Key Management Practices for Successful Malt Barley Production

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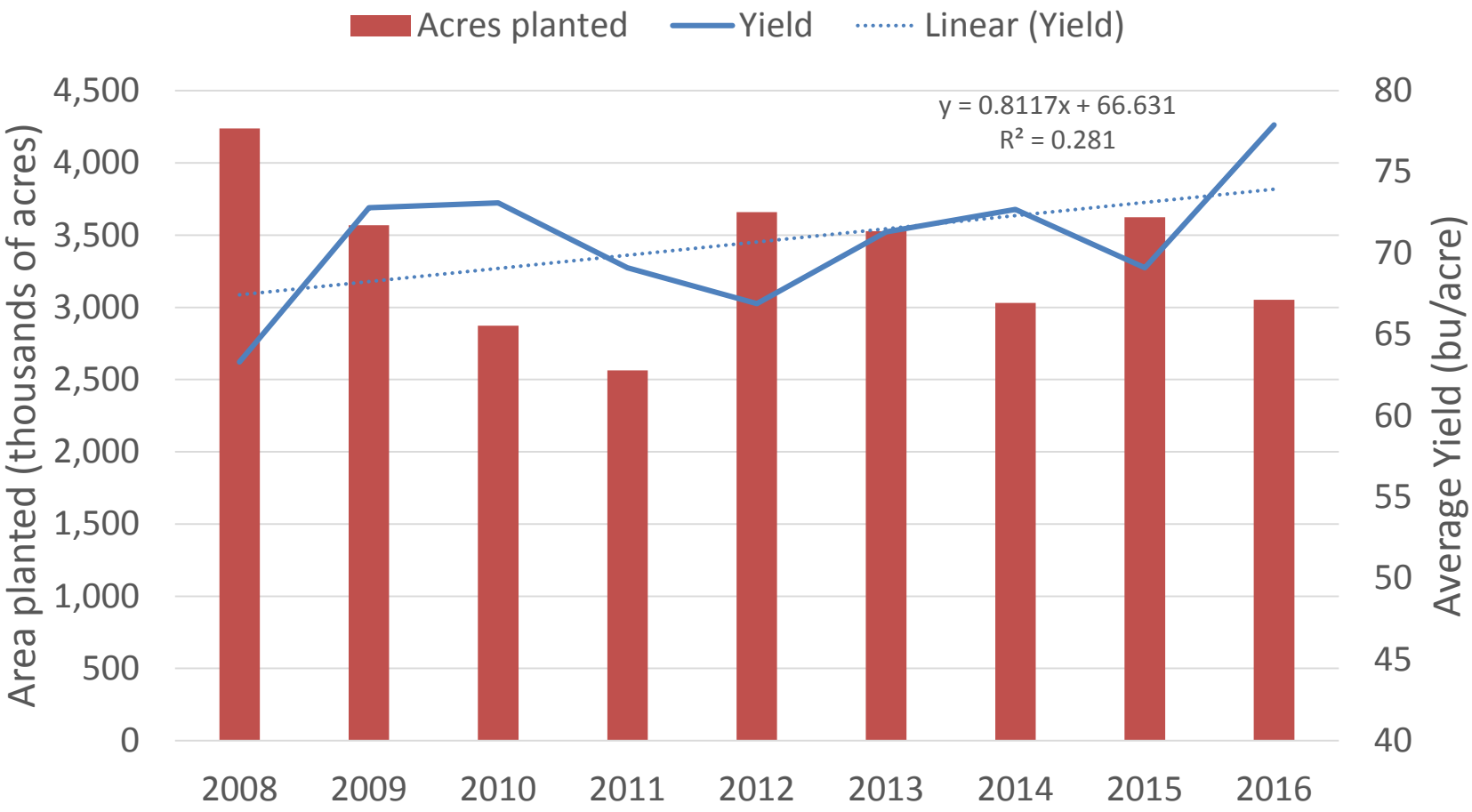
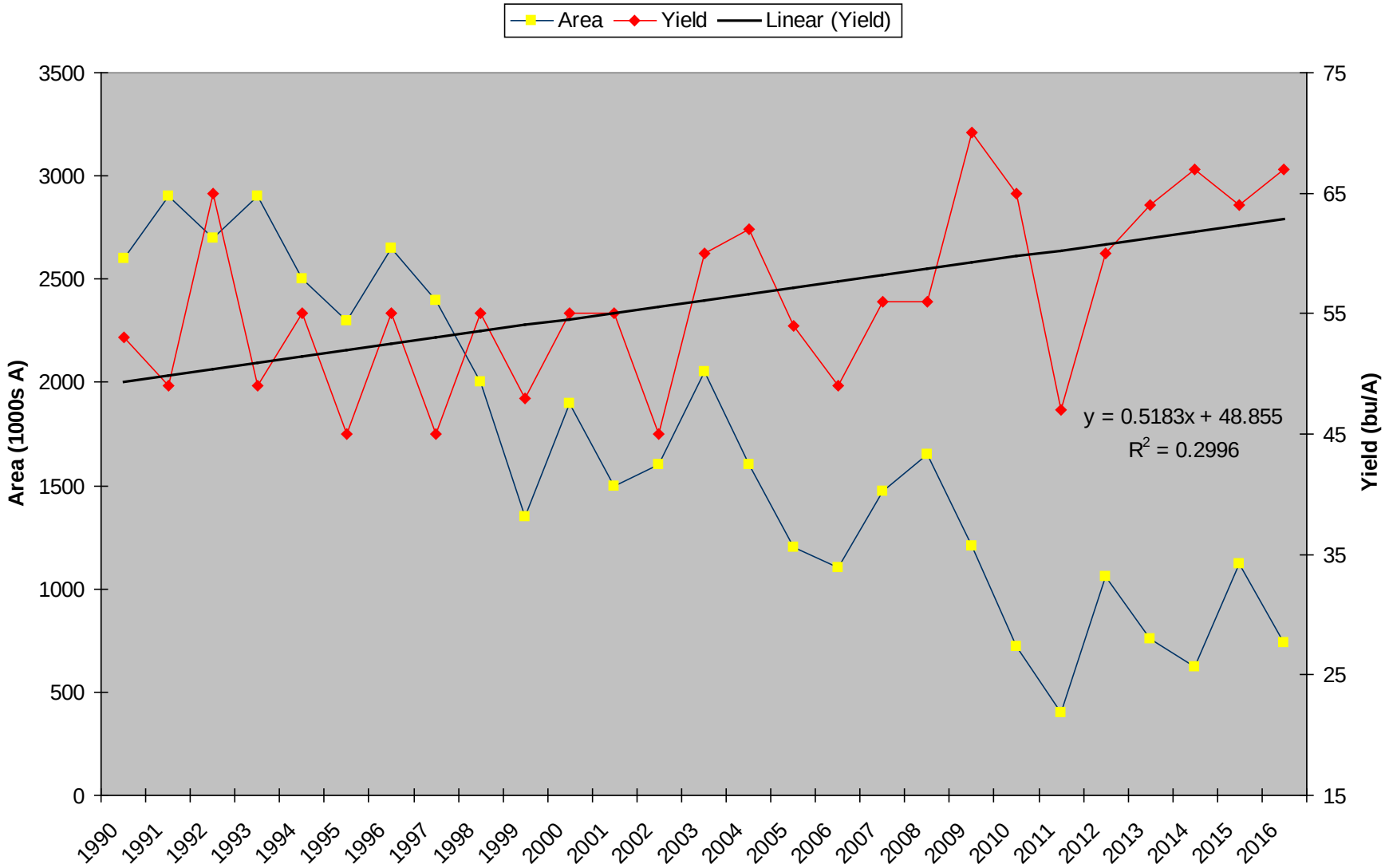
Joel Ransom, Extension Agronomist for Cereal Crops

Trends in barley area and yield, USA



Trends in barley production in ND



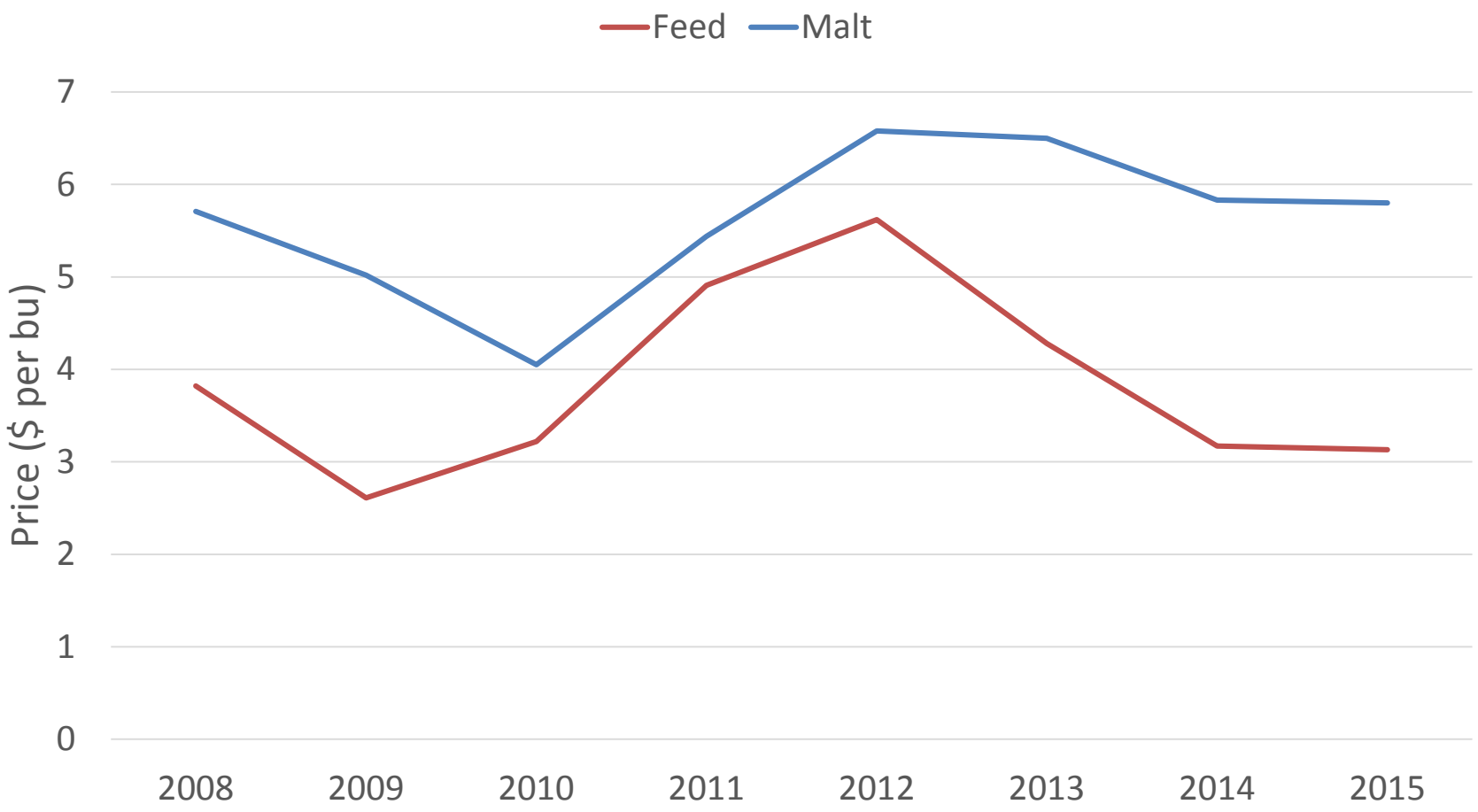
Managing Barley for Malt

Barley is used for malt, feed and food

Most grower that grow barley want to market it for use as malt

Locally produced barley for more local malt houses/breweries is trending, hence the interest in producing barley in non-traditional areas of the country

Trends in barley price, USA



Production costs of barley and corn, eastern ND, 2016

	Barley	Corn
Yield	75 (86) bu/acre	135 (171) bu/acre
Seed	$17.00	$95.48
Herbicides	$19.20	$24.00
Fungicides	$17.00	0
Fertilizers	$57.13	$90.72
Insurance	$17.20	$23.80
Fuel	$14.38	$18.27
Repairs	$21.64	$26.51
Rent	$123.00	$123.00
Machinery & Depreciation	$48.96	$66.18
Other (drying, interest…)	$11.13	$42.53
Total	$346.64	$510.49
Breakeven price	$4.61($4.03)	$3.78($2.98)

