Malting Barley in North America

Scott E. Heisel

American Malting Barley Association, Inc.

Good Beer Requires Quality Barley

"…barley is to beer as grapes are to wine. You cannot make a good wine out of bad grapes and you can't make a good beer out of bad barley. You can make a terrible beer out of good barley, that's easy to do. But at least start right."
– Bill Coors


Champlain's Garden - 1610
Newfoundland -1617
Martha's Vineyard - 1602
Jamestown -1611
Spanish Introduction - 1494
1701
CANADA
UNITED STATES
MEXICO
ROCKY MOUNTAINS
APPALACHIAN MOUNTAINS
Hudson Bay
Baffin Bay
Labrador Sea
Gulf of Mexico
Atlantic Ocean
Caribbean Sea
Greenland (DENMARK)
Reykjavík
QUEEN ELIZABETH ISLANDS
Barrow
Prudhoe Bay
Beaufort Sea
Tasiilaq (Ammassalik)
Denmark Strait
Kangerlussuaq (Søndre Strømfjord)
Nuuk (Godthåb)
Narsarsuaq
Paamiut (Frederikshåb)
Davis Strait
Kaujuitoq (Resolute)
Banks Island
Victoria Island
Baffin Island
Inuvik
Cambridge Bay
Dawson
Repulse Bay
Iqaluit (Frobisher Bay)
Echo Bay
Whitehorse
Watson Lake
Yellowknife
Kangiqcliniq (Rankin Inlet)
Ivujivik
Hay River
Happy Valley-Goose Bay
Schefferville
Churchill
Prince Rupert
Prince George
Chisasibi (Fort George)
Edmonton
Moosonee
Victoria
Vancouver
Calgary
Saskatoon
Regina
Winnipeg
Thunder Bay
Québec
Fredericton
Halifax
Saint John
Montréal
Ottawa
Seattle
Portland
Toronto
Hamilton
Boston
Minneapolis
Milwaukee
Detroit
Windsor
Chicago
Cleveland
Pittsburgh
Columbus
Indianapolis
St. Louis
Norfolk
Bermuda (U.K.)
Salt Lake City
Denver
Kansas City
Las Vegas
Oklahoma City
Memphis
Atlanta
Charleston
Albuquerque
Phoenix
San Diego
Tijuana
Mexicali
Dallas
Jacksonville
El Paso
New Orleans
San Antonio
Houston
THE BAHAMAS
Nassau
Miami
Monterrey
Torreón
Matamoros
Havana
La Paz
Mazatlán
Tampico
Cancún
Mérida
JAMAICA
Guadalajara
León
Mexico
Veracruz
Puebla
BELIZE
Belmopan
Oaxaca
Acapulco
HONDURAS
Tegucigalpa
Guatemala
GUATEMALA
NICARAGUA
Managua
San Salvador
ISLAS REVILLAGIGEDO (MEXICO)

Land Races

Mixtures of many lines
Change when grown in new area

First pure varieties were from selections out of land races
Chevalier – 1824 selection

"hybrid" barley originating in the late 1800's

August 10, 1788

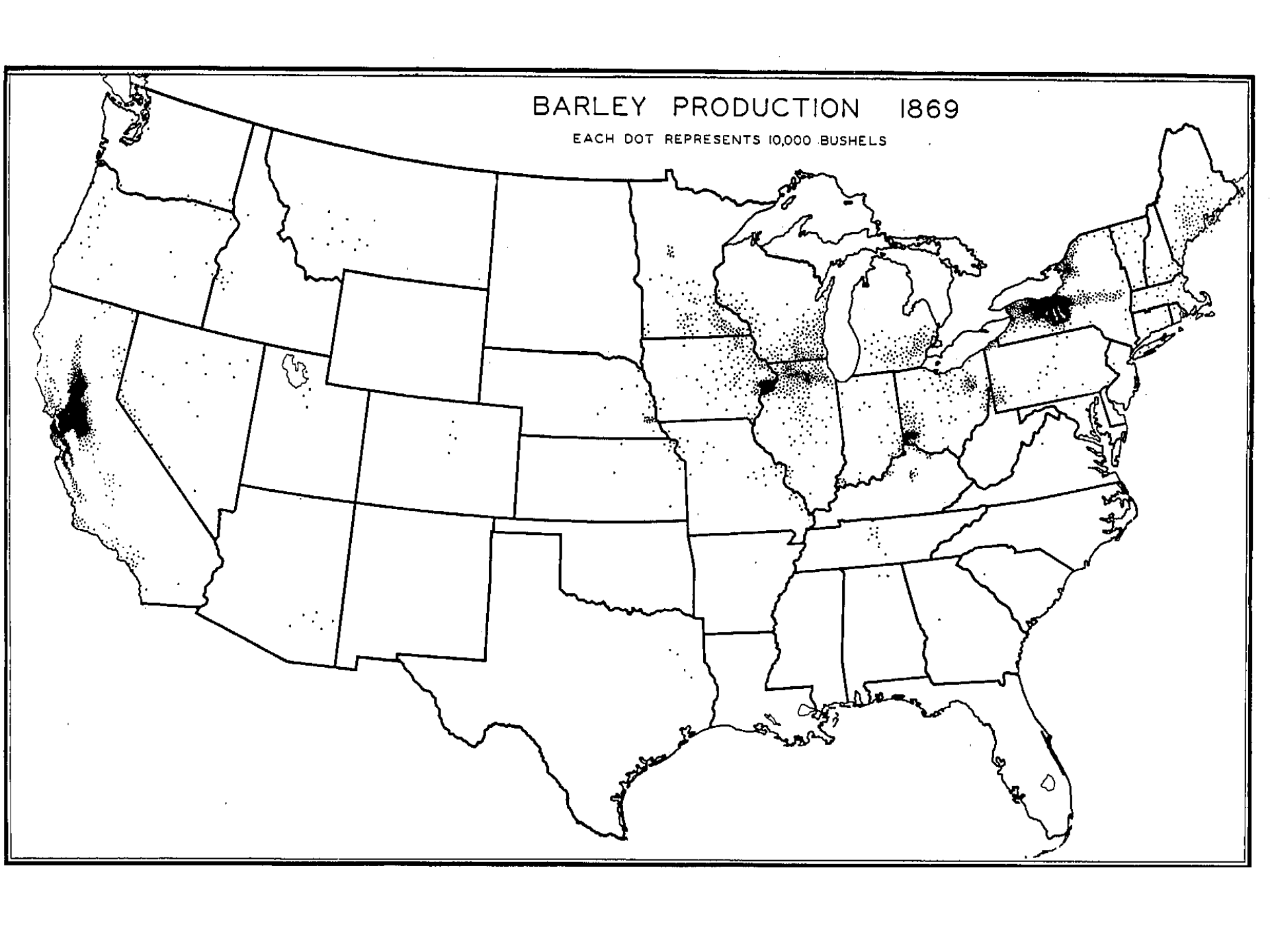
"Should this letter get to your hands in time for the Sailing of Captn. Ellwood, and you can readily procure 25 bushls. of the *best* kind of *Winter* Barley I beg you to send it by him that I may try the success of it. The continual rains destroyed my Crop of spring Barley this year, but, if it had been otherwise, the Barley which you sent me the year before was so mixed with Oats (a circumstances I did not know till this Summer, as it was harvested while I was in Philadelphia) that it would no longer do to sow it. Could I be supplied with a quantity of that (spring Barley) which is really good from your City? Could I get it upon better terms from Rhode Island? and at what price (delivered here) might it be received from either place?"

September 16, 1788

…… "If you have not already purchased the Winter Barley I would not wish you to do it, for I think it is very probable that I may be able to get the quantity which I shall want of the Brewer in Alexandria in exchange for Spring Barley, or if I should be disappointed there, that I can obtain it upon better terms and perhaps of a better quality upon James River than at Philadelphia, as you observe that the crops of it have generally failed, and none has yet been seen that is fit for seed."

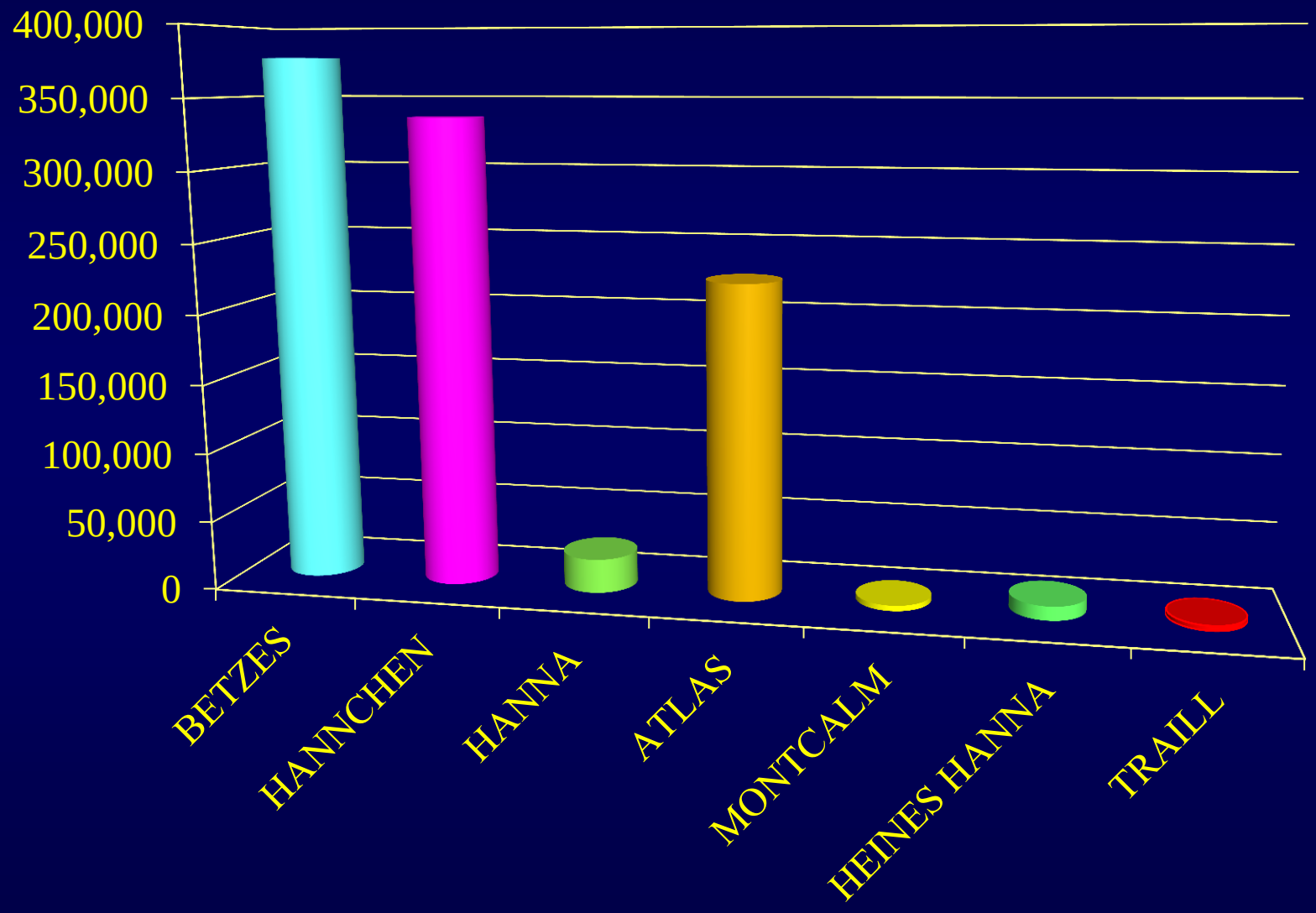
Transportation

- Barley produced locally
- Barge transportation
- Railroads opened new production areas


