North Central Canola Research Program

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United States Department of Agriculture

National Institute of Food and Agriculture

North Central Canola Research Program

- North Dakota
- Minnesota
- South Dakota
- Wisconsin

2015 Priorities

High priority will be given to research that identifies and addresses the major impediments to the expansion of canola acreage and production. Specific research priorities considered for funding may include, but are not limited to (not listed in order of importance):

1. **Production practices that optimize yield, quality, and profit**
2. **Disease management with emphasis on blackleg management.**
3. **Insect management, identification and control**
4. **Straight-harvest canola research, including the use of desiccants**

2015 Priorities

5. **Rotation studies that determine optimal broadleaf crops to precede canola**
6. **Reduction of pod shattering, including identification of varieties resistant to shattering**
7. **Increasing oil yield per acre in canola**
8. **Nitrogen/sulfur fertility management, including use-efficiency studies**
9. **Other traditional or non-traditional research that has potential to increase canola acres and production**
10. **Evaluating and improving canola production on marginal lands (e.g., saline soils).**

2015 Funding

1. **Dr. Nancy Ehlke, Agronomist, Univ. of MN**
    - **Optimizing nitrogen use**
    - **Straight combining and canola desiccation**
    - **Disease management**

2. **Dr. Mukhlus Rahman, NDSU Canola Breeder**
    - **Increased yield and oil content**

2015 Funding

3. Dr. Luis del Rio, NDSU Plant Pathologist
    - Blackleg resistance

4. Dr. Brian Jenks, NDSU Weed Scientist
    - Benefit of canola/soybean rotation

5. Ed Davis, Montana State Weed Specialist
    - Volunteer canola control

Impact of previous crop on soybean and canola yield

Investigators:
Dr. Brian Jenks, NDSU-Minot
Dr. Mike Ostlie, NDSU-Carrington
Dr. Jasper Teboh, NDSU-Carrington
Bryan Hanson, NDSU-Langdon
Eric Eriksmoen, NDSU-Minot
Dr. Nancy Ehlke, Univ. of MN

Dates of Proposed Research:
April 2014-May 2017

Double-Crop Soybean after Canola vs. Wheat

Year	Previous Crop	Soybean Yield (bu/A)
1989	Canola planted Jun 17	46.0 a
	Canola planted June 30	37.6 b
	Wheat planted June 30	29.8 c
1990	Canola	44.2 a
	Wheat	41.9 a
2008	Canola	43.0 a
	Wheat	36.4 b
2009	Canola	63.8 a
	Wheat	65.9 a

Murdock and Herbek, U of Kentucky

Canola / Soybean studies

- One South Carolina grower indicated that he plants soybean following canola with soybean yields showing a 10-20% advantage over soybean following wheat (Roberson 2012).

- An Alabama study in 2003 and 2004 showed that canola plant density and yield were generally higher after soybean than after corn, sorghum, cotton, or fallow (Kumar et al. 2007).

- Not all experience has shown a favorable response to a tight rotation between canola and soybean. A long-term study (1998-2007) in Saskatchewan, Canada evaluated canola yield when grown following various crops. Canola yielded lower after soybean (101) compared to spring wheat (124), dry pea (122), barley (120), flax (118), oat (114), and winter wheat (113). (The number in parentheses is the canola yield expressed as a percent of the canola on canola yield (100)), (Brandt and Kubinec).

- A long-term rotation study in Georgia (1994-1999) showed that soybean stand was 18-25% lower following canola than following small grains in all years except 1998. Soybean yields were lower following canola compared to wheat in all years, though statistically significant only in one year. False chinch bug population was higher following canola, but no seedling injury was observed. Soybean stand reduction was mainly attributed to interference of canola stubble with planter performance or possibly chemical or biological factors associated with canola stubble (Buntin et al. 2007).


Objectives
1: Determine if soybean yield is greater following canola than wheat
2: Determine if canola yield is greater following soybean than wheat

Table 1. Planned crop sequence to evaluate effect of previous crop on soybean and canola yield.			
Treatment	2013	2014	2015
1	Wheat	Wheat	Soybean
2	Wheat	Canola	Soybean
3	Wheat	Wheat	Canola
4	Wheat	Soybean	Canola

Methods

- 4 locations (Minot, Langdon, Carrington, Roseau)
- Plots 30 by 30 ft
- 4 replications
- Managed for optimum growth
- LL canola, RR soybean
- Data: Yield, test weight, oil, protein, crop density, crop height, flowering date, physiological maturity, sclerotinia evaluations
- Every phase not present every year

Soybean on wheat vs canola (2015)

Minot

Rotation	Density	Height	Yield	Test wt	Oil
	sq ft	cm	bu/A	lb/bu	----%----
W-W-S	4.5 a	22.9 a	32.7 a	58.2 a	15.9 a
W-C-S	5.1 a	20.9 a	32.8 a	58.3 a	16.2 a

Langdon

Rotation	Density	Height	Yield	Test wt	Oil
	sq ft	cm	bu/A	lb/bu	----%----
W-W-S	5.3 a	38.3 a	39.5 a	57.3 a	15.9 a
W-C-S	6.3 a	37.2 a	41.1 a	57.0 b	16.1 a

Carrington

Rotation	Density	Height	Yield	Test wt	Oil
	sq ft	cm	bu/A	lb/bu	----%----
W-W-S	5.0 a	66.4 a	34.9 a	58.0 a	xx.x a
W-C-S	4.7 a	58.5 b	33.5 a	58.2 a	xx.x a

Canola on wheat vs soybean (2015)

Minot

Rotation	Density	Height	Yield	Test wt	Oil
	sq ft	cm	bu/A	lb/bu	----%----
W-W-C	10.7 a	72.0 a	2005 a	51.5 a	40.4 a
W-S-C	9.1 a	72.8 a	2213 a	51.7 a	39.4 b

Langdon

Rotation	Density	Height	Yield	Test wt	Oil
	sq ft	cm	bu/A	lb/bu	----%----
W-W-C	12.4 a	56.7 a	3335 a	51.9 a	49.3 a
W-S-C	11.6 a	56.2 a	3330 a	52.1 a	48.4 a

Carrington

Rotation	Density	Height	Yield	Test wt	Oil
	sq ft	cm	bu/A	lb/bu	----%----
W-W-C	11.1 a	104 a	2150 a	52.0 a	43.1 a
W-S-C	12.6 a	105 a	1976 a	52.2 a	43.1 a

Summary

- No significant difference in yield, test weight, density, height, oil, protein, etc.
- Very little disease at any of the locations (dry July, August).
- 2016 will be final year of the study.

Table 1. Planned crop sequence to evaluate effect of previous crop on soybean and canola yield.			
Treatment	2014	2015	2016
1	Wheat	Wheat	Soybean
2	Wheat	Canola	Soybean
3	Wheat	Wheat	Canola
4	Wheat	Soybean	Canola

Canola Pathology – Summary

- Dr. Luis del Rio

Canola Pathology – Summary

❑ Current situation:

- Two most important diseases affecting canola production are blackleg and sclerotinia stem rot.
- Blackleg remains a significant challenge while sclerotinia has declined slightly in recent years
- A 2015 survey of 91 fields revealed blackleg presence in 78% of them; severe yield losses recorded in a few fields
- Genetic resistance is the most effective way to manage these diseases, combined with good crop rotation.

Canola Pathology – Summary

❑ What have we accomplished so far?

- Crosses using blackleg-resistant plant introductions were made to study and transfer genes involved.
- Production of double haploids from a *B. juncea* cross is underway. This will help speed up breeding and mapping of blackleg resistant genes.
- Identified five markers associated with resistance to Sclerotinia in a double haploid *B. napus* breeding population. Validation is in progress.
- Validation of role of seven genes involved in infection of canola plants by Sclerotinia is underway.

Canola Pathology – Summary

❑ What is next?