“Making” malt (with price difference of $4.50/$2.18 malt/feed risk is high)

- Good germination
  - >95%
- Moderate level of protein
  - 11.0-13.0%
- Low screenings of foreign material (<0.5%)
- Proper moisture content
  - Less than 13%
- Uniformly plump kernels
- Bright color, no blight
- No mold or off odors
- Minimum DON levels (<1 ppm)
- Minimum skinned kernels or broken kernels (<4%)

Main challenges in ND

- In eastern and central ND
  - DON levels
- In western ND
  - Elevated protein
  - Lack of plumps

Key management recommendations for producing barley for malt

- Where to plant
- Varietal selection
- Planting date
- Seeding rate
- Disease control
- Fertilization (managing protein)

Where to plant

- Do not follow other small grains or corn
  - Residues harbor diseases, especially FHB
- Tolerates salts (relative to corn, other small grains and soybeans)
- Tilled field verses no-till. Amount and type of residue and ease of early planting are considerations

Variety selection

- Often, malt barley production is through an identify preserved system, therefore, variety choice may be restricted and certified seed required.
- If you have flexibility in variety grown, in addition to yield, consider:
  - Protein content
  - Standability
  - Disease resistance
  - Winter verses spring types

2016 AMBA Recommended Varieties

Recommended Six-rowed Malting Barley Varieties

Variety	Year	Variety	Year
Celebration	2011	Stellar-ND	2006
Innovation	2014	Thoroughbred	2015
Lacey	2000	Tradition	2004
Legacy	2001		
Quest	2011		

Recommended Two-rowed Malting Barley Varieties

Variety	Year	Variety	Year
AAC Synergy	2015	Endeavor	2014
ABI Voyager	2014	Exhibition	2013
AC Metcalfe	2005	Harrington	1989
CDC Copeland	2007	Hockett	2010
CDC Meredith	2013	Merit	2000
Charles	2009	Merit 57	2010
Conlon	2000	Moravian 37	2010
Conrad	2007	Moravian 69	2010
		ND Genesis	2016
		Pinnacle	2011
		Scarlett	2008
		Wintmalt	2014

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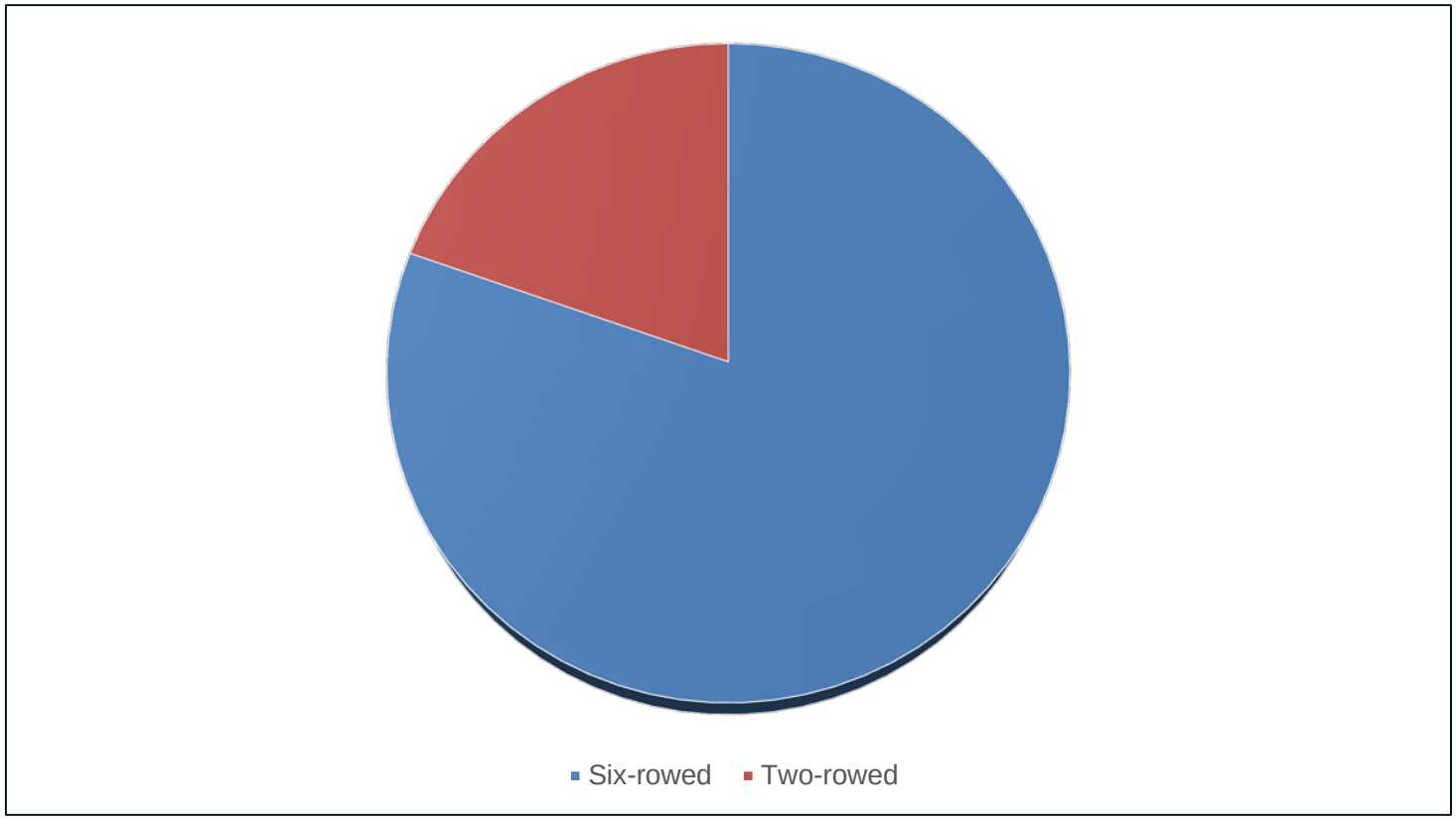
Increased Demand for Two-rowed Barley from the Midwest US

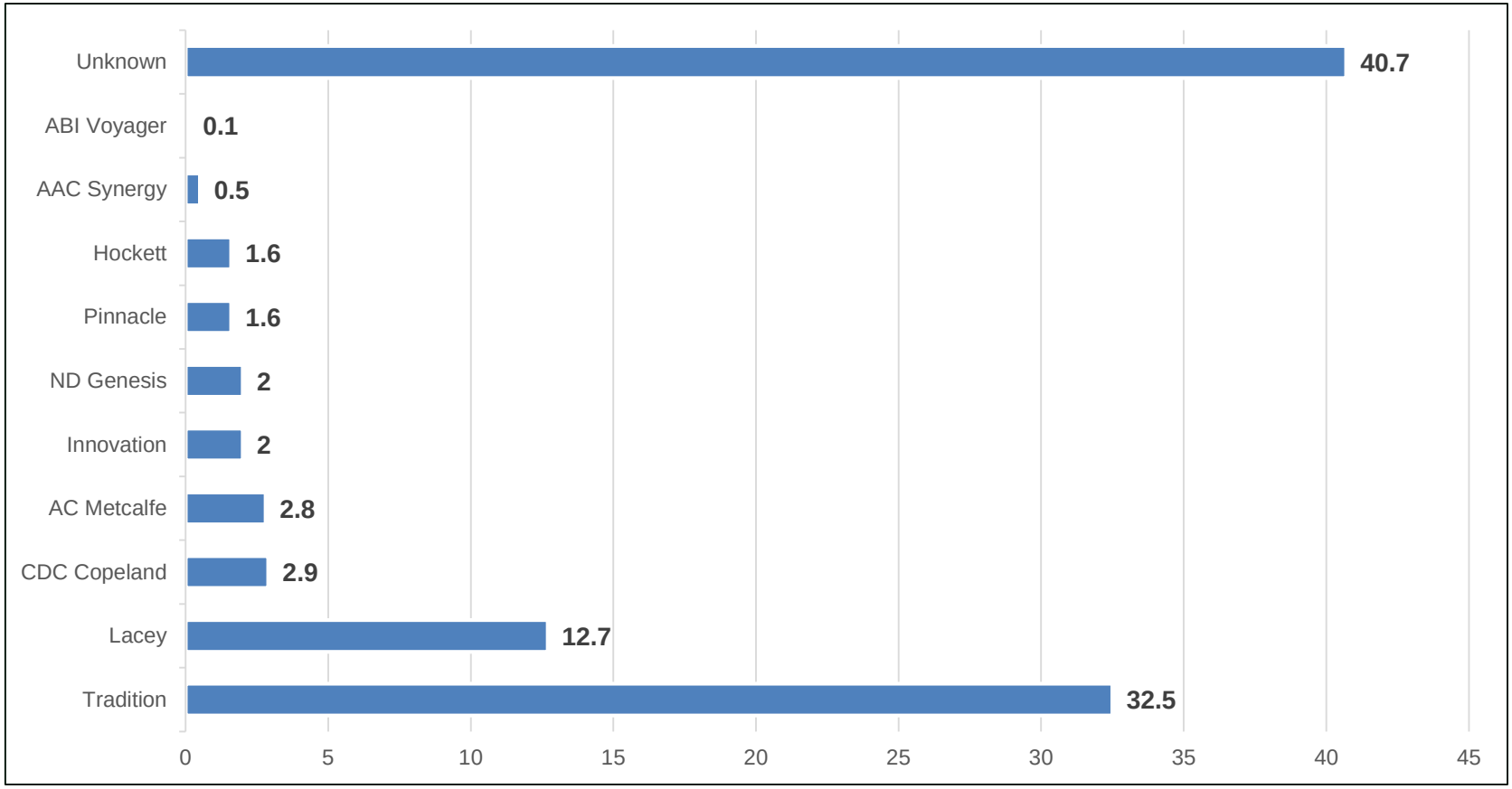
- Growing use of two-rowed malt by adjunct brewers
  - Two-rowed malt has higher extract
- Growth in craft brewer sector
  - ~12.2% of total beer sales by volume (BA)
  - ~22-25% of US malt is used by craft

Percent of Barley Acres Seeded in ND by row type



Data obtained from the American Malting Barley Association's survey of their member.

2016 Barley Variety Survey† – North Dakota



Data obtained from the American Malting Barley Association's survey of their member.

