Vegetation Health Applications in USDA

Mark D. Brusberg
Deputy Chief Meteorologist
USDA Office of the Chief Economist / World Agricultural Outlook Board

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STAR JPSS

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1972 Soviet Grain Purchases

Former National Security Advisor Henry Kissinger had this to say about record July 1972 Soviet grain purchases from the United States:

- "Our intelligence about Soviet needs was appalling.
- Our knowledge of what was happening in our markets was thin.
- The U.S. Government was simply not organized at the time to supervise or even monitor private grain sales as a foreign policy matter."

WASDE Report

World Agricultural Outlook Board

waob

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World Agricultural Supply and Demand Estimates

United States Department of Agriculture

Office of the Chief Economist | Agricultural Marketing Service, Farm Service Agency | Economic Research Service, Foreign Agricultural Service

WASDE - 510 | Approved by the World Agricultural Outlook Board | September 12, 2012

WHEAT: The 2012/13 U.S. wheat balance sheet is unchanged this month; however, small by-class adjustments are made to projected exports and stocks. Projected exports for Hard Red Winter wheat are lowered 25 million bushels with Hard Red Spring and White wheat exports raised 15 million bushels and 10 million bushels, respectively. Corresponding changes are made to projected ending stocks for these three classes. The proje
price is lowered to $7.50 to $8.70 per bushel con
Prices reported for the summer months, when pr
remained well below cash bids and futures prices
producers earlier in the year.

Global wheat supplies for 2012/13 are projected
production in Russia. An increase in foreign beg
ton reduction in world wheat output. Beginning s
for Argentina. Production for Russia is reduced
reduced yields as harvest results confirm additio
spring wheat crops. Production is also lowered
experienced the same adverse drought and heat
in the central and eastern growing regions of Rus
mostly reflecting lower expected yields in the Uni
million tons based on higher reported yields. Pro
mostly on higher reported area.

Global wheat consumption for 2012/13 is lowere
residual use in Russia and Kazakhstan. Food us
additional reductions projected for food use in Eg
Afghanistan, Iran, and Libya.

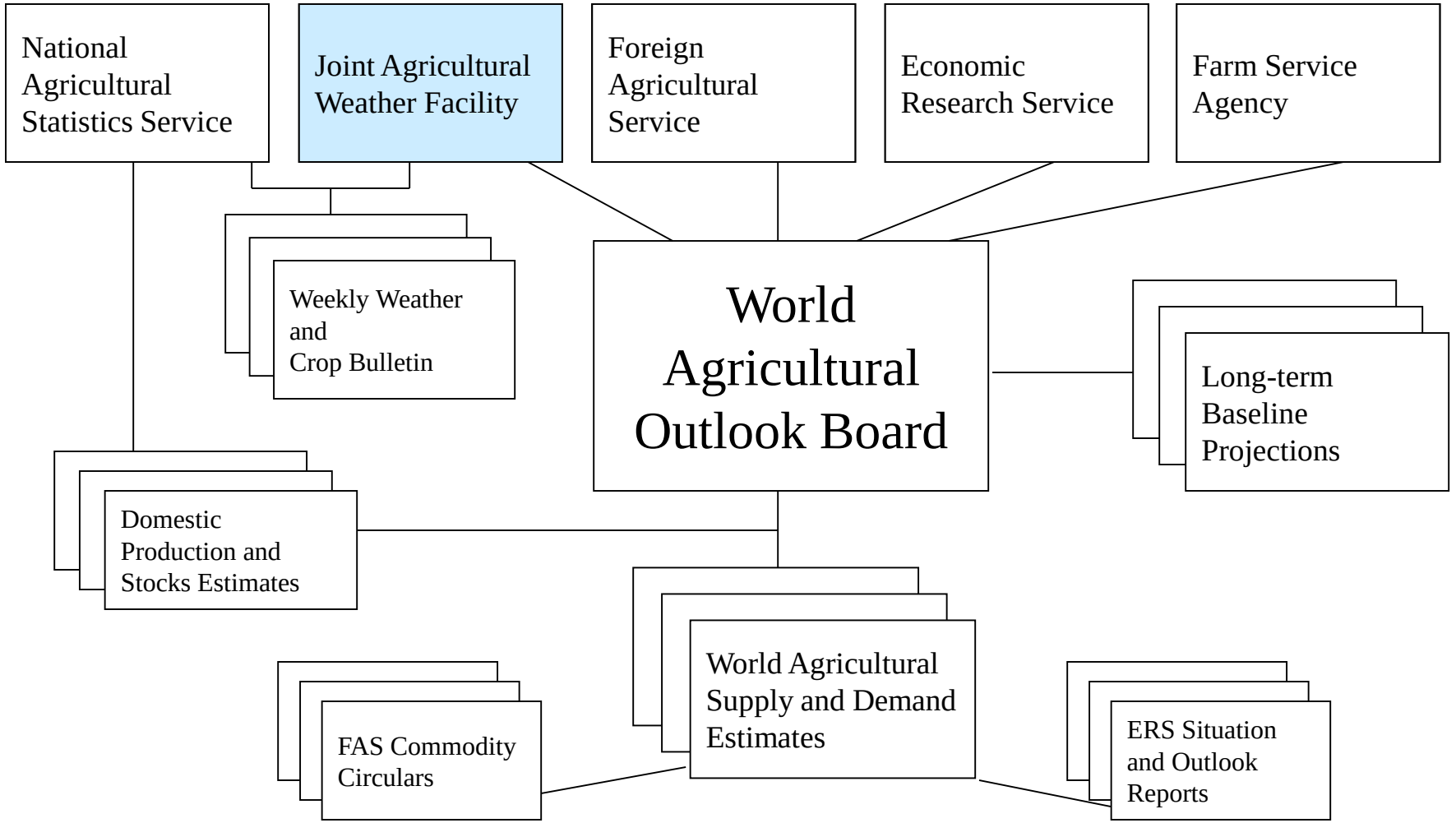
Global wheat trade for 2012/13 is lowered slightl
EU-27, Israel, and Nigeria. Import increases for
Exports are reduced 2.0 million tons for Ukraine
government officials and grain traders to limit shi
domestic supplies. Higher expected exports for
Ukraine reduction.

