

An aerial photograph of a vast agricultural landscape. The foreground and middle ground are dominated by a grid of rectangular fields in various stages of growth and harvest, showing colors from vibrant green to golden yellow and brown. A central area contains a distinct research plot with smaller, more uniform sections. In the background, rolling hills and a clear sky with light clouds are visible.

# Cool-Season Pulse & Canola Variety Trials

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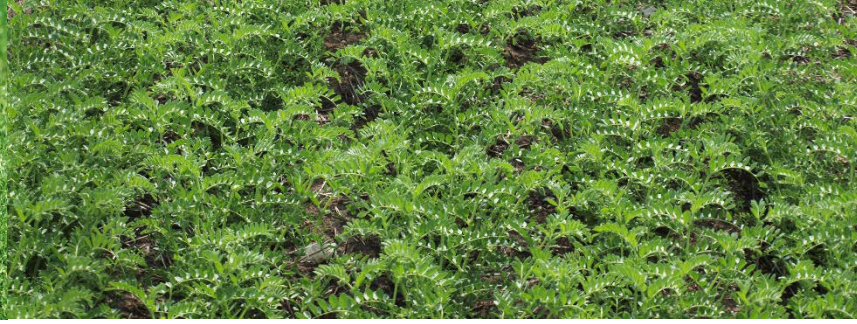












Weather.....Pg. 12

Spring Field Pea Variety Trial.....Pg. 31

Spring Lentil Variety Trial.....Pg. 34

Spring Chickpea Variety Trial.....Pg. 37

Spring Canola Variety Trial.....Pg. 40

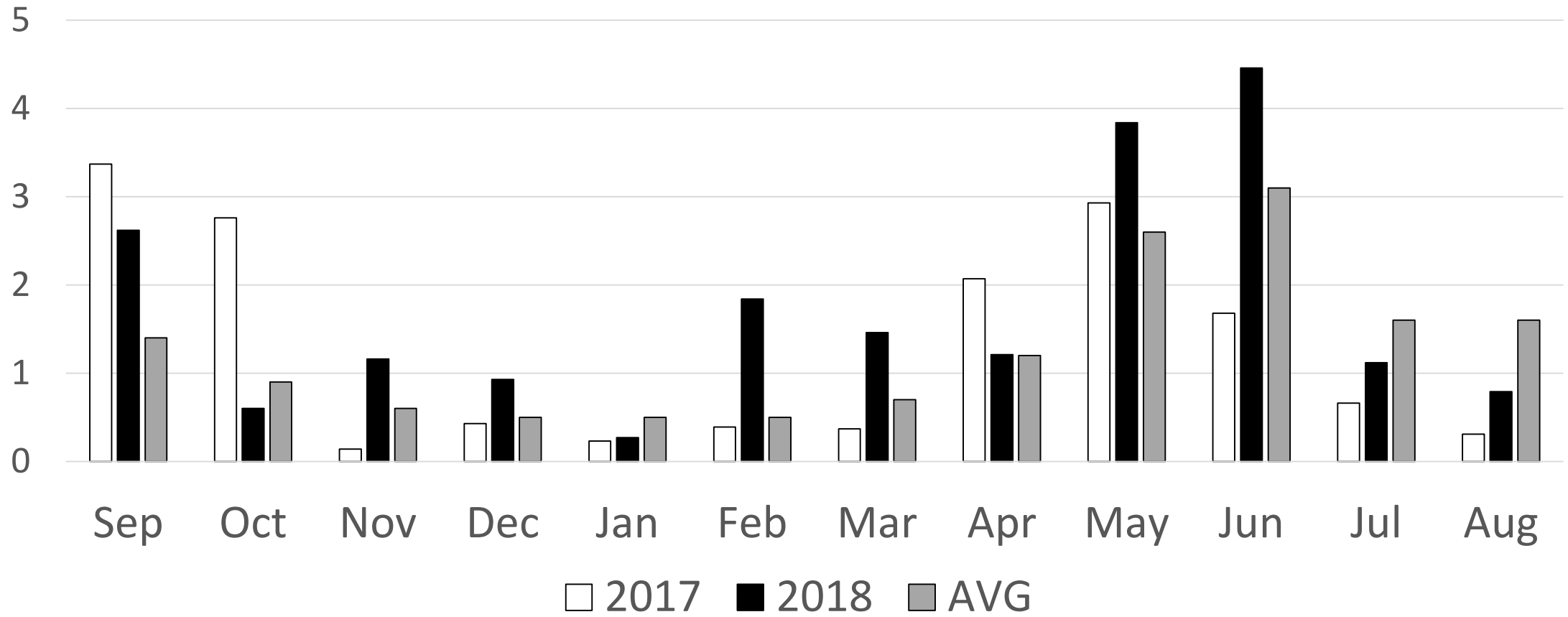
Acidic Soils Synopsis.....Pg. 68





# Weather Summary, precipitation (inches)

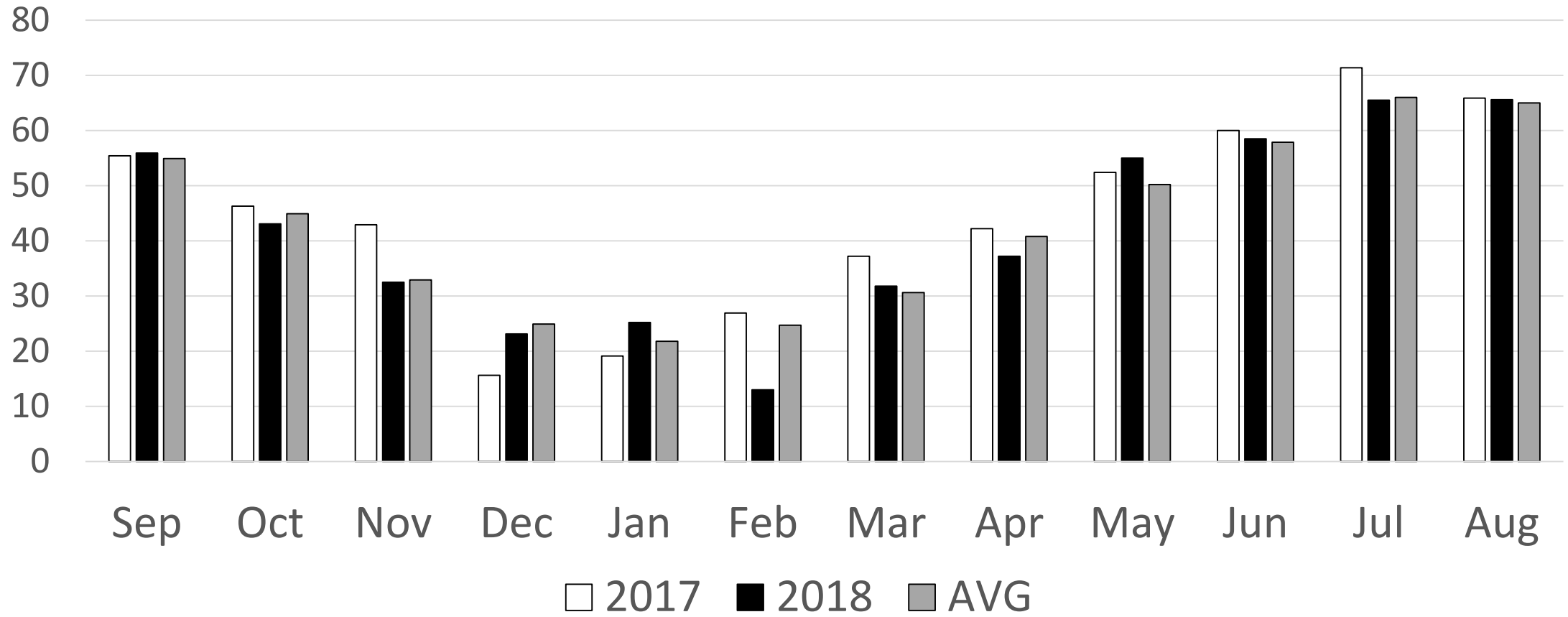
2017 and 2018 crop years with 109-yr average, Central Ag Research Center, Moccasin, MT





# Weather Summary, air temperature (°F)

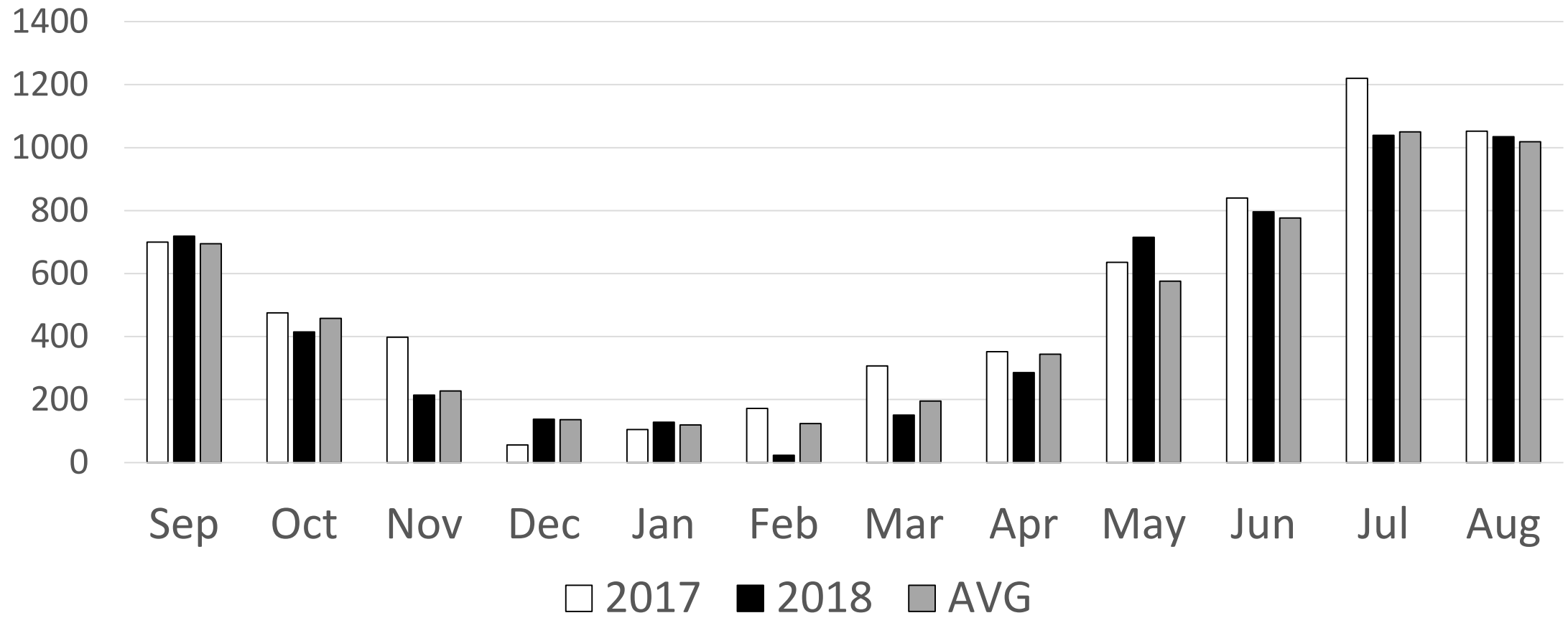
2017 and 2018 crop years with 107-yr average, Central Ag Research Center, Moccasin, MT





# Weather Summary, growing degree days

2017 and 2018 crop years with 107-yr average, Central Ag Research Center, Moccasin, MT







# Spring Field Pea Variety Trial

(Pg. 31)





# Background

- Spring field pea may be grown economically as a green fallow crop or a grain crop in Montana
- Fallow replacement with pea can reduce nitrate leaching without decreasing profit (John et al., 2017)





# Justification

- Montana's dry pea yields are consistently depressed relative to those of other top-producing states (NASS, 2018).
- At CARC, selection of the appropriate variety can mean a difference in yield of 611 lb/ac (10 bu/ac) in a dry growing season (2017) and 889 lb/ac (15 bu/ac) in a wet growing season (2018; n=14)





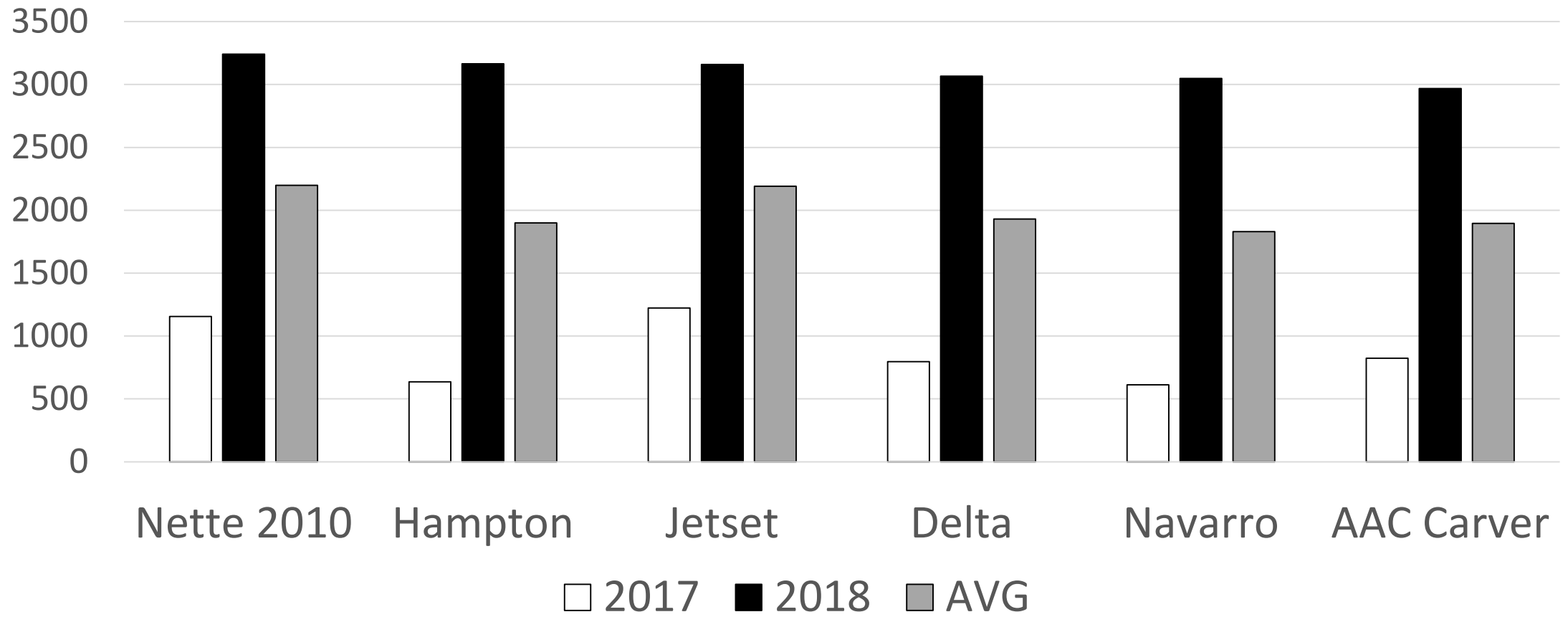
# Methods

- 23 varieties (6 green and 17 yellow cotyledon types)
- 8 experimental lines (results not shown)
- Planted: April 25<sup>th</sup> in 2018, April 19<sup>th</sup> in 2017
- Seeding rate: of 8 pure live seeds/ft<sup>2</sup>
- Soil temperature at planting: 42 °F
- Seed treat: Apron Maxx (fungicide) and Cruiser Maxx (insecticide)
- Grizzly Too insecticide at 1.9 oz/ac applied on May 17<sup>th</sup> for pea leaf weevil control
- Harvested: August 7<sup>th</sup> in 2018, July 25<sup>th</sup> in 2017