BARLEY PRODUCTION 1869
EACH DOT REPRESENTS 10,000 BUSHELS

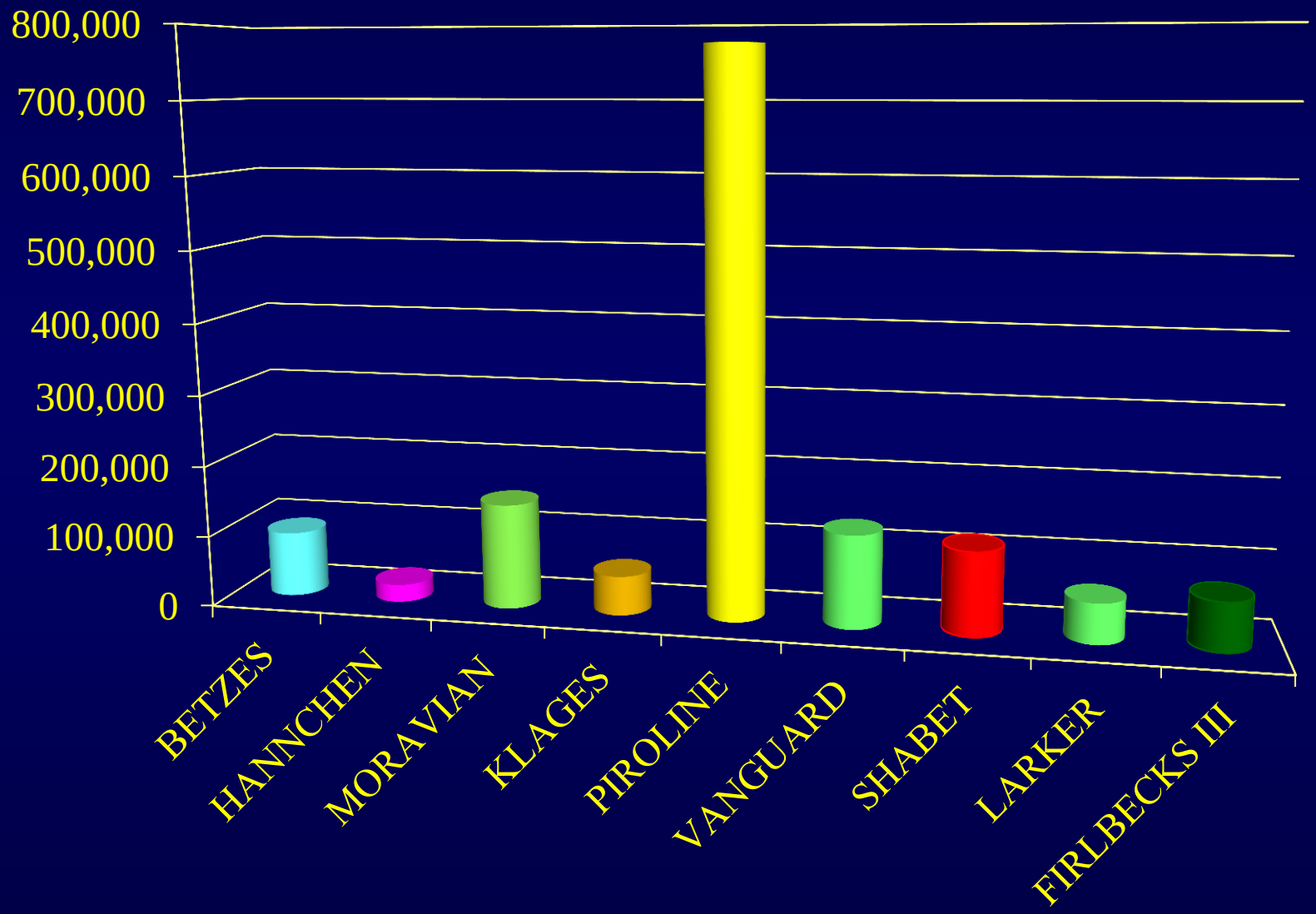
1959 WESTERN MALTING BARLEY VARIETIES

(California, Colorado, Idaho, Montana, Washington & Wyoming)



1974 WESTERN MALTING BARLEY VARIETIES

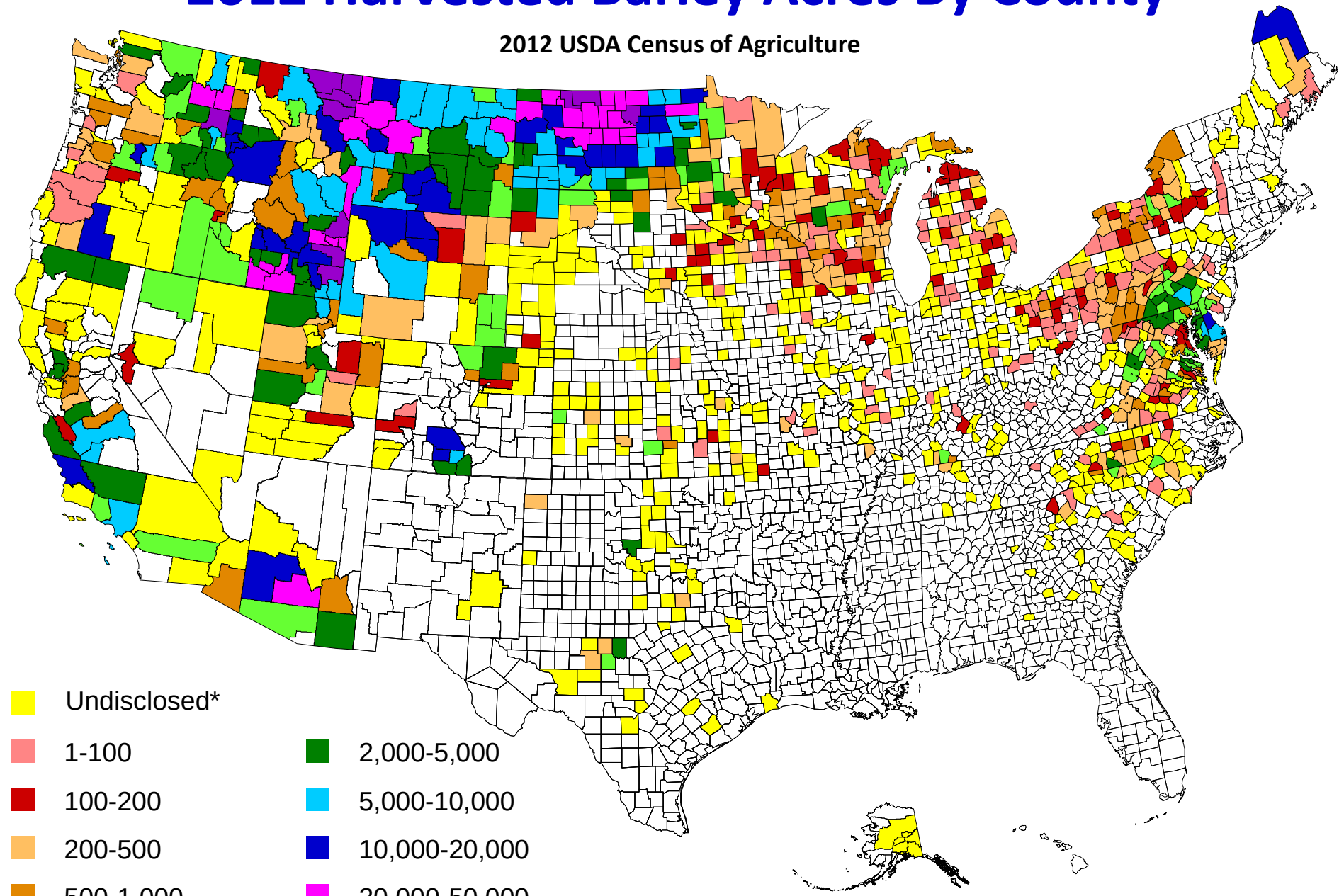
(California, Colorado, Idaho, Montana, Washington & Wyoming)



	US **2012 Census**	Canada **2011 Census**
Acres Planted	3,283,905	6,888,693
% Irrigated	25.9%	NA
# of Farms	18,667	29,943
Acres/Farm	176	230

