Basics of Spring Wheat and Barley Production in North Dakota

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Trends in wheat area and yield, ND

## Trends in yield in ND over the past 13 years for three classes of wheat.



## Key production practices





# Early planting positions the crop into a more favorable environment



Wheat is a cool season crop and develops best when temperatures are relative cool!



#### CCSP FARM HRSW, HRWW YIELD vs MEAN TEMPERATURE FOR MAY - JULY FROM 2004 TO 2010



### Effect of planting date on yield of spring wheat, average of cultivars and seeding rates, 2013-2015.



Early Late





Slafer & Rawson (1994) Miralles & Slafer (1999)

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



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





## No-till planting

- Especially important in the dryer regions of the state
- More moisture conservation
- Reduced labor requirements
- Equipment savings
- Fuel savings
- No incorporation tillage
  - Herbicides replace tillage for weed control
- Erosion control

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Newest systems allow fertilizer to be placed at the time of planting in a single pass



## Effect of tillage and rotation on wheat yield, Dickinson and Carrington, ND.

CT cont wheat NT pea-wheat



- Will no-till be preferable in Iowa?
  - Main issue in ND is moisture conservation
  - Tillage may reduce the potential for issues with Fusarium Head Blight
  - Wet soils that delay spring planting may benefit from previous tillage

## EFFECT OF SEEDING RATE ON YIELD OF VARIOUS CULTIVARS, PROSPER, 2013.



#### locations, 2013 and 2015, ND. • Early13 • Late 13 • Early 15 • Late 15 •••••Poly. (Early13) •••••Poly. (Late 13) ••••Poly. (Early 15)•••••Poly. (Late 15) 90 85 80 75 Yield (bu per acre) 70 65 60 • 55 50 45 40 0.9 1.1 1.3 1.5 0.5 0.7 1.7 1.9 2.1 2.3 Seeding rate (millions per acre)

Effect fo seeding rate and planting date, average of three

#### Recommendation





### Fertilizer Use

- Nitrogen is the most important and commonly used nutrient
- Rate is based on the yield expectation
- 2.5 lbs N for each expected bushel minus amount in the soil at planting, minus a credit of 40 lbs if following a legume crop (beans soybeans, peas, etc.)





#### Relationship between protein and yield



Northern locations 2009 - 2011: 20 environments

# Relationship between protein and loaf volume.



## Fertilizer timing

- Research suggests that it is most cost effective to apply all at or before planting
- Splits should be applied around 5 leaf stage to benefit yield
- Use of streamer bars



Can we increase yields and improve N use efficiency by splitting N applications?

Effect of N timing on yield of wheat in five environments.

PP 2 Splits 3 Splits



Data from B. Otteson et al, 2007

#### Post Flowering Applications of UAN

- Applied after flowering
- UAN mixed with water 50:50 at an N rate of 30 lb/acre
- Don't mix with fungicides, the timing is slightly different





### **Disease control**

- Genetic resistance
  - Good rust resistance
  - Intermediate tan spot resistance
  - Moderate scab resistance
- Crop rotation
  - Avoid wheat after wheat and wheat after corn
- Fungicides



### **Diseases of wheat**

- Leaf rust
- Septoria and tan spot
- Fusarium Head Blight









#### Tan Spot Generally Most Common Disease Observed in Wheat







**Overwintering Fruiting Bodies on Wheat Straw** 

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Tan Spot Percent Incidence Field Season 2006



Tan Spot Percent Incidence Field Season 2007



• 0 🖩 1-5 🛦 6-15 🔵 16-25 📃 26-50 🛕 > 50

Disease Forecasting Info Carrington, ND, June 22, July 8, 2008								
Early Flag Risk	6/ 21	6/ 20	6/ 19	6/ 18	6/ 17	6/ 16	6/ 15	6/ 14
Tan spot	Υ	Υ	Υ	Ν	Υ	Υ	Υ	Ν
Septoria	Ν	Ν	Υ	Ν	Ν	Ν	Ν	Ν
Flowering	7/	7/	7/	7/	7/	7/	7/	6/
risk	7	6	5	4	3	2	1	30
Tan spot	Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ
Septoria	Υ	Υ	Ν	Ν	Υ	Ν	Ν	N

Leaf spot disease risk was present at Early Flag leaf emergence and even higher risk at flowering stage



#### 2007 Early Season Application to Wheat: Minot

Data from Kent McKay, NCREC

**Extension Service** 



Winter wheat at Roseglen, across multiple varieties Spring wheat at Minot, across multiple varieties Fungicides applied only once, at 4-5 leaf stage.