# Spring pea variety trial results, yield (lb/ac)

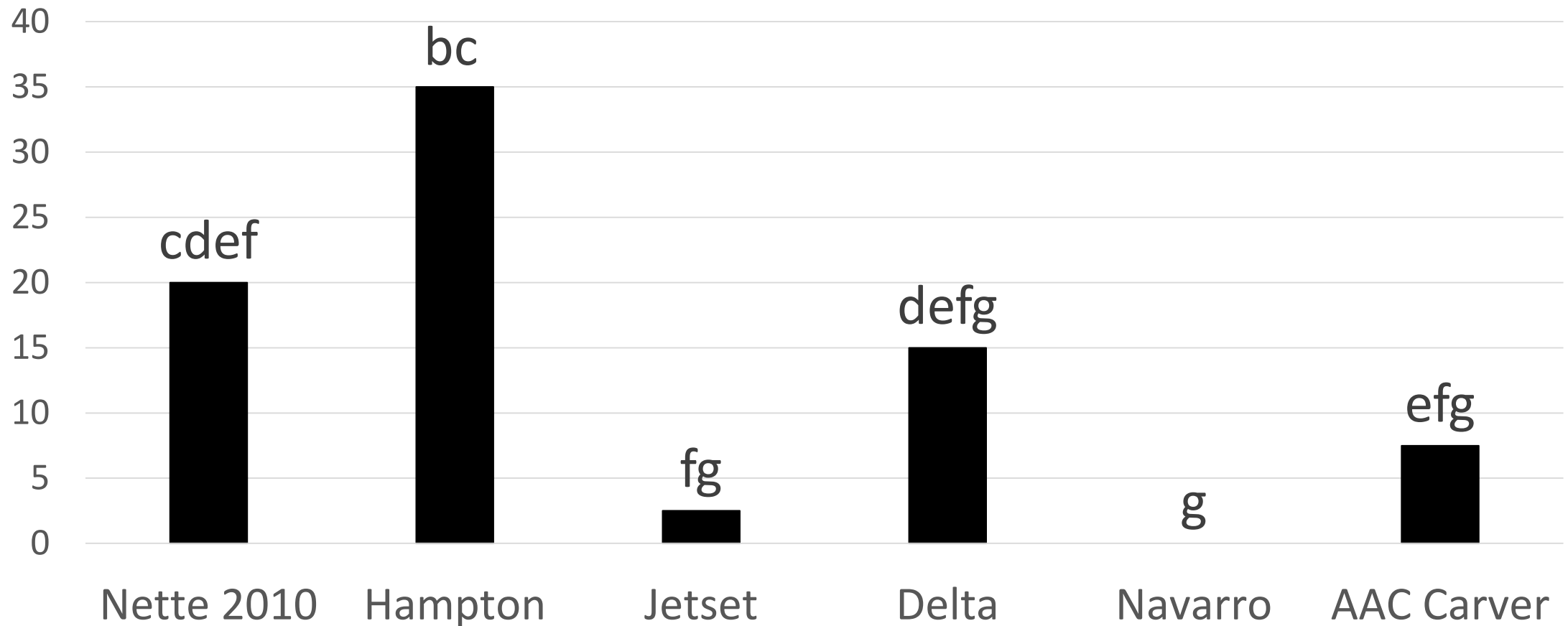
Cultivars yielding statistically equivalent to 2018 top performer, Nette 2010 (Central Ag Research Center, Moccasin, MT, 2018)





# Spring pea variety trial results, % lodging

Cultivars yielding statistically equivalent to 2018 top yielder, Nette 2010 (Central Ag Research Center, Moccasin, MT, 2018)



*Statistical analysis includes cultivars not listed*

# Nette 2010

- Supplier: Pulse USA Inc.
- Seed color: Yellow
- Most similar to: Lumina
- Resistant to:
  - Fusarium Wilt – Race 1
- Susceptible to:
  - Powdery Mildew
- Among the earliest flowerers

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobeImages/201400205.pdf>





# Hampton

- Owner: USDA ARS, Pullman, WA
- Seed color: Green
- Most similar to: Aragorn, Banner
- Resistant to:
  - Pea Enation Mosaic Virus
  - Bean Leaf Roll Virus
  - Powdery Mildew
  - Fusarium Wilt – Race 1
- Susceptible to:
  - Fusarium Wilt– Race 2

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobelImages/201500303.pdf>





# Jetset

- Supplier: Meridian Seeds
- Seed color: Yellow
- Resistant to:
  - Fusarium Wilt – Race 1
- Susceptible to:
  - Powdery Mildew
- Among the top performers for:
  - Establishment
  - Vine Length and Plant Height
  - Lodging

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobelImages/201400192.pdf>





# Delta

- Supplier: Limagrain
- Seed color: Yellow
- Among the top performers for:
  - Establishment
  - Lodging





# Navarro

- Owner: DL Seeds Inc
- Supplier: Great Northern Ag
- Seed color: Yellow
- Most similar to: CDC Golden, DS Admiral
- No disease resistances tested
- Among the earliest flowerers
- Among the top performers for:
  - Vine length and Plant Height
  - Lodging
  - Kernel Weight

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobelImages/201300192.pdf>





# AAC Carver

- Supplier: Meridian Seeds
- Seed color: Yellow
- Resistant to:
  - Powdery Mildew
- Moderately susceptible to:
  - Fusarium Wilt – Race 2
  - Mycosphaerella blight
- Among the top performers for:
  - Establishment
  - Vine Length & Plant Height
  - Lodging

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobelImages/201600249.pdf>







Photo Credit: Heather Fryer





# Spring Lentil Variety Trial

(Pg. 34)





# Background

- Spring lentil may be grown economically as a green fallow crop or a grain crop in Montana
- Spring lentil improves soil fertility and breaks pest cycles when incorporated into wheat-fallow or wheat-only systems





# Justification

- Montana typically leads the nation in total lentil acreage, but the state's production on a per acre basis is consistently below national averages
- At CARC, selection of the appropriate variety can mean a difference in yield of 264 lb/ac (4.4 bu/ac) in a dry growing season (2017) and 561 lb/ac (9.3 bu/ac) in a wet growing season (2018; n=5)





# Methods

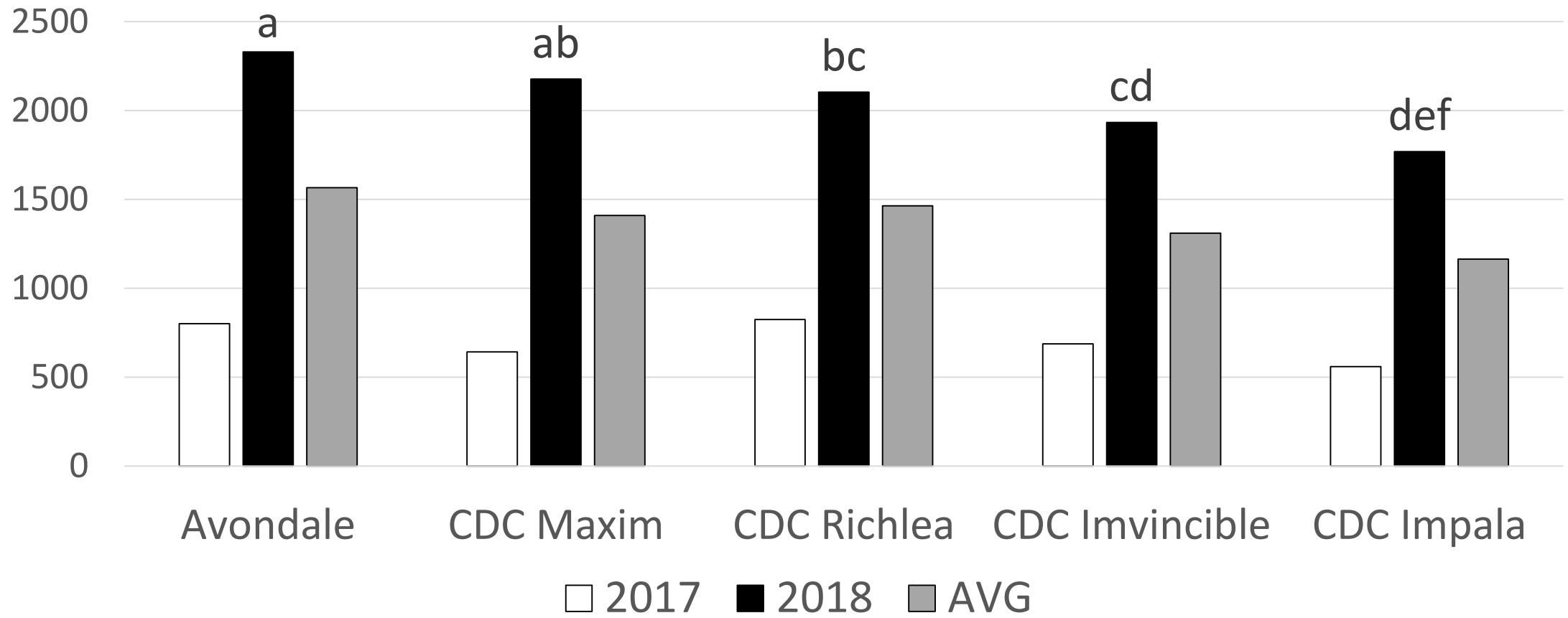
- 5 varieties
- 61 experimental lines (results not shown)
- Planted on April 25<sup>th</sup> at a rate of 12 pure live seeds/ft<sup>2</sup>
- Soil temperature was 42 °F at time of planting
- Seed treat: Apron Maxx (fungicide) and Cruiser Maxx (insecticide)
- Harvested August 13<sup>th</sup>





# Spring lentil variety trial results, yield (lb/ac)

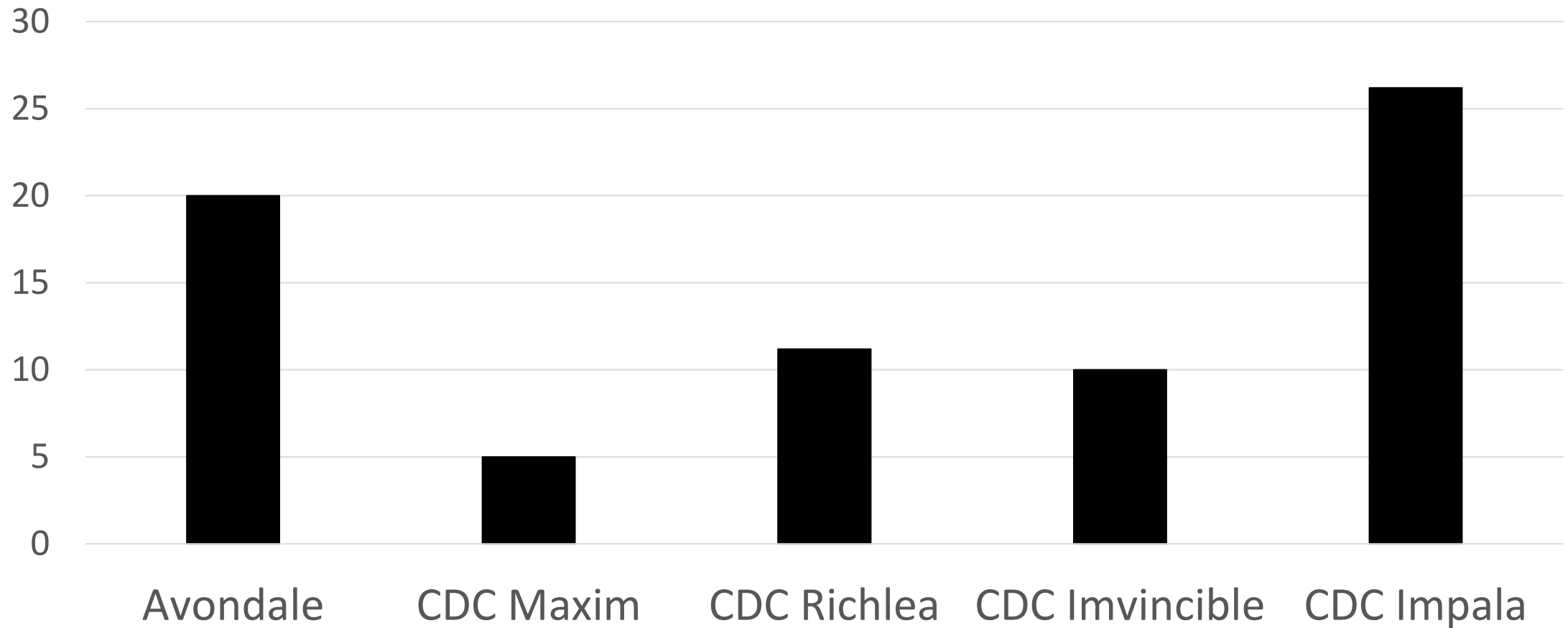
(Central Ag Research Center, Moccasin, MT, 2018)