- Field trials to validate resistance of NDSU advanced breeding lines to blackleg
- Identify markers and transfer blackleg resistance from *B. juncea* and *B. napus* plant introductions into advanced *B. napus* breeding lines
- Evaluate other *B. napus* plant introductions for resistance to other strains of blackleg

Canola Pathology – Summary

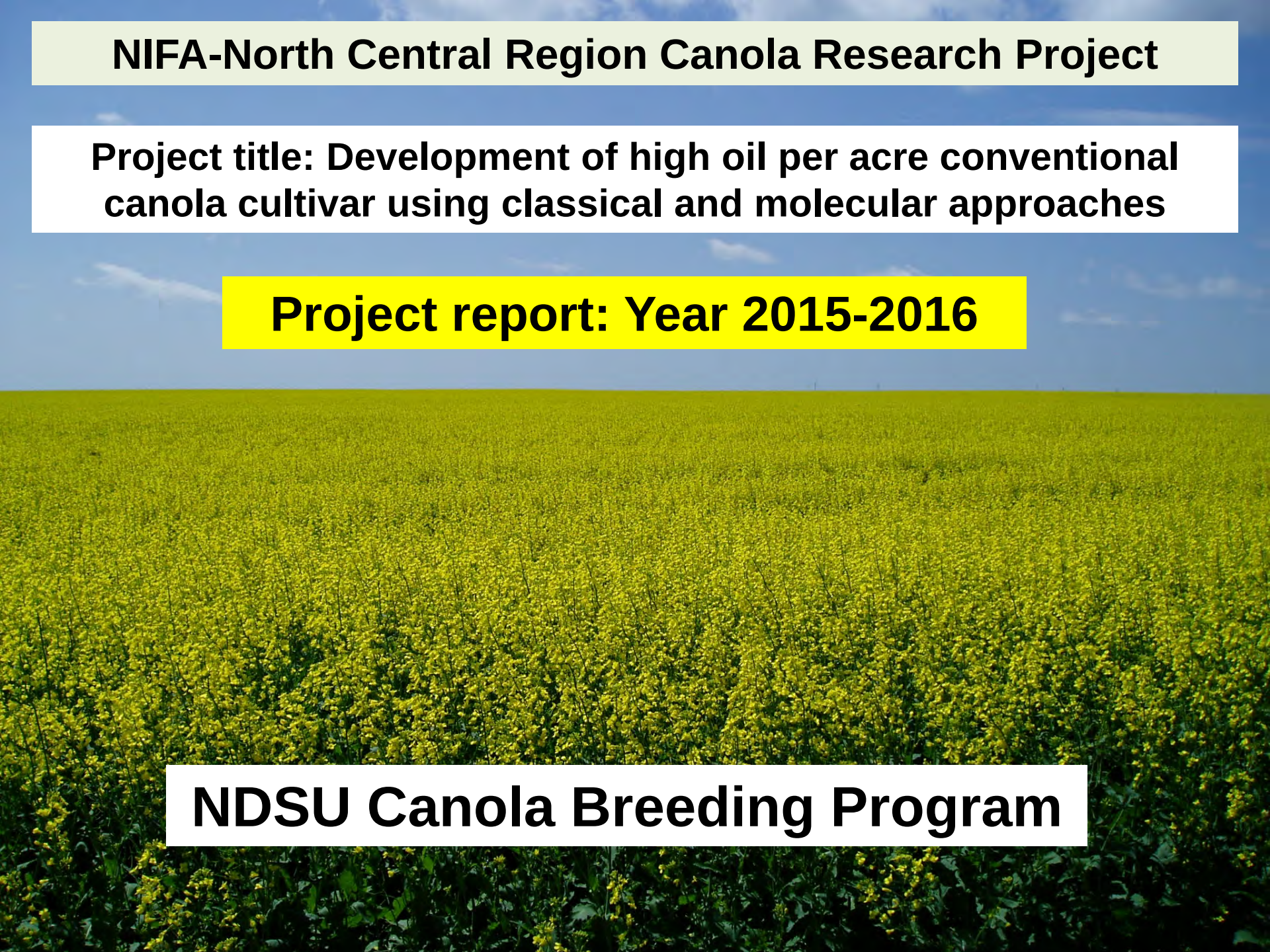
- What is next? Continued...

- Transfer resistance to stem rot into advanced *B. napus* breeding lines
- Evaluate other *B. napus* sources of resistance against stem rot
- Validate reaction of new resistant breeding lines in field prior to release

NIFA-North Central Region Canola Research Project

Project title: Development of high oil per acre conventional canola cultivar using classical and molecular approaches

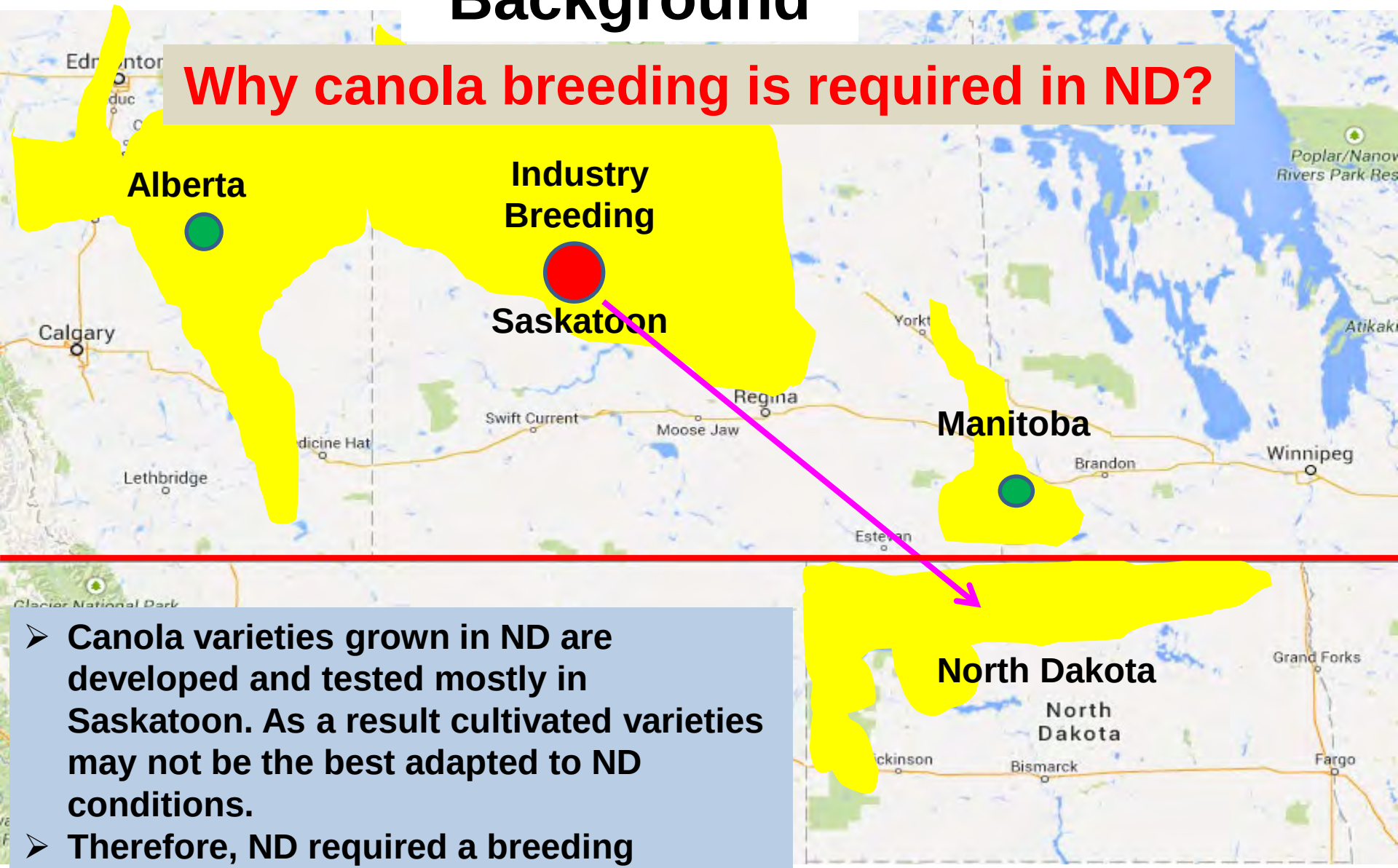
Project report: Year 2015-2016



NDSU Canola Breeding Program

Background

Why canola breeding is required in ND?