World ending stocks for 2012/13 are projected 0.5 million tons lower with changes to a number of countries. The largest declines in stocks are for Russia, EU-27, China, Brazil, and Argentina. The largest increases are for Ukraine, Canada, Iran, and Turkey.

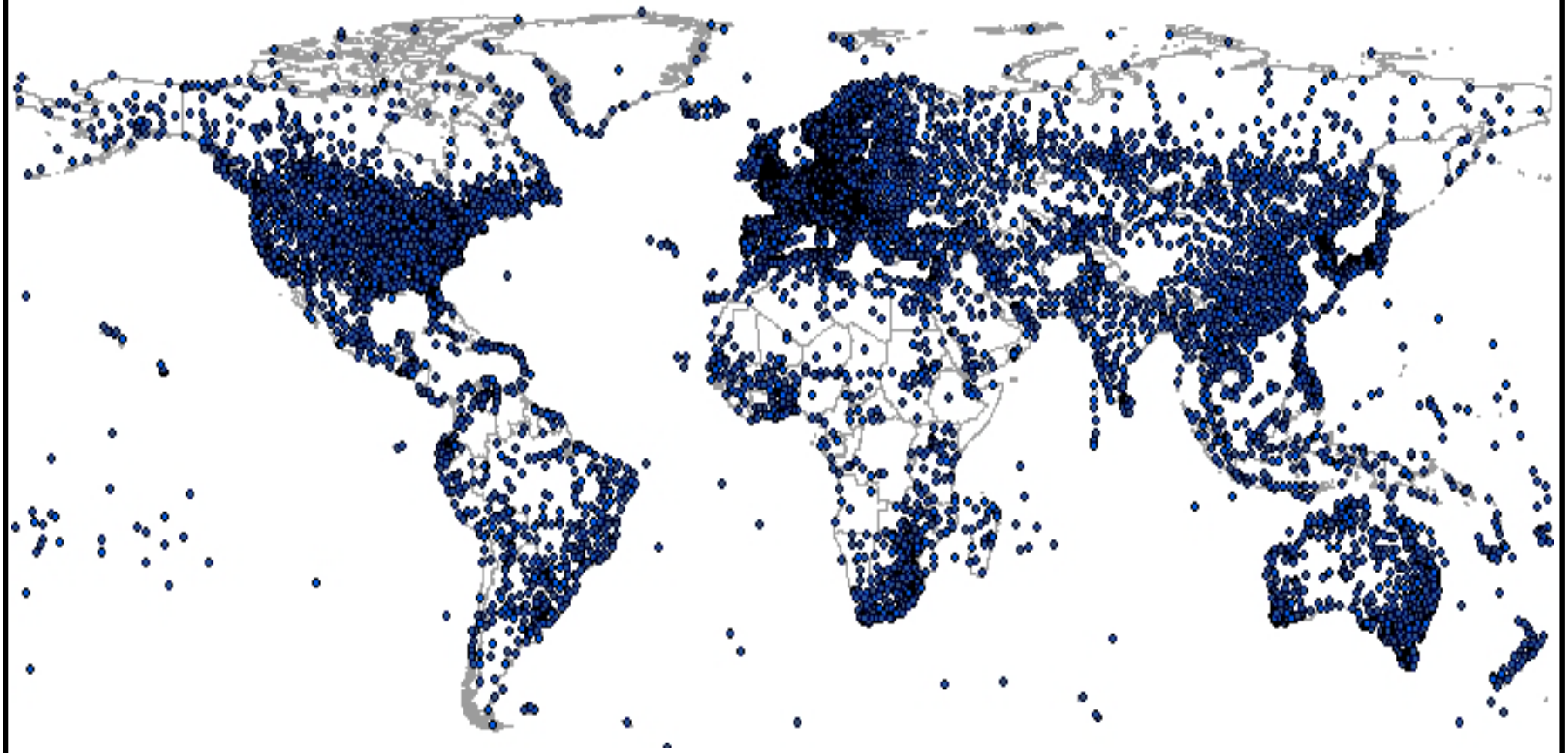
COARSE GRAINS: U.S. feed grain supplies for 2012/13 are projected higher this month with a reduction in forecast corn production more than offset by higher projected corn carryin. U.S. corn production is lowered 52 million bushels with the national average yield forecast 0.6 bushels per acre lower at 122.8 bushels. Lower yields and production in the Corn Belt and Central Plains are partly

Global wheat supplies for 2012/13 are projected 3.1 million tons lower mostly due to lower expected production in Russia. An increase in foreign beginning stocks partly offsets the projected 4.1-million-ton reduction in world wheat output. Beginning stocks are raised for Canada and Egypt, but lowered for Argentina. Production for Russia is reduced 4.0 million tons with lower reported area and reduced yields as harvest results confirm additional drought and heat damage to both the winter and spring wheat crops. Production is also lowered 0.5 million tons for adjoining Kazakhstan, which experienced the same adverse drought and heat during July and August that affected spring wheat in the central and eastern growing regions of Russia. EU-27 production is lowered 0.5 million tons mostly reflecting lower expected yields in the United Kingdom. Ukraine production is raised 0.5 million tons based on higher reported yields. Production for Afghanistan is raised 0.4 million tons mostly on higher reported area.

