Average of 3 Years (2013-2015). SOM > 6% .
Melfort (2013), Rosthern (2014-15)

Group 2 Resistant cleavers control
Average of 2 Years (2014-2015). SOM > 6% . Rosthern, SK.



Fababean – Data generated for potential Minor Uses

- Heat – pre-seed
- Authority – pre-seed
- Viper – post-emergence
- Heat and Heat / glyphosate, glufosinate – desiccation
- Valtera – pre-emergence
- Focus – pre-emergence
- Investigating injury from residual herbicides.

Soybean - Current Herbicide Options

Pre-Seed / Pre-Emergent	Group
Aim® / CleanStart® (carfentrazone)	14
Authority® / Authority Charge® (sulfentrazone / +carfentrazone)	14
Blackhawk™ (carfentrazone + 2,4-D)	14+4
Edge™ Granular (ethafluralin)	3
Express® SG (tribenuron)	2
Fierce® (flumioxazin + pyroxasulfone)	14+15
Focus® (carfentrazone + pyroxasulfone)	14+15
Heat® (saflufenacil)	14
Reflex® / Flexstar® (fomesafen)	14**
Valtera™ (flumioxazin)	14

In-Crop	Group
Basagran® / Basagran Forte® (Bentazon)	6
Blazer® (acifluorfen)	14
Odyssey® / Odyssey Ultra® (imazamox + imazethapyr / +sethodxydim)	2 / 2+1
Pinnacle® SG (thifensulfuron methyl)	2
Solo® ADV (imazamox)	2
Viper® ADV (imazamox +bentazon)	2+6
Reflex® / Flexstar® (fomesafen)	14**
Quizalofop, sethoxydim, clethodim	1

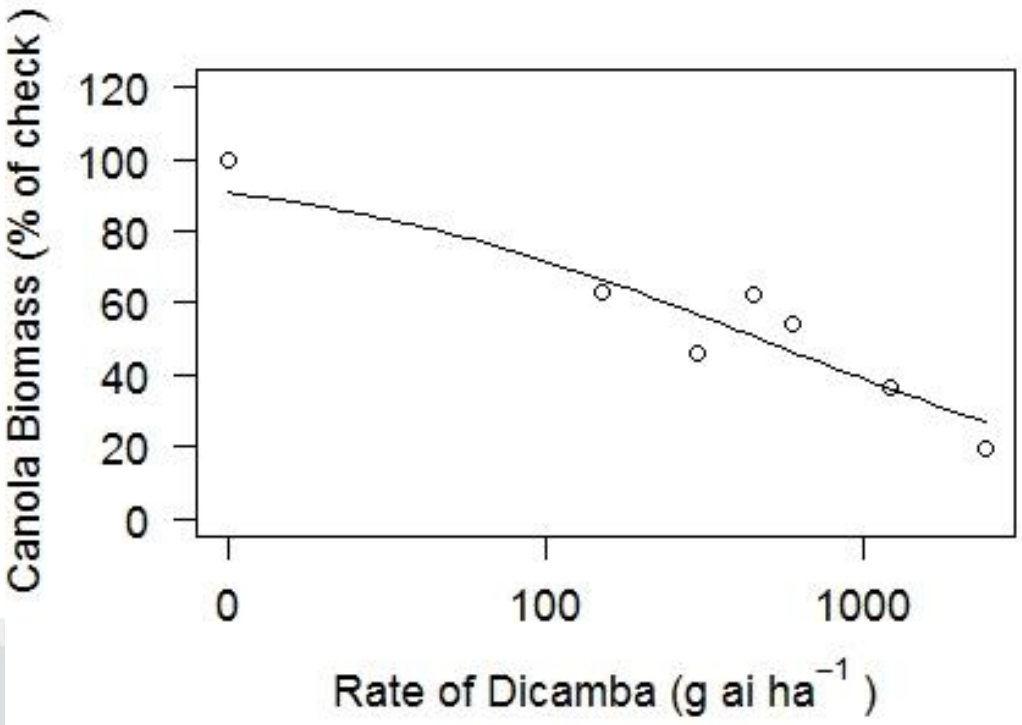
****Fomesafen is for use in Manitoba Red River Valley Only**

Xtend soybean

- Resistant to Dicamba
- Lower-volatile formulation (still volatile)
- Applied PRE- and/or POST-
- Rates of dicamba
  - 300 to 600 g ai/ha (4.3 to 8.6 ounces active per acre)
- Not great on volunteer Roundup Ready Canola!!

Volunteer Canola Control in Xtend Soybean – Saskatoon 2017

To achieve 70% reduction in Canola Biomass POST, Dicamba had to be applied at a rate of 1942.3 g ai/ha



Untreated	300	600	2400




Suggestion for Xtend Soybean

- Think of it as 2-pass system!!!
  - PRE- and POST-
- Apply PRE- glyphosate + dicamba at 300 to 600 g ai/ha.
- Apply POST- glyphosate + either Solo, Odyssey, Basagran, or Viper
- Glyphosate + Dicamba PRE- followed by Glyphosate + Viper POST- (4 different modes of action, 2, 4, 6, 9)

Untreated

Dicamba

Date

June 22, 2015

Dicamba applied at 600 g ai/ha May 15, 2015

July 16, 2015

Aug 5, 2015

usask.ca

SPG Demo – Ag In Motion Glyphosate only pre

Viper + Glyphosate
in crop

Engenia (Dicamba)
+ Glyphosate in-crop

Credit: Sherrilyn Phelps

Enginia (dicamba) + Glyphosate Pre

Viper + Glyphosate in crop

Enginia + Glyphosate in crop

Credit: Sherrilyn Phelps

Enginia + Glyphosate Pre

Viper + Glyphosate
in crop

Enginia + Glyphosate
in crop

Glyphosate
in crop

Credit: Sherrilyn Phelps

Interrow spraying of low to non-selective herbicide in lentil

Untreated

Inter-row sprayed with glyphosate + glufosinate

To Conclude:

- Herbicide Options for Pulses in the Future
  - For most pulses, herbicide options will continue to be few and far between;
  - Will likely not be totally safe to use on crop;
  - Will likely require other herbicides / integrated practices to provide broad-spectrum control
  - Soybean – potential for more options in future due to large acreage world-wide.
    - HPPD (Group 27) resistance under development (Syngenta and Bayer). Syngenta MGI tolerant to mesotrione, glufosinate, and isoxaflutole.

Acknowlegements

SASKATCHEWAN pulse Growers