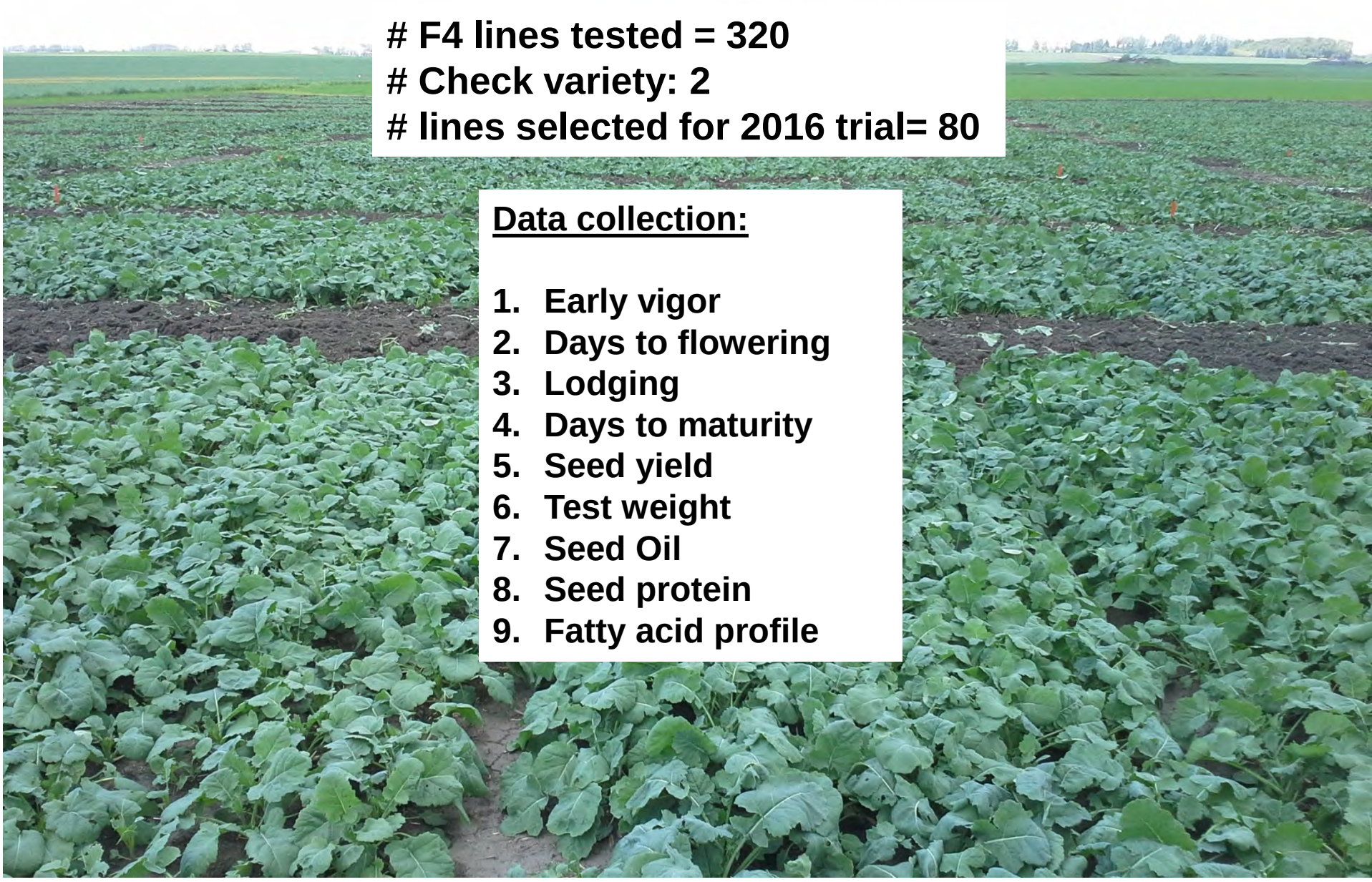
- Canola varieties grown in ND are developed and tested mostly in Saskatoon. As a result cultivated varieties may not be the best adapted to ND conditions.
- Therefore, ND required a breeding program to develop and to evaluate canola variety in ND conditions.

Activities accomplished in 2015-2016

Breeding approaches

- **Parents used for crossing:** 6 high seed yield, and 6 high oil content parents were used.
- **Crossing:** Partial Diallel crosses were made.
- **Place of activities:** NDSU greenhouse.

2015 Early Generation Testing at Langdon and Prosper



 # F4 lines tested = 320
 # Check variety: 2
 # lines selected for 2016 trial= 80

Data collection:

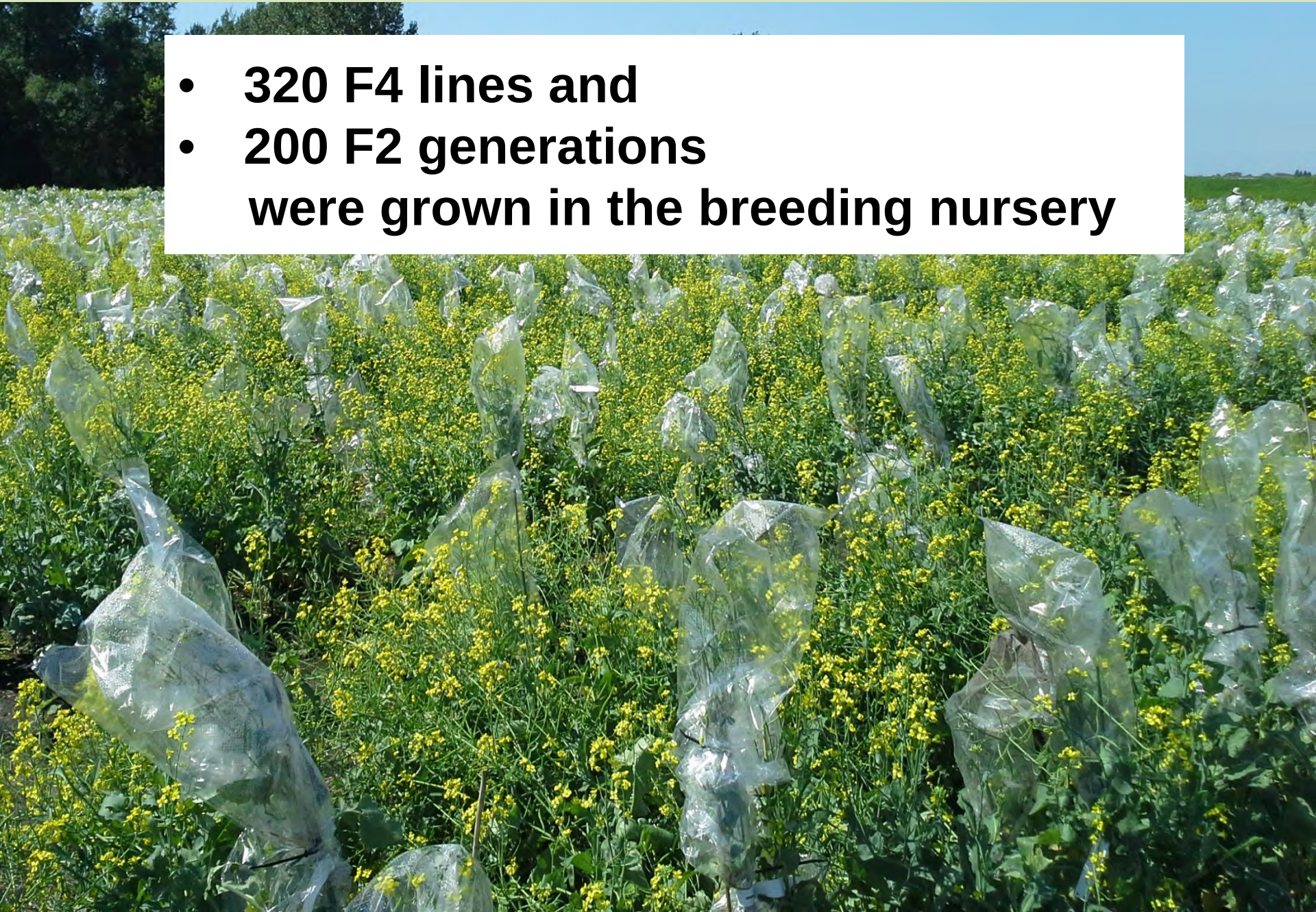
1. **Early vigor**
2. **Days to flowering**
3. **Lodging**
4. **Days to maturity**
5. **Seed yield**
6. **Test weight**
7. **Seed Oil**
8. **Seed protein**
9. **Fatty acid profile**

2015 Early Generation Testing at Langdon and Prosper

Performance of a few EGT lines

Entry	Yield (lb/a)	Yield Over check (%)
15-EC-295	2491	27.9
15-EC-319	2470	26.9
15-EC-178	2454	26.0
15-EC-262	2441	25.4
15-EC-39	2375	22.0
15-EC-169	2342	20.3
15-EC-161	2336	20.0
15-EC-144	2332	19.8
15-EC-320	2317	19.0
15-EC-79	2301	18.2
15-EC-24	2293	17.8
15-EC-301	2220	14.0
15-EC-261	2208	13.4
15-EC-184	2200	13.0
15-EC-266	2196	12.8
15-EC-278	2194	12.7
15-EC-260	2175	11.7
15-EC-70	2152	10.5
15-EC-216	2132	9.5
15-EC-81	2122	9.0
15-EC-68	2119	8.8
15-EC-151	2088	7.2
15-EC-195	2077	6.7
15-EC-252	2075	6.6
15-EC-255	2074	6.5
15-EC-130	2074	6.5

2015 Breeding nursery (Prosper, ND)



- 320 F4 lines and
- 200 F2 generations

were grown in the breeding nursery

2015-2016 Winter Nursery (Chile) activities

Number of breeding lines sent to 2015-16 WN: 450

Benefits of WN: Two breeding generation in a year. To obtain enough seeds for 2016 field trial.