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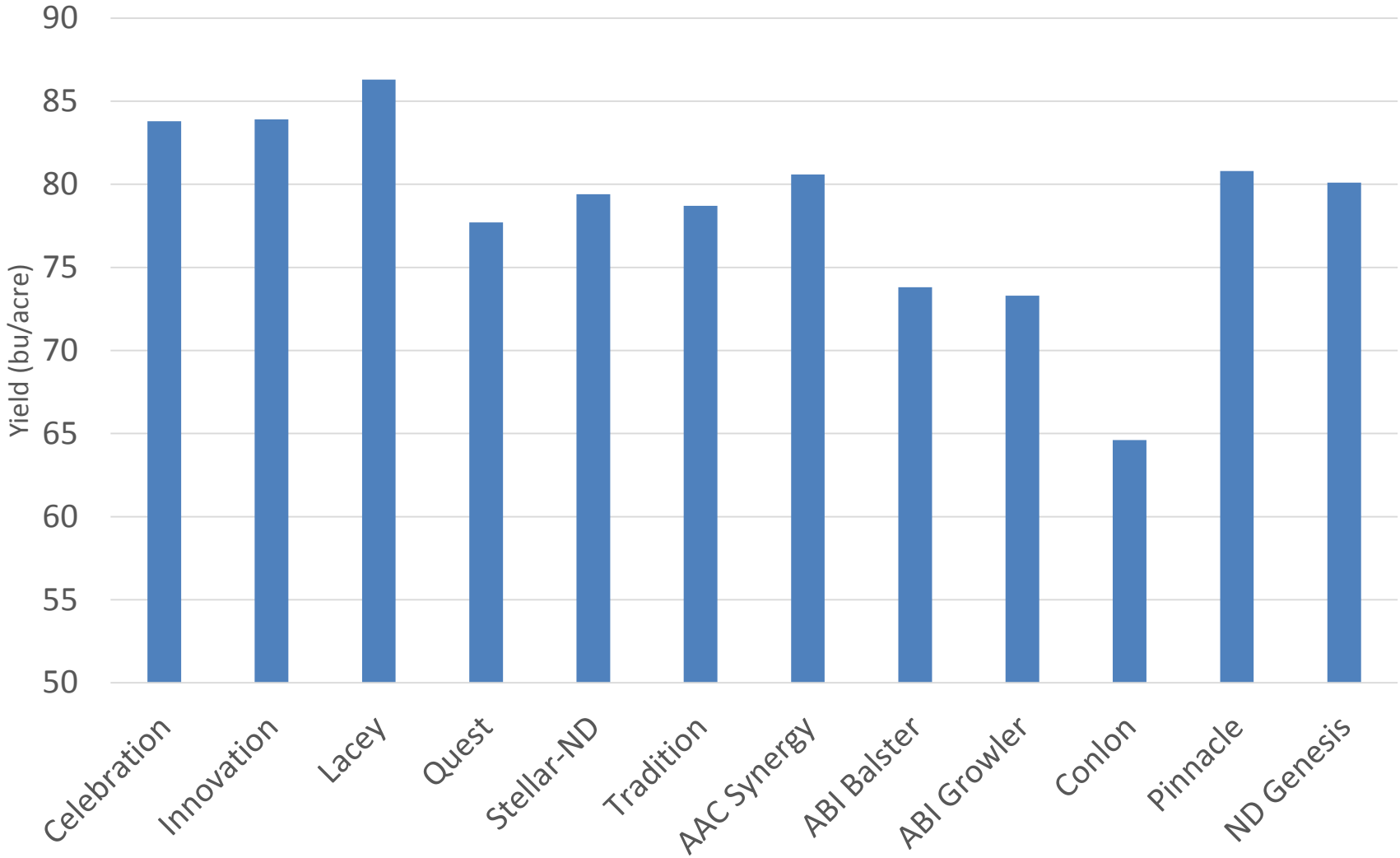
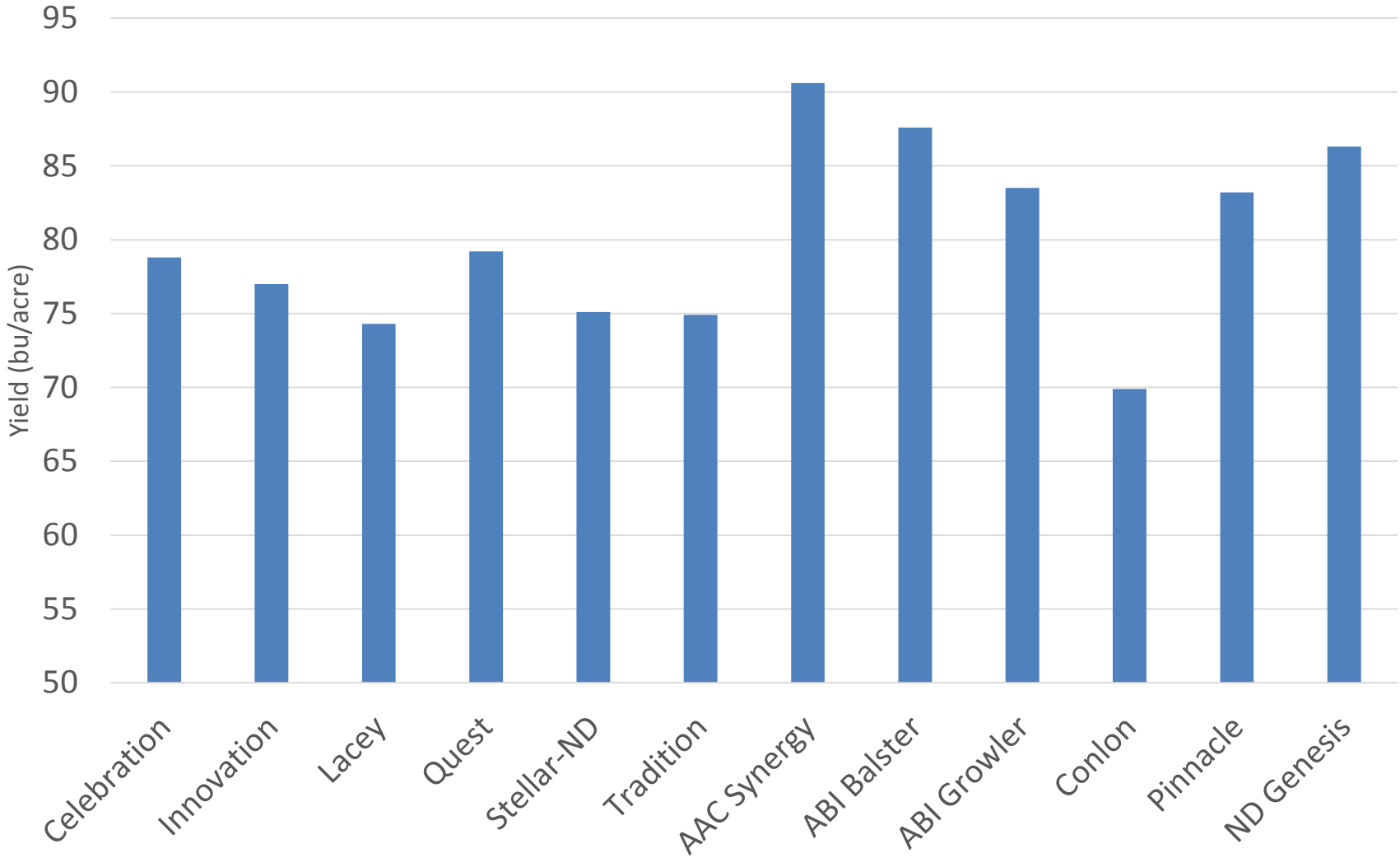
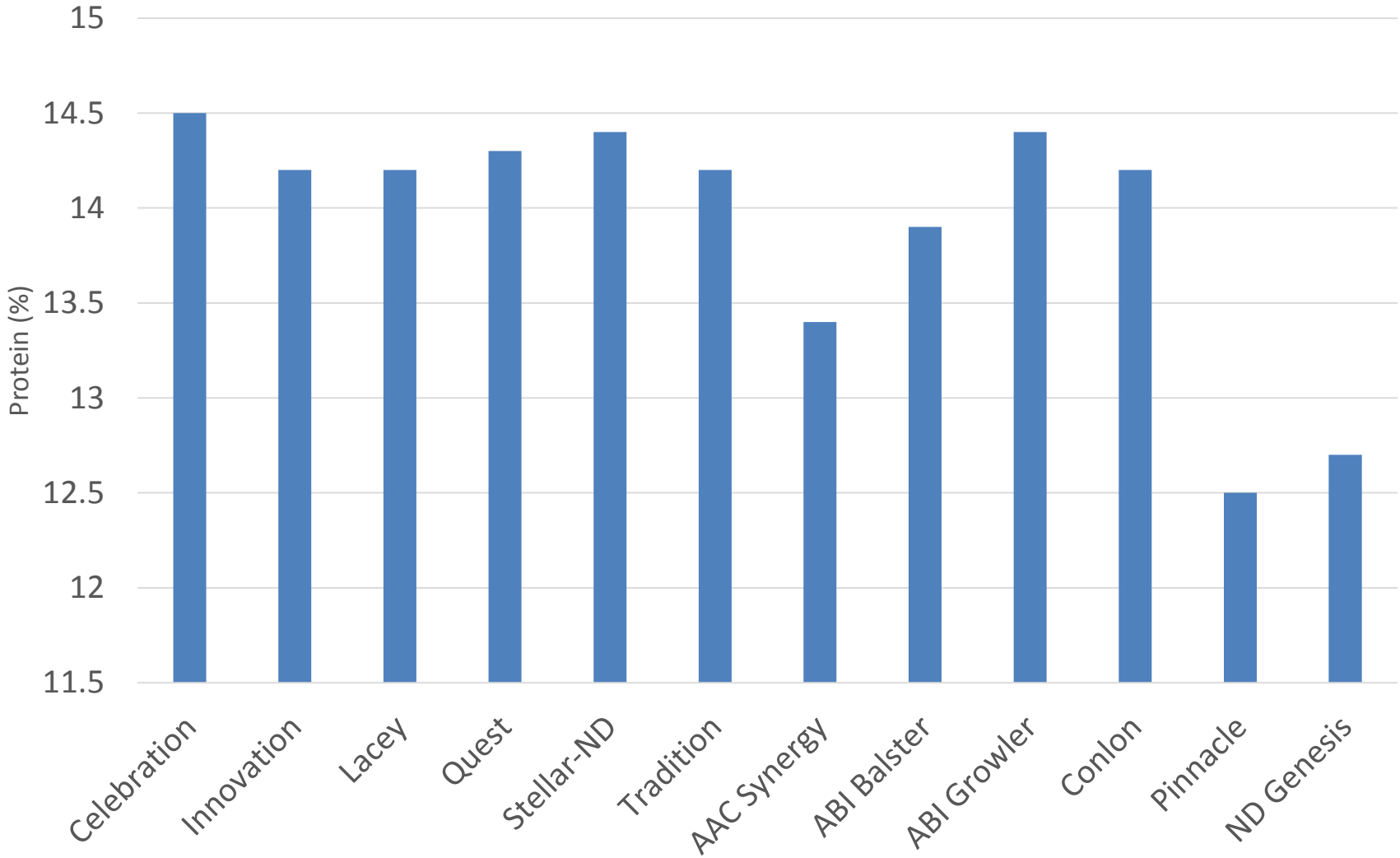
Yield of malting barley varieties in eastern ND, 2016



Yield of malting barley varieties in western ND, 2016



Protein of malting barley varieties in western ND, 2016



Identifying Varieties for the Eastern Growing Region

- Established the Eastern Spring Barley Nursery (ESBN) in 2015.
- 2016 ESBN was funded in part from a grant from the Brewers Association.
- Common list of 20 varieties grown in ME, VT, MA, NY, PA, OH, IN, MI in the US and QB and PEI in Canada.
- Varieties selected based on input from craft industry personnel and university researchers in the region.
- Varieties included two- and six-rowed entries, and newer and “heritage” varieties.

ESBN Research Sites

Institute	Locations	Cooperator
Univ. of Maine	Orono and Preque Isle	Ellen Mallory
Univ. of Vermont	St. Albans	Heather Darby
Umass Amherst	Amherst	Masoud Hashem
Cornell Univ.	Ithaca	Mark Sorrels
Penn State Univ.	State College	Greg Roth
Ohio State Univ.	Wooster	Eric Stockinger
Purdue Univ.	West Lafayette	Mohsen Mohammadi
Michigan State Univ.	Buckley and Chatham	Chris Kapp
North Dakota State Univ.	Fargo	Rich Horsley
AAFC PEI	Charlottetown, PEI	Aaron Mills
Semican	Princeville, QB	Jean Goulet

2015 ESBN Entry List (Two-rowed Entries)

Variety	Developer
AAC Synergy	Agriculture and Agri-Food Canada
AC Metcalfe	Agriculture and Agri-Food Canada
Newdale	Agriculture and Agri-Food Canada
Cerveza	Agriculture and Agri-Food Canada
CDC Copeland	Crop Development Centre
CDC Meredith	Crop Development Centre
Bentley	Field Crop Development Centre
Harrington	Crop Development Centre
Klages	USDA-ARS Aberdeen, ID
Conlon	North Dakota State University
ND Genesis	North Dakota State University
Pinnacle	North Dakota State University
Full Pint	Oregon State University
Scarlett	Saatzucht Josef Breun GmbH & Co (Germany)

2015 ESBN Entry List (Six-rowed Entries)

Variety	Developer
Robust	University of Minnesota
Innovation	Busch Agricultural Resources, LLC
Tradition	Busch Agricultural Resources, LL
ND22421	North Dakota State University
Quest	University of Minnesota
Lacey	University of Minnesota

Mean Performance Across Entries for the 10 ESBN Locations in 2015

Location	Foliar disease	Lodging	Yield	Protein	DON	Plumps	RVA†
	(1-9)	(1-9)	(bu/ac)	(%)	(ppm)	(%)	(SN)
Cornell		1.0	61.3				49.5
Michigan State (Buckley)			73.4	10.4	0.0	96.9	40.1
Michigan State (Chatham)			52.4	12.1	0.0	93.0	114.0
Ohio State		2.5	56.7	11.7	1.6	81.7	53.6
Penn State		1.2	43.1	12.8	2.7	87.5	114.4
Purdue			51.2	11.7	1.6	62.5	10.2
Univ. of Maine (Orono)	5.2		95.6	9.1	0.0	92.8	139.6
Univ. of Maine (Presque Isle)	5.3		91.2	10.6	0.2	95.9	36.1
Univ. of Vermont			32.6	10.1	0.5	92.9	113.9
North Dakota State Univ.	5.6	1.6	60.5	11.8	0.2	80.8	163.8

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Mean Performance of Two-rowed vs. Six-rowed Varieties Across Locations

Row type	Foliar disease	Lodging	Yield	Test weight	Protein	DON	Plumps
	(1-9)†	(1-9)‡	(bu/ac)	(lb/bu)	(%)	(ppm)	(%)
Station years	3	4	10	8	8	8	8
Two-rowed	5.5	1.7	59.5	47.0	10.8	0.6	82.3
Six-rowed	4.9	1.1	66.9	47.2	11.6	0.9	86.8

†Foliar disease score of 1 = no disease and 9 = severe disease.
‡Lodging score of 1 = no lodging and 9 = severe lodging.