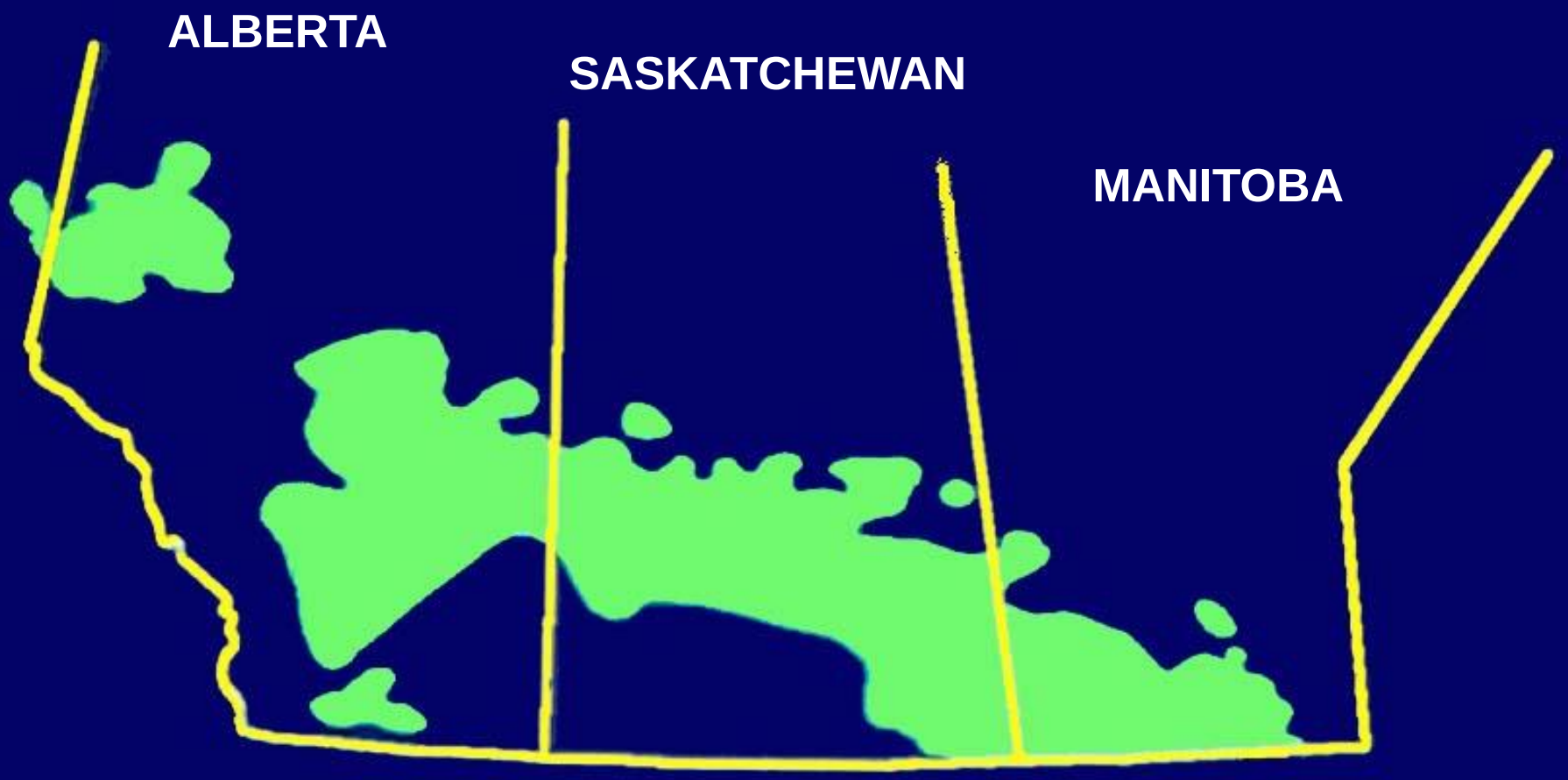
2012 Harvested Barley Acres By County

2012 USDA Census of Agriculture

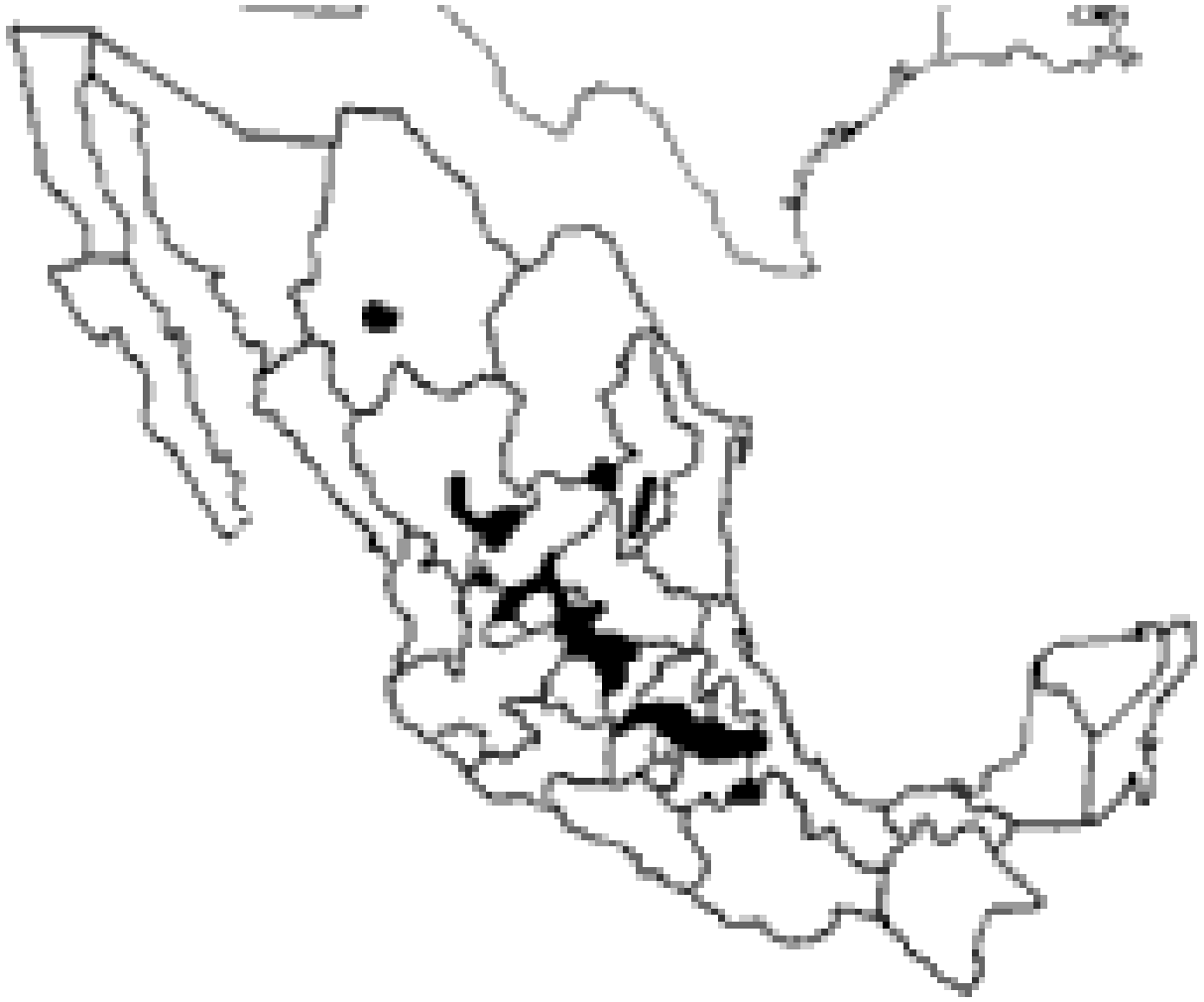


*Data not disclosed to avoid identifying an individual operation.
Typically means only a single barley farm in the county.

CANADIAN BARLEY GROWING AREA



MEXICAN BARLEY GROWING AREAS



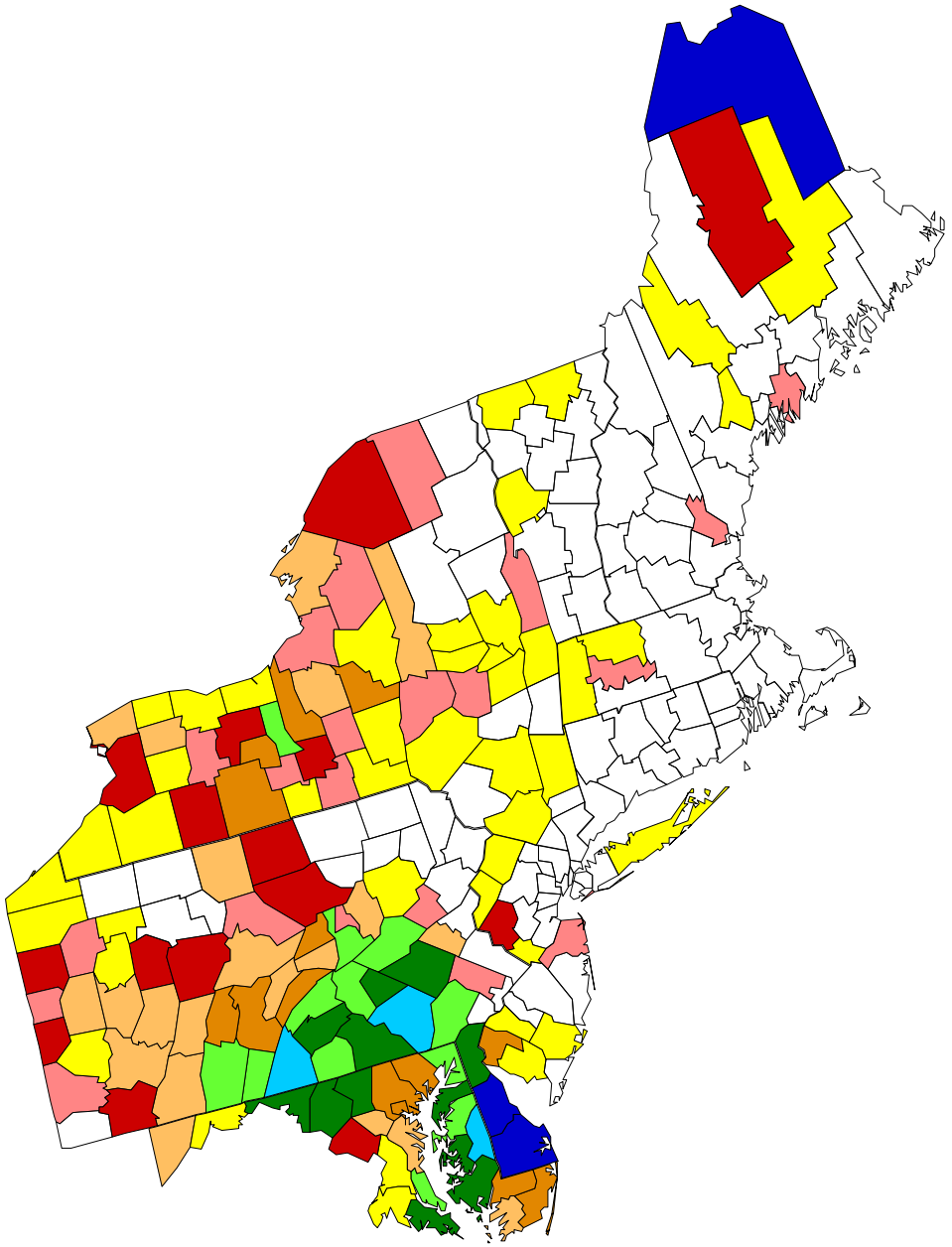
Source: A Comparison of North American Two-Row and Six-Row Malting Barley, Schwarz & Horsley

2012 Harvested Barley Acres By County

Northeast US

2012 USDA Census of Agriculture

- Undisclosed*
- 1-100
- 100-200
- 200-500
- 500-1,000
- 1,000-2,000
- 2,000-5,000
- 5,000-10,000
- 10,000-20,000
- 20,000-50,000
- > 50,000



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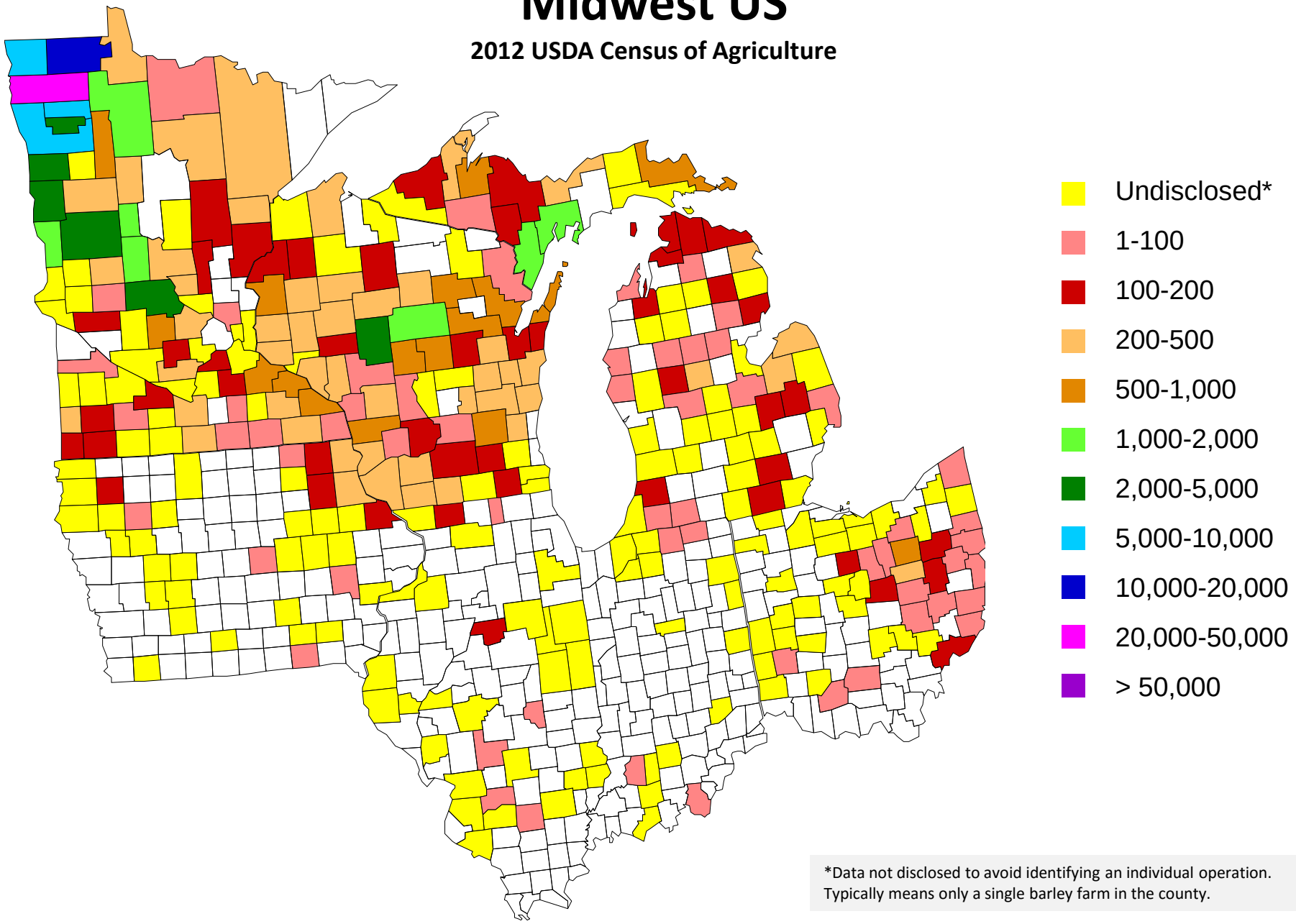
Typically means only a single barley farm in the county.