## Yield of winter and spring wheat (average of all varieties) with and without fungicide, 2012





	Scab
2004 WestBred	3
2005 NDSU	3
2009 MN	4
2000 NDSU	4
2008 MN	4
2004 AgriPro	4
2007 NDSU	4
2008 Trigen	4
2007 WestBred	4
2006 Trigen	4
2007 Thunder Seed	4
2002 SDSU	5
2004 SDSU	5
2006 AgriPro	5
2003 MN	5
2007 MN	5
2006 WestBred	5
2006 SDSU	5
2007 WestBred	5
2006 MN	6
2006 NDSU	6
2001 AgriPro	6
2007 AgriPro	6
2004 NDSU	6
1982 MN	7
2007 WestBred	7
	2004 WestBred   2005 NDSU   2009 MN   2000 NDSU   2000 NDSU   2004 AgriPro   2007 NDSU   2008 MN   2007 NDSU   2007 NDSU   2008 Trigen   2007 WestBred   2006 Trigen   2007 Thunder Seed   2002 SDSU   2006 AgriPro   2007 MN   2006 AgriPro   2007 MN   2006 SDSU   2007 MN   2006 SDSU   2007 WestBred   2006 SDSU   2007 WestBred   2006 NDSU   2006 NDSU   2007 AgriPro   2006 NDSU   2007 AgriPro   2007 AgriPro   2007 AgriPro   2007 AgriPro   2007 AgriPr

## **Scab Ratings**





**Disease Severity** 

**Grain Damage** Vomitoxin



### Recommendation

- Apply fungicide based on predicted need
- Use genetic resistance as part of an integrated package to maximize total returns, even when planning to use fungicides





#### Wheat Ergot Percent Incidence

Season Final, 2013





### Wheat Stem Maggot



#### Adult fly

- 1/5 inch long
- Three black stripes on thorax
- Bright green eyes



#### Larva

- Maggot (headless and legles
- 1/16 inch long



## Wheat Stem Sawfly



## Lodging caused by Wheat Stem Sawfly



L	Variety	<b>Bacterial Leaf Streak</b>
	Blade	2
	Breaker	2
	Cromwell	3
	WB-Lyn	3
	Glenn	4
	Rollag	4
	Sabin	4
	Faller	4
	Oklee	4
	Prosper	4
	Knudson	4
	Ada	4
	SY-Soren	4
	Brick	5
	Barlow	5
	Tom	5
	Briggs	5
	Jenna	5
	Velva	5
	Marshall	5
	Samson	5
	RB07	6
	Select	6
	Albany	6
	Kelby	6
	Brogan	6
	Vantage	6
	Brennan	6
	WB-Digger	6
	Pivot	6
	Edge	6
	WB-Mayville	6

#### **Bacterial Leaf Streak**



- No control options, but there are differences among variety responses
- Good data in 2011, 1<sup>st</sup> complete set of ratings presented

#### Variety selection

- Selection based on the results of variety trials
- Variety trials are conducted in at least seven locations each year
- Most varieties are tested several years
- Recommendation
  - Select varieties that are high yielding and stable varieties based on many environments (years and locations)
  - Consider quality (protein the most important)
  - Consider disease resistance