*Statistical analysis includes cultivars not listed*

# Spring lentil variety trial results, % lodging

No statistical differences (Central Ag Research Center, Moccasin, MT, 2018)



*Statistical analysis includes cultivars not listed*



# Avondale

- Owner: USDA ARS, Pullman WA
- Seed color/size: Medium Green
- Most similar to: Brewer, Merrit
- Tolerant to:
  - Stemphylium Blight
  - Stemphylium botryosum
- Earliest flowerer
- Among the tallest at vegetative stage

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobeImages/201400093.pdf>





# CDC Maxim

- Owner: Crop Development Center
- Supplier: Pulse USA Inc.
- Seed color/size: Small Red
- Most similar to: CDC Redberry, CDC Impact
- Tolerant to: Anthracnose
- Resistant to: *Ascochyta lentis*
- Herbicide Resistance: Clearfield
- Among the tallest at maturity

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobelImages/201100265.pdf>







Photo Credit: Heather Fryer





# Spring Chickpea Variety Trial

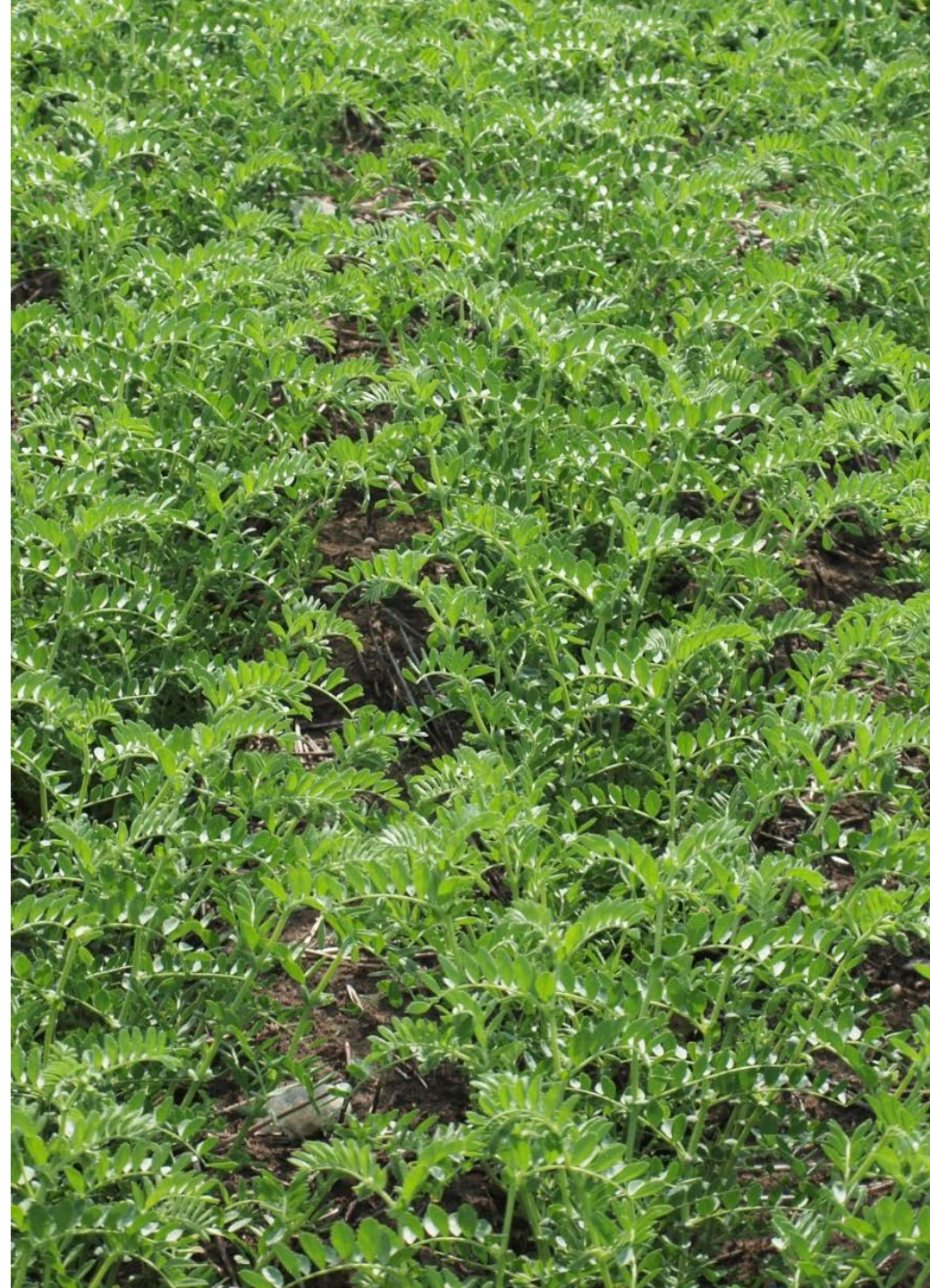
(Pg. 37)





# Background

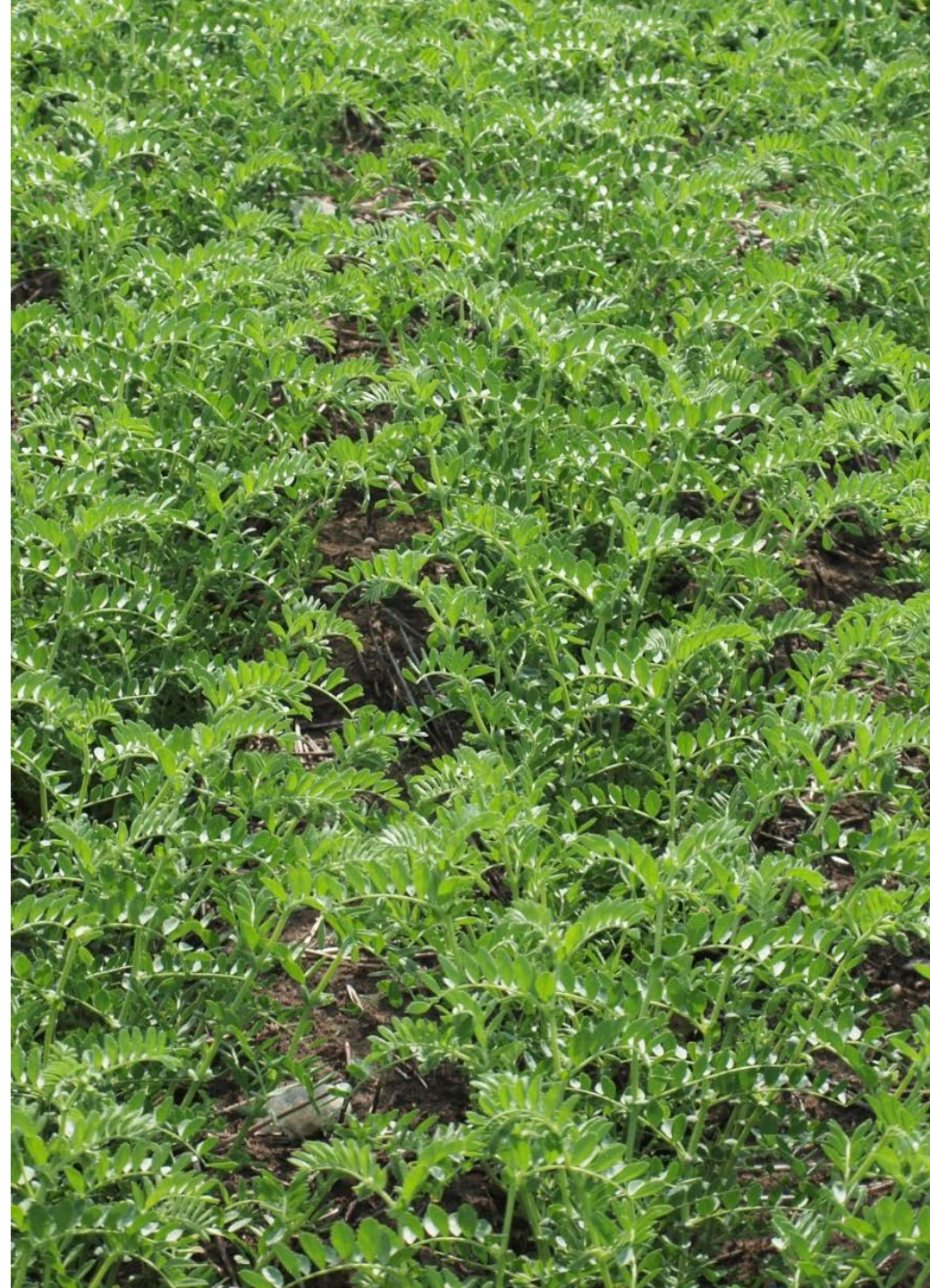
- Chickpeas can be a challenging crop for growers due to problems with fungal diseases, particularly during periods of cool, wet weather.
- Chickpea prices decrease with seed size, falling off below 7 mm
- Seed size:
  - Desi < Large Kabuli < Large Café Kabuli





# Justification

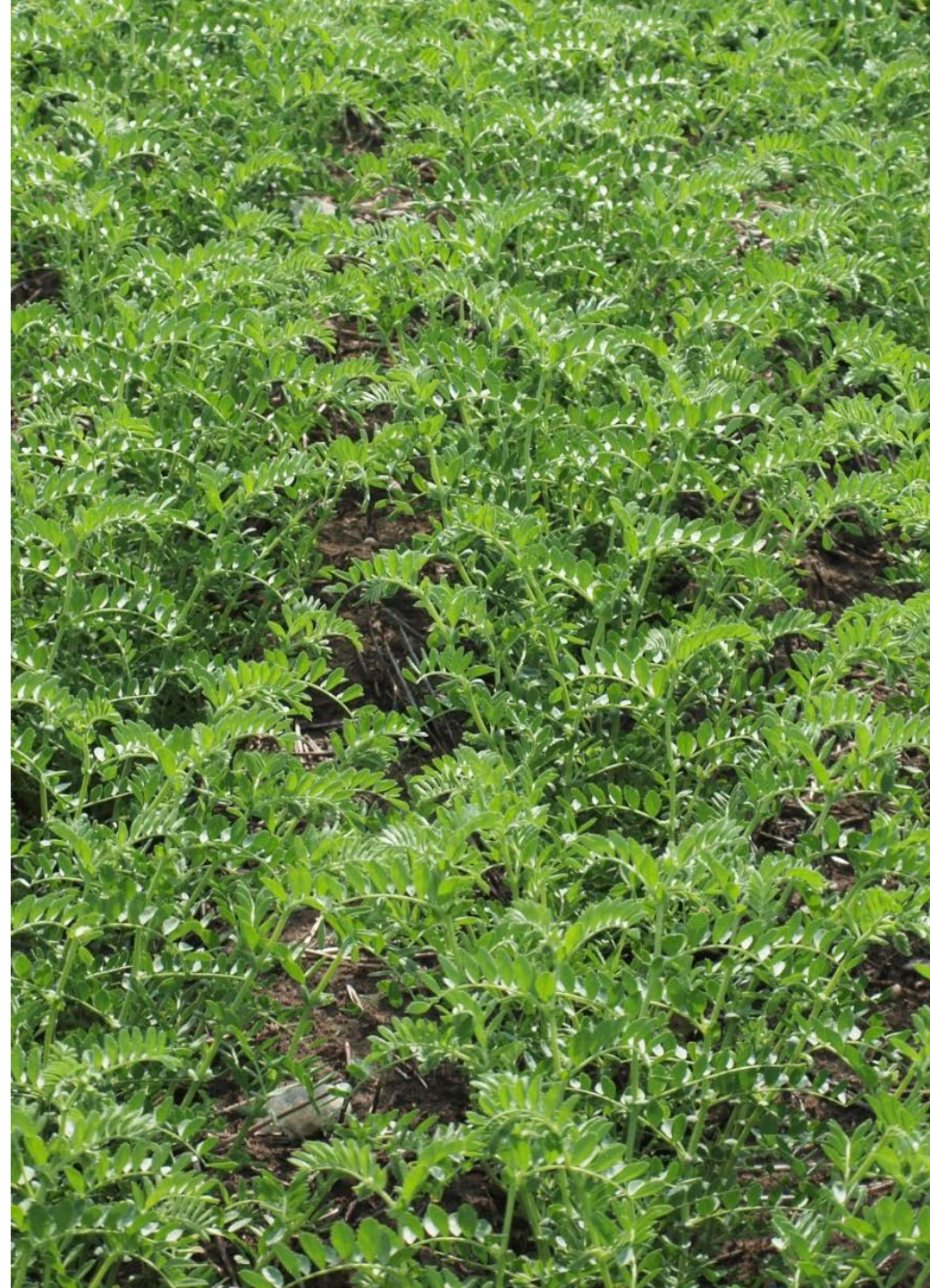
- Montana produces more chickpeas than any other state
- At CARC, selection of the appropriate named variety can mean a difference in yield of 754 lb/ac in a wet growing season (2018; n=9)