Industry collaboration established

- **Monsanto (Hybrid breeding)**
- **DL Seeds Inc. (Hybrid breeding)**
- **Proseed (Hybrid commercialization)**
- **Croplan (Hybrid commercialization)**
- **Star Seed Inc. (Hybrid commercialization)**
- **INRA, France (CMS Licensing)**
- **INRA, France (Restorer gene Licensing)**

Other achievements until now (2006-2016)

- Released 1st high oil canola variety in North Dakota.
- Created and identified thousands conventional breeding lines with variable characteristics.
- Developed full capacity for field experiment, greenhouse experiment and Lab analysis.
- Introduced double haploid technology to increase breeding efficiency.
- Partial genome sequenced of 366 conventional lines.
- Established collaborative research with public researchers and private sector.
- Initiated Ogura-CMS-Restorer inbred line development program for hybrid breeding.

MN Canola Production Center

Research Results - 2015

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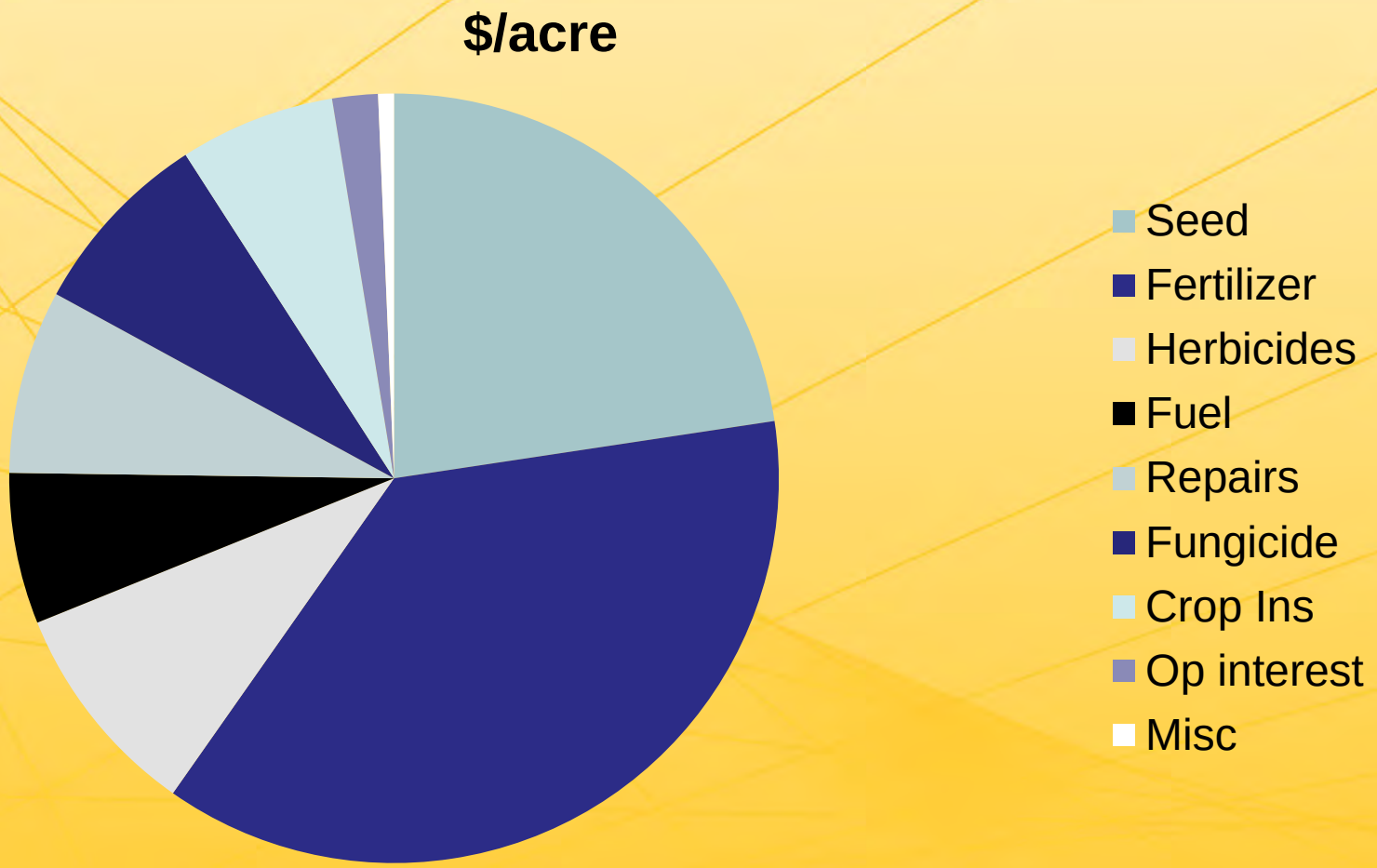
Canola Direct Costs ($226.56) $/A
Source: NDSU Crop Budget - 2015



Canola Fertility

- Fertility alone accounts for approximately 40% of direct costs in canola production
- Research objective: 1) improve nitrogen use efficiency in canola by the use of coated urea, split applications and sequential treatments and, 2) investigate application methods that provide an economic return for canola growers, while at the same time be good environmental stewards

Nitrogen Use Efficiency

- **Strategies to reduce nitrogen loss**
  - **Delay N availability**
  - **Split applications**
  - **Coated urea (ESN)**
  - **Stabilized nitrogen (Agrotain)**

Small Plot Fertility Treatments

- Urea PPI - 0, 45, 90, 135, 180
- Urea + ESN - 0, 45, 90, 135, 180
- Urea PPI + Post - 45+45, 45+90, 45+135
- Urea PPI + Post w/Agrotain Ultra
  - 45+45, 45+90, 45+135
- Urea Post - 0, 45, 90, 135
- Urea Post + Agrotain Ultra - 45, 90, 135
- Post treatments applied June, 15