	Agent						Reaction to Disease <sup>2</sup>				
Variety	or Origin <sup>1</sup>	Year Released	Beard	Height	Straw Strength	Maturity	Stem Rust	Leaf Rust	Foliar Disease	Root Rot	Head (Scab)
AC Superb	Can	2001	yes	sdwf	strg	m.early	R	S	S	Μ	S
AP 604 CL	AgriPro	2007	yes	sdwf	m.strg	m.early	R	MS	MS	NA	NA
Ada	MN	2006	yes	sdwf	strg	med	R	MR	MS	NA	MS
Alsen	ND	2000	yes	sdwf	strg	m.early	R	MR-MS	S	Μ	MR
Bakker Gold	N. Star G.	2006	yes	med	NA	late	S	NA	NA	NA	NA
Banton	Trigen	2004	yes	sdwf	strg	m.early	R	MR	MS	NA	S
Bigg Red	WestBred	2004	yes	sdwf	med	med	R-MR	S	MS	NA	MR
Blade	WestBred/Sabre	2007	yes	sdwf	m.strg	med	R	MR-MS	MS	NA	NA
Briggs	SD	2002	yes	sđwf	med	m.early	R-MR	R	MS	S	S
Choteau	MT	2004	yes	sdwf	NA	m.early	NA	NA	NA	NA	NA
Cromwell	Thunder Seed	2007	yes	sdwf	strg	m.late	NA	MR	MR	NA	NA
Dapps	ND	2003	yes	sdwf	med	m.early	R	R	Μ	Μ	MS
Faller	ND	2007	yes	sdwf	strg	med	R	R	MR	NA	MR
FBC Dylan	FBC	2006	yes	sdwf	med	med	NA	MR	S	NA	NA
Fireball	N. Star G.	2006	yes	sdwf	NA	med	NA	R	NA	NA	NA
Freyr	AgriPro	2004	yes	sdwf	strg	med	R	MR-MS	MS	NA	MR
Glenn	ND	2005	yes	sdwf	strg	m.early	R	R	Μ	NA	MR
Granger	SD	2004	yes	sdwf	m.strg.	m.early	R	R	MS	NA	MS
Granite	WestBred	2002	yes	sdwf	v.strg	m.late	R-MR	MR	S	NA	MS

Table 1. 2007 North Dakota hard red spring wheat variety description table, agronomic traits.

	2007 N.D.	Test	Protein	Vitreous	Falling	Farinograph	Farinograph	Farinograph	Loaf	Gluten	Mill & Bake
Variety	Planted	Weight	$(12\%~{\rm MB})$	Kernels	Number	Classification	Stability	Absorption	Volume	Strength	Quality Rating
	Acres (%)	(lb/bu)	(%)	(%)	(seconds)	(1-8)1	(minutes)	(%)	(cc)	Description	(1-5 Stars) <sup>2</sup>
Alsen	15.1	60.2	15.7	85	427	6.7	17.9	66.5	1055	Trad. Strong	****
Banton <sup>3</sup>	0.8	62.1	15.1	78	435	5.7	17.4	60.1	1010	Mellow	**
Briggs	9.2	60.0	15.1	77	466	5.3	14.7	65.8	980	Mellow	**
Dapps	1.4	58.8	16.7	85	465	6.7	17.6	65.9	1109	Trad. Strong	****
Faller	0	58.5	14.5	75	437	6.4	18.1	65.5	1043	Trad. Strong	***
Freyr	9.5	59.8	15.0	76	476	6.8	19.1	66.1	1001	Trad. Strong	***
Glenn⁴	20.9	62.5	15.7	88	410	7.3	22.8	66.5	1101	Trad. Strong	*****
Granger	2.2	60.1	15.0	80	460	5.9	14.6	66.8	1028	Mellow	***
Granite	1.9	61.1	16.4	82	369	6.5	15.4	65.7	1015	Trad. Strong	***
Howard	0.9	60.2	15.6	81	449	5.9	16.5	67.2	1040	Mellow	***
Knudson	4.4	59.7	14.6	70	466	7.2	28.5	65.6	960	Extra Strong	***
Parshall	1.1	60.6	15.5	91	425	6.2	16.7	66.3	1079	Trad. Strong	****
Polaris	0	58.5	14.6	64	432	5.8	15.4	60.1	1009	Mellow	**
Reeder	8.8	59.0	15.1	79	442	5.6	12.9	65.2	1005	Mellow	**
Steele-ND	9.1	60.3	15.7	79	457	6.1	16.7	68.1	1037	Trad. Strong	***
Trooper	0.6	60.4	14.5	73	456	6.5	23.1	65.2	919	Trad. Strong	**
Ulen	0	60.4	15.2	72	446	6.2	15.7	64.6	1027	Trad. Strong	***

Table 3. 2005 and 2006 analytical milling and baking data from field plot variety trials at Carrington, Casselton, Dickinson, Hettinger, Langdon, Minot and Williston. Analyses conducted at the NDSU Hard Red Spring Wheat Quality Laboratory in Fargo, N.D.