Top and Bottom Yielding Varieties at Each Location

Location	Top three varieties	Bottom three varieties
Cornell	Innovation, Lacey, Quest	Scarlett, Harrington, Klages
Michigan (Buckley)	Klages, Lacey, Innovation	Bentley, CDC Copeland, Conlon
Michigan (Chatham)	Lacey, Innovation, Cerveza	Harrington, Full Pint, Conlon
Ohio	Cerveza, Newdale, ND22421	Scarlett, Full Pint, Klages
Penn State	Bentley, AAC Synergy, Tradition	Scarlett, Klages, ND22421
Purdue	Lacey, Robust, Quest	Scarlett, CDC Copeland, Harrington
Maine (Orono)	ND22421, Innovation, Quest	Scarlett, Harrington, Full Pint
Maine (Presqe Isle)	ND22421, AAC Synergy, Quest	Scarlett, Harrington, Conlon
Vermont	Lacey, Cerveza, Tradition	Conlon, Robust, Newdale
North Dakota	AAC Synergy, Newdale, Lacey	Conlon, Full Pint, CDC Copeland
Across locations	Lacey, AAC Synergy, Innovation	Scarlett, Full Pint, Harrington

Top and Bottom Yielding Two-rowed Varieties at Each Location (non-heritage)

Location	Top three varieties	Bottom three varieties
Cornell	AAC Synergy, ND Genesis, Cerveza	Full Pint, Conlon, CDC Meredith
Michigan (Buckley)	Newdale, ND Genesis, AC Metcalfe	Bentley, CDC Copeland, Conlon
Michigan (Chatham)	Cerveza, AAC Synergy, Pinnacle	Harrington, Full Pint, Conlon
Ohio	Cerveza, AAC Synergy, Pinnacle	Full Pint, Conlon, CDC Copeland
Penn State	Bentley, AAC Synergy, Conlon	Full Pint, CDC Copeland, CDC Meredith
Purdue	ND Genesis, Conlon, Pinnacle	CDC Copeland, AC Metcalfe, Full Pint
Maine (Orono)	Newdale, AAC Synergy, Bentley	Full Pint, Pinnacle, CDC Copeland
Maine (Presque Isle)	AAC Synergy, CDC Meredith, Cerveza	Conlon, Full Pint, Newdale
Vermont	Cerveza, AAC Synergy, Bentley	Conlon, Newdale, Full Pint
North Dakota	AAC Synergy, Newdale, AC Metcalfe	Conlon, Full Pint, CDC Copeland
Across locations	AAC Synergy, Cerveza, Bentley	Full Pint, Conlon, CDC Copeland

Mean Malt Quality Across Entries for Six ESBN Locations in 2015

Location	Plump	Protein	Extract	Wort protein	S/T	DP	Alpha-amylase	Beta-glucan
	(%)	(%)	(%)	(%)	(%)	(°ASBC)	(20° DU)	(ppm)
Cornell University	76.6	9.0	80.8	4.87	54.5	78	70.1	244
Michigan State (Chatham)	93.0	12.1	80.2	4.89	40.7	88	61.9	375
Penn State	87.5	12.8	79.9	6.38	50.1	118	70.9	251
Univ. of Maine (Orono)	92.8	9.1	81.8	5.22	57.8	64	66.5	376
Univ. of Vermont	92.9	10.1	80.9	5.50	57.8	74	71.9	242
North Dakota State Univ.	80.8	11.8	80.7	7.04	60.2	112	75.4	156

Mean Malt Quality of Selected Entries Across Six ESBN Locations in 2015

Location	Plump	Protein	Extract	Wort protein	S/T	DP	Alpha-amylase	Beta-glucan
	(%)	(%)	(%)	(%)	(%)	(°ASBC)	(20° DU)	(ppm)
Two-rowed								
AAC Synergy	94.8	10.1	81.7	5.78	57.8	72	75.4	173
Newdale	83.2	10.5	80.8	5.70	55.3	85	77.4	232
Conlon	94.8	11.0	80.8	5.50	50.2	94	67.0	411
Pinnacle	90.0	9.6	81.4	4.93	51.8	52	57.2	381
ND Genesis	90.0	9.5	81.7	50.08	53.8	64	67.3	291
Six-rowed								
Tradition	92.9	11.3	80.8	5.33	47.0	121	66.6	357
Innovation	92.8	11.3	80.7	5.68	50.3	104	66.7	307

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For spring barley, early planting positions the crop into a more favorable environment

Barley is a cool season crop and develops best when temperatures are relatively cool!

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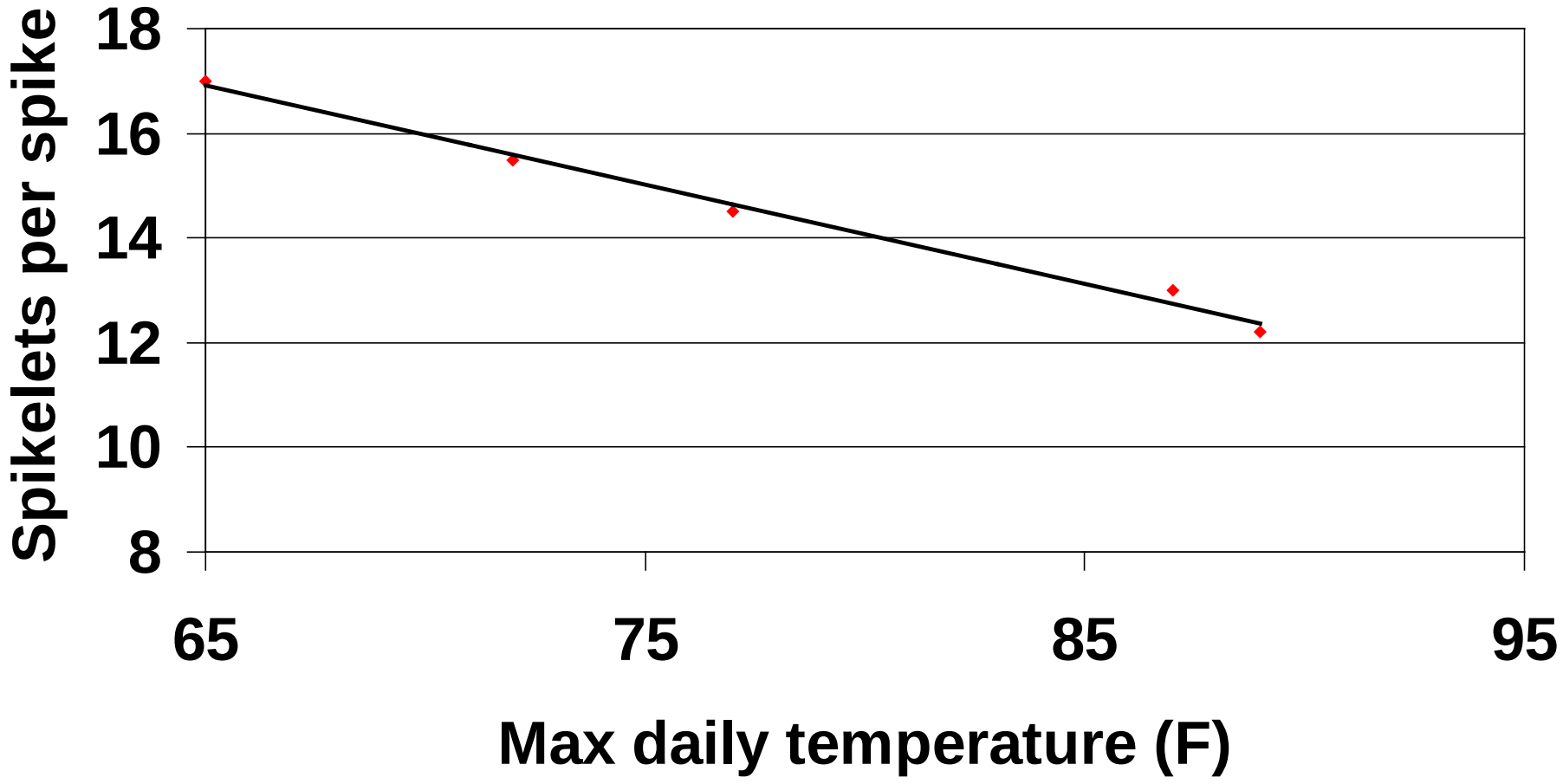
Effect of maximum daily temperature during the 4-5.5 leaf stage on spikelets per spike.

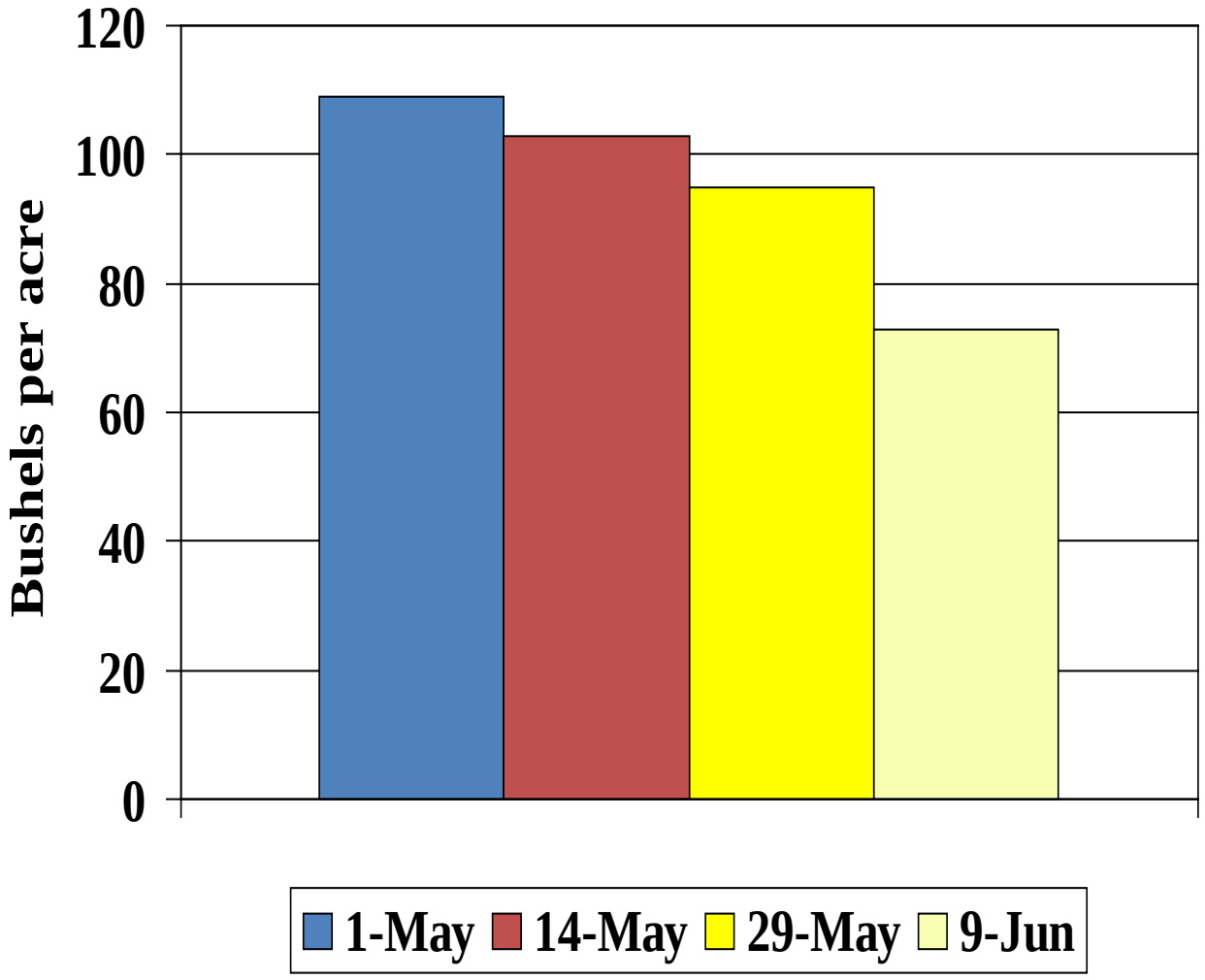


Early planting in Indiana: As early as you can get into the field in the spring? Frost damage potential is low with barley while growing point is below the soil's surface.