2012 Harvested Barley Acres By County

Midwest US

2012 USDA Census of Agriculture



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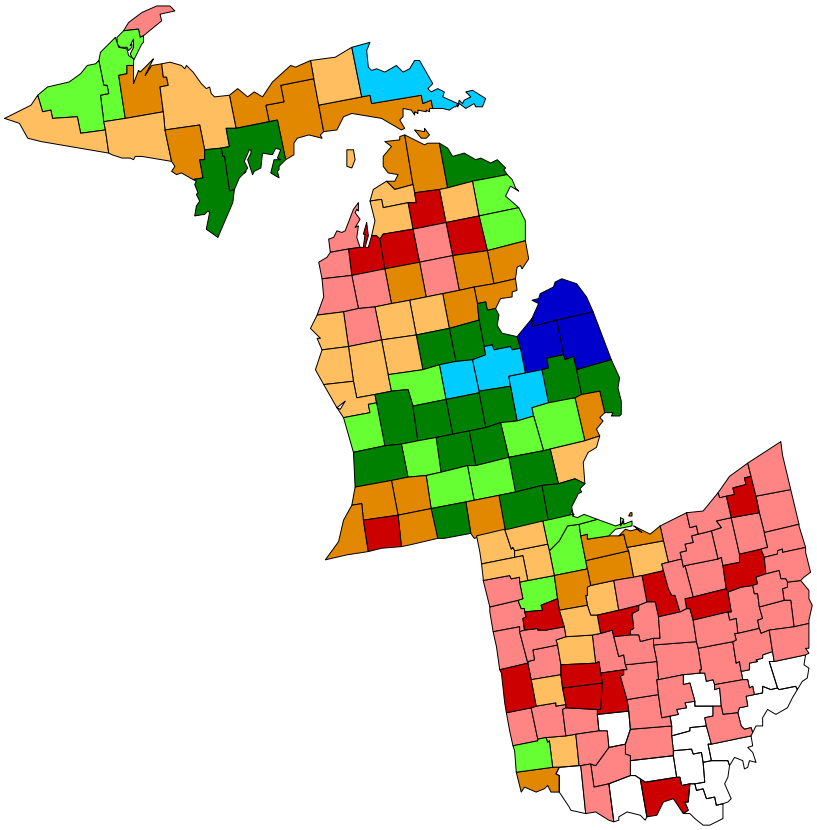
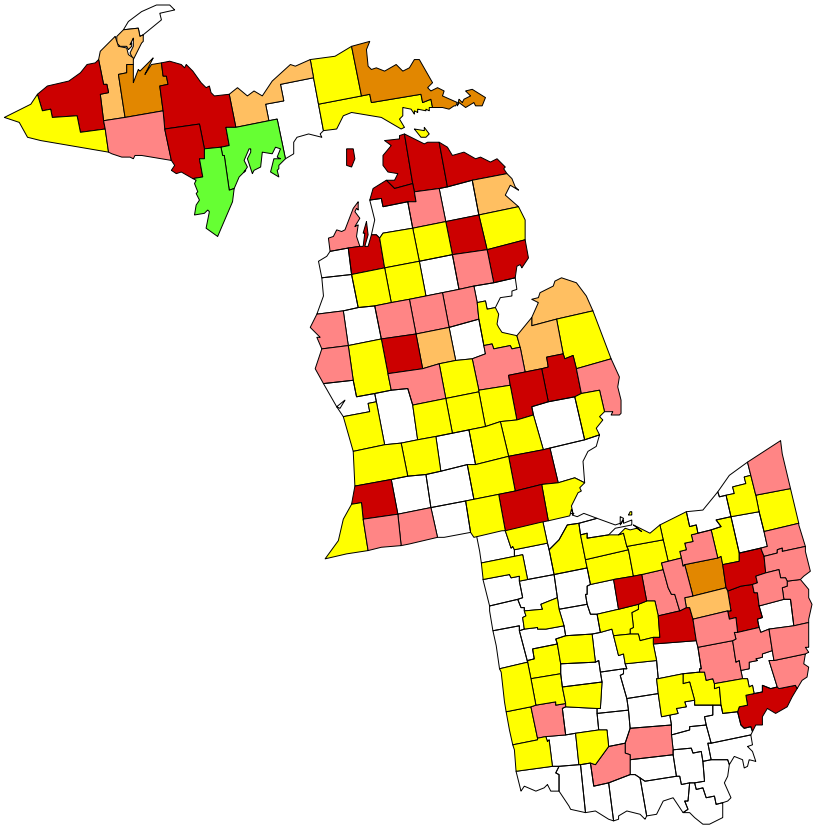
Harvested Barley Acres By County

USDA Census of Agriculture

1934



2012



- Undisclosed*
- 1-100
- 100-200
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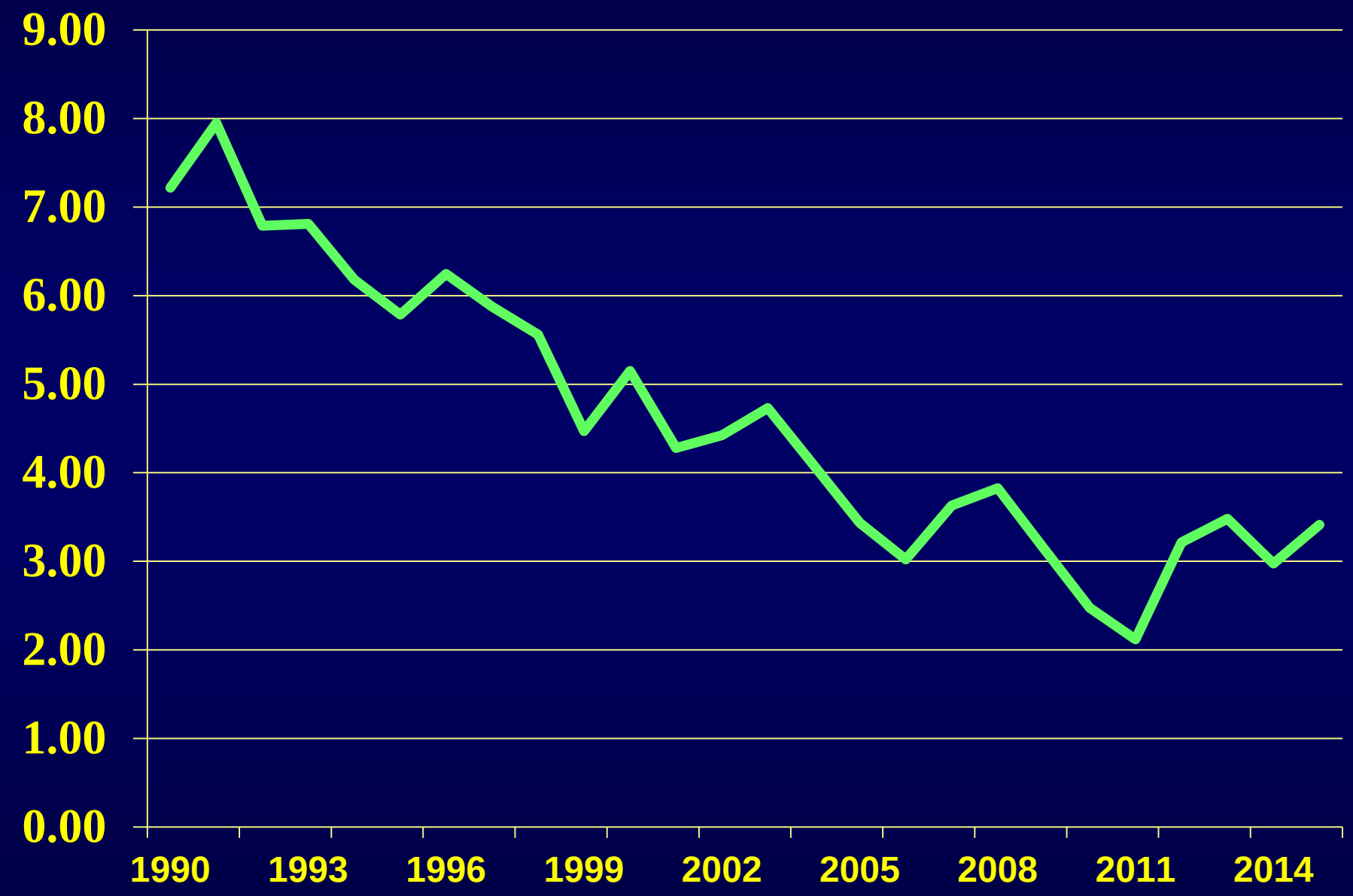
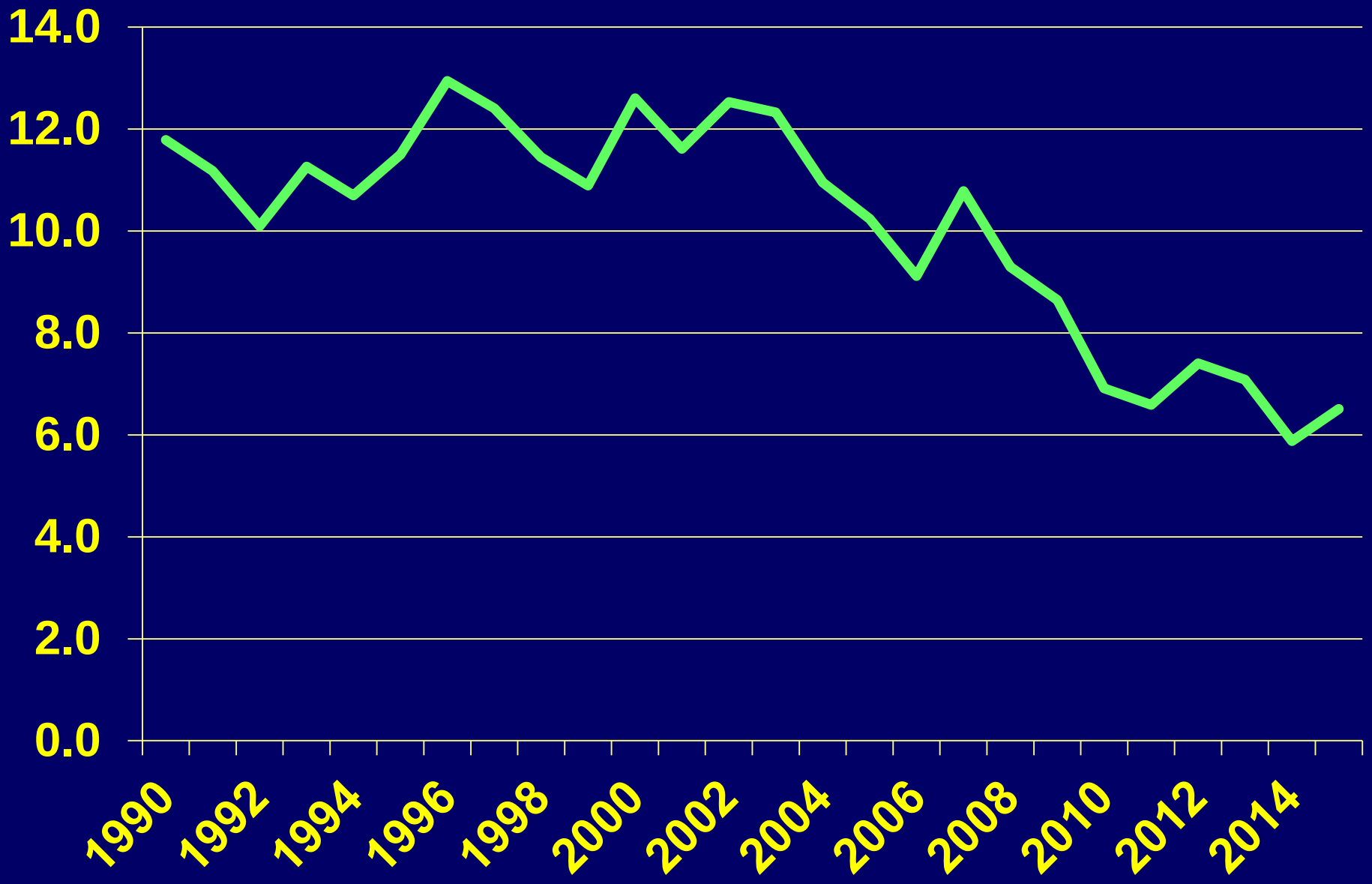
- 2,000-5,000
- 5,000-10,000
- 10,000-20,000

US Barley Acreage



Canadian Barley Acreage



Why Has Barley Acreage Declined?