# Methods

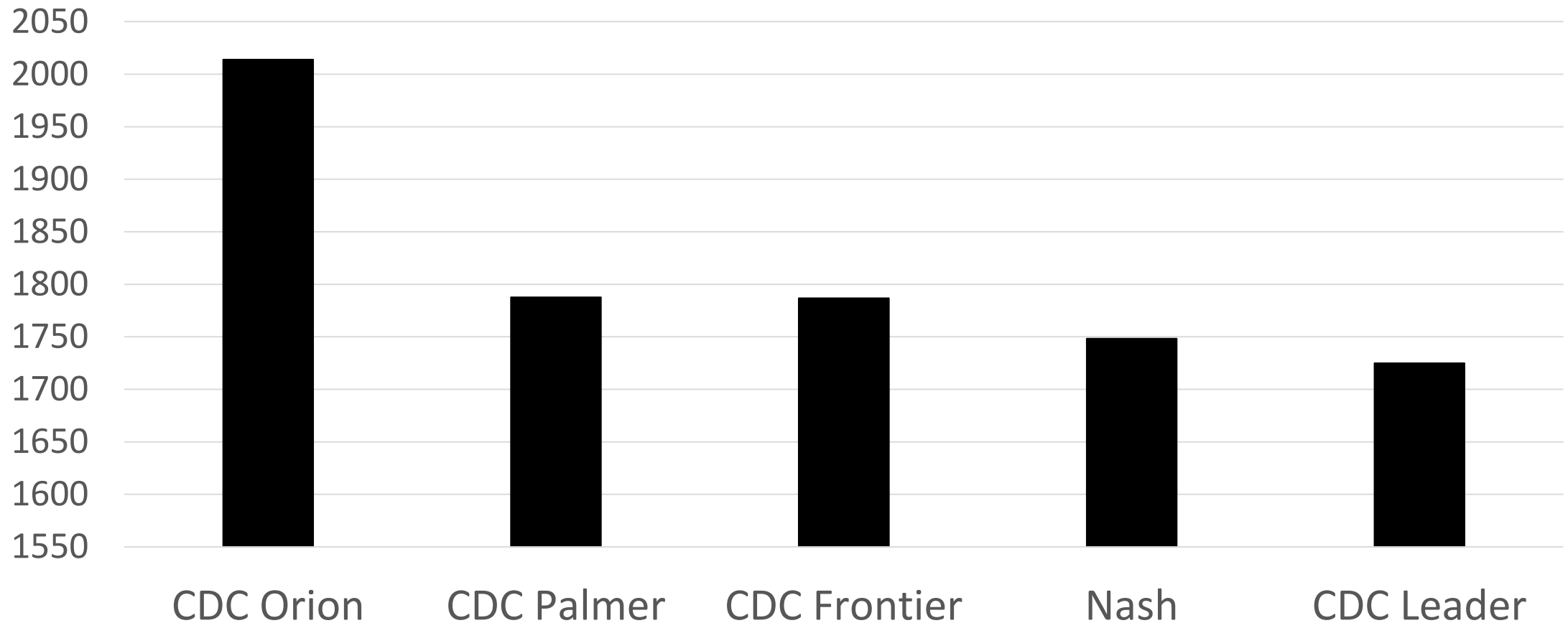
- 9 named varieties
- 30 experimental lines (results not shown)
- Planted on May 9<sup>th</sup> at a rate of 4 pure live seeds/ft<sup>2</sup>
- Seed treat: Apron Maxx (fungicide) and Cruiser Maxx (insecticide)
- Harvested September 7th





# Chickpea variety trial results, yield (lb/ac)

Cultivars yielding statistically equivalent to 2018 top performer, CDC Orion (Central Ag Research Center, Moccasin, MT, 2018)

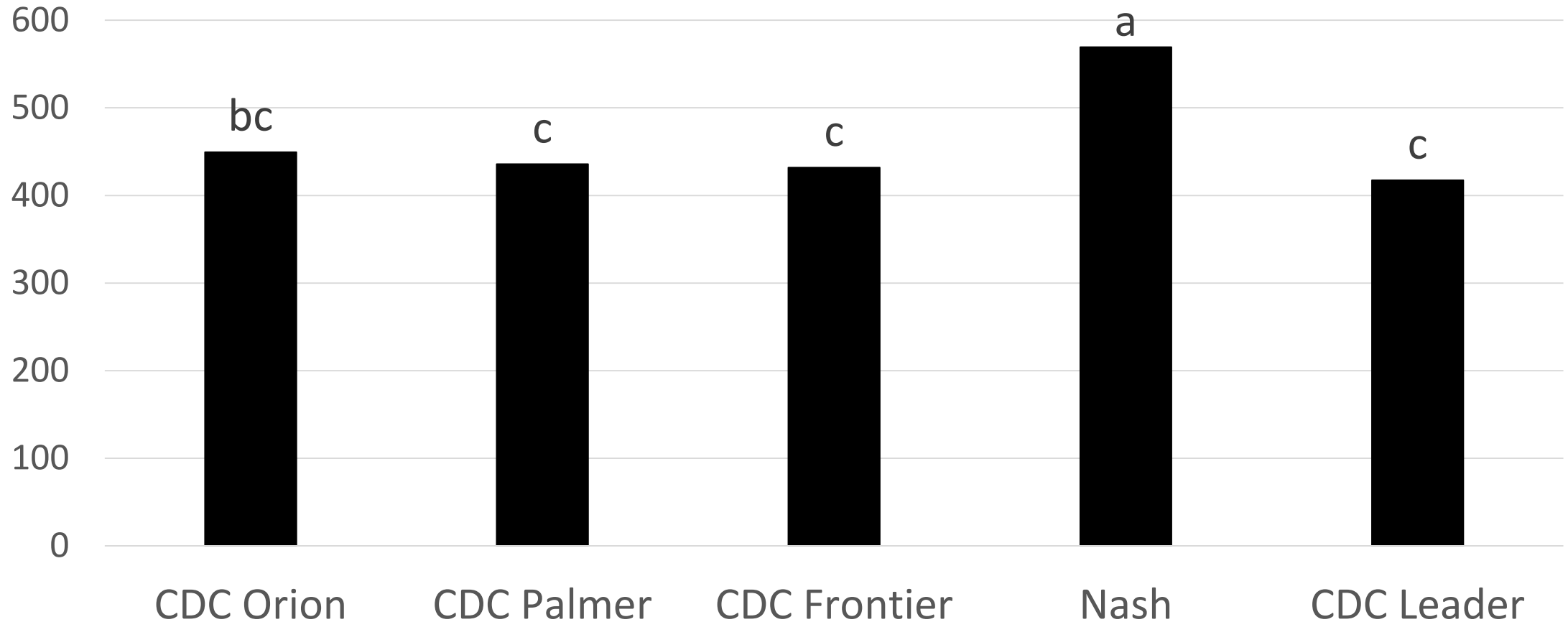


*Statistical analysis includes cultivars not listed*



# Chickpea variety trial results, 1000 Kernel Wt (g)

Cultivars yielding statistically equivalent to 2018 top performer, CDC Orion (Central Ag Research Center, Moccasin, MT, 2018)



*Statistical analysis includes cultivars not listed*

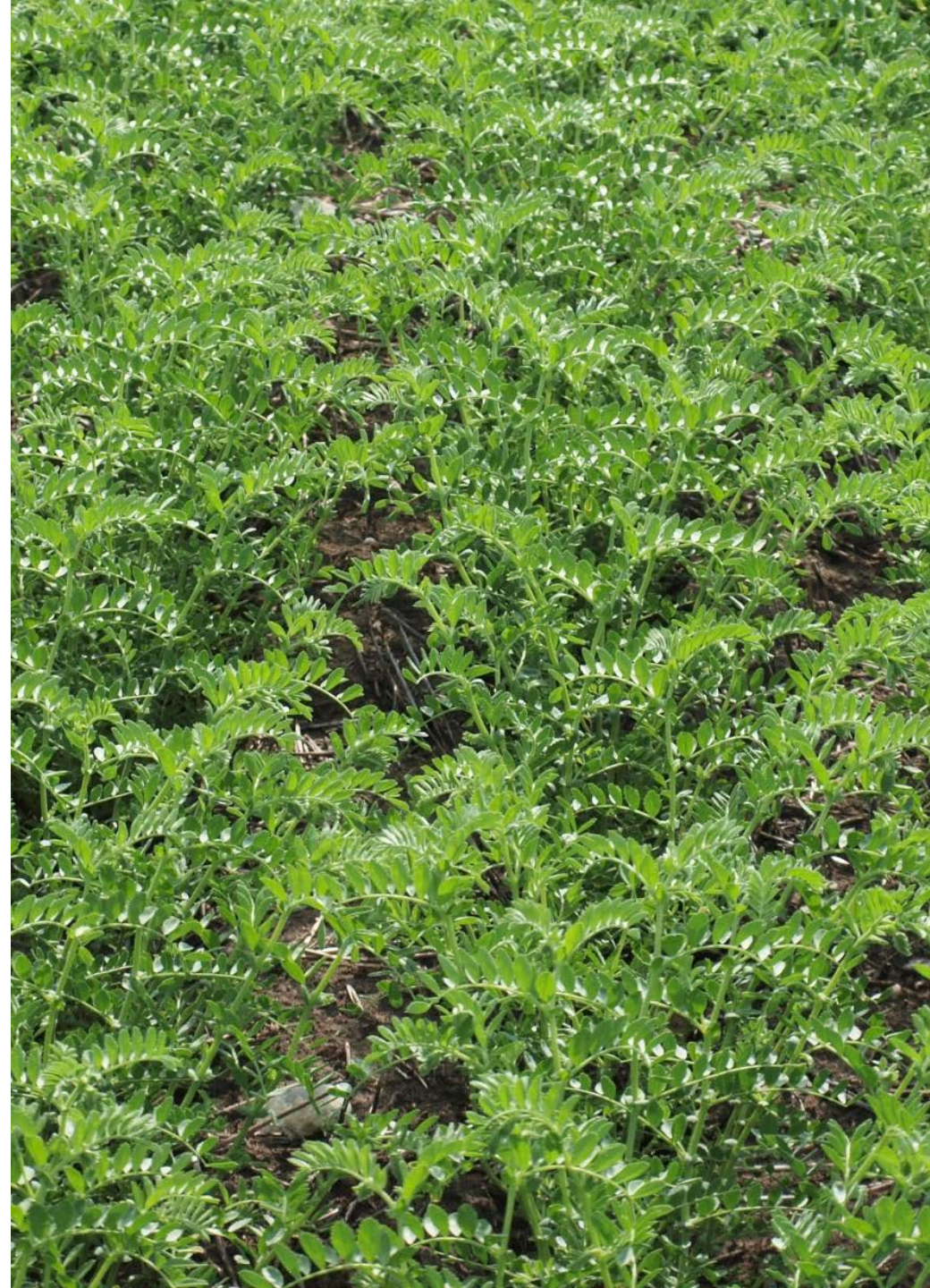


# CDC Orion

- Owner: Crop Development Center
- Supplier: Meridian Seeds
- Seed type: Kabuli
- Most similar to: CDC Frontier
- Selected for improved Ascochyta Blight resistance
- Earliest flowerer

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobelImages/201400327.pdf>



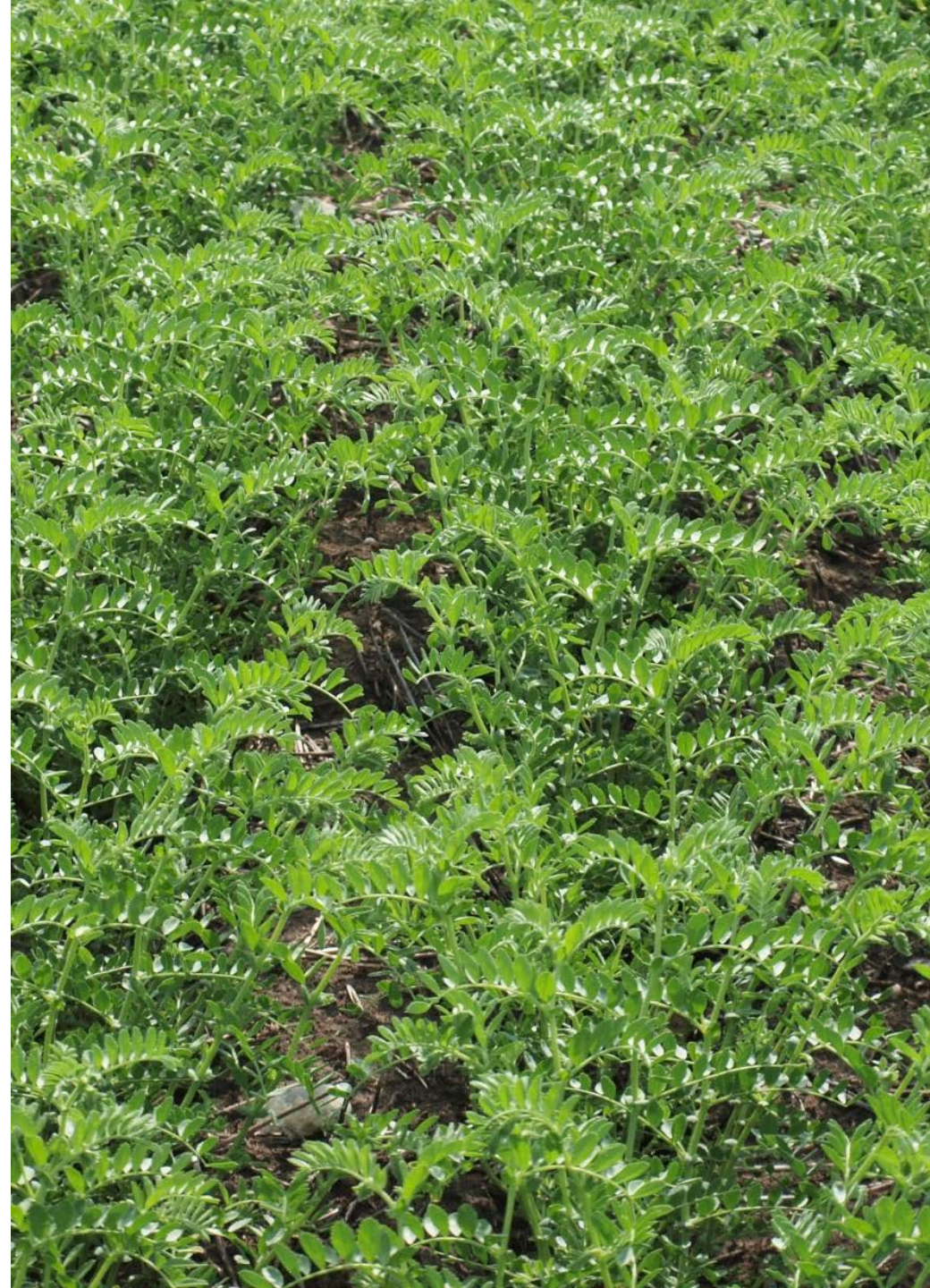


# CDC Palmer

- Owner: Crop Development Center
- Supplier: Meridian Seeds
- Seed type: Kabuli
- From description, higher seed weight than:
  - CDC Leader (NS at CARC)
  - CDC Frontier (NS at CARC)
  - Amit
  - CDC Alma