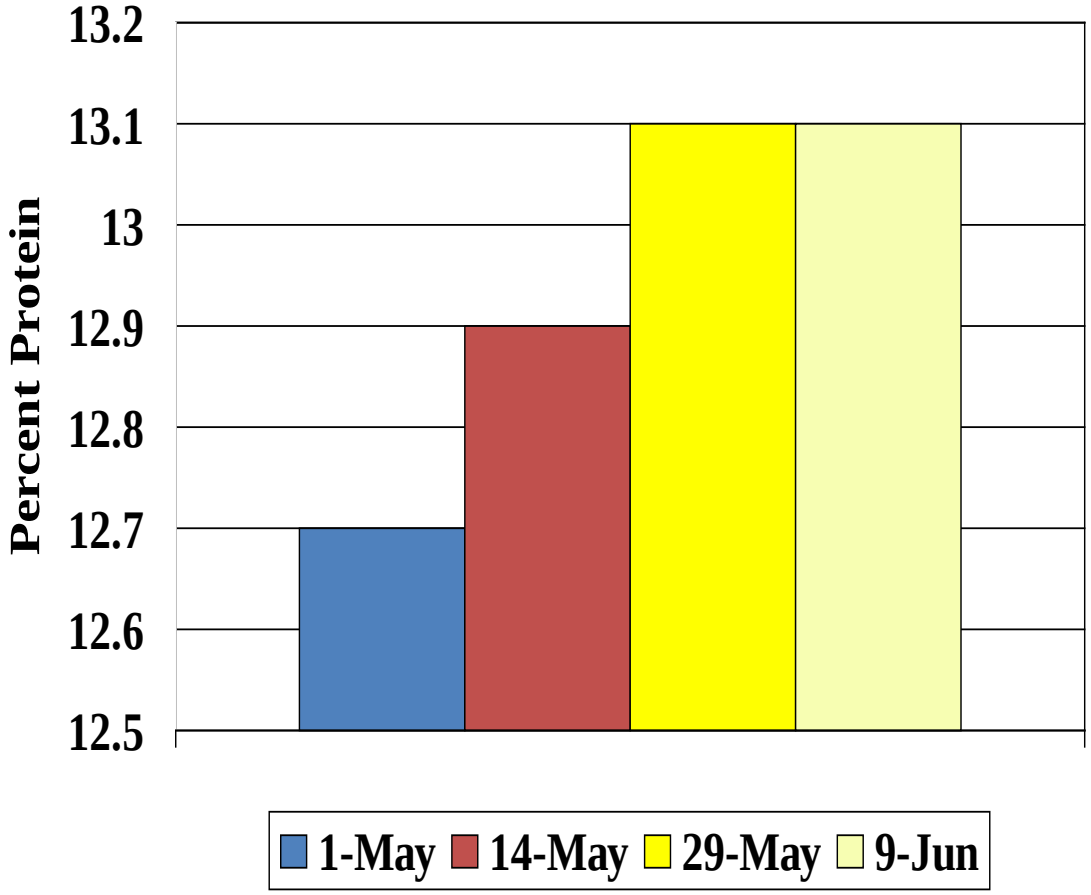
Plant barley like you would oats is one suggestion:
Probably first week of March to third week of March, soil conditions permitting.

For winter barley, plant like winter wheat but with more care as it is less winter hardy.

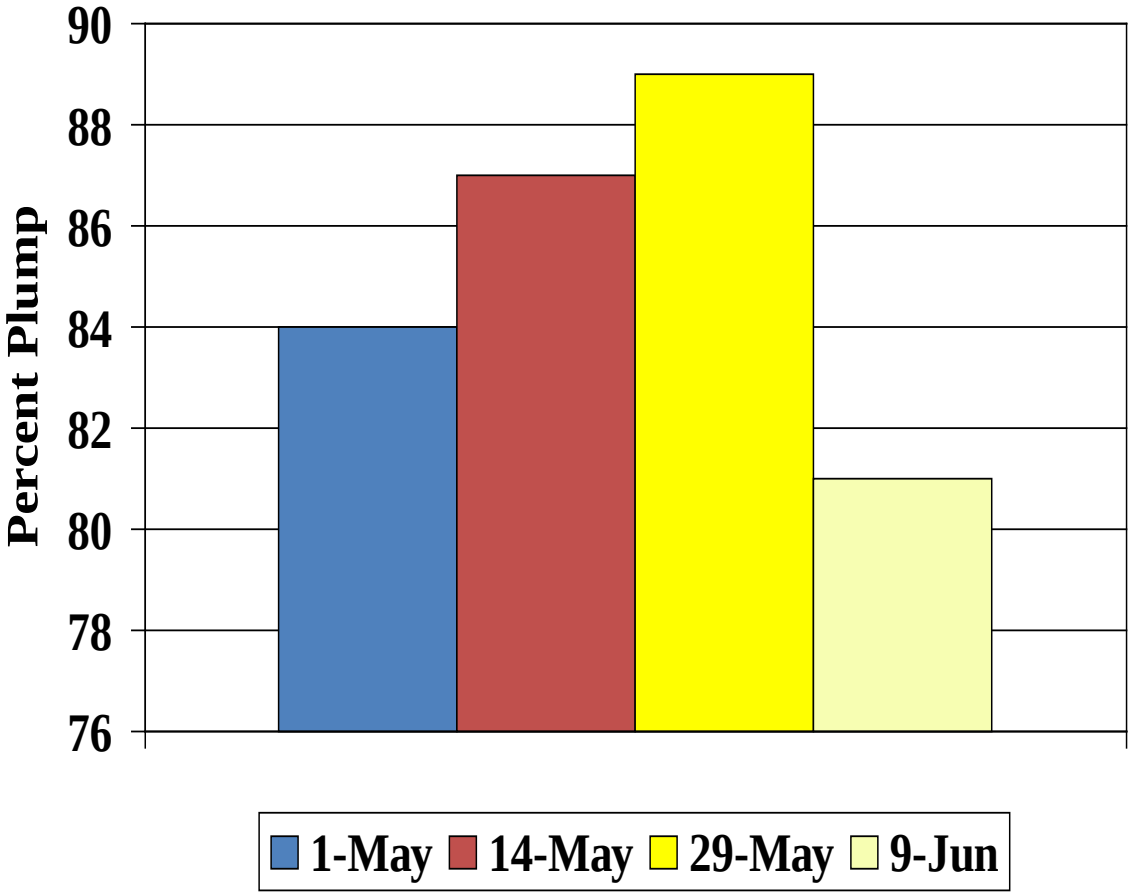
Affect of Planting Date on Barley Yields from 1996-01 at Langdon ND.



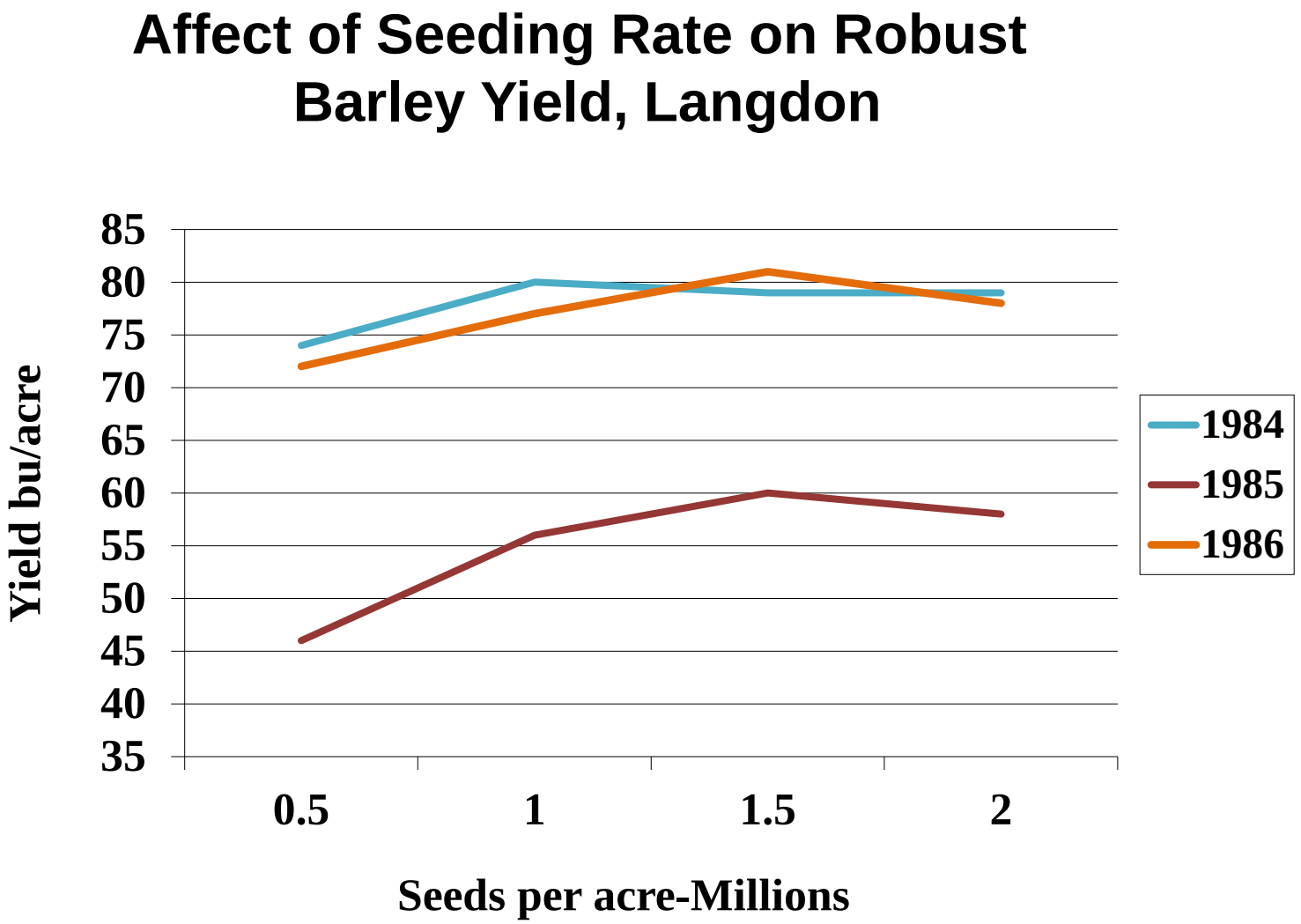
Affect of Planting Date on Barley Percent Protein from 1996-01 at Langdon ND.