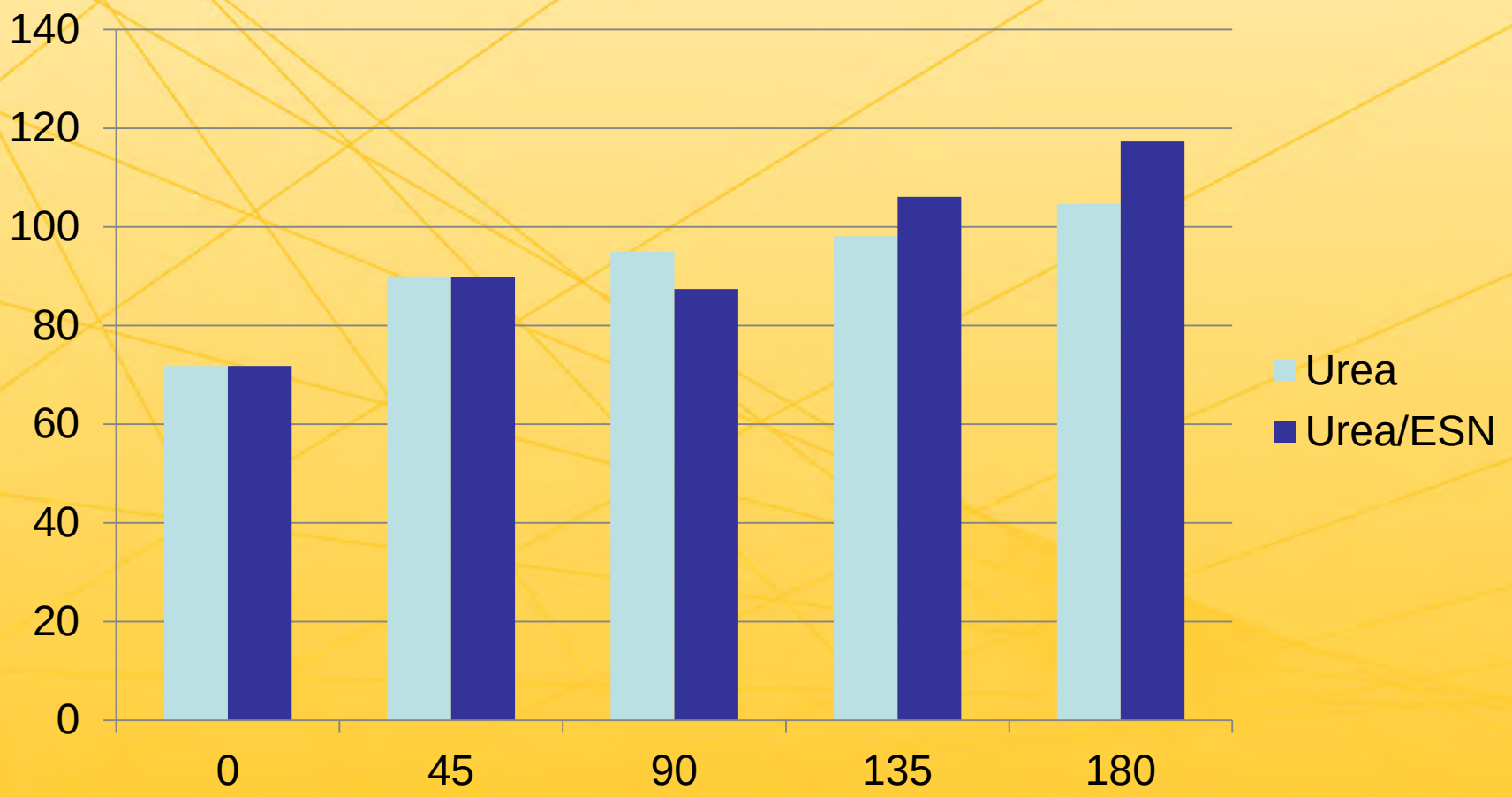
Small Plot Fertility Trial

- Previous crop - wheat
- Planting date May 23
- RCB w/4 reps
- Background nitrogen
- 0-6 = 25#; 6-24 = 7#
- Post fertility applied June, 15 (3-5 lf canola)

Canola Fertility Trial

- **Canola variety - InVigor LL 252**
- **Seeding date: May 23**
- **Post fertilizer applied June 15 to 3 to 5 lf canola**
- **0.5 inch rain after post fertilizer treatments applied**
- **Canola yields ranged from 2,503 to 3,361 #/A**

Canola Yield (% of Mean)
Mean Yield = 2,864 #/acre



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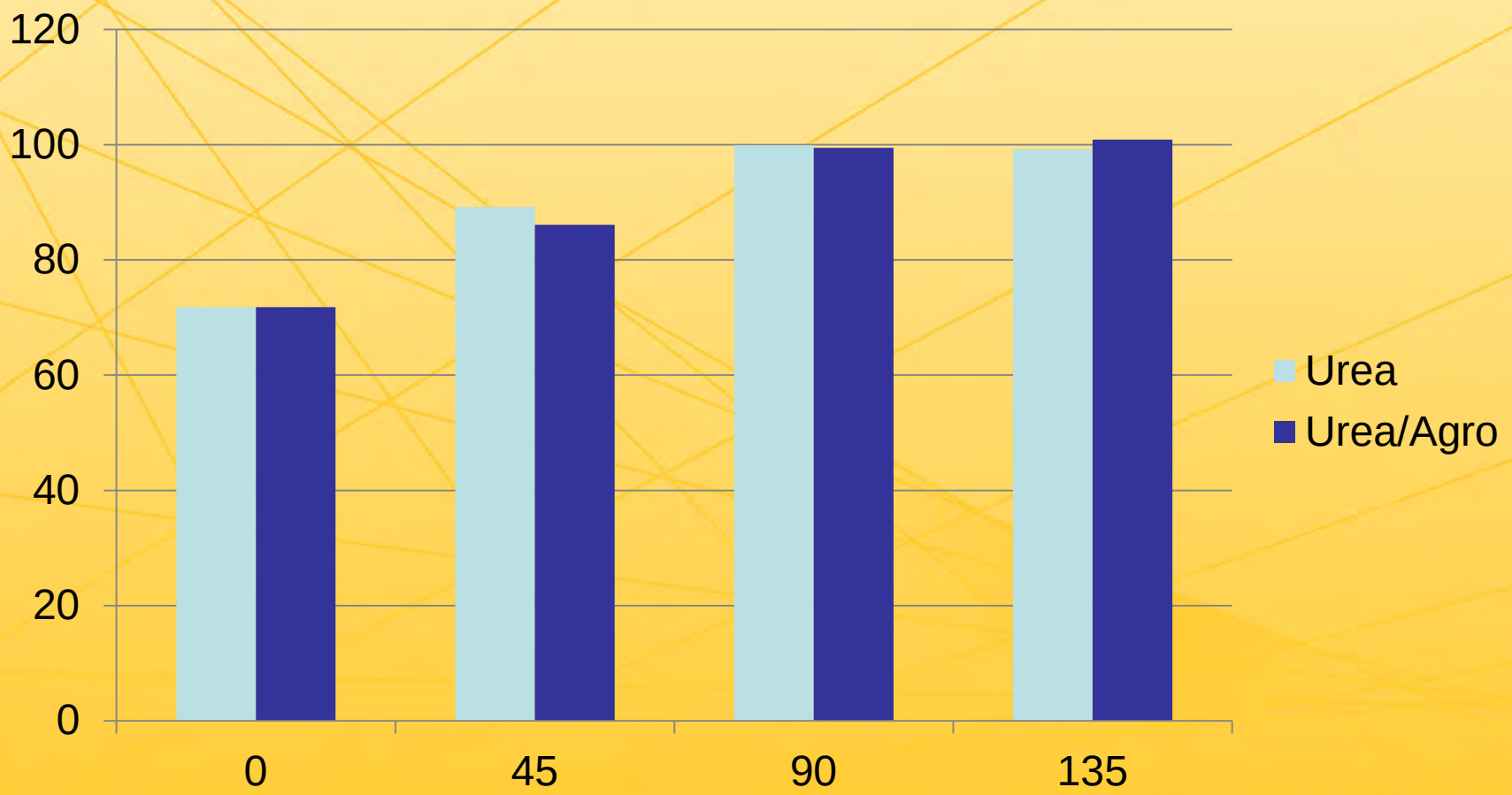