Link to cultivar description sheet:

<http://www.inspection.gc.ca/english/plaveg/pbrpov/cropreport/chkp/app00009571e.shtml>



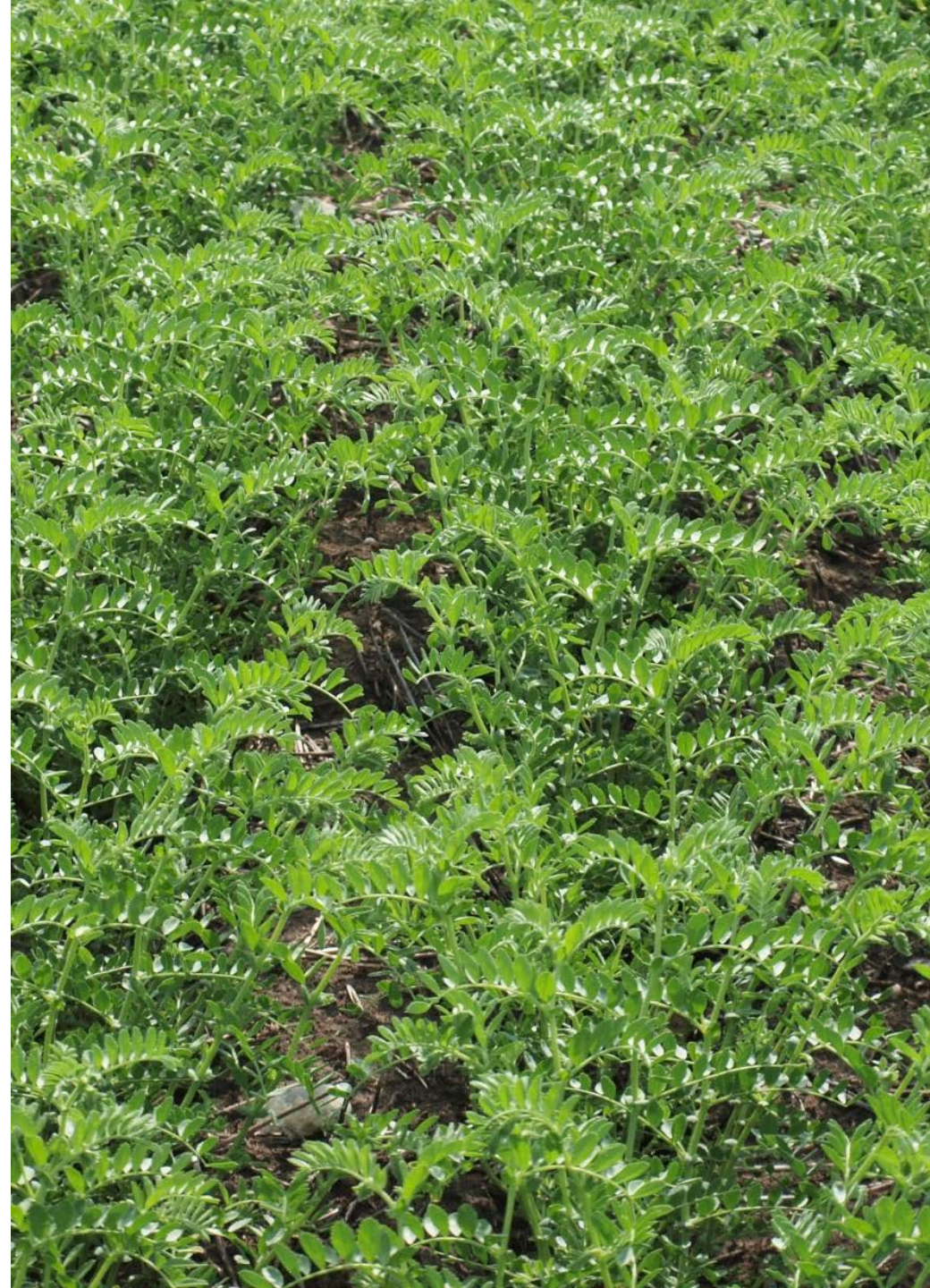


# CDC Frontier

- Owner: Crop Development Center
- Supplier: Meridian Seeds
- Seed type: Kabuli
- Higher seed weight than Amit
- Among the top performers for:
  - Plant Height
  - Test Weight

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobeImages/200800173.pdf>



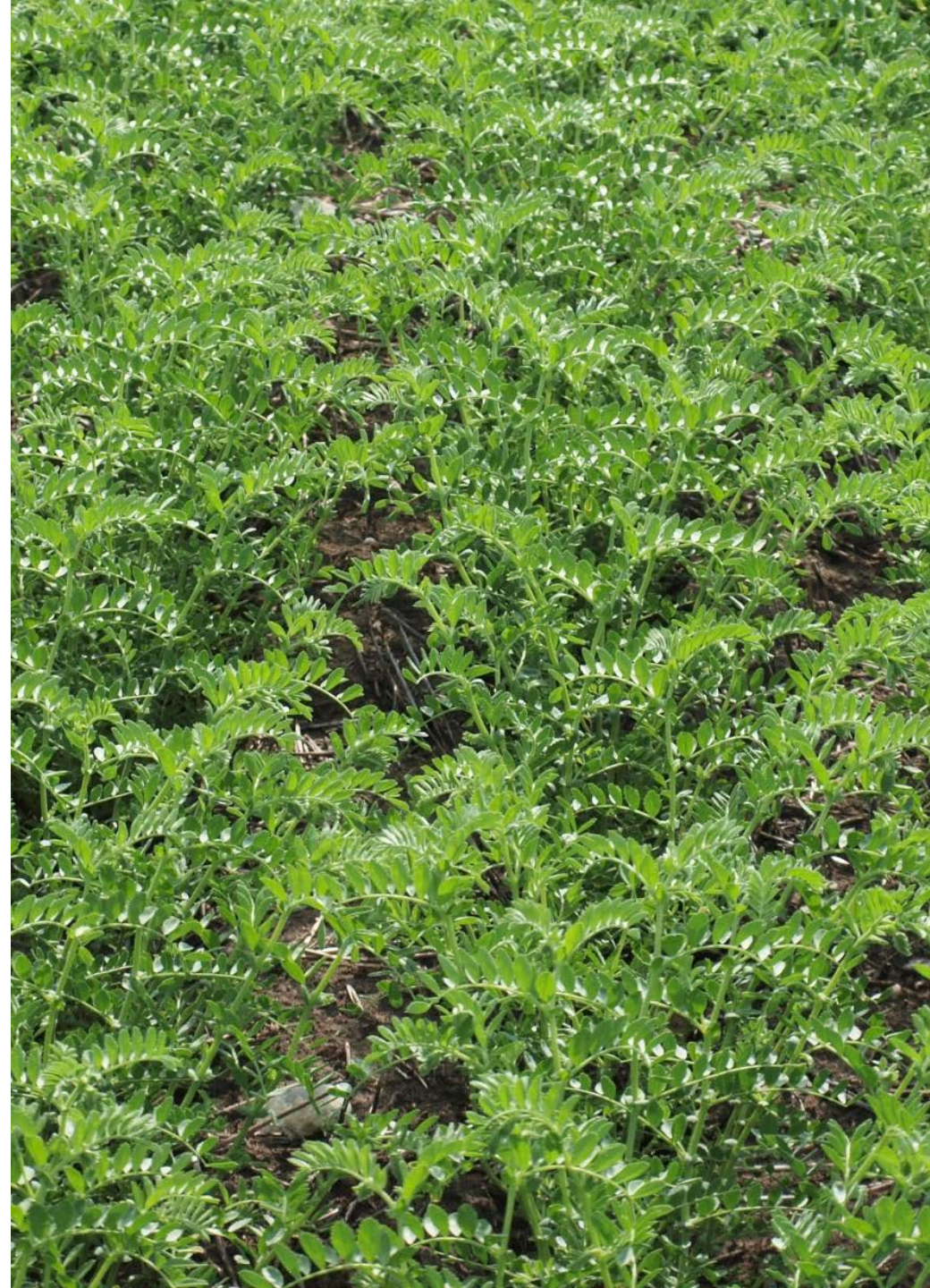


# Nash

- Owner: USDA ARS, Pullman, WA
- Seed type: Café Kabuli
- Moderate resistance to Ascochyta Blight
- Among the top performers for:
  - Plant Height
  - Kernel Weight

Link to cultivar description sheet:

<https://apps.ams.usda.gov/CMS/AdobeImages/201400312.pdf>





# CDC Leader

- Owner: Crop Development Center
- Supplier: Meridian Seeds
- Seed type: Kabuli
- Earlier Maturity than CDC Frontier and Amit
- Moderate resistance to Ascochyta Blight

Link to cultivar description sheet:

[https://saskpulse.com/files/general/151026\\_Chickpea\\_variety\\_report2.pdf](https://saskpulse.com/files/general/151026_Chickpea_variety_report2.pdf)

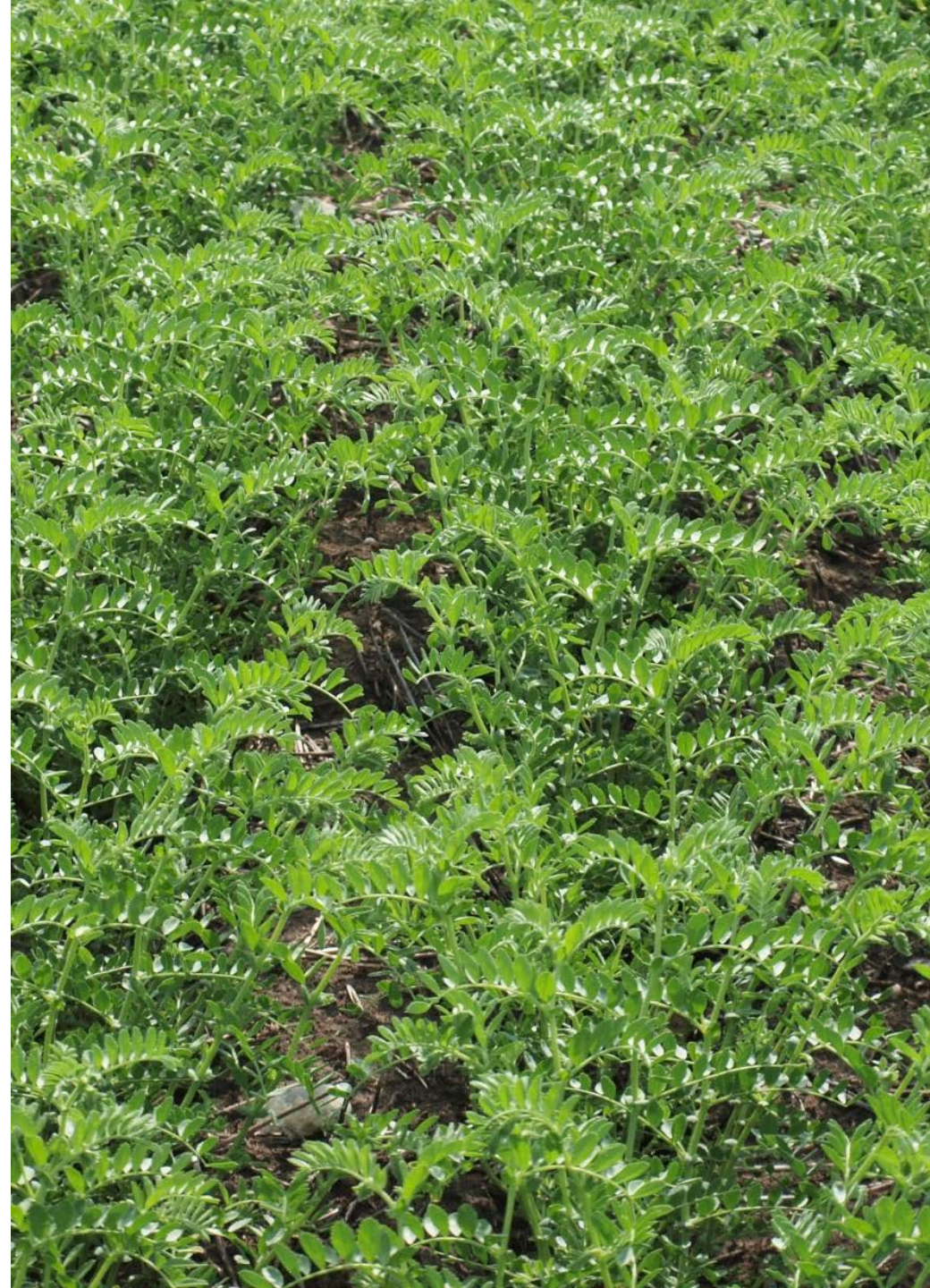






Photo Credit: Heather Fryer





# Spring Canola Variety Trial

(Pg. 40)





# Background

- Technological advances in hybridization systems have led to the release of canola hybrids, which generally outperform cultivars developed by traditional breeding methods
- Many herbicide resistances exist among canola hybrids (e.g., Liberty Link, Clearfield, Roundup Ready, Sulfonylurea)