Static domestic malt use, limited barley & malt exports

Decline in use for feed = primary secondary use

Competition from abundant supplies of corn and dried distillers grain (DDGs)

Static & limited food use – although has FDA Healthy Heart Claim

USDA Barley Health Benefits Project – AMBA/NBIC lobbying

High risk crop – many chances for failure in making malting grade

Good return as malting, low or no return as feed

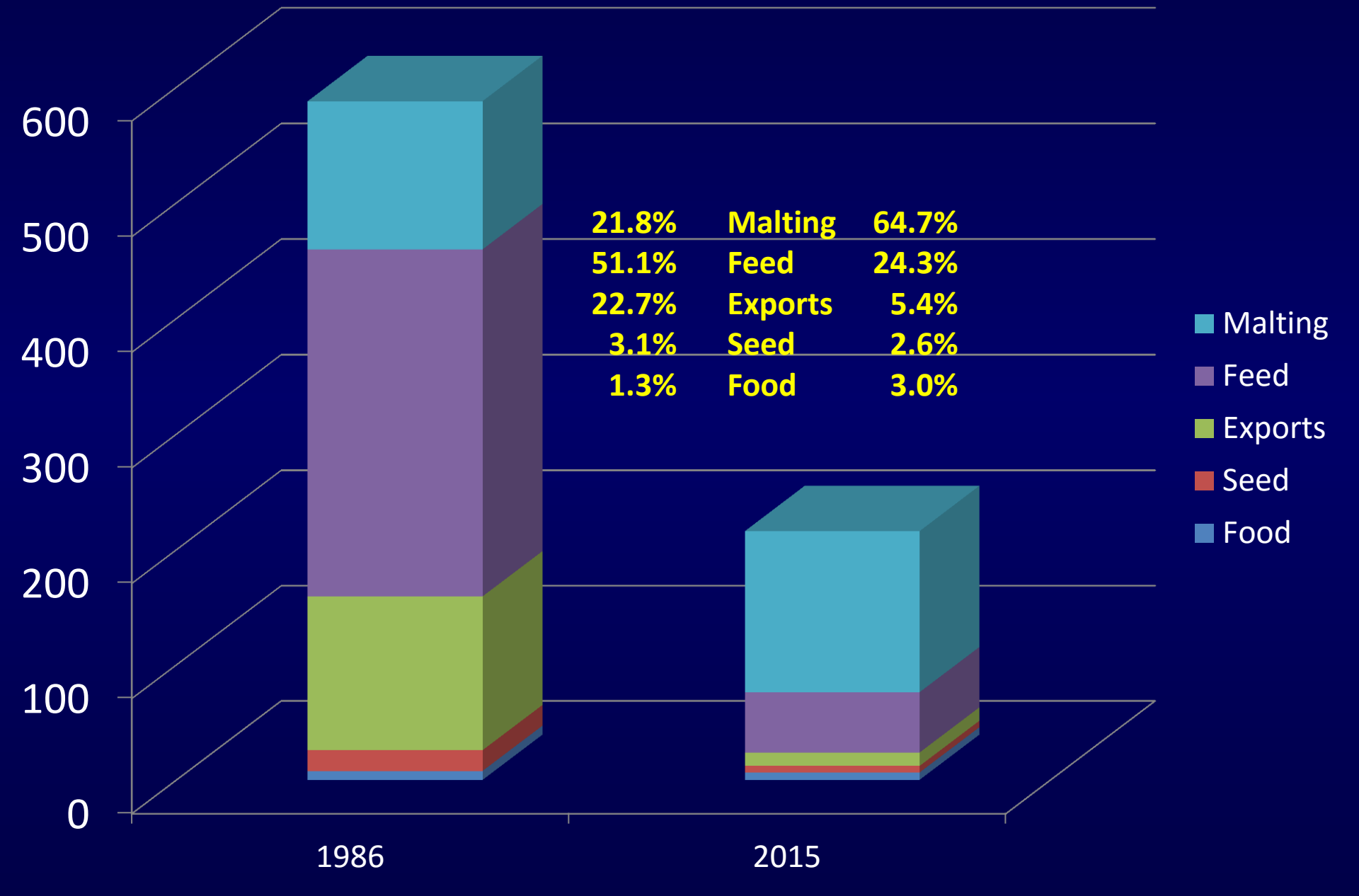
Risks: - Fusarium head blight (scab), other diseases, drought & heat stress, quality requirements

Competition with other crops – <u>GROWERS HAVE OTHER OPTIONS</u>

Corn, soybeans, canola = large and growing markets

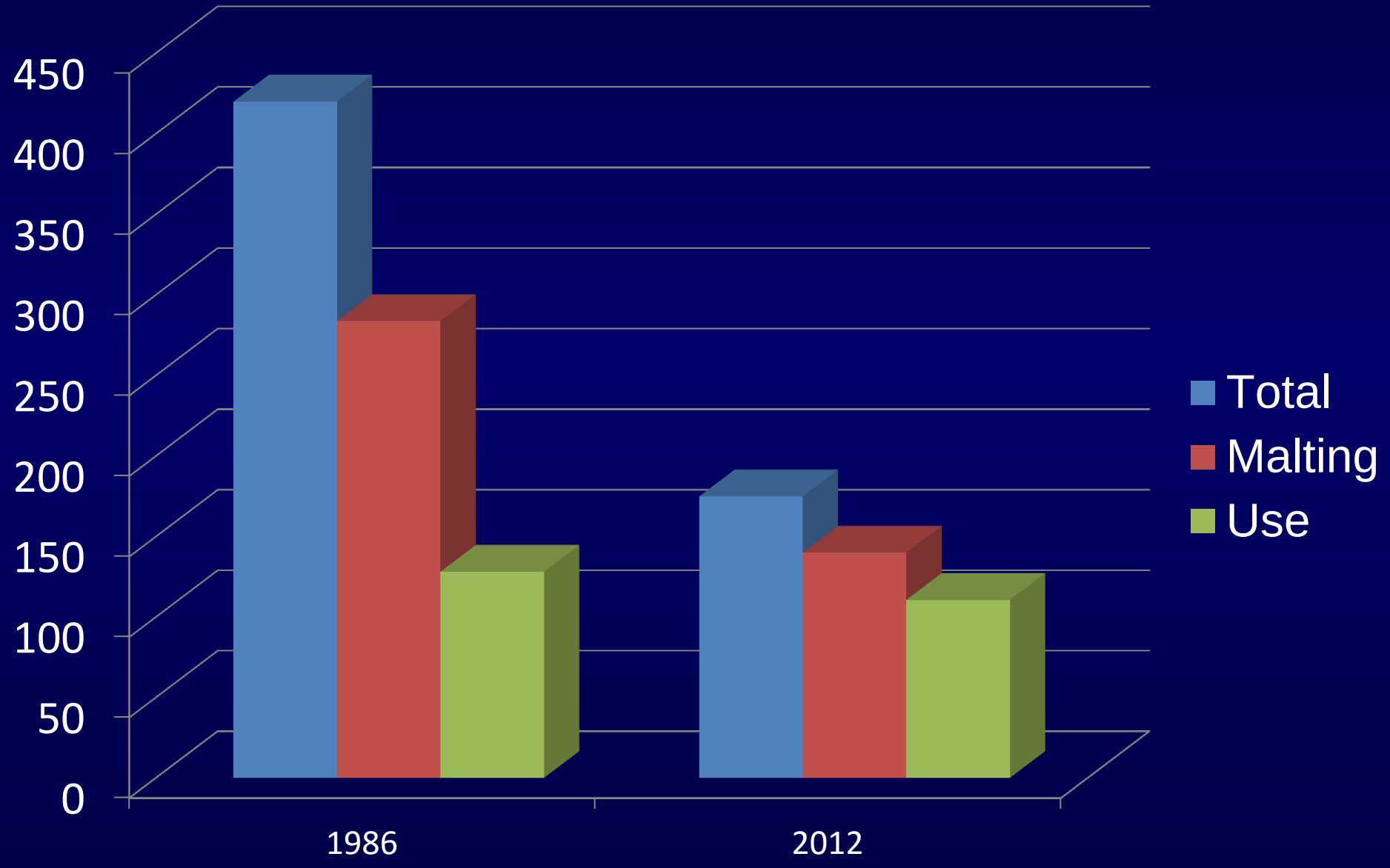
Substantial investment by biotech seed companies, including GM variety development, in these crops and now wheat