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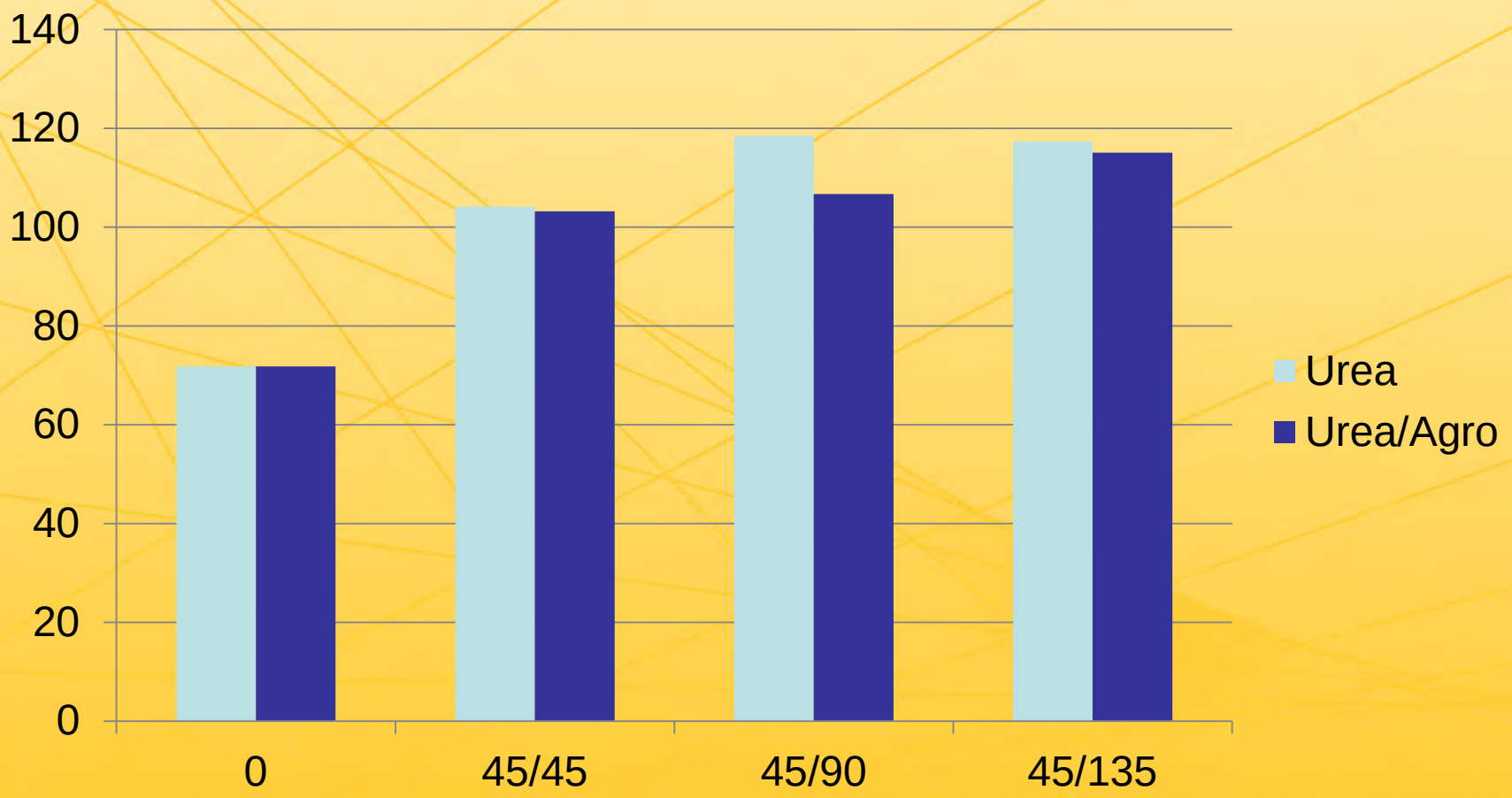
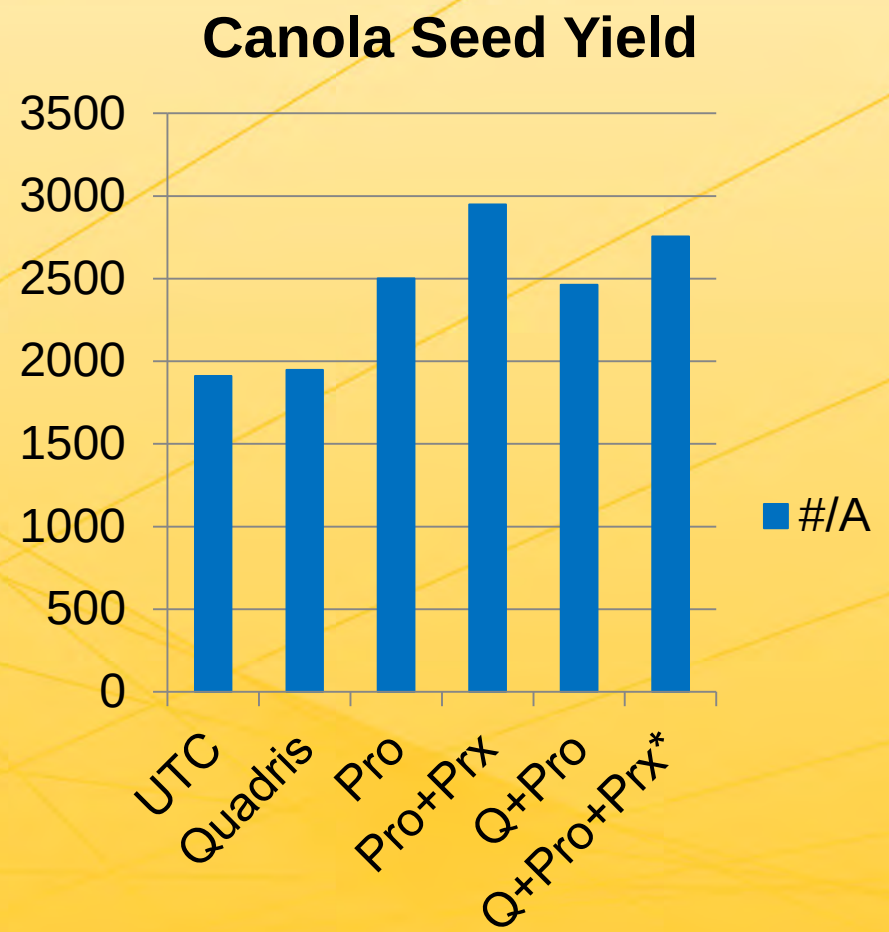


Canola Disease Trial

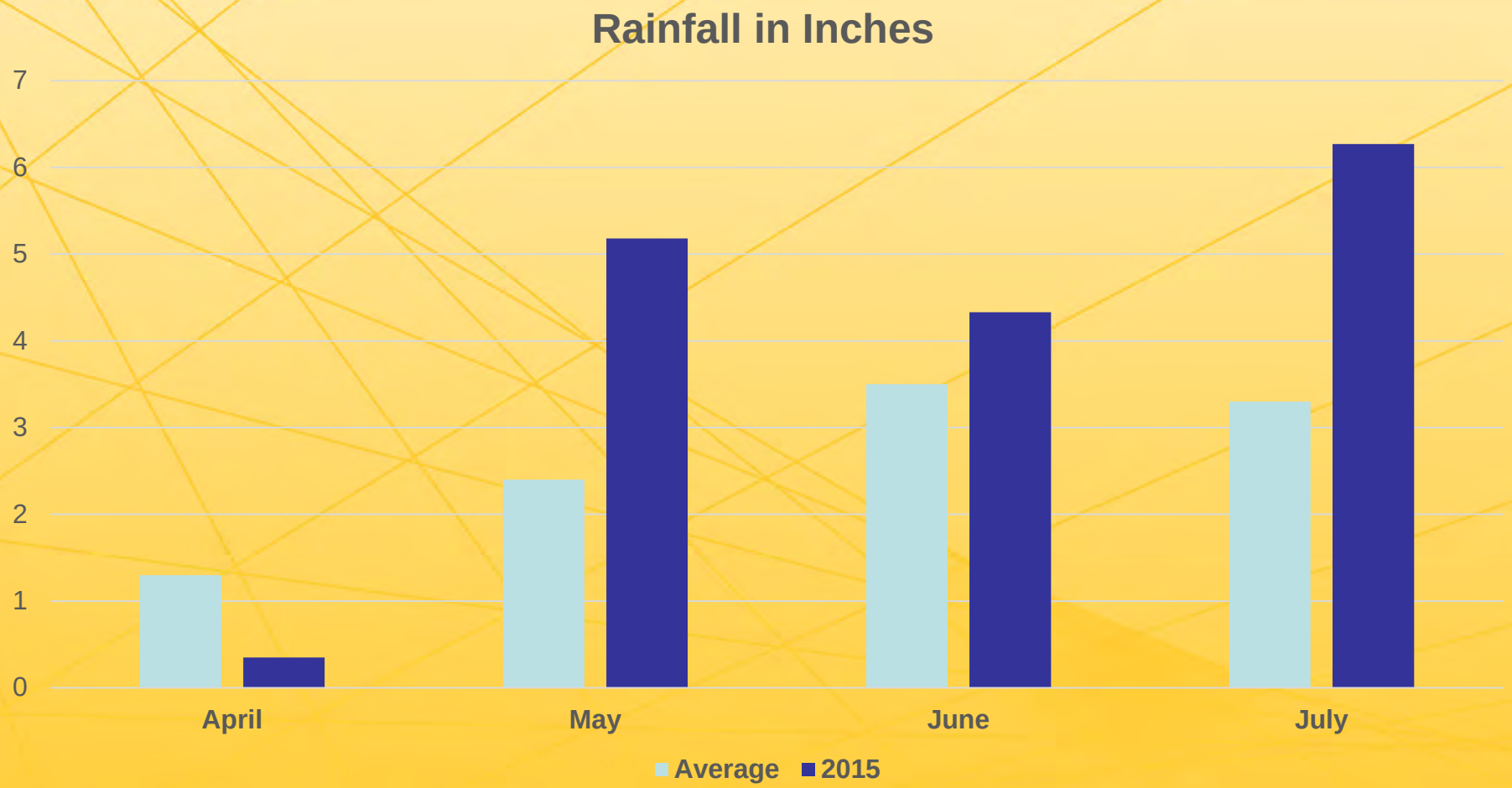
- Canola susceptible to several diseases which occur at different times during the growing season
- Blackleg - early season
- White mold - early-to-late flowering
- Alternaria - flowering through seed set
- Research question: Will canola respond to multiple fungicide applications?