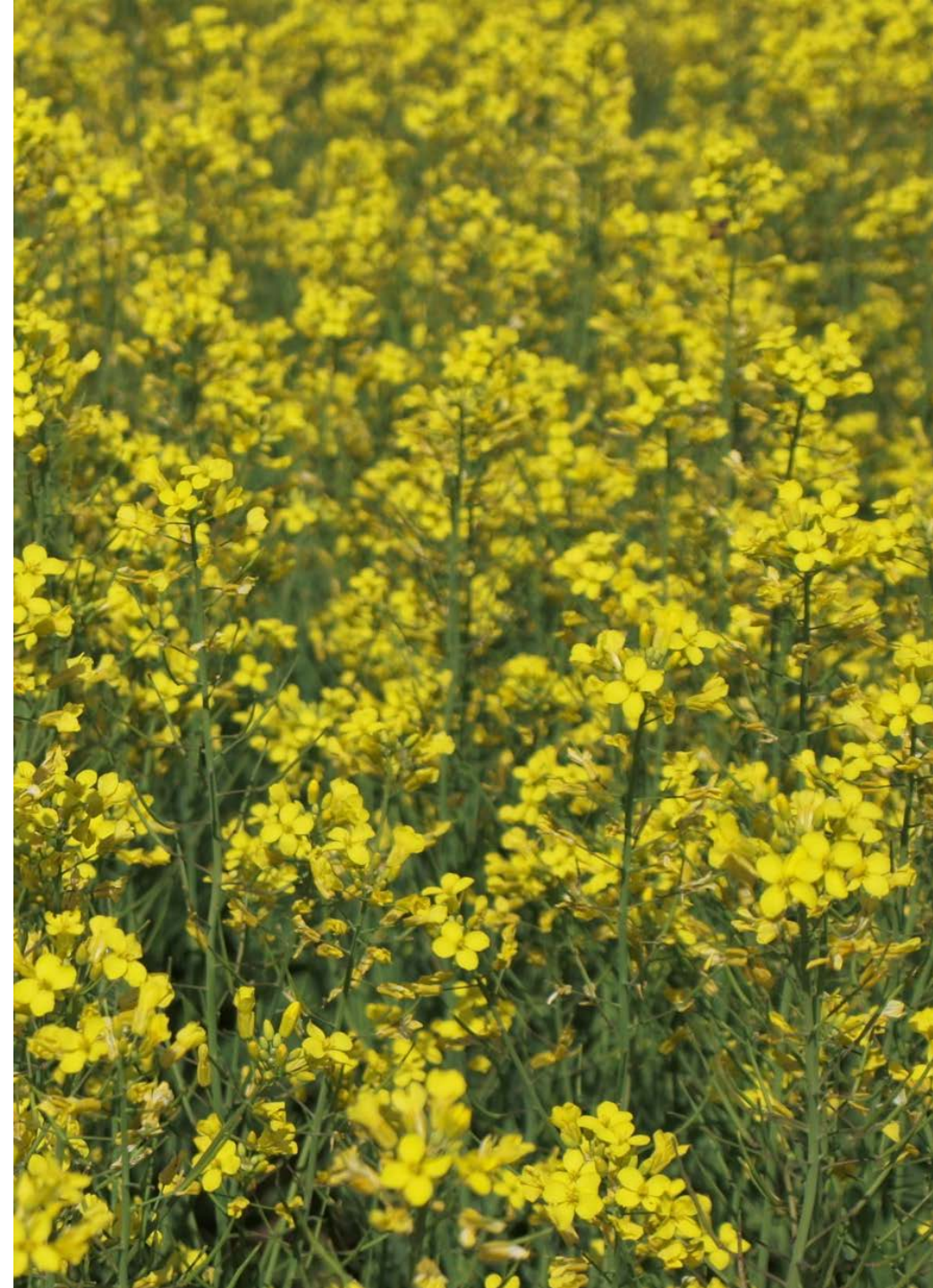
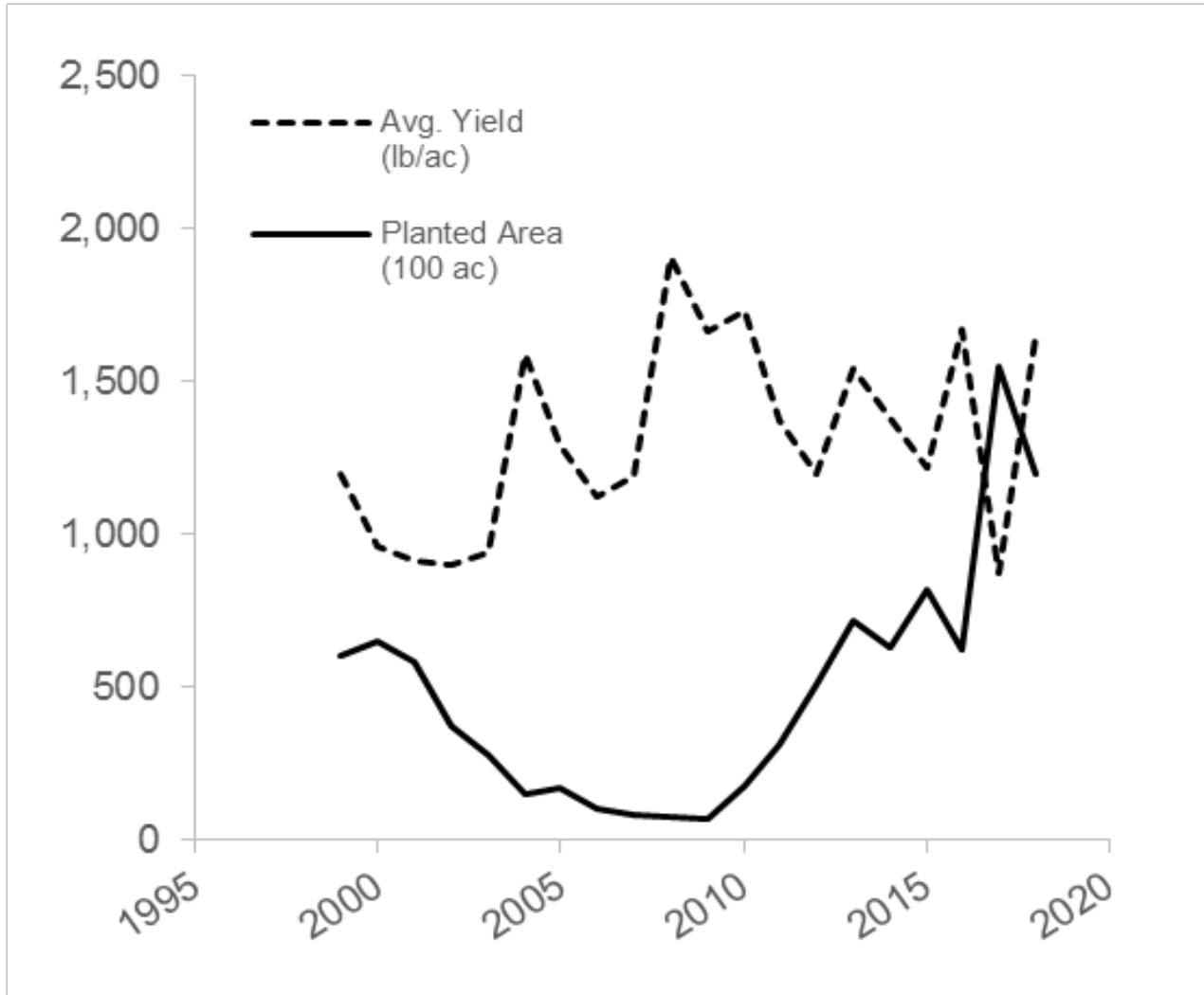
# Justification

- Canola acreage in Montana has increased at a rate of 14,000 acres per year since 2010 ( $P < 0.01$ )
- Statewide average yields have increased at a rate of 22 pounds per acre per year since 1999 ( $P < 0.1$ )





# Justification



Source: National Agriculture Statistics Service (NASS)

Link to searchable database: <https://quickstats.nass.usda.gov/>



# Justification

- At CARC, selection of the appropriate hybrid can mean a difference in yield of 278 lb/ac (5.6 bu/ac) in a dry growing season (2017) and 183 lb/ac (3.7 bu/ac) in a wet growing season (2018; n=6)
- Frost damage may explain greater differences in 2017





# Methods

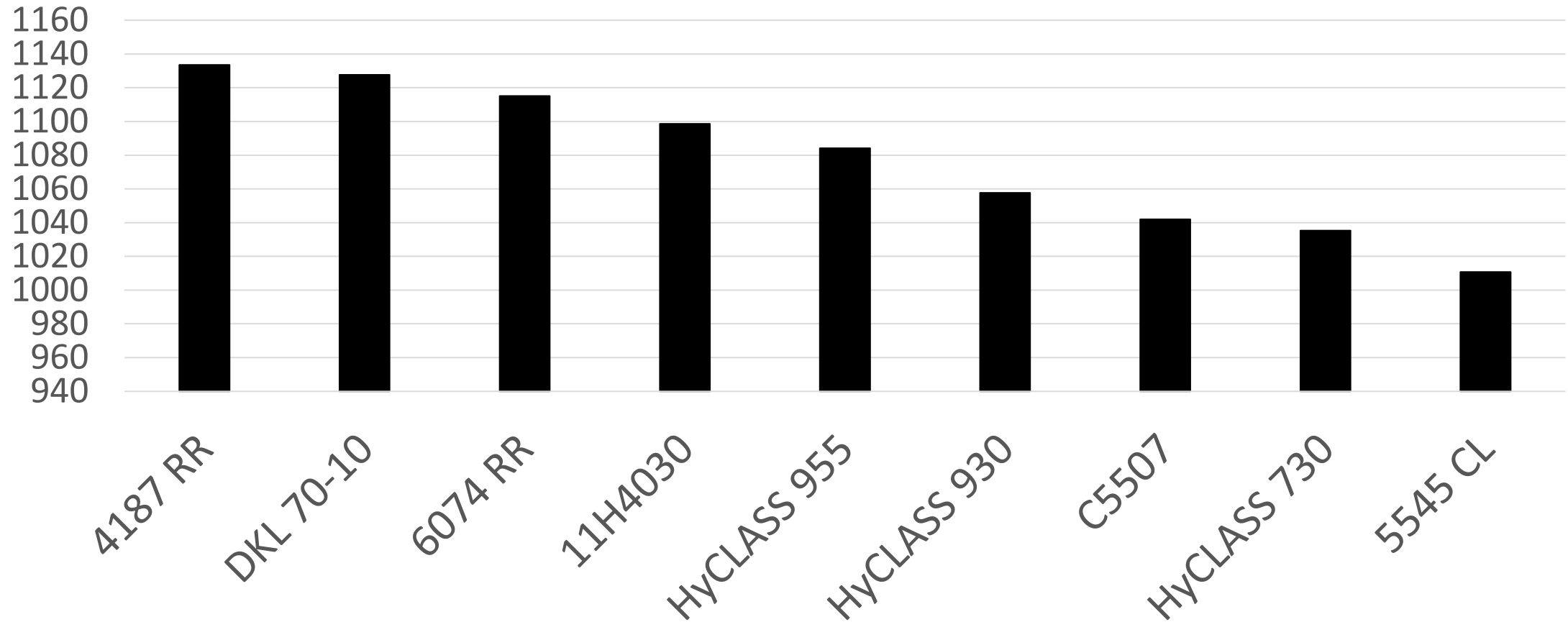
- 13 hybrids
- 6 suppliers
- 4 Herbicide Resistances
- Planted on April 26<sup>th</sup> at a rate of 14 pure live seeds/ft<sup>2</sup>
- Seed treat: Helix Xtra or Prosper for control of flea beetle
- Harvested August 10<sup>th</sup>





# Spring canola variety trial results, yield (lb/ac)

Cultivars yielding statistically equivalent to 2018 top performer, 4187 RR (Central Ag Research Center, Moccasin, MT, 2018)

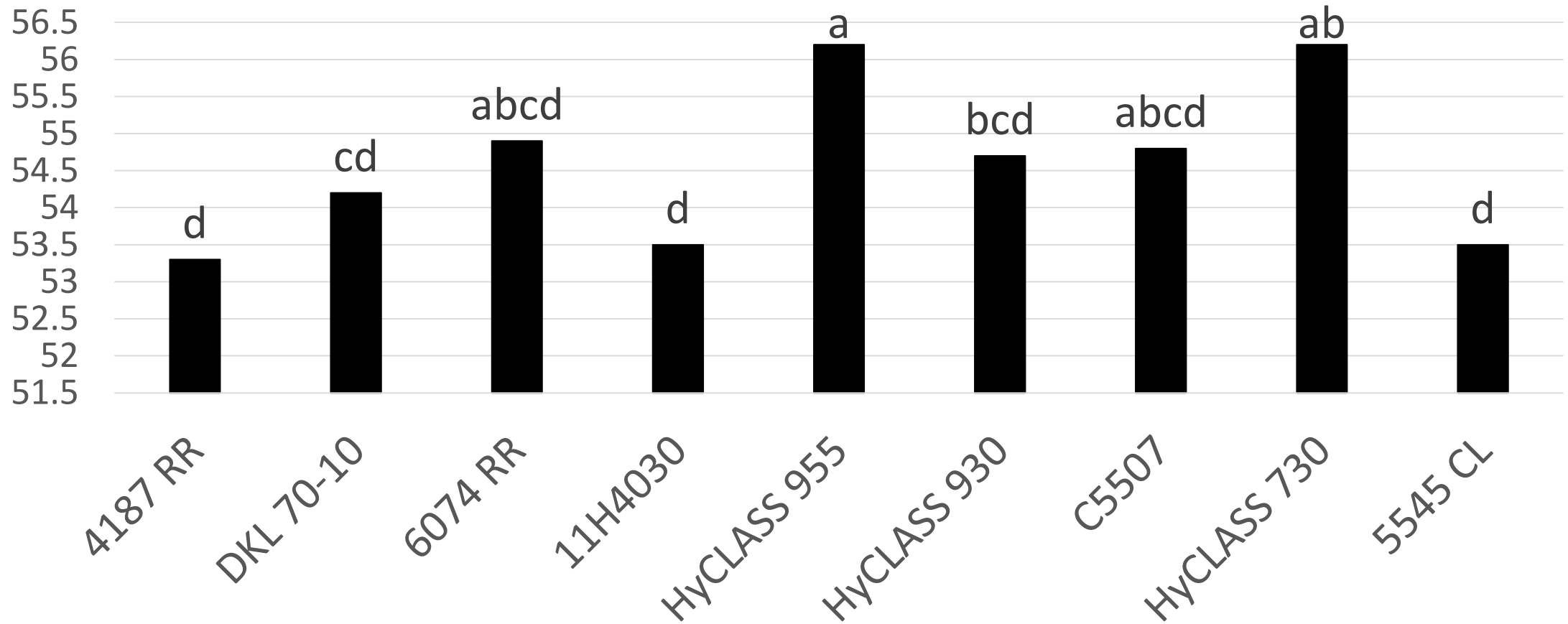


*Statistical analysis includes cultivars not listed*



# Spring canola variety trial results, oil content (%)

Cultivars yielding statistically equivalent to 2018 top performer, 4187 RR (Central Ag Research Center, Moccasin, MT, 2018)