US Barley Use



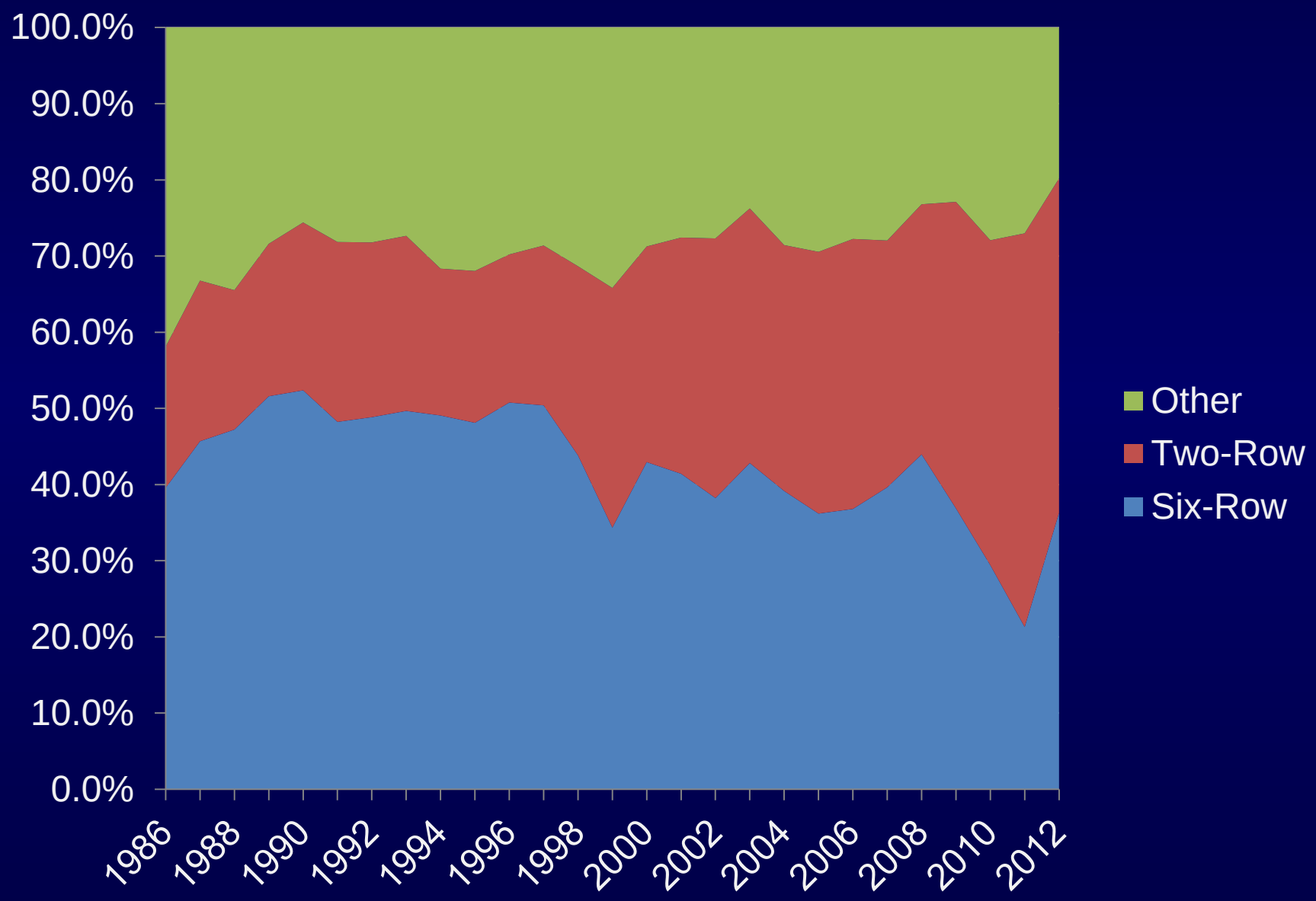
US Barley Production & Malt Use

CO, ID, MN, MT, ND, WY



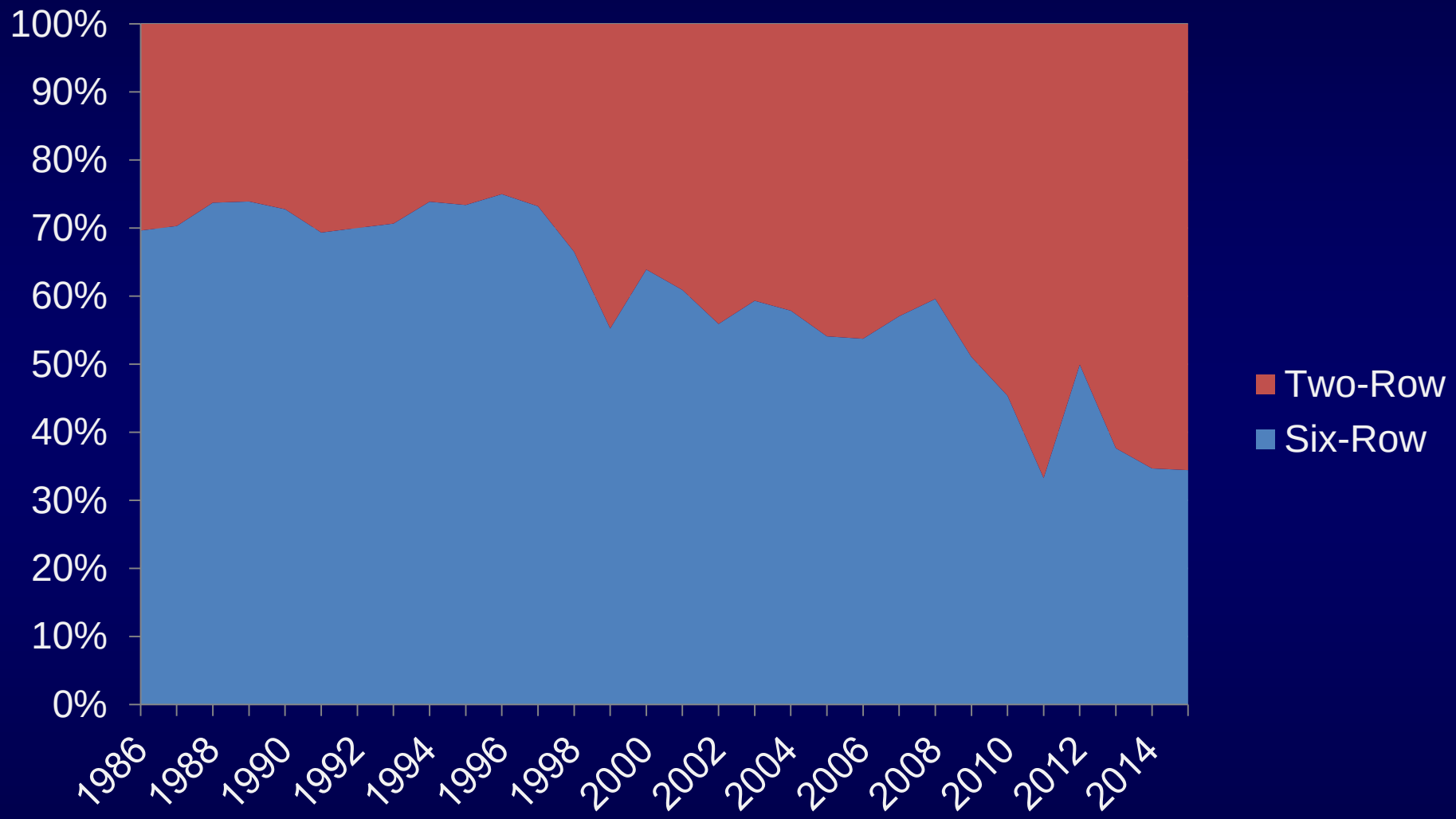
US Barley Variety Types

Malting as a % of Total



US Barley Variety Types

Head Type as a % of Total Malt



Note: 1986-2012 based on USDA Variety Surveys and 2013-2015 based on Industry contracting survey.

Barley Development

Quality Barley

“The breeder’s avenue to quality is to produce barleys well adapted to the region – barleys that will mature well and will not lodge.”

“Scab is a serious disease in the Mississippi Valley. It is particularly bad on cornlands and heavy, poorly drained soils. It becomes more and more serous as barley growing is pushed southward into the hotter parts of the Corn Belt. In northern and western sections of the valley it decreases much as does the cultivation of corn itself. Its presence is ruinous to malting quality. It also makes the grain unsuited for feeding to hogs or horses, but it can be used for cattle and poultry.”

1936 USDA Yearbook of Agriculture

Table 2. Minimum, optimum, and maximum growth temperatures for the cereal crops.

Crop	Growth Temperature		
	Minimum	Optimum	Maximum
	..... (F)		
Wheat	37-39	75-77	86-90
Barley	37-39	68-70	82-86
Rye	37-39	65-70	82-86
Triticale	37-39	68-70	82-86
Oat	37-39	68-70	82-86
Corn	48-50	84-88	105-110
Sorghum	55-60	86-90	105-110
Millet	55-60	86-90	105-110

US Malting Barley Variety Development Programs

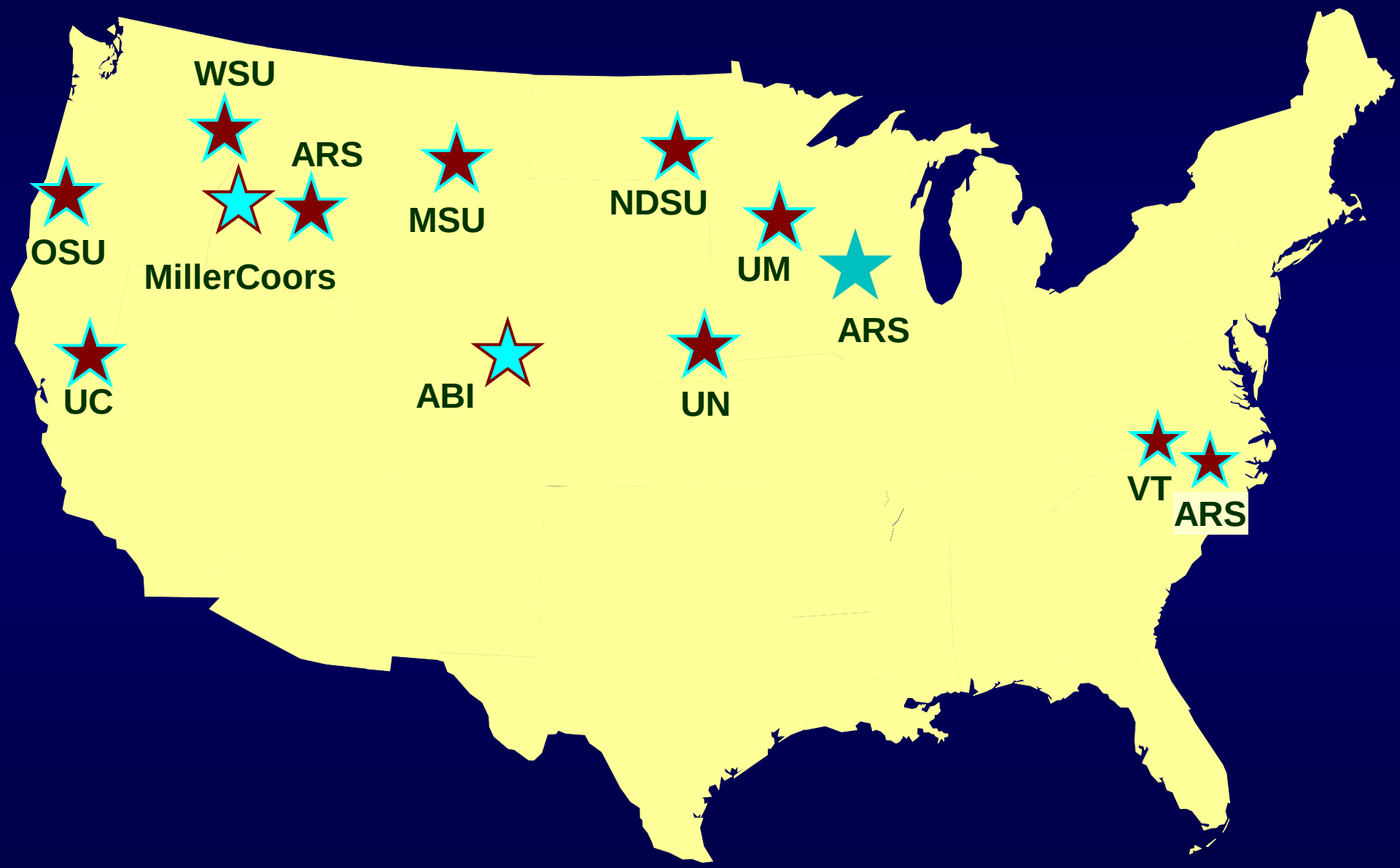
(*breeding, genetics, supporting and other research*)

Montana State University
North Dakota State University
Oregon State University
University of California – Davis
University of Minnesota
University of Nebraska
USDA-ARS, Aberdeen, ID
USDA-ARS, Raleigh, NC
Utah State University
Virginia Polytech & State University
Washington State University

AB-InBev
Malteurop
MillerCoors
Limagrain

AMBA member
Funded by AMBA

US Breeding Programs



Canadian Malting Barley Variety Development Programs

Primary
AAFC, Brandon, MB
University of Saskatchewan
Alberta Agriculture and Rural Development

Secondary
Sapporo Breweries Ltd.
Syngenta

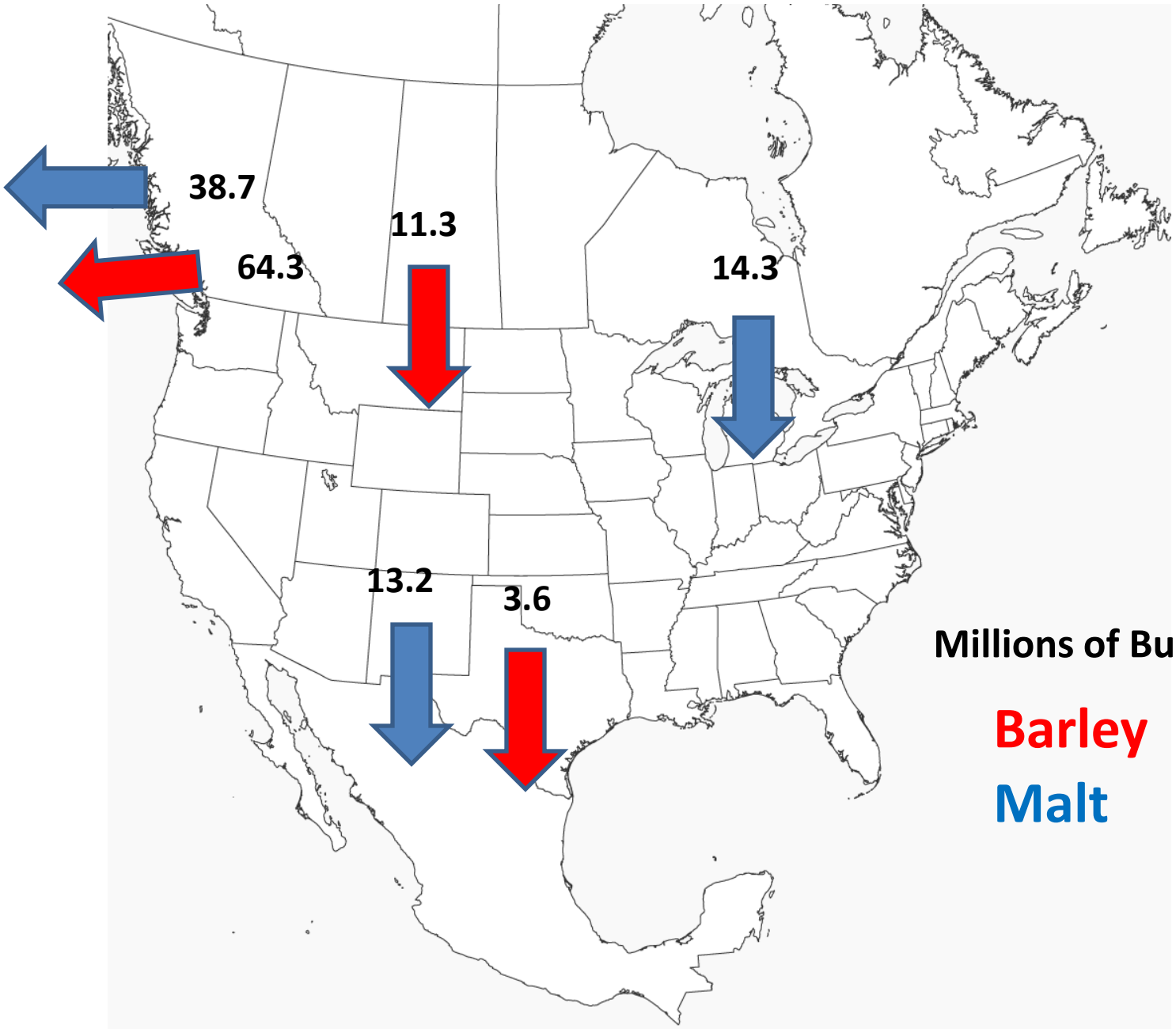
US Varieties are entered into Canadian testing system for potential registration and production