Small Plot Fungicide Trial MN CPC in 2015

- Trial located at CPC
- RCB w/4 reps
- UTC = Untreated
- Pro = Proline 5.7 oz/A @ first petal fall
- Prx = Priaxor 6.0 oz/A applied @ 80% bloom
- Q = Quadris 7 oz/A applied at 2 to 4 lf
- * Warrior with Quadris

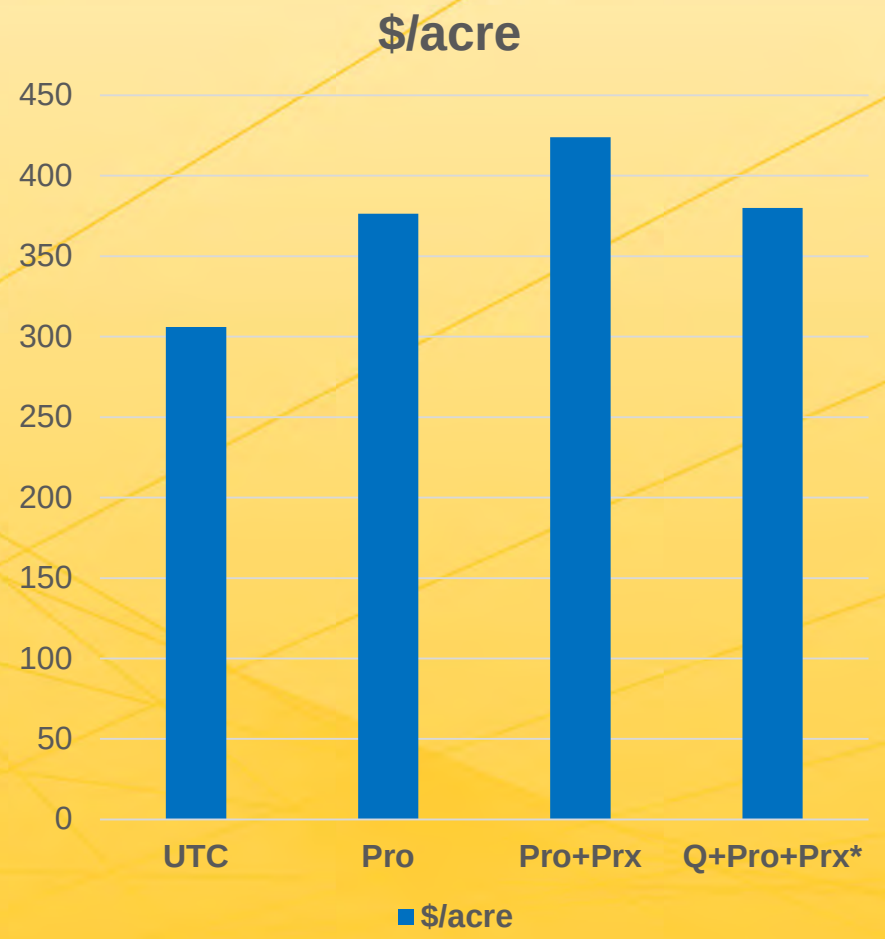


Roseau Rainfall in April - July Average Compared to 2015



Fungicide Economics

- Canola price $0.16/#
- Fungicides for white mold $18.00/acre. Source: NDSU Crop Budgets for 2015
- $6.00/acre application
- Single timing $24.00
- Sequential $48.00/acre



Summary Fungicide Trial

- In 2015, severe white mold, moderate Alternaria with no blackleg observed
- Standard treatment: Proline @ first petal fall, 590#/A more yield than untreated
- Sequential treatment: Proline @ first petal fall/Priaxor at 75% bloom, 1,037#/A more yield than untreated
- In wet years, sequential fungicides required to maximize canola yields

Canola Direct Harvest Trial

- Majority of canola swathed prior to harvest
- New canola genetics incorporates shatter tolerance, which makes direct canola harvest a realistic management option
- Direct harvest, one less trip across the field
- Average swathing cost $13.10/acre, Source: 2015 Iowa Farm Custom Rate Survey
- A farmer with 500 acres of canola could gain an additional $6,550/year by direct harvest canola compared to swath and harvest

Large On-Farm Canola Trial: Swath vs Direct Harvest

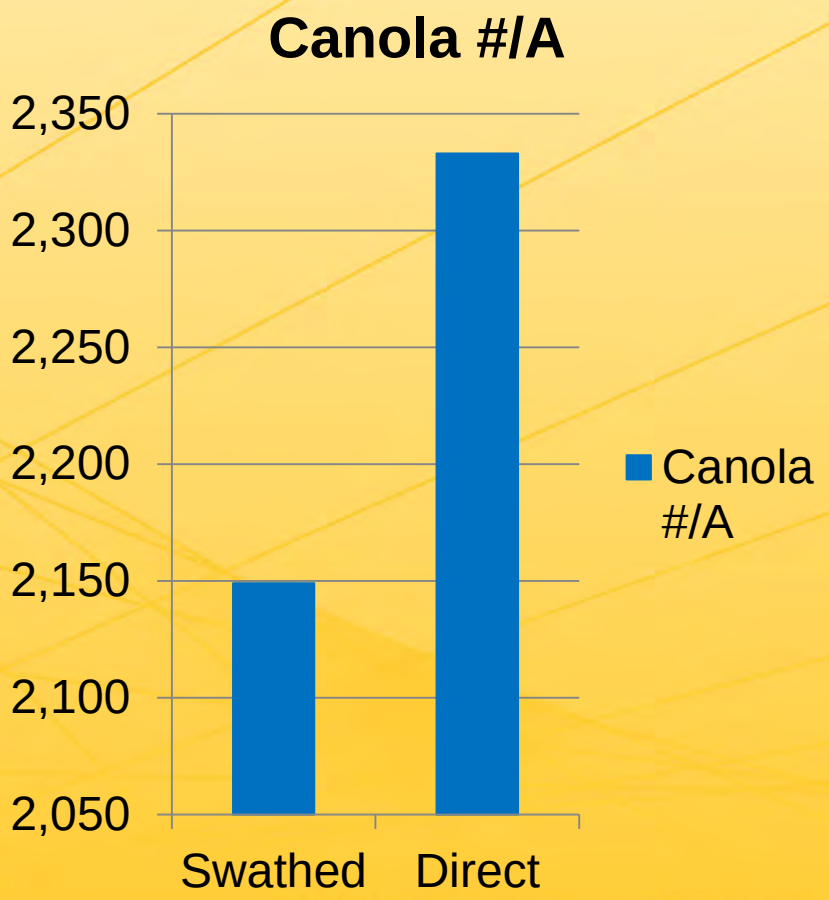
- Trial location Hugh Hunt farm - Hallock
- Star 402 planted 4/27/15
- Both treatments combined on 8/19/15
- Treatments were swathing and direct harvest

Combine Harvest of Swaths and Straight Harvest Canola

Windrows

Direct Harvest

On-Farm Swathed vs. Direct Harvest Data - 2015



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Volunteer Canola Control

- **Treatments applied at 3-leaf canola provided significantly better control compared to bolting canola**

- **>80% control**
  - **Raptor 2 oz, Reflex, Extreme fb Raptor, Auth MTZ fb Raptor, Valor fb Raptor**
- **50-80% control**
  - **Basagran, Liberty, Raptor 1 oz**

TOUGH™ 5EC Herbicide

KEY CROPS

- Click

CABBAGES

ONIONS

LEEK

ASPARRAGUS

ARTICHOKES

FRESH HERBS AND SPICES

LENTILS

BLACK SALSIFY

TOUGH™ 5EC
Herbicide

KEY CROPS

- Click

CORN

ALFALFA

GROUNDNUTS

CHICKPEAS

MINT

OSR

TOBACCO

NEW DEVELOPMENT

TABLE 4. Susceptibility of some common broad-leaved weeds to approved winter oilseed rape herbicides and common mixtur (based on label recommendations)

	Weeds pre-emergence						Weeds post-emergence											
WEEDS	Metazachlor	Metazachlor + quinmerac	Propachlor	Tebutam	Trifluralin	Trifluralin/napropamide	Benazolin	Benazolin + clopyralid	Clopyralid	Cyanazine	Metazachlor	Metazachlor + quinmerac	Propyzamide	Propyzamide + clopyralid	Propyzamide/benazolin + clopyralid	Prpopyzamide/cyanazine	Pyridate	Metazachlor/benazolin + clopyralid
Bugloss	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-
Charlock	-	-	-	-	-	-	-	M	-	S	-	-	-	-	-	S	M	-
Chickweed, common	S	S	S	S	S	S	S	S	-	S	S	M	S	S	S	S	M	S
Cleavers	M	S	S	-	-	-	S	S	-	-	-	S	M	M	M	M	S	-
Cranes-bills	S	-	-	-	-	-	-	-	-	-	M	-	-	-	-	-	S	-
Deadnettle, red	S	S	S	M	M	S	-	M	-	S	S	M	-	-	M	S	S	M/S
Forget-me-not, field	S	S	-	S	-	-	-	-	-	S	S	-	S	-	S	S	S	M/S
Fumitory	-	-	-	-	M	M	M	S	-	-	-	-	-	-	S	-	-	M/S
Gromwell, field	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-
Groundsel	-	S	-	-	-	-	-	-	S	-	S	-	-	-	S	-	-	S
Hemp-nettle /Day-nettle	-	-	-	S	S	M	-	-	-	-	-	-	-	-	-	S	S	-
Marigold, corn	S	-	S	-	-	-	-	S	S	-	S	-	-	S	S	-	S	-
Mayweeds	S	S	S	S	-	S	-	S	S	-	S	S	-	S	S	-	M	S
Mustard species	-	-	-	-	-	-	-	-	-	S	-	-	-	-	-	S	-	-
Nettle, small	M	-	S	M	M	M	-	-	-	S	-	-	S	S	S	S	M	-
Nipplewort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	S	-
Pansy, field	-	M	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parsley-piert	S	S	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Parsley species	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
Poppy	S	S	-	S	M	M	-	M	-	-	-	S	-	-	M	-	-	M
Runch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shepherd's purse	S	S	S	-	-	-	-	-	-	S	-	-	-	-	-	S	M	M
Speedwells	S	S	S	M	S	S	-	-	-	S	S	-	M	-	M	S	S	M/S
Spurrey, corn	M	-	S	-	M	S	-	-	-	-	-	-	S	-	S	S	-	-
WEED SIZE	Pre	Pre	Pre	Pre	Pre	Pre	Pt	Pt	Pt	Pre-sd	Pre-sd	Pre-pt	Pre-pt	Pre-pt	Pre-pt	Pre-pt	Pt	Pre-pt