*Statistical analysis includes cultivars not listed*



# 4187 RR

- Supplier: BrettYoung
- Herbicide Resistance: Roundup Ready
- Resistant to:
  - Blackleg
  - Clubroot
- Among the top performers for:
  - Establishment
  - Plant Height
  - Test Weight





# DKL 70-10

- Supplier: Dekalb
- Herbicide Resistance: Roundup Ready
- Resistant to:
  - Blackleg
- Among the hybrids exhibiting the least frost damage in 2017





# 6074 RR

- Supplier: BrettYoung
- Herbicide Resistance: Roundup Ready
- Resistant to:
  - Blackleg
- Among the top performers for:
  - Establishment
  - Test Weight
  - Oil Content





# 11H4030

- Supplier: Cargill
- Herbicide Resistance: Roundup Ready
- Resistant to:
  - Blackleg
  - Fusarium
- Earliest flowerer
- Among the top performers for:
  - Establishment
  - Test Weight





# HyCLASS 955

- Supplier: CROPLAN by WinField
- Herbicide Resistance: Roundup Ready
- Resistant to:
  - Blackleg
  - Clubroot
- Among the top performers for:
  - Establishment
  - Test Weight
  - Oil Content





# HyCLASS 930

- Supplier: CROPLAN by WinField
- Herbicide Resistance: Roundup Ready
- Resistant to:
  - Blackleg
- Among the top performers for:
  - Establishment
  - Test Weight
  - Oil Content





# C5507

- Supplier: Cibus
- Herbicide Resistance: Sulfonylurea
- Resistant to:
  - Blackleg
- Among the top performers for:
  - Plant Height
  - Oil Content





# HyCLASS 730

- Supplier: CROPLAN by WinField
- Herbicide Resistance: Roundup Ready
- Resistant to:
  - Blackleg
- Among the top performers for:
  - Establishment
  - Test Weight
  - Oil Content





# 5545 CL

- Supplier: BrettYoung
- Herbicide Resistance: Clearfield
- Resistant to:
  - Blackleg
- Among the top performers for:
  - Plant Height









# Understanding Acidification and Management of Montana Soils

(Pg. 68)





# Background

## **Soil acidity in Montana can be traced to:**

### 1. Increasing N fertilizer consumption (3x since 1980s)

Microbial oxidation (i.e., nitrification) releases protons ( $H^+$ ) and increases soil acidity

### 2. Adoption of no-till

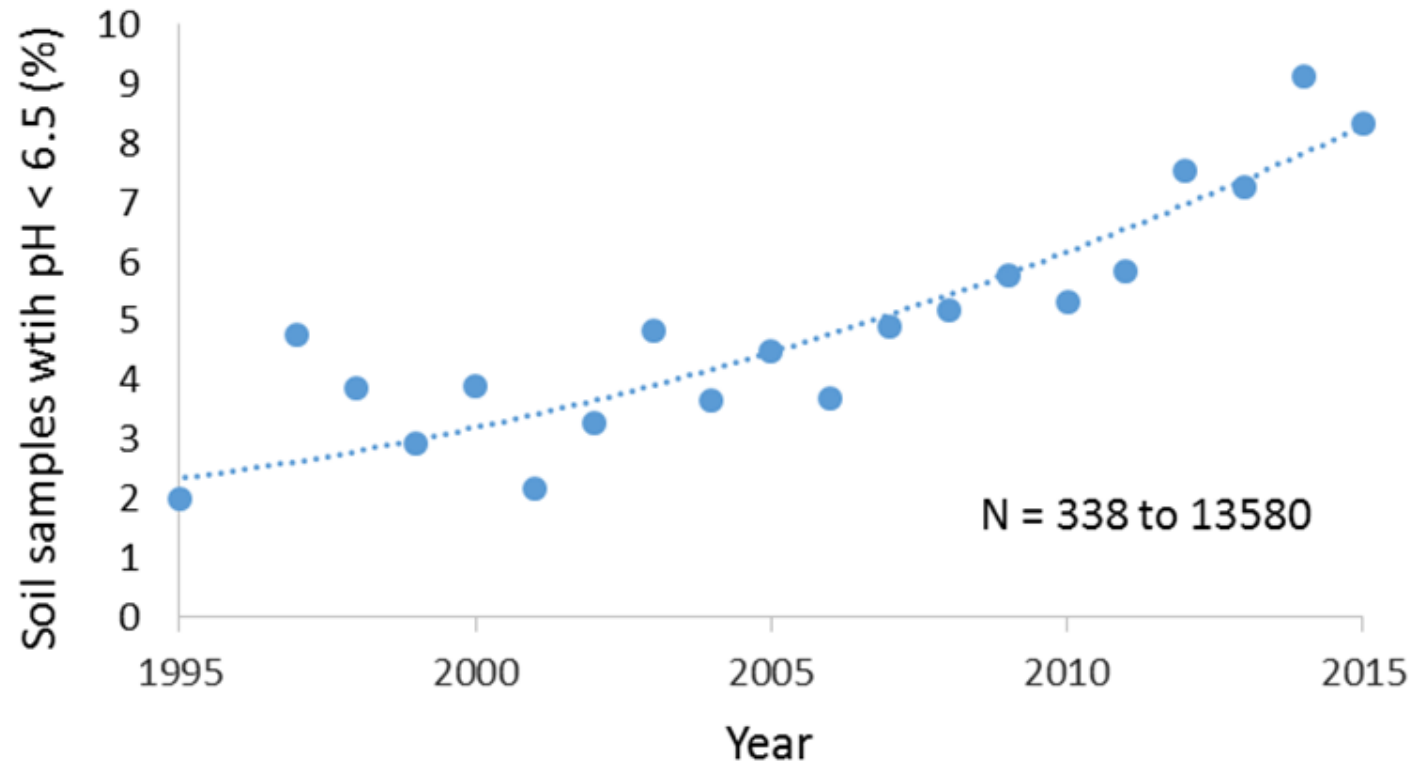
Absence of tillage eliminates mixing with higher pH soil layers below





# Background

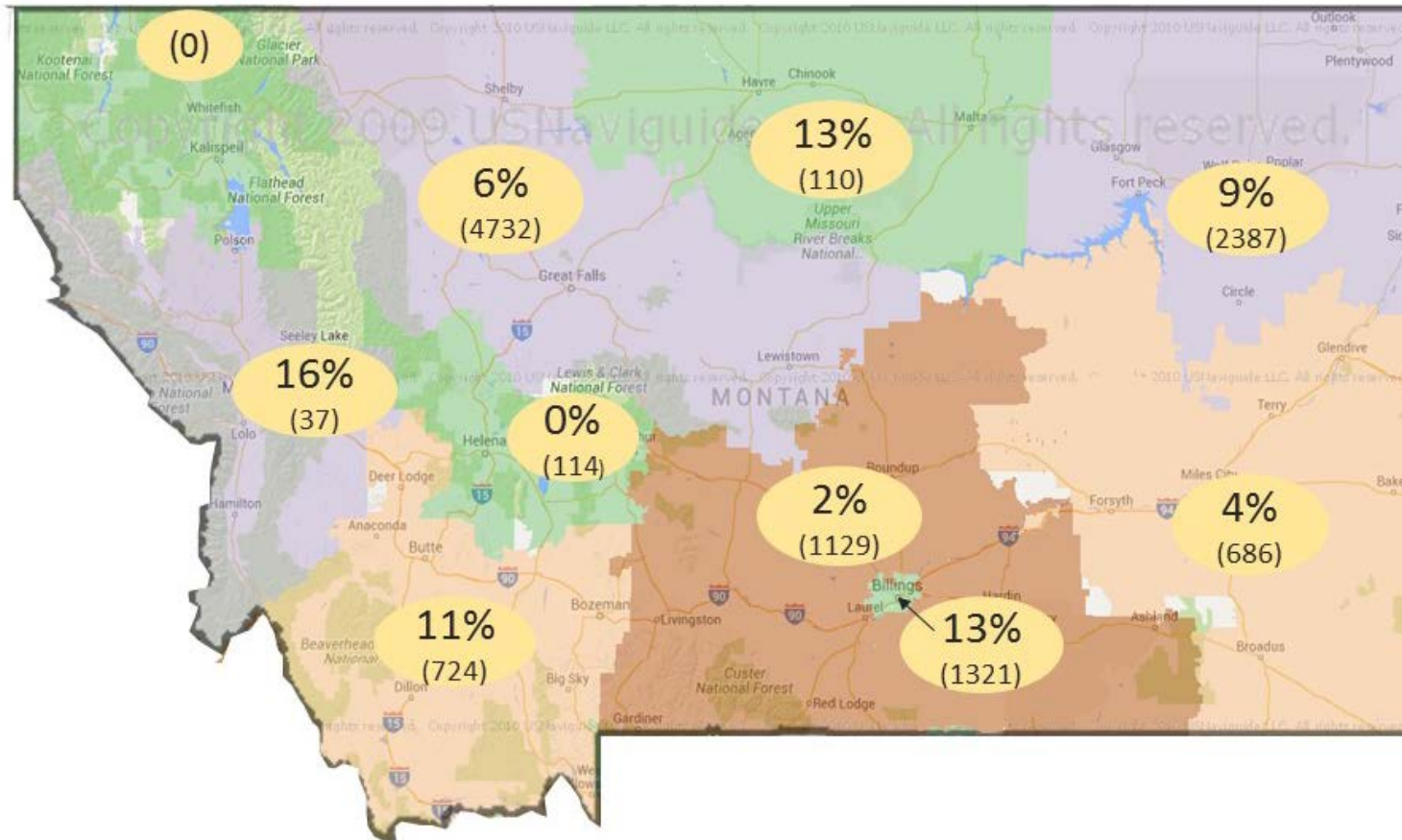
Growth of soil acidity in Montana soils since 1995





# Background

Percentage of soil samples with pH < 6.5 by zip code region





# Methods

- 9 cultivars of:
  - Spring canola
  - Spring pea
  - Spring wheat
  - Spring barley
- Limed (5 ton/ac) and unlimed conditions
- Two locations:
  - Near Highwood (soil pH < 4.5)
  - Near Fort Benton/Geraldine (not summarized)





# Results

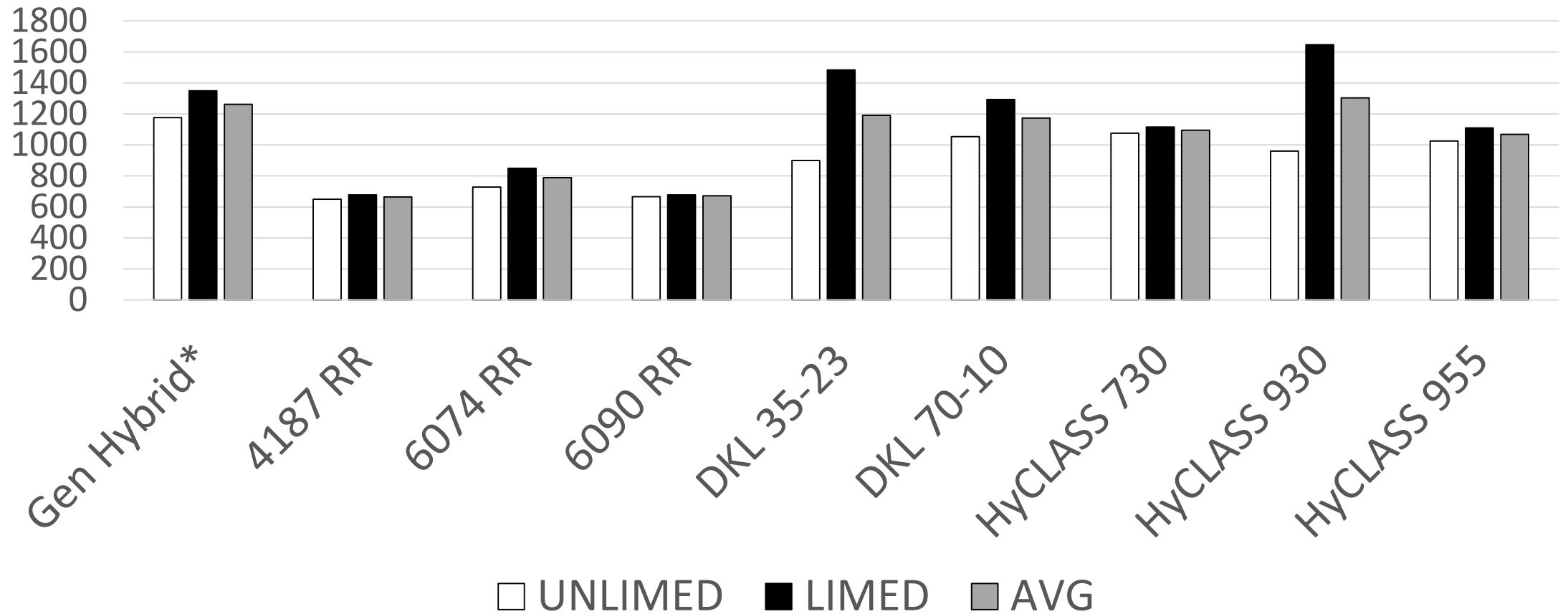
- The potential for lime application to boost test weights is crop-dependent ( $P < 0.1$ )
- There is good potential for lime applications to boost spring pea yields, spring canola yields, and spring canola test weights, though these responses were cultivar dependent ( $P < 0.05$ )
- ROI of lime application in spring pea and spring canola systems with acidic soils may be increased with careful selection of cultivars
- A formal assessment of cultivar-specific tolerance to soil acidity is ongoing