Brewing & Malting Barley Research Institute (BMBRI) – AMBA's Canadian Counterpart

Crop Disappearance

	US	Canada
Exports	**5.4%**	**15.8%**
FSI	**70.3%**	**13.8%**
Feed	**24.3%**	**70.3%**

Movement of Barley and Malt in North America



MALTING BARLEY BREEDING GUIDELINES
IDEAL COMMERCIAL MALT CRITERIA

	Six-Row	Adjunct Two-Row	All Malt Two-Row	Distillers'
AMBA Member Interest*	20%	55%	25%	
Barley Factors				
Plump Kernels (on 6/64)	> 80%	> 90%	> 90%	> 70%
Thin Kernels (thru 5/64)	< 3%	< 3%	< 3%	< 5%
Germination (4ml 72 hr. GE)	> 98%	> 98%	> 98%	> 98%
Protein	≤ 13.0%	≤ 13.0%	≤ 12.0%	11.5 -14.0%
Skinned & Broken Kernels	< 5%	< 5%	< 5%	< 5%
Malt Factors				
Total Protein	≤ 12.8%	≤ 12.8%	≤ 11.8%	11.0 - 13.5%
on 7/64 screen	> 60%	> 70%	> 75%	>50%

* Based on a survey of AMBA's regular members.

General Comments

Barley should mature rapidly, break dormancy quickly without pregermination and germinate uniformly.
The hull should be thin, bright and adhere tightly during harvesting, cleaning and malting.
Malted barley should exhibit a well-balanced, modification in a conventional malting schedule with four day germination.
Malted barley must provide desired beer flavor.
Distillers' Malt guidelines are designed to reflect how good varieties will performed when malted in the normal Brewers' cycles used for AMBA and CCRU variety trials.

December, 2015

MALTING BARLEY BREEDING GUIDELINES
IDEAL COMMERCIAL MALT CRITERIA

	Six-Row	Adjunct Two-Row	All Malt Two-Row	Distillers'
AMBA Member Interest*	20%	55%	25%	
Measures of Malt Modification				
Beta-Glucan (ppm)	< 120	< 100	< 100	
F/C Difference	< 1.2	< 1.2	< 1.2	
Soluble/Total Protein	42-47%	40-47%	38-45%	>48%
Turbidity (NTU)	< 10	< 10	< 10	
Viscosity (absolute cp)	< 1.50	< 1.50	< 1.50	
Congress Wort				
Soluble Protein	5.2-5.7%	4.8-5.6%	< 5.3%	>6.0%
Extract (FG db)	> 79.0%	> 81.0%	> 81.0%	> 79.0%
Color (°ASBC)	1.8-2.5	1.6-2.5	1.6-2.8	<4.0
FAN	> 210	> 210	140-190	>250
Malt Enzymes				
Diastatic Power (°ASBC)	> 150	> 120	110-150	>200
Alpha Amylase (DU)	> 50	> 50	40-70	>75

* Based on a survey of AMBA's regular members.

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December, 2015

2016 AMBA Recommended Malting Barley Varieties

Two-Rows

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

*Winter

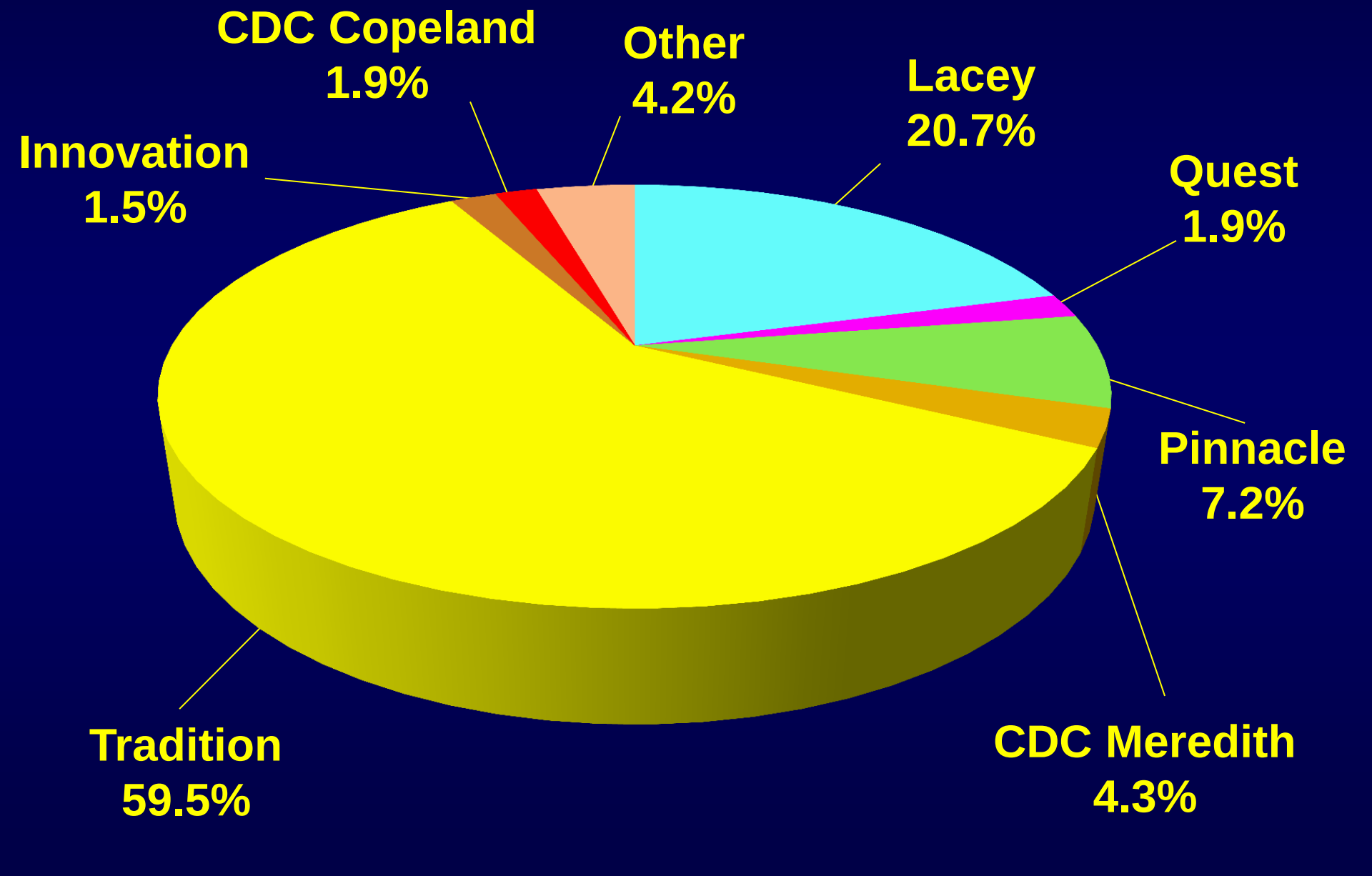
Six-Rows

Celebration	(2011)
Innovation	(2014)
Lacey	(2000)
Legacy	(2001)
Quest	(2011)
Stellar-ND	(2006)
Thoroughbred*	(2015)
Tradition	(2004)

Variety name & year first recommended

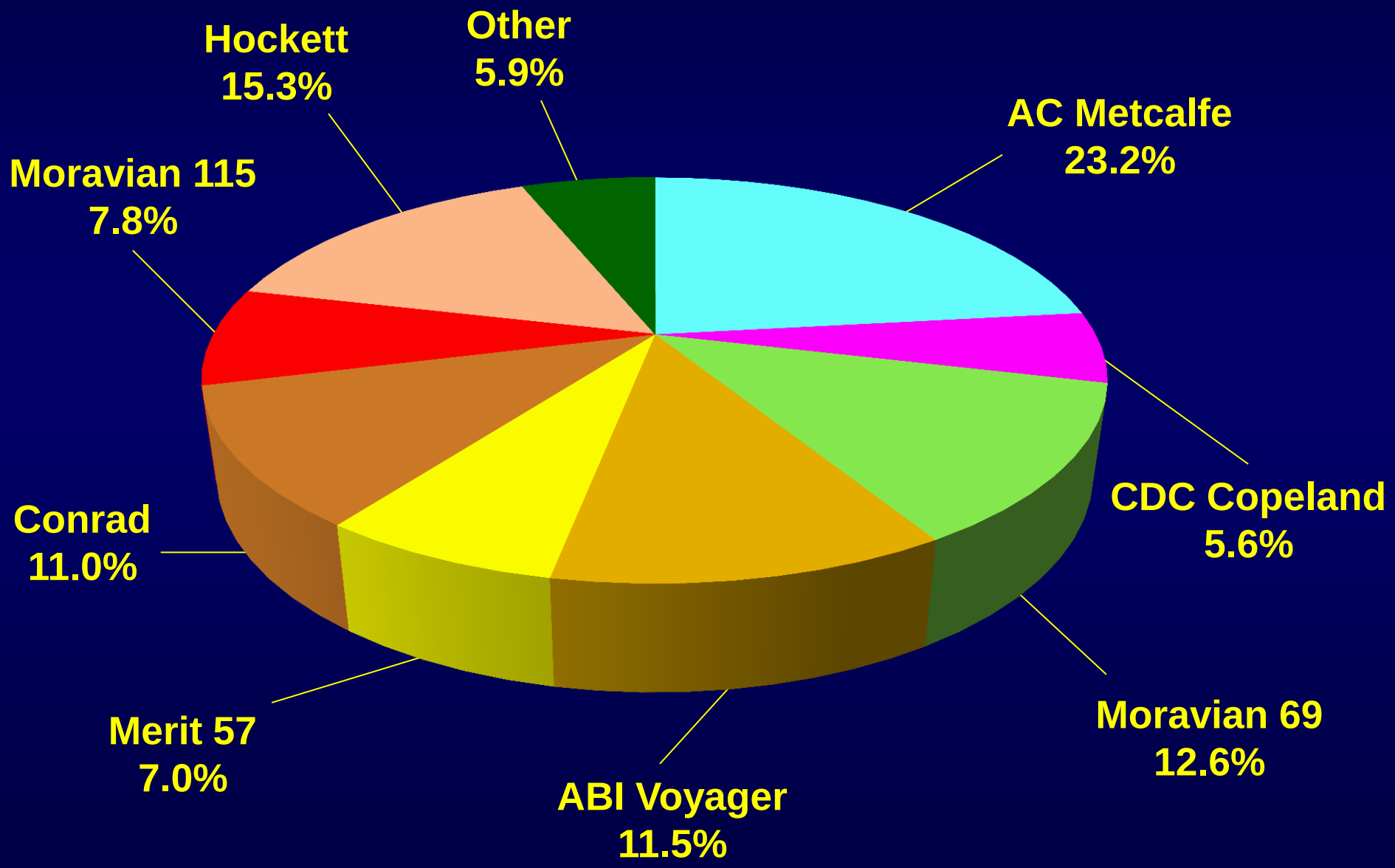
2015 MIDWEST CONTRACTED BARLEY VARIETIES

(Minnesota, North Dakota, South Dakota & Wisconsin)



2015 WESTERN CONTRACTED BARLEY VARIETIES

(Colorado, Idaho, Montana, Washington & Wyoming)



2015/2016 Recommended Varieties in Canada

Two-Row Varieties

VARIETY	MARKET COMMENTS
CDC Copeland[1]	Established Demand
AC Metcalfe[1]	Established Demand
CDC Meredith[1]	Limited, Increasing Demand
Bentley[2]	Limited, Stable Demand
CDC Kindersley[1]	Undergoing Commercial Market Development
Cerveza [6]	Undergoing Commercial Market Development
AAC Synergy[5]	Undergoing Commercial Market Development

Additional Two-Row Varieties:*

VARIETY	MARKET COMMENTS
Newdale[4]	Limited, Stable Demand
CDC PolarStar[2]	Limited, Stable Demand
Merit 57[2]	Undergoing Commercial Market Development

*These two-row varieties are primarily handled by one company. For interest in growing Newdale, please contact Canada Malting Company. CDC PolarStar is produced in a closed loop, identity preserved program. For interest in growing CDC PolarStar, please contact Prairie Malt-Cargill. For interest in growing Merit 57, please contact BARI-Canada.