USDA's Economic Intelligence System



* Random sampling of available daily weather data

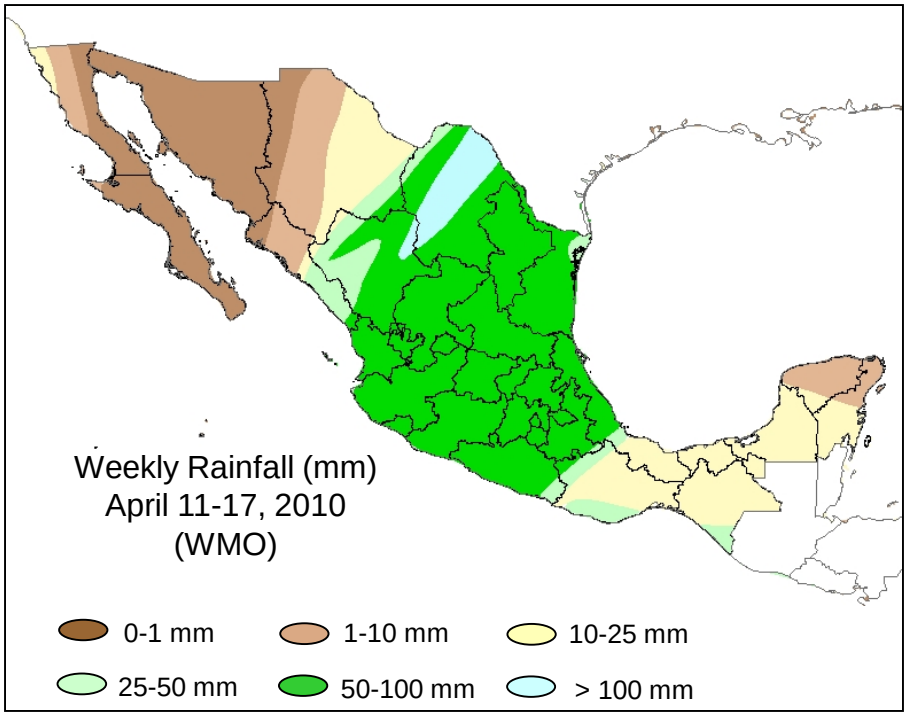


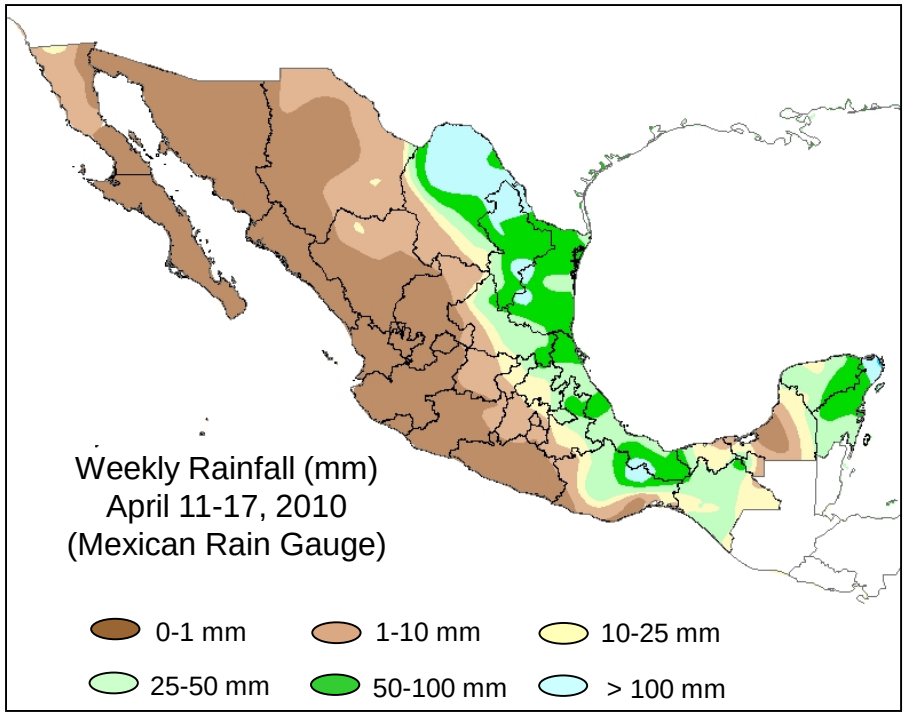
* Most have data since at least 1982
(many with normals)

Location of weather stations
received daily via the WMO[1]