# Response to sugar beet lime in cultivars of spring canola grown in acidic soils, yield (lb/ac)

Highwood, MT, 2018

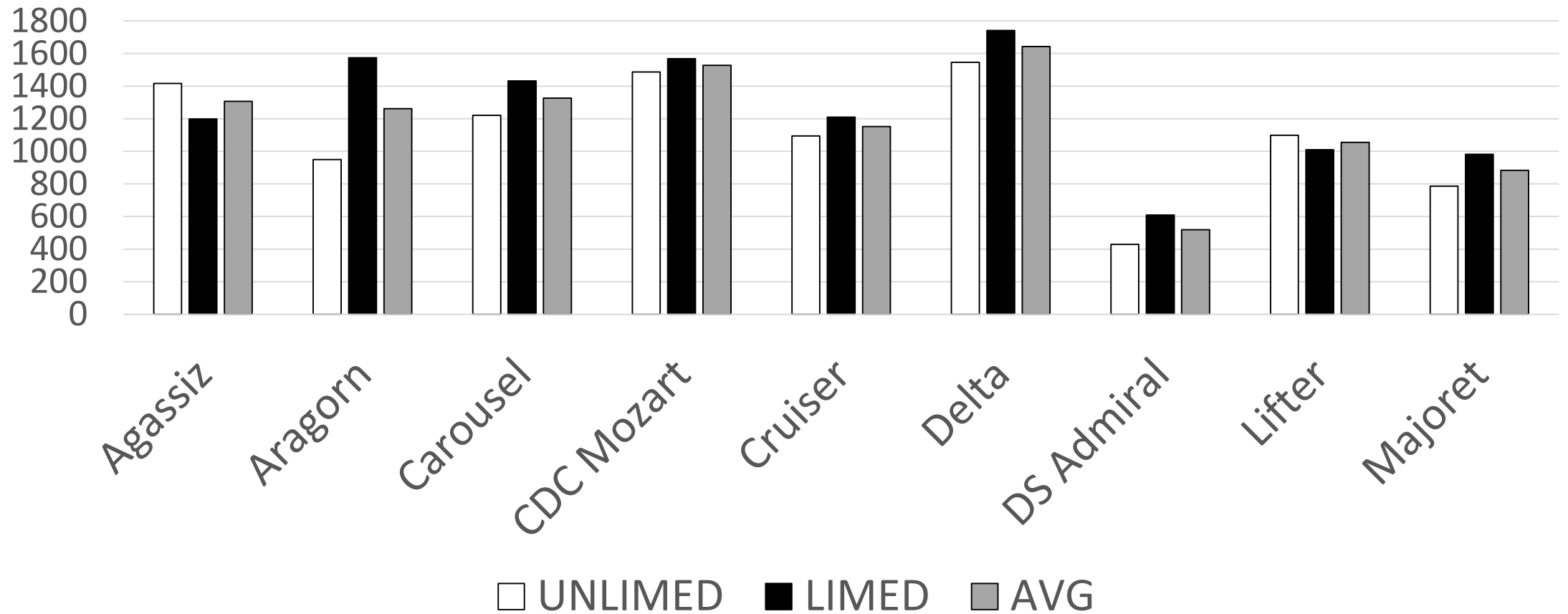


\*Identifier omitted at request of breeder



# Response to sugar beet lime in cultivars of spring pea grown in acidic soils, yield (lb/ac)

Highwood, MT, 2018





# Top-yielders

(Central Ag Research Center, Moccasin, MT, 2018)

## Spring Pea

- Nette 2010
- Hampton
- Jetset
- Delta
- Navarro
- AAC Carver





# Top-yielders

(Central Ag Research Center, Moccasin, MT, 2018)

## Spring Lentil

- Avondale
- CDC Maxim



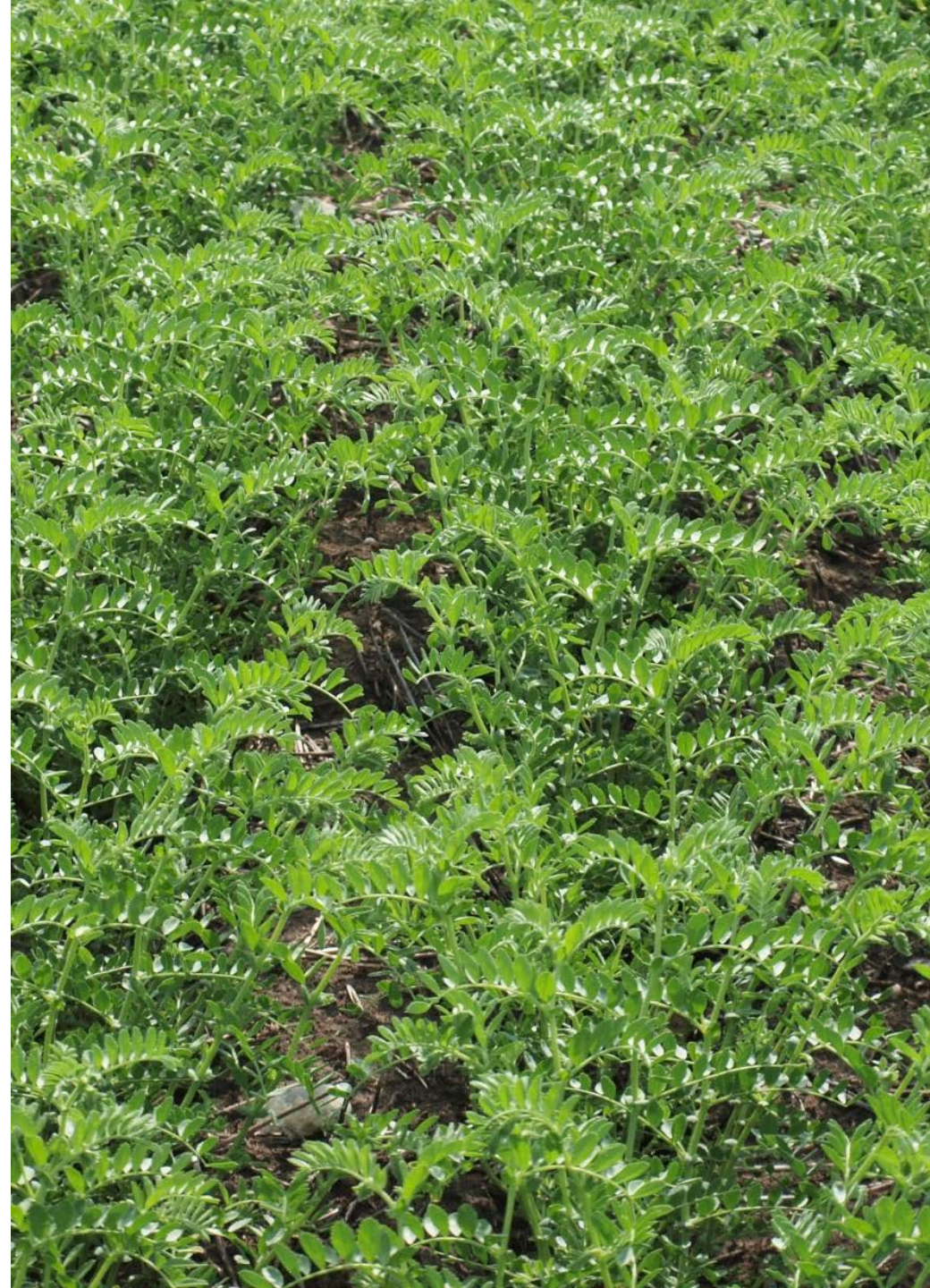


# Top-yielders

(Central Ag Research Center, Moccasin, MT, 2018)

## Spring Chickpea

- CDC Orion
- CDC Palmer
- CDC Frontier
- Nash
- CDC Leader



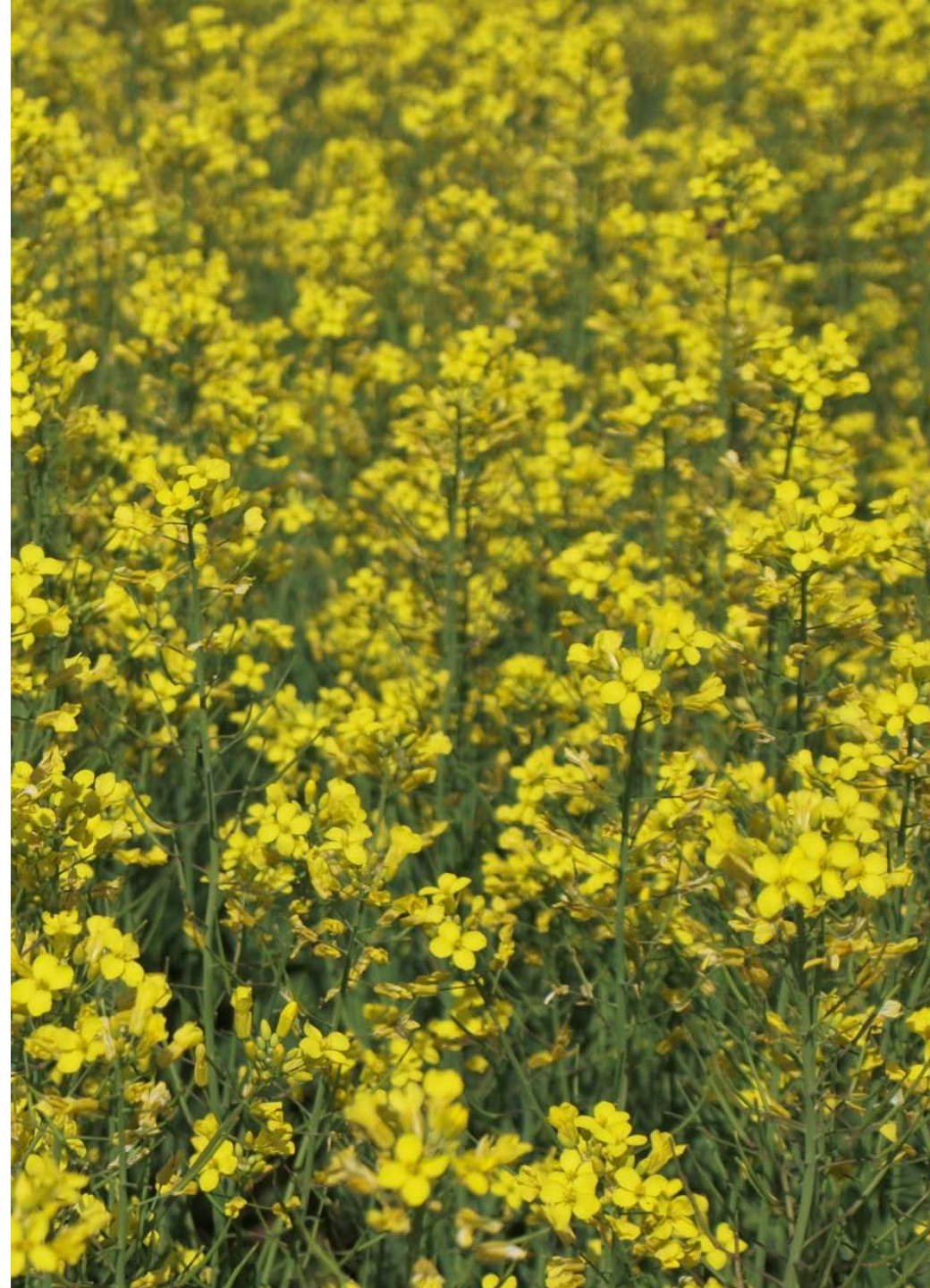


# Top-yielders

(Central Ag Research Center, Moccasin, MT, 2018)

## Spring Canola

- 4187 RR
- DKL 70-10
- 6074 RR
- 11H4030
- HyCLASS 955
- HyCLASS 930
- C5507
- HyCLASS 730
- 5545 CL





# Tolerance to Acidic Soils

- Look for formal assessment in next year's report or check CARC's website for updates:

Link to CARC's website:

<http://agresearch.montana.edu/carc/>







Thank you!

**Thanks to** Peggy Lamb for canola oil analyses, Luther Talbert, Jamie Sherman, and Kevin McPhee for providing seed, Sherry Bishop for seed treatments, Alyssa Thomas, Hayden Hammontree, Jordan Nees, and Zach Thomas for weed management.

**Special thanks to** Sally Dahlhausen for her outstanding work in the lab and field preparing and executing these trials.

#### References:

- John et al. (2017) Fallow replacement and alternative nitrogen management for reducing nitrate leaching in a semiarid region. *Nutr Cycl Agroecosyst*. 108(3): 279-96  
<https://link.springer.com/article/10.1007/s10705-017-9855-9>
- Engel et al. (2016) Soil acidity management of long-term no-till fields in Montana to prevent crop failure. [https://projects.sare.org/sare\\_project/sw17-016/](https://projects.sare.org/sare_project/sw17-016/)  
National Agriculture Statistics Service <https://www.nass.usda.gov/>
- Montana State University. 2017 Cool-Season Pulse Variety Evaluation Annual Report <http://agresearch.montana.edu>  
United States Department of Agriculture Agricultural Marketing Service <https://www.ams.usda.gov/>