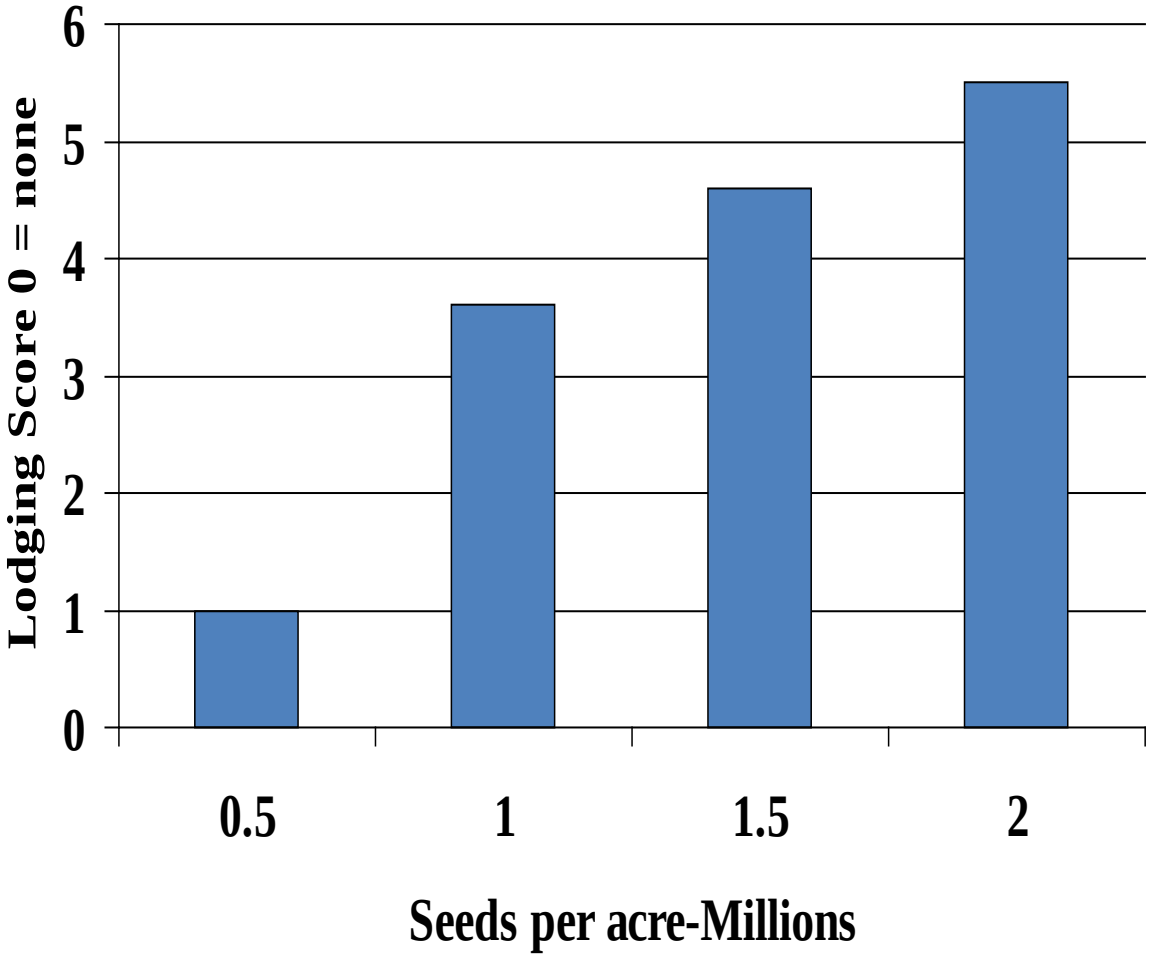
Affect of Planting Date on Barley Percent Plump from 1996-01 at Langdon ND.



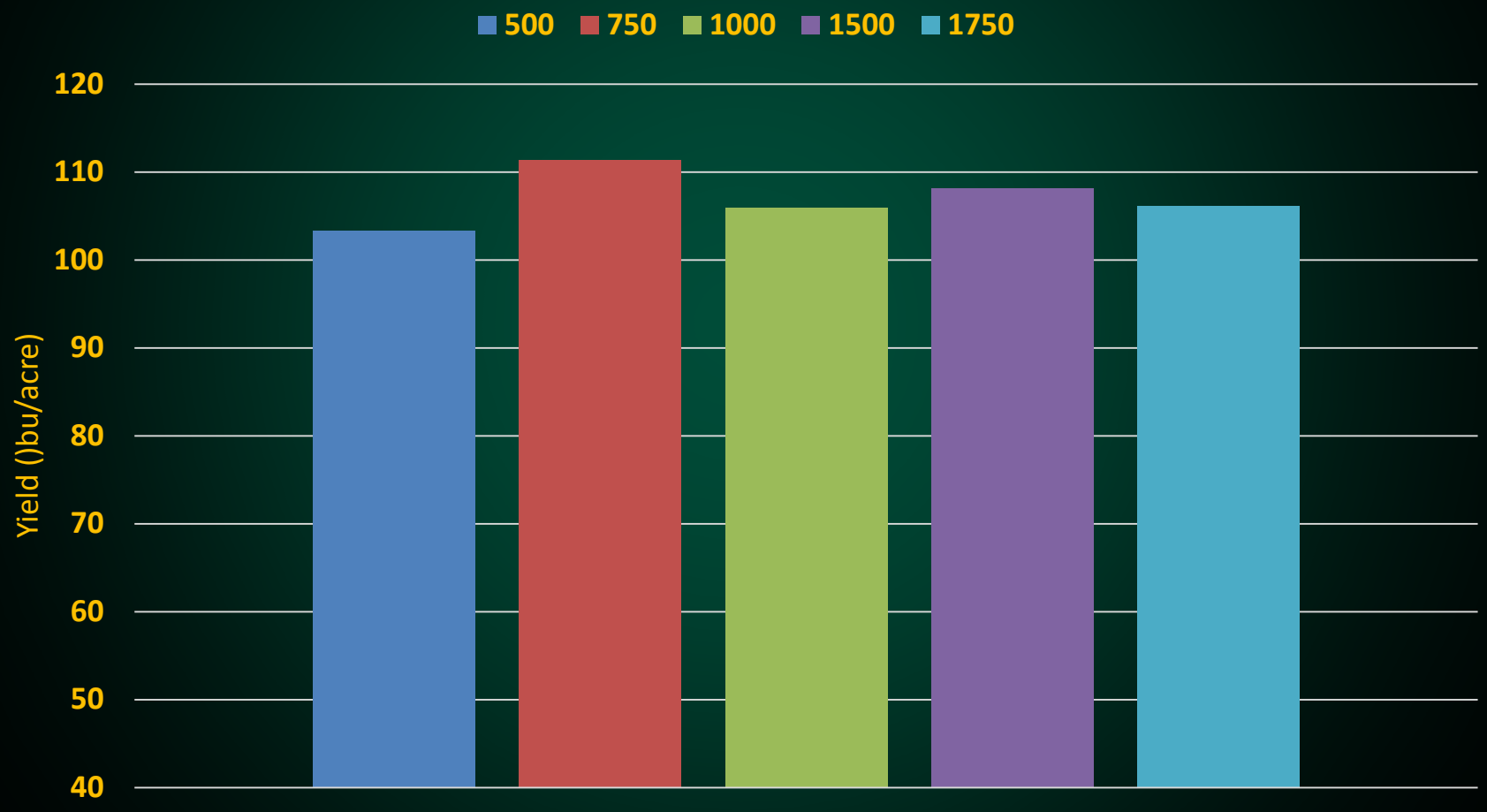
Seeding rate



Affect of Seeding Rate on Lodging, Robust Barley, Langdon



Effect of seeding rate on yield of ND-Genesis Barley, four environments, 2015



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Foliar Diseases of Barley

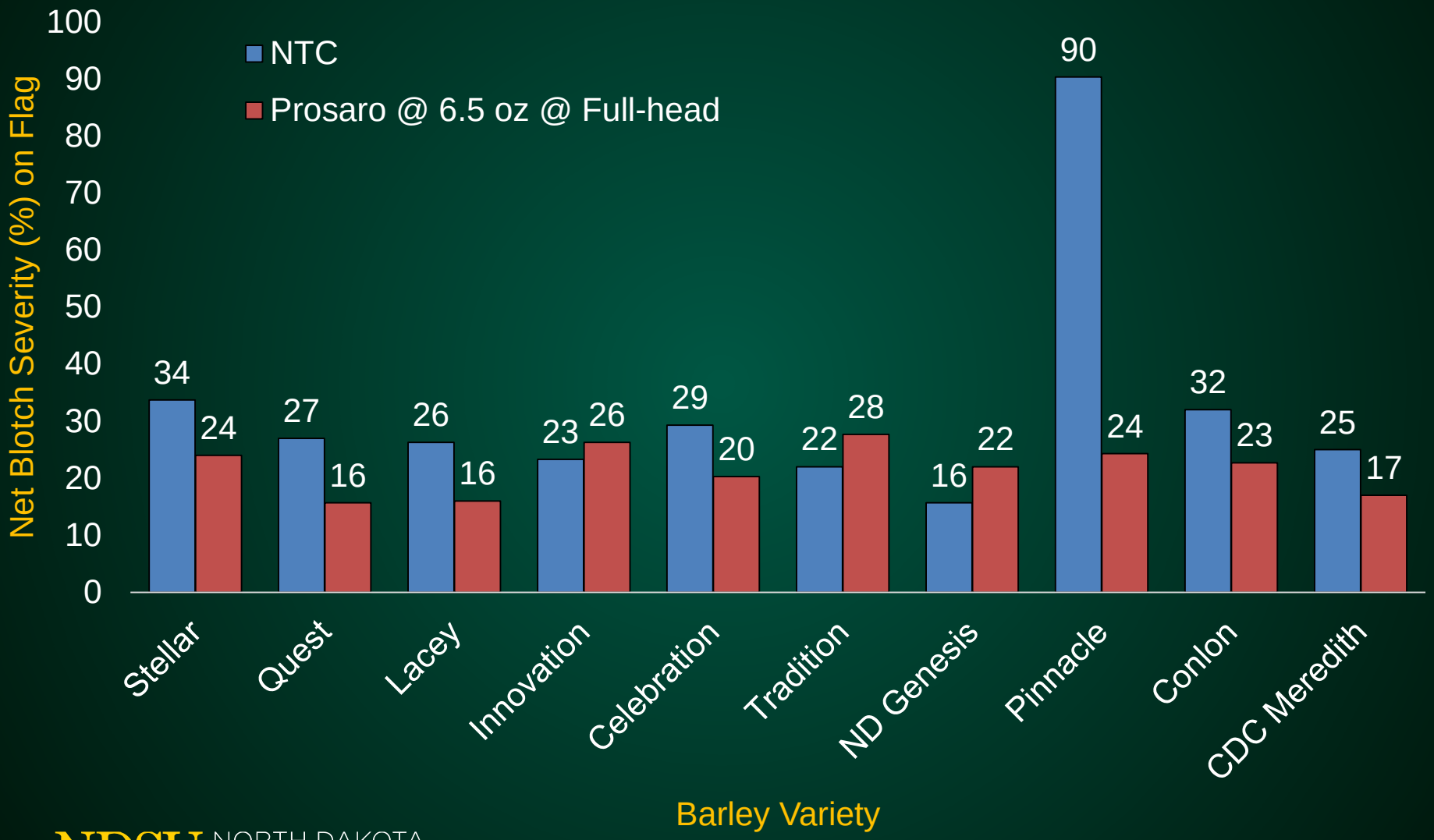
- Net-blotch (two forms)
- Spot blotch
- Scald
- Bacterial Leaf Streak
- Leaf Rust
- Stripe Rust
- Barley Yellow Dwarf Virus