[1] United Nations World Meteorological Organization

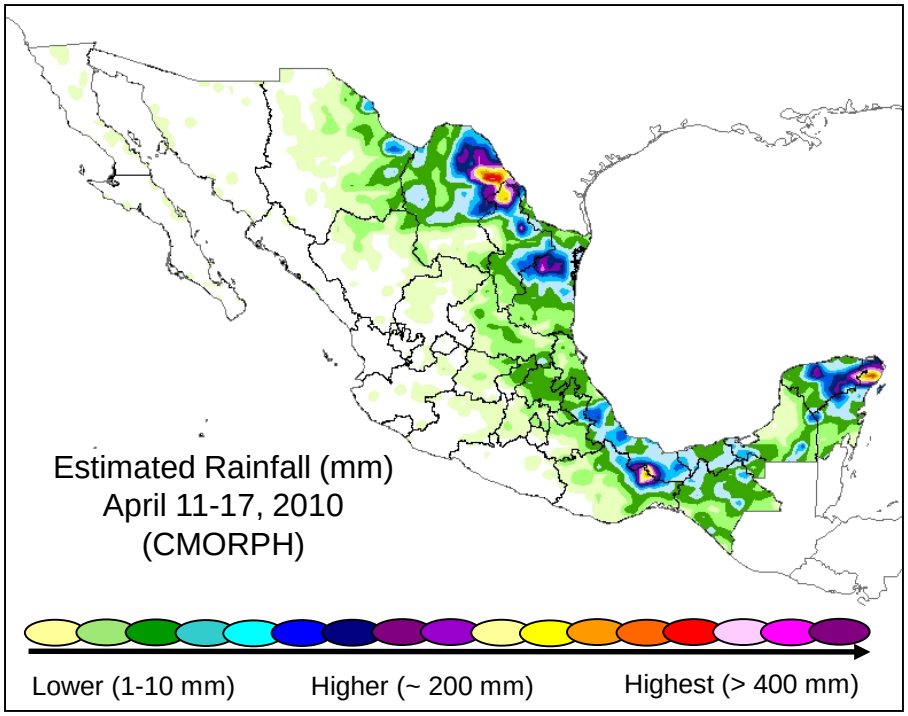
Secondary sources of weather data

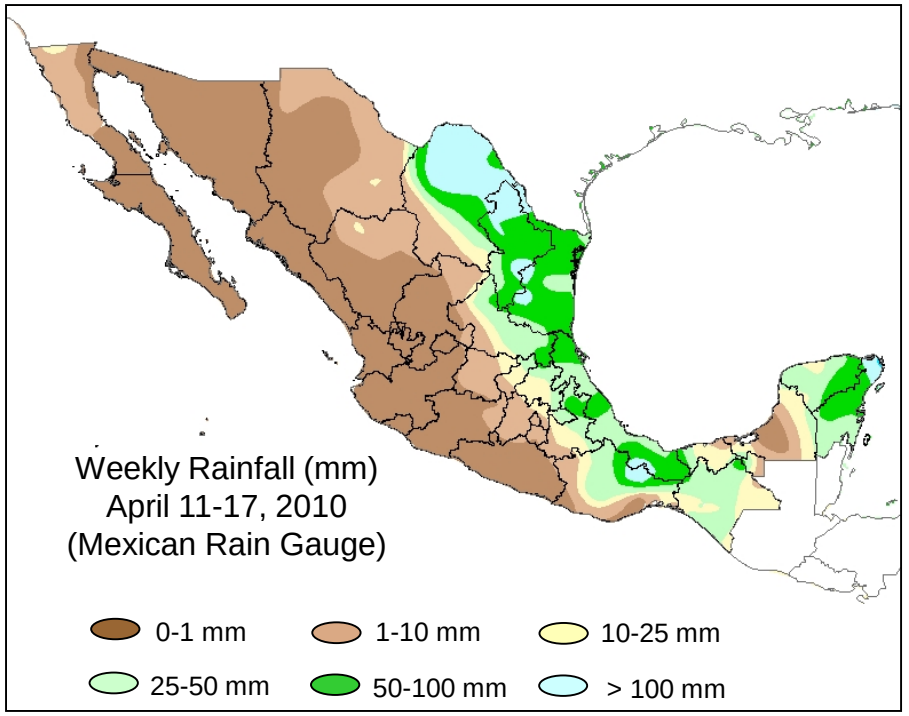




The maps above highlight the differences that arise using WMO data, which are sparse in coverage, versus the supplemental rain gauge data, which provides a denser network of stations and a better representation of rainfall.