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	Pro	sner	Carri	Carrington Langdon			Average eastern N.D.		
Variety	2007	3 Yr.	2007	3 Yr.	2007	3 Yr.	2007	3 Yr.	
					(bu/A)-				
AC Superb	30.2		40.3	35.5	51.0	50.1	40.5		
AP 604 CL	45.9		51.0		58.6		51.8		
Ada	48.1		53.3	48.0	71.2	62.9	57.5		
Alsen	47.7	55.1	48.2	46.1	59.1	59.3	51.7	53.5	
Bakker Gold			41.4	43.1	66.8	63.3			
Banton			56.2	57.9					
Bigg Red			48.8	50.6	58.6	57.5			
Blade	52.0								
Briggs	49.2	59.1	59.7	52.9	64.6	61.2	57.8	57.7	
Cromwell	46.8		52.0		73.1		57.3		
Dapps	47.6	53.4	54.4	45.0	66.9	63.1	56.3	53.8	
Faller	46.3		61.4	54.7	75.6	74.7	61.1		
FBC Dylan	40.8		49.0	47.2	59.8		49.9		
Fireball			50.1	44.9	63.6	58.7			
Freyr	48.2	59.2	54.7	49.5	72.3	61.8	58.4	56.8	
Glenn	45.1	56.6	56.8	53.4	76.2	63.6	59.4	57.9	
Granger	48.3	59.6	55.4	53.4	68.6	61.4	57.4	58.1	
Granite	47.4	54.6	54.3	47.5	62.9	60.3	54.9	54.1	
Gunner	35.6	42.5	40.7	38.7	49.6	49.6	42.0	43.6	

Table 5. Yield of hard red spring wheat varieties grown at three locations in eastern North Dakota, 2005-2007.

# Comparative protein content of HRSW varieties, ave of 8 ND locations, 2009



Variety	\$5 Wheat \$1 Protein	\$4 Wheat \$.50 Protein	\$5 Wheat \$.50 Protein
Glenn	381	312	347-
Briggs	406*	335	357
Steele-ND	383	309	372*
Howard	346	273	368
Kelby	435*	365	355
Faller	329-	252	382*
RB07	333	265	344-
Traverse	298-	224	368
Samson	350	278	361
Vantage	403	331	360
Barlow	371	298	364
Brennan	407*	334	363
Brick	330-	260	351-
Brogan	357	286	353
Jenna	384	309	373*
Mott	344	274	351-
Sabin	349	277	360

## **Other topics?**

#### Best rotations

- Wheat following soybean, preferred over wheat following corn
- Weed control
  - Wide range of herbicides, most applied at 4 to 5 leaf stage

#### Harvesting spring wheat

- Max storage moisture 14% for less than 9 months, 13% for more than 9 months
- Natural air drying is commonly practiced

## **Managing Barley for Malt**

Barley is used for malt, feed and food

Barley for malt is the generally the desired market

Locally produced barley for more local malt houses/breweries is trending

#### Trends in barley production in ND

---- Area ---- Yield ----- Linear (Yield)



## "Making" malt

- Good germination
  - >95%
- Moderate level of protein
  - 11.0-13.0%
- Low screenings of foreign material
- Proper moisture content
  - Less than 13%
- Uniformly plump kernels
- No broken kernels
- Bright color, no blight
- No mold or off odors
- Minimum DON levels
- Minimum skinned kernels
- Two row vs six row types