Migrators

Blend of both

Net Blotch

Fungicide x Variety – Net Blotch Severity



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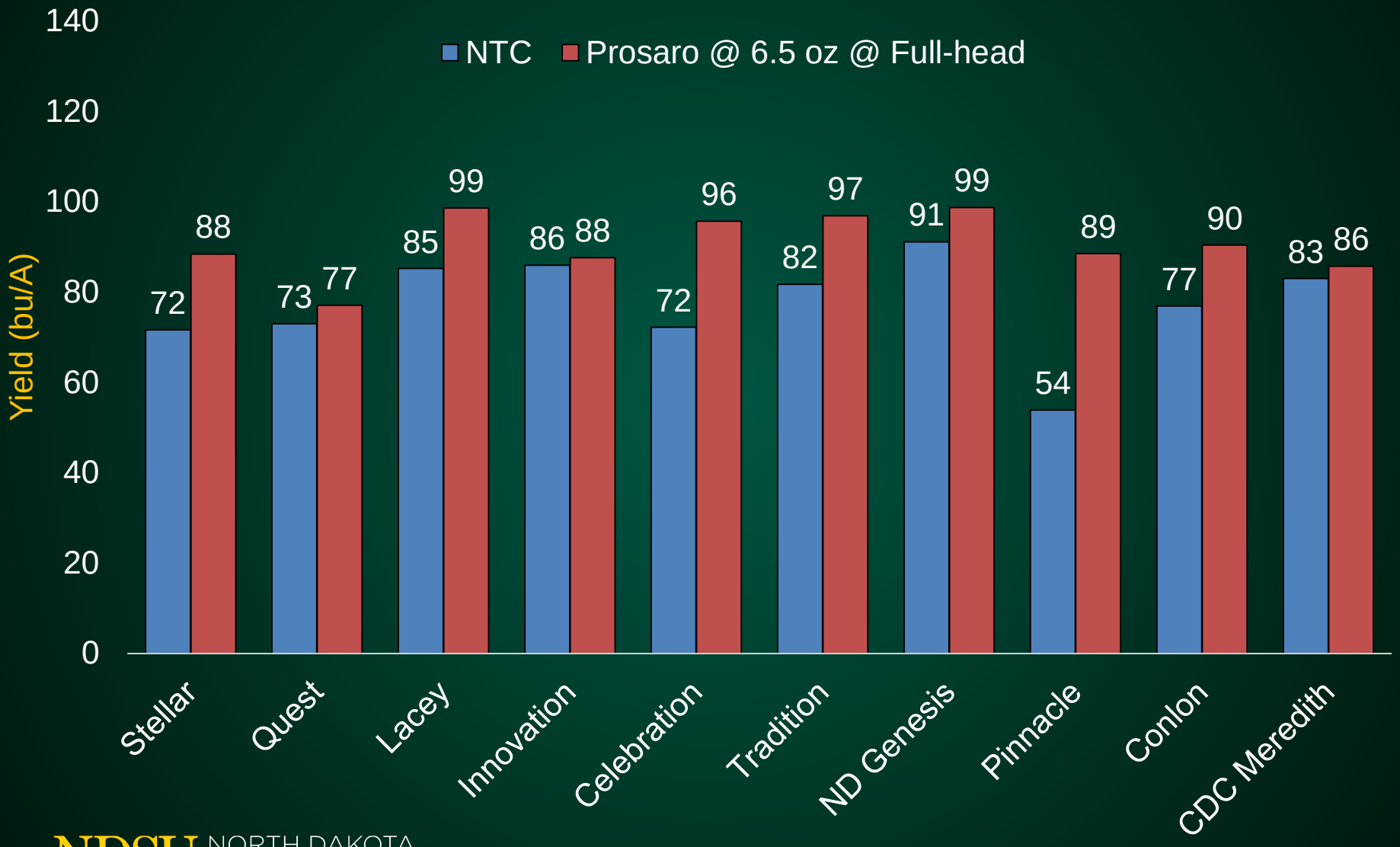
Ransom and Friskop et al.

Fungicide x Variety – Yield



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*FHB and DON also present in trial

Ransom and Friskop et al.

Spot Blotch of Barley

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Nathan Kleczewski, Delaware

Scald

McMullen – NDSU Professor Emeritus

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Burrows, Montana State

Bacterial Leaf Streak

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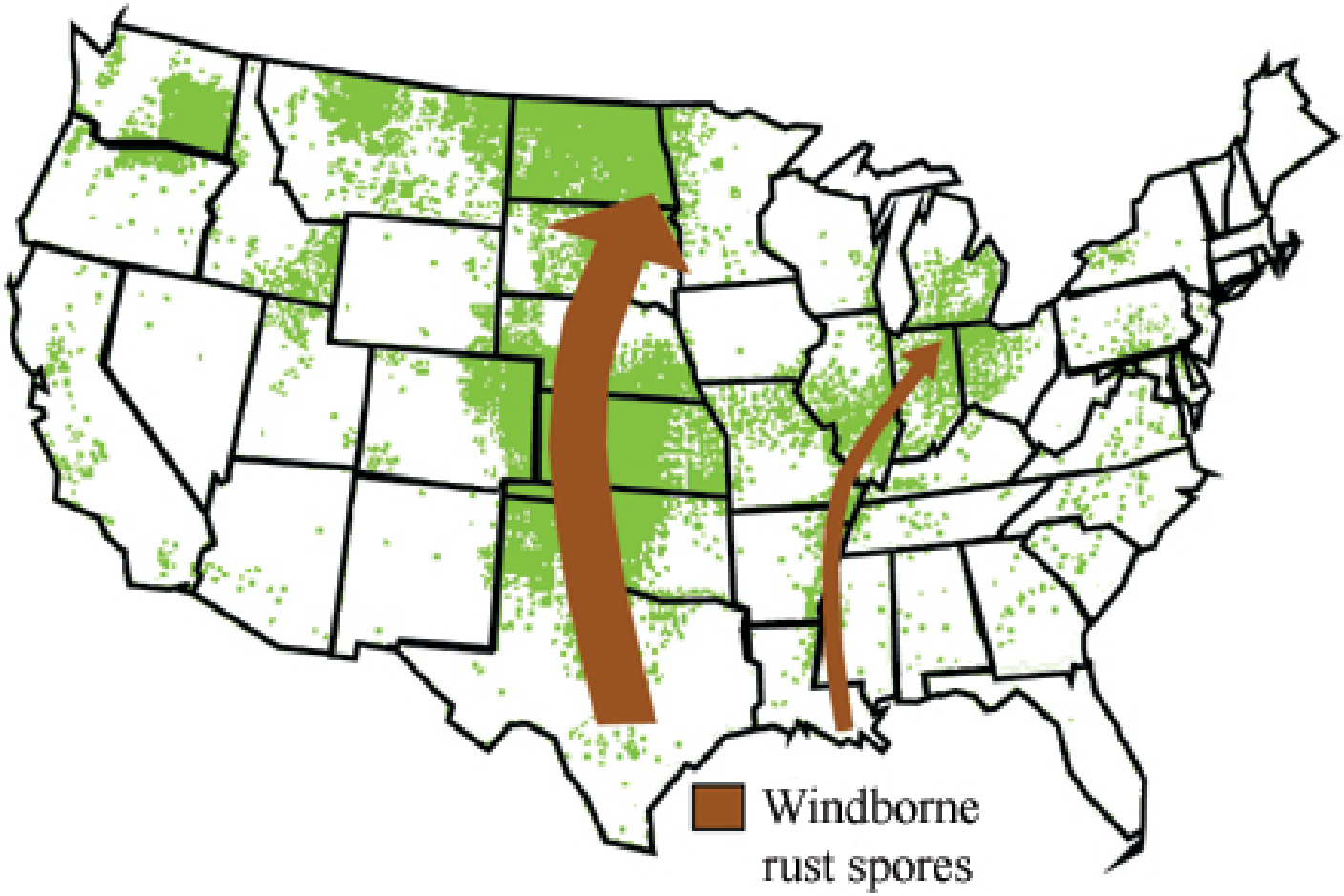
Leaf Rust


Windborne
rust spores

Fusarium Head Blight (Scab)

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Fusarium Head Blight (Scab)

- *Fusarium graminearum*
- Hosts: spring wheat, winter wheat, durum, barley, and oat
- Overwinters on cereal crop (including corn) residue
- Warm temperatures (75-85˚F), high humidity and persistent moisture at and prior to heading

What is DON?

- Mycotoxin - Secondary metabolite produced by a fungus (*F. graminearum*)
- Deoxynivalenol (DON) = Vomitoxin (VOM)
- DON does not occur spontaneously
- DON indicates Fusarium head blight (scab) was in your small grain field!
- FDA established advisory levels of 1 ppm
- DON in brewing causes gushing

Conducive Weather
*75-85°F
*High humidity
*Rain

Cereal Crop Residue – wheat, barley, corn, oat

FHB management

- Little varietal resistance, though 2-row types tend to accumulate less DON than 6-row types
- Avoid growing barley after other cereals – especially corn
- Stagger planting dates
- Fungicides

FUSARIUM HEAD BLIGHT Prediction Center

FUSARIUM RISK Assessment Tool

- Introduction
- Model Basics
- User Guide
- Fusarium
- Developers
- Login

ND Commentary *last update 2015-06-17* Andrew Friskop,

According to the model, the areas with the highest level of scab risk continue to be in south central to southwestern ND. A few more pockets of elevated scab risk are apparent on the eastern side of the state as well. Areas south of I-94 received a steady rain yesterday, which will likely increase scab risk in the small grains. Also, the dew point temperatures have been relatively high resulting in prolonged moisture periods (dew) in the morning. The combination of these factors and with rain in the forecast could elevate scab risk throughout he state.

1. Choose a State

State: North Dakota Help

2. Choose a Model

Wheat: Spring Winter

Susceptibility: Susceptible

Link to Spring Wheat Variety Information

3. Weather Forecast Mode

Forecast (hrs): 0 24 48 72

Assessment Date: 06/22/2015

6/15 6/16 6/17 6/18 6/19 6/20 6/21 6/22

Advanced: Save Model and Location

Name: Save As New

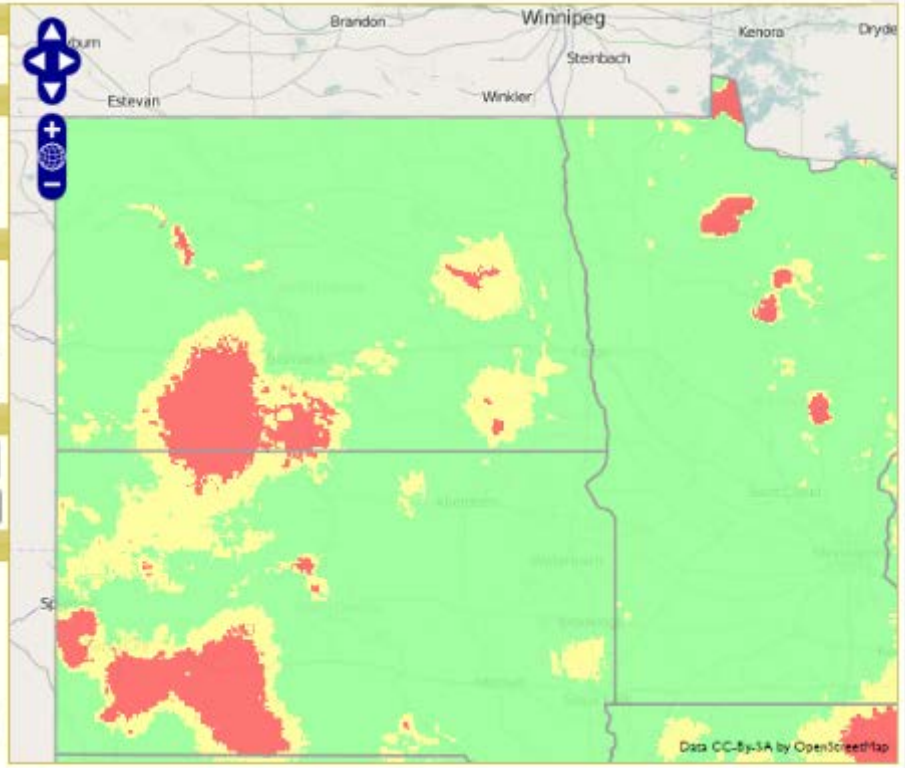
Saved Locs: Delete

Legend

Blight Risk
- High
- Medium
- Low
- No Data

Weather Stations
- FAA
- AgNet
- Inactive (for model)