Secondary sources of weather data





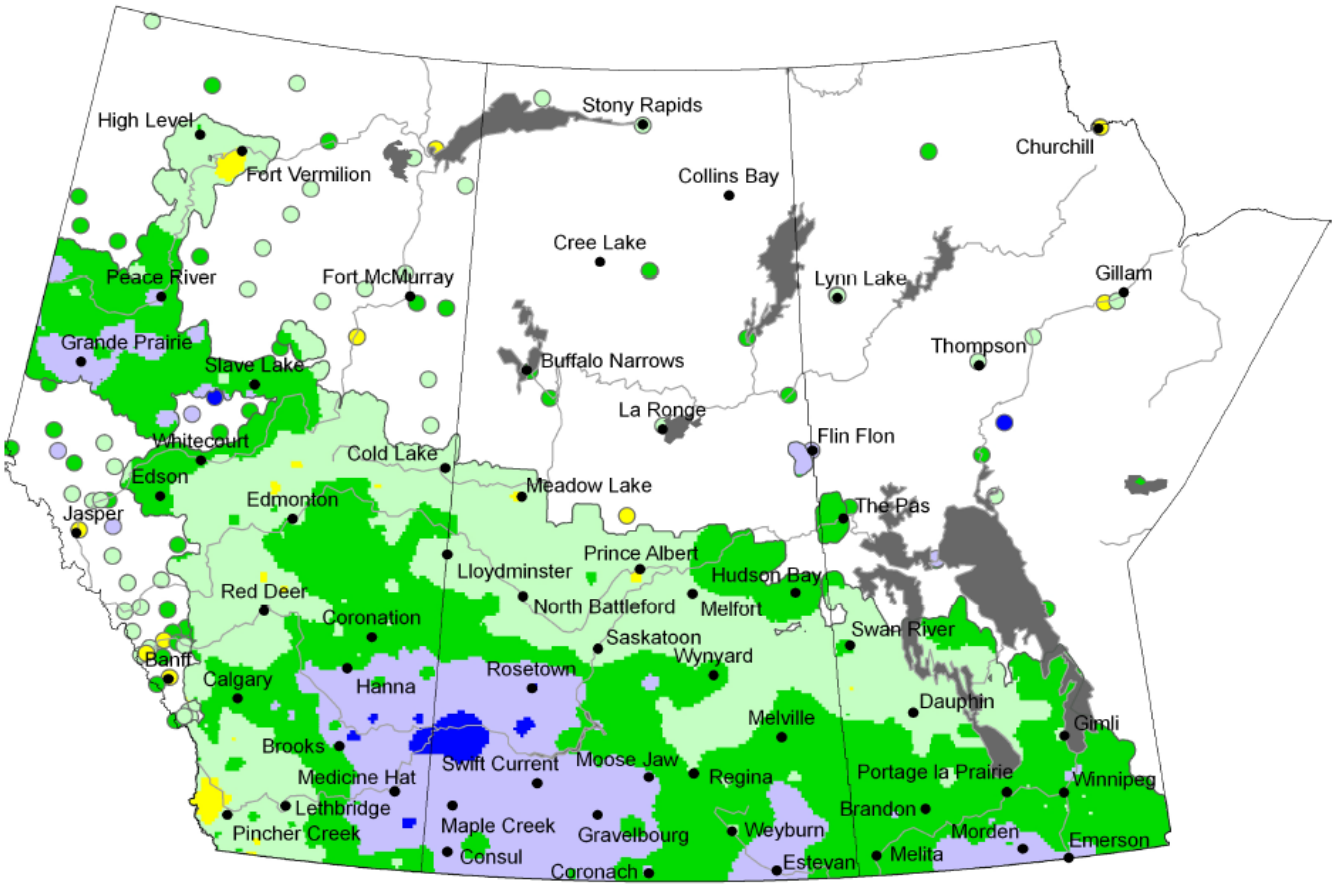
Comparison with other sources of information, including satellite derived estimates (CMORPH), support the rain gauge analysis.