S = susceptible, M = moderately susceptible, M/S = control of seedlings

Pre: pre-emergence of weeds; Pt: post-emergence at most growth stages; Pre-sd: pre-emergence to seedling stages; Pre-pt: pre-emergence to post-emergence, weed, but check individual products for Pre and Pt activity.

(table 6 continued below)

Active Ingredient and Timing	Products	Manufacturer	Information
Cycloxydim*	Various (eg Laser)* plus	Various	From expanded cotyledons to crop canopy closing, weeds from 2 leaves. Note label for adjuvant requirements.
Fluazifop-P-butyl*	Citadel/Corral/Fusilade 250EW* plus adjuvant	Syngenta	From 1 leaf to before flowerbuds on crop. Weeds from 2 leaves. Note label for adjuvant requirements.
Propaquizafop*	Various (eg Falcon)* Some products (excluding Falcon) require LERAP(B) assessment.	Various	From expanded cotyledons to before flowerbuds appear. Weeds from 2 leaves.
Propyzamide	Various (eg Kerb)	Various	From 1 Oct, 3 leaves on crop, to 31 Jan. Some residual activity. Grass weeds all stages, some small broad-leaved weeds.
Propyzamide + clopyralid	Matrikerb	Sumi	From 1 Oct, 3 leaves on crop, to 31 Jan. Some residual activity. Grass weeds all stages, some small broad-leaved weeds, plus mayweeds.
Pyridate*	Lentagran* LERAP (B) assessment	Syngenta	From 6 leaves on crop to mid-Dec, then from start of spring growth to 15cm stem extension. Weeds 4-6 leaves.
Quizalofop-p-ethyl*	CoPilot/Pilot D/Sceptre* plus adjuvant	Aventis	From expanded cotyledon to before crop canopy closes. Weeds from 2 leaves. Note label for adjuvant requirement.
Sethoxydim*	Checkmate* plus adjuvant	Hortichem	All stages of growth until crop canopy closes. Weeds from 2 leaves. Note label for adjuvant requirement.
Tepraloxydim*	Aramo*	BASF	From expanded cotyledon to end-Nov or 9 crop leaves, whichever occurs first. Emerged small weeds.
Pre-harvest			
Diquat	Reglone	Syngenta	Pre-harvest desiccant, check label for details of timing. Will desiccate green weed foliage.
Glufosinate-ammonium	Challenge/Harvest	Aventis	Pre-harvst desiccant, grain < 30% moisture - check label for further details. Will desicacate many weeds.
Glyphosate	Various	Various	Pre-harvest, grain < 30% moisture, 75% grain brown-check label for further details. Control of many perennial weeds if foliage still green.

*NB Take care mixing these products with other products, and note the intervals required when used in sequence with other herbicides and other pesticides. In some cases, the crop foliage may need testing for waxiness.

TOUGH™ 5EC Herbicide

KEY WEEDS
Sensitive at all stages

Amaranthus spp.	pigweeds	*Kochia scoparia*	Kochia
Bidens spp.	beggarticks	*Lamium spp.*	deadnettle sp.
Chenopodium spp.	common lambsquarters and goosefoots	*Lapsana communis*	nippleworth
Datura stramonium	Jimsonweed	*Lithospermum arvense*	gromwell
Desmodium tortuosum	Florida beggarweed	*Lycopsis arvensis*	bugloss
Fumaria spp.	Fumitory sp.	*Senecio vulgaris*	groundsel
Galeopsis spp.	hempnettle.	*Solanum spp.*	nightshades
Galinsoga spp.	Galinsoga sp.	*Xanthium pennsylvanicum*	Canada cocklebur
Galium aparine	bedstraw	*Xanthium strumarium*	common cocklebur

TOUGH™ 5EC Herbicide

KEY WEEDS

Application to be done by 3 to 4 leaf stage

Abutilon theophrasti	velvetleaf	*Ipomoea hederacea*	ivyleaf morningglory
Acanthospermum hispidum	bristly starbur	*Ipomoea purpurea*	tall morningglory
Ambrosia artemisiifolia	common ragweeds	*Matricaria spp.*	chamomile
Anagallis arvensis	Scarlet pimpernel	*Mercurialis annua*	annual mercury
Anthemis arvensis	corn chamomile	*Portulaca oleracea*	common purslane
Atriplex patula	orach	*Ranunculus arvensis*	corn buttercup
Capsella bursa-pastoris	Shepherd's-purse	*Salsola kali*	common salwort
Cassia obtusifolia	sicklepod	*Sida spinosa*	prickly sida
Conyza canadiensis	horseweed	*Sonchus oleraceus*	annual sowthistle
Datura ferox	oakleaf datura	*Stachys annua*	hedgenettle
Euphorbia spp.	spurge	*Stellaria media*	common chickweed
Helianthus annuus	sunflower	*Urtica urens*	burning nettle
Heliotropium europaeum	European heliotrope	*Veronica spp.*	speedwell
Hibiscus trionum	Venice mallow	*Vicia spp.*	vetches

TOUGH™ 5EC Herbicide

WEED SPECTRUM

Weed (Latin Name)	ONYX 0,5 L/Ha	ONYX 1 L/Ha	ONYX 1,5 L/Ha
Abutilon theophrasti			
Amaranthus species			
Ambrosia elatior			
Anagallis arvensis			
Anthemis			
Arabidopsis thaliana			
Atriplex patula			
Capsella bursa-pastoris			
Chenopodium species			
Datura stramonium			
Euphorbia helioscopia			
Fumaria officinalis			
Galeopsis species			
Galium aparine			
Galinsoga species			
Geranium species			
Kickxia elatine			

Weed (Latin Name)	ONYX 0,5 L/Ha	ONYX 1 L/Ha	ONYX 1,5 L/Ha
Lamium sp			
Lapsana communis			
Matricaria species			
Mercurialis annua			
Polygonum aviculare			
Polygonum convulus			
Polygonum lapathifolium			
Polygonum persicaria			
Senecio vulgaris			
Sinapis arvensis			
Solanum nigrum			
Stachys annua			
Stellaria media			
Thlaspi arvense			
Veronica species			
Xanthium species			

< 65 % | 65-85 % | 85-95 % | 95-100 %

Identify Clubroot - Canola ...

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Search

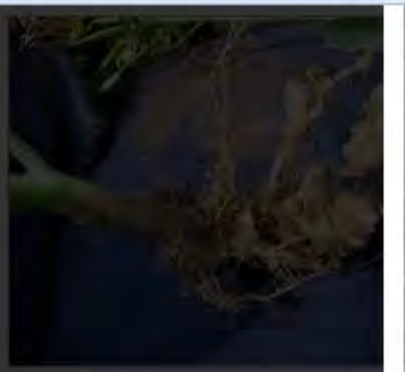

Figure 3. Always dig up roots when clubroot [Photo courtesy of Parkla Agricultural Services, Alberta C

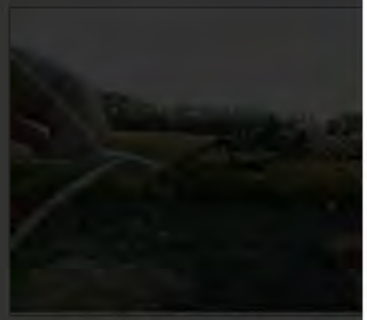

Figure 5. The small galls begin to ex infection progresses [©Monsanto Can with permission]

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Figure 4. Initial infection with small gall formed on a lateral root.[©Monsanto Canada Inc. Used with permission]

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Figure 5. The small galls begin to expand as the infection progresses [©Monsanto Canada Inc. Used with permission]

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Figure 6. A moderately infected canola root. [©Monsanto Canada Inc. Used with permission]

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