Risk Map Opacity Query



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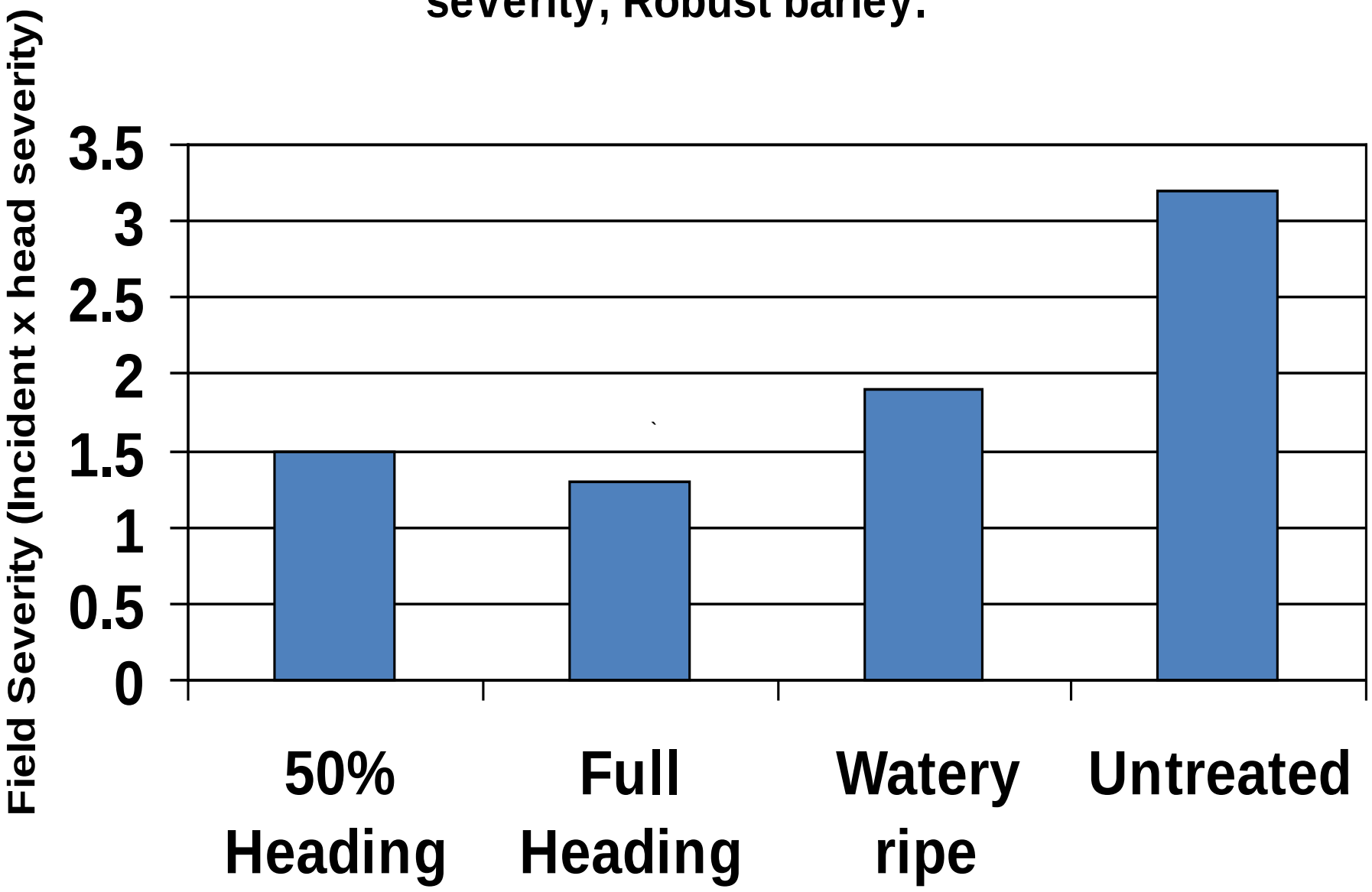
Disclaimer

Effect of application timing of Folicur on FHB field severity, Robust barley.



Best timing for fungicide application is at full heading

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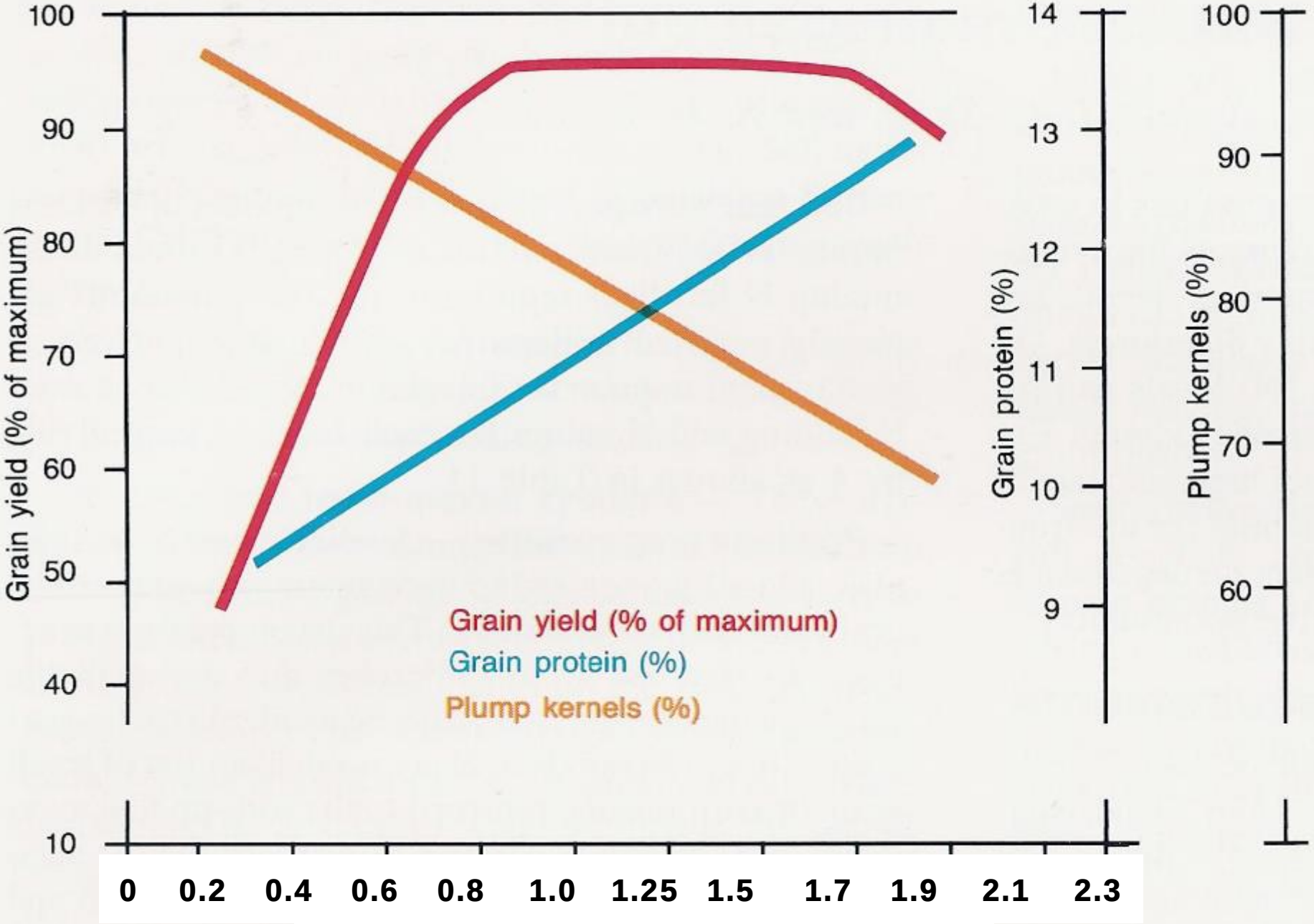
Treatment	FRAC	Rate	Timing	Flag Leaf Severity (%)	DON (ppm)	Yield (bu/A)
Non-treated Control				66.3 a	1.45 bc	115.5 c
Headline Caramba	11 3	7.5 oz/A 13.5 oz/A	Flag Leaf Full-Head	9.5 d	0.78 d	131.3 ab
Stratego Prosaro	3+11 3	7.0 oz/A 7.3 oz/A	Flag Leaf Full-Head	16.5 d	0.58 d	134.2 ab
Folicur	3	4.0 oz/A	Flag Leaf	26.5 b	1.75 ab	129.0 ab
Caramba	3	8.0 oz/A	Flag Leaf	17.0 bcd	1.90 ab	130.0 ab
Fortix	3+11	5.0 oz/A	Flag Leaf	19.5 bcd	2.13 a	127.1 ab
Headline	11	7.5 oz/A	Half-Head	12.5 cd	1.93 ab	126.4 b
Proline	3	5.0 oz/A	Half-Head	18.5 bcd	1.05 cd	130.0 ab
Evito	11	3.0 oz/A	Full-Head	25.5 b	1.80 ab	128.7 ab
Prosaro	3	7.3 oz/A	Full-head	18.0 bcd	0.65 d	129.4 ab
Caramba	3	13.5 oz/A	Full-Head	22.5 bc	0.78 d	126.0 b

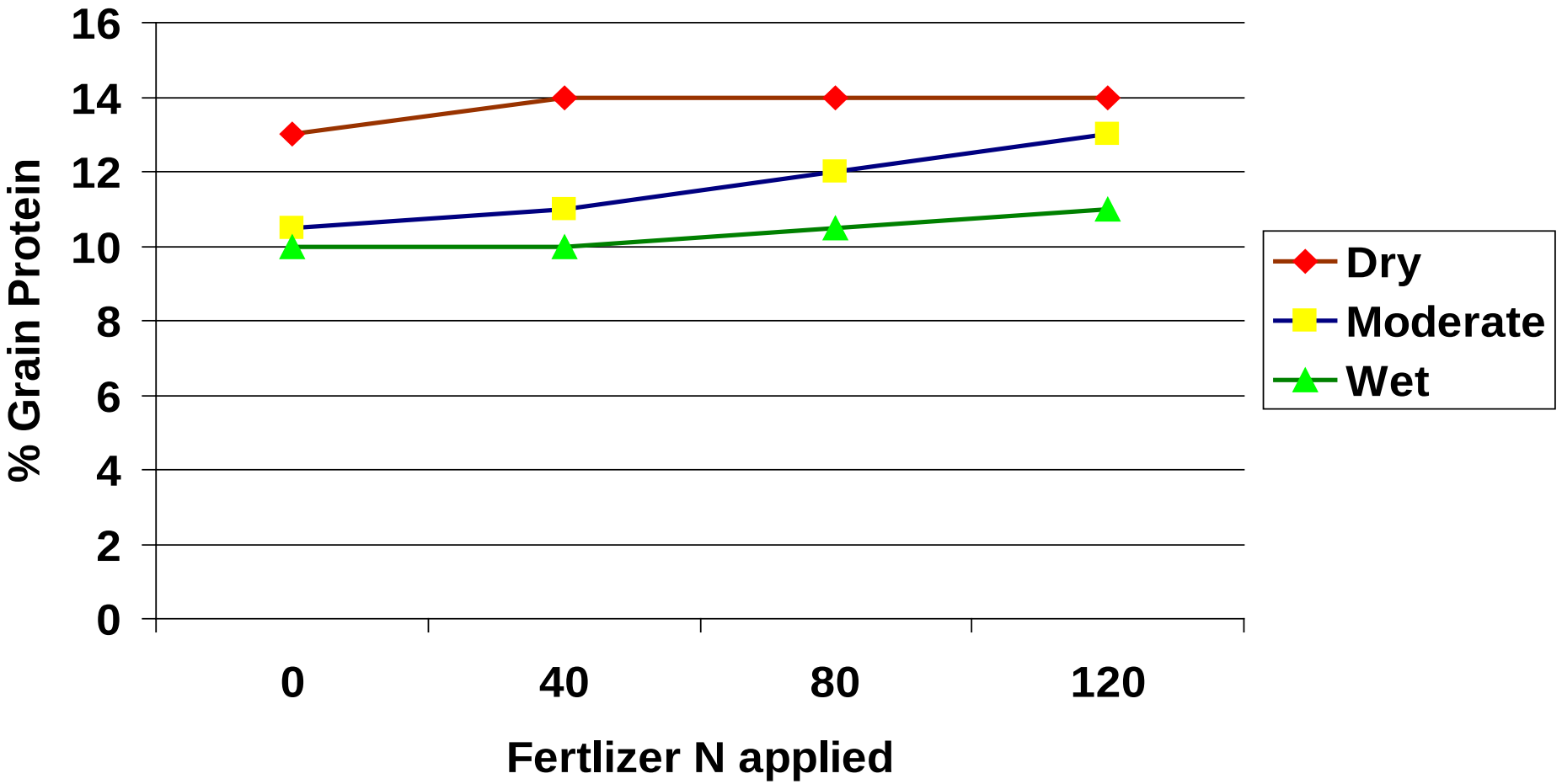
Managing Protein

- Plant early
- Fertilize early (no splits)
- Variety choice (some varieties have genes for low protein (i.e. ND-Genesis, Pinnacle)
- 1.5 lbs N per bu yield goal minus any soil nitrate from fall soil sample
  - Accurately predicting yield goal may be difficult without experience.



Modified from Tindall, Stark and Brown

Protein management – the art of matching available N to yield potential



Summary

- **Making malt requires good management and cooperative weather**
- **Current varieties of spring types may not be well adapted**
- **Planting early and after broadleaf crop**
- **Controlling diseases will be important to achieve adequate quality, especially FHB**
- **Be prepared to use well timed fungicides**
- **Carefully calculate nitrogen fertilizer additions**
- **Secure a market and source of seed early in process**

Comments from AgTalk

- Grow winter barley as a double crop with soybean.
- Matures 2 weeks ahead of wheat
- Soybeans do much better than when following wheat
- Grow corn and forget barley unless you want to brew your own beer
- Planting of winter barley is like winter wheat but needs more precision as it is not as winter hardy


Questions?