## Main challenges in ND

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



# Management recommendations for producing barley for malt

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



AMBA Maintains a list of approved malting barley varieties

#### 2016 Recommended Malting Barley Varieties

#### Two-Rows

	AAC Synergy	(2015)			
	ABI Voyager	(2014)			
	AC Metcalfe	(2005)			
	CDC Copeland	(2007)			
	CDC Meredith	(2013)	City Day		
	Charles*	(2009)	SIX-ROW	s	
	Conlon	(2000)	<b>/</b> //		1
	Conrad	(2007)	Celebration	(2011)	1002
à.	Endeavor*	(2015)	Innovation	(2014)	1
•	Expedition	(2013)	Lacey	(2000)	1
6	Harrington	(1989)	Legacy	(2001)	3
	Hockett	(2010)	Quest	(2011)	
	Merit	(2000)	Stellar-ND	(2006)	6
	Merit 57	(2010)	Thoroughbred*	(2015)	
	Moravian 37	(2010)	Tradition	(2004)	
	Moravian 69	(2010)	Madata and Succession		
	ND Genesis	(2016)	variety name & year first reco	mmended	
	Pinnacle	(2011)			
	Scarlett	(2008)			
	Wintmalt*	(2013)			

#### \*Winter

These malting varieties listed in alphabetical order are recommended by AMBA for planting in 2016. When delivered to market in pure carlots of sound, bright, plump, low moisture barley in an acceptable protein range, they may command premium prices over feed barley. Growers are encouraged to contact their local elevator, grain handler or processor to gauge market demand for any variety grown in their region prior to seeding. 2015 crop plantings by variety are included at the end of this publication.

Since in most cases, malt barley production would be through an identify preserved system, varieties may be restricted and certified seed required.

- If you have flexibility in variety grown consider
  - Protein content
  - Standability
  - Disease resistance (not much difference in FHB resistance, though two row types may accumulate less DON)

# Trends in barley variety use, ND (no data collected since 2013)



#### Yield of malting barley varieties in eastern ND, 2015 & 3-yr average

■ 2015 ■ 3 yr ave



#### Protein of malting barley varieties in western ND, 2015



#### Affect of Planting Date on Barley Yields over 3 Years at Minot



■ 13-Mar ■ 16-Apr ■ 15-May ■ 5-Jun

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



■ 1-May ■ 14-May ■ 29-May ■ 9-Jun

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



■ 1-May ■ 14-May ■ 29-May ■ 9-Jun

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



■ 1-May ■ 14-May ■ 29-May ■ 9-Jun



Seeding rate

#### Affect of Seeding Rate on Robust Barley Yield, Langdon



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

**500 750 1000 1500 1750 1751** 





#### Affect of Seeding Rate on Lodging, Robust **Barley, Langdon**



Seeds per acre-Millions

# Disease management (FHB of primary concern)

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



## **DON or Vomitoxin**

- Caused by Fusarium Infection
- Reasons for DON formation are not well understood
- Can have DON w/out scabby kernels
- Barley is susceptible to infection as the heads emerge
- Head Infection easier in warmer conditions

 Due to tillering, barley heading is not uniform and may increase susceptibility

## **DON or Vomitoxin**

- Heading variability makes fungicide application timing and coverage extremely difficult.
- Fungicides have not been consistently effective in reducing DON
- Barley variety resistance is a long way in the future.
- Conlon 2 row often has about 1/3 the DON of 6 row barley.
- 6 row barleys are not much different from one another in fusarium tolerance.



#### Effect of application timing of Folicur on FHB field severity, Robust barley. Field Severity (Incident x head severity) 3.5 3 2.5 2 1.5 0.5 50% Full Watery Untreated ripe Heading Heading

## Managing Protein

- Plant early
- Fertilize early (no splits)
- Variety choice (i.e. Tradition, Drummond < than Robust)</li>
- 1.5 lbs N per bu yield goal
  - Accurately predicting yield goal in dryer regions critical





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



## Conclusions

- Making malt requires good management and cooperative weather
- Some newer varieties offer yield, standability and protein improvements over older types.
- Growing interest in two row barly
- Plant early for yield and lower protein
- Seed ~1.25 million
- Stagger plantings, fungicide at heading reduce risks of FHB and DON
- < 1.5 lbs N per bu yield goal</li>