Note: CDC Landis is not yet grown for commercial use. Production is limited to quantities required for pre-market development testing.

Six-Row Varieties**

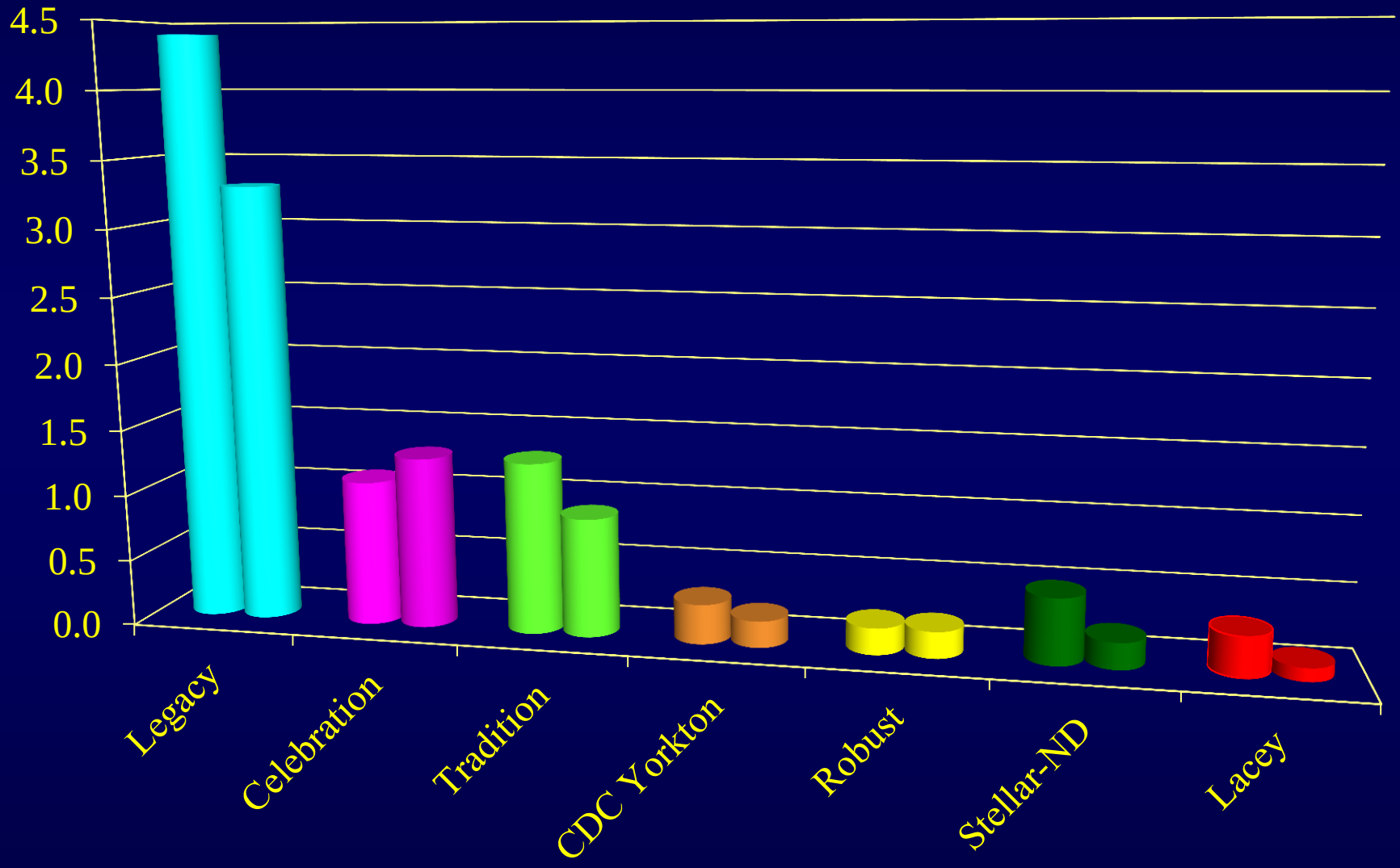
VARIETY	MARKET COMMENTS
Legacy[3,4]	Limited Demand
Tradition [4]	Limited Demand
Celebration[2]	Limited Demand

**Demand for six-row malting barley has been declining. Please talk to your local malting company selector in regard to demand for six-row varieties in your area.

CANADIAN SIX-ROW MALTING BARLEY VARIETIES

2014 & 2015

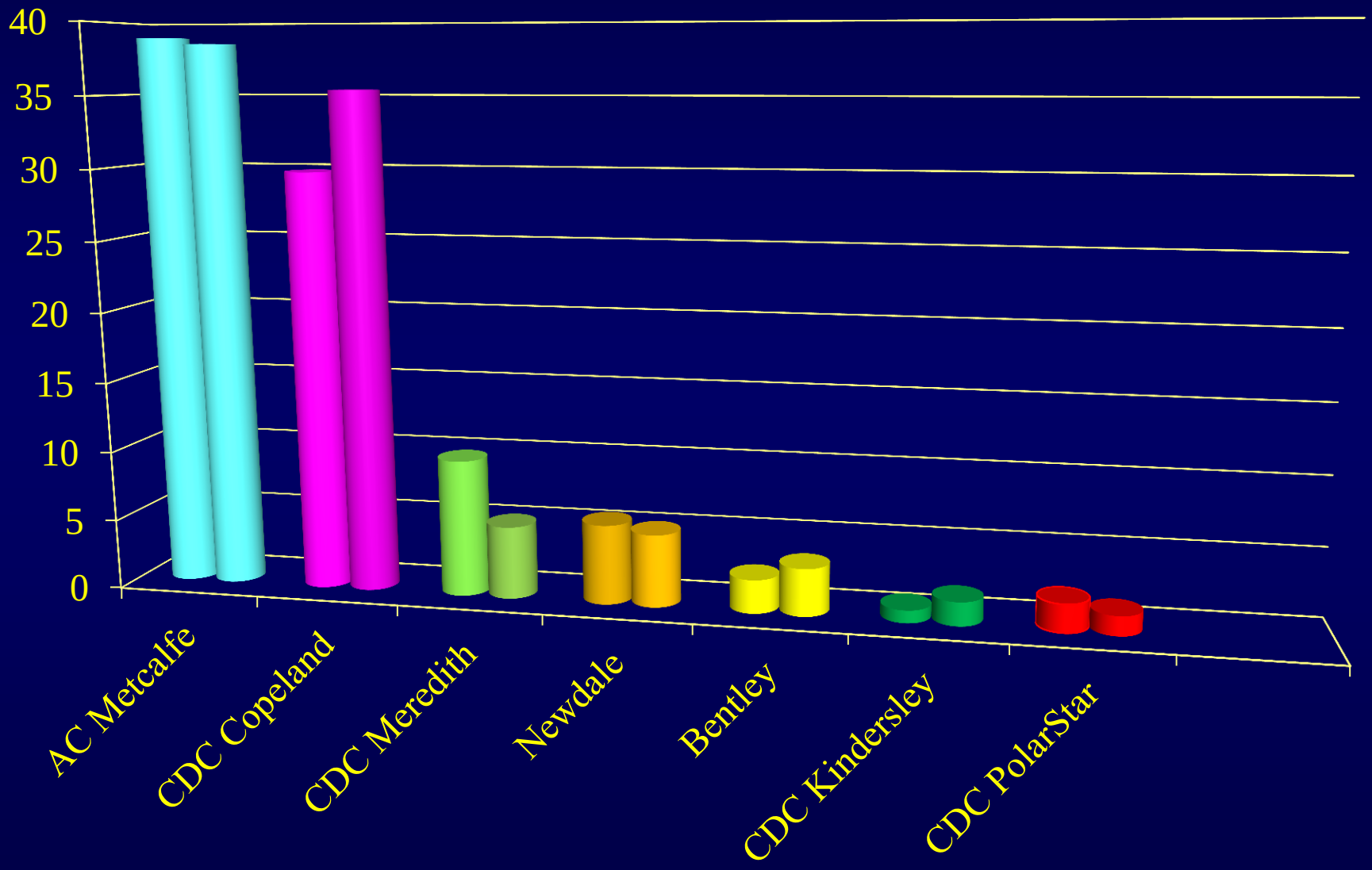
(ALBERTA, SASKATCHEWAN & MANITOBA)



CANADIAN TWO-ROW MALTING BARLEY VARIETIES

2014 & 2015

(ALBERTA, SASKATCHEWAN & MANITOBA)



US Barley Production

	Seeded		Yield		Production		
	2014	2015	2014	2015	2013	2014	2015
	----(000s acres)----		(bu/acre)		----------(000s bushels)----------		
Minnesota	75	100	52.0	70.0	5,175	3,120	5,950
North Dakota	620	900	67.0	66.0	46,080	35,845	54,450
South Dakota	28	40	52.0	*	1,026	884	*
Three States	**723**	**1,040**	**65.1**	**64.9**	**52,281**	**39,849**	**60,400**
California	80	70	73.0	70.0	3,150	1,825	1,750
Colorado	57	65	124.0	134.0	7,714	6,696	8,308
Idaho	560	610	94.0	100.0	57,660	47,940	58,000
Montana	920	1,010	58.0	55.0	43,160	44,660	47,300
Oregon	40	65	50.0	59.0	3,500	1,500	3,245
Washington	115	115	60.0	57.0	14,040	6,300	5,985
Wyoming	80	85	107.0	107.0	6,052	6,741	6,955
Seven States	**1,852**	**2,020**	**74.3**	**75.1**	**135,276**	**115,662**	**131,543**
Other	400	353	77.7	74.9	29,188	21,283	17,747
Total U.S.	**2,975**	**3,413**	**72.4**	**71.8**	**216,745**	**176,794**	**209,690**

Canadian Barley Production

	Seeded		Yield		Production		
	2014	2015	2014	2015	2013	2014	2015
	----(000s acres)----		(bu/acre)		----------(000s bushels)----------		
Alberta	3,200	3,400	67.3	60.6	254,700	189,750	170,600
Saskatchewan	2,000	2,400	54.2	54.2	156,700	99,800	120,100
Manitoba	300	350	61.5	70.8	32,400	16,300	23,360
Other	380	361	59.8	62.9	26,388	21,123	21,466
Canada	**5,880**	**6,511**	**61.9**	**58.8**	**470,188**	**326,973**	**335,526**

2015 Season

- Much Improved over 2014
- Started very dry in western US and western Canadian Prairies
- Just in time June rains saved many farms from devastating drought
- Widespread rain in early September compromised the quality of much of the crop in Canada (60% harvested at the time)
- Good size crop in US with average to good quality
- Lower yields in Canada with marginal to average quality

Good Beer Requires Quality Barley

"…barley is to beer as grapes are to wine. You cannot make a good wine out of bad grapes and you can't make a good beer out of bad barley. You can make a terrible beer out of good barley, that's easy to do. But at least start right."
– Bill Coors


THANK YOU