Agriculture and Agri-Food Canada | Agriculture et Agroalimentaire Canada

Canada

Percent of Average Precipitation (Prairie Region)

April 1, 2016 to August 8, 2016



- < 40%
- 40 - 60%
- 60 - 85%
- 85 - 115%
- 115 - 150%
- 150 - 200%
- > 200%
- Extent of Agricultural Land
- Lakes and Rivers

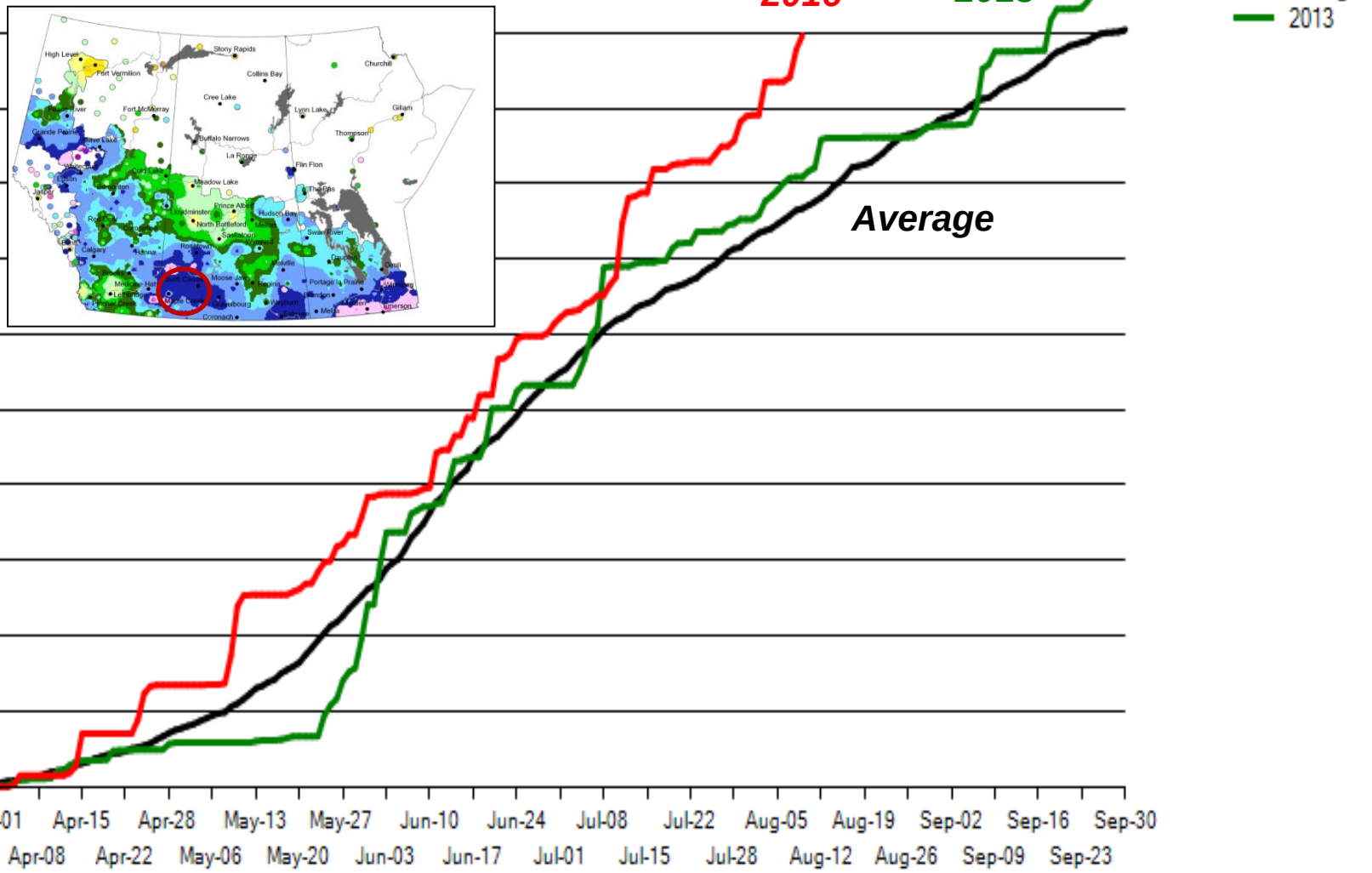
Produced using near real-time data that has undergone initial quality control. The map may not be accurate for all regions due to data availability and data errors.

Prepared by Agriculture and Agri-Food Canada's National Agroclimate Information Service (NAIS). Data provided through partnership with Environment Canada, Natural Resources Canada, and many Provincial agencies.

Created: 08/09/16
www.agr.gc.ca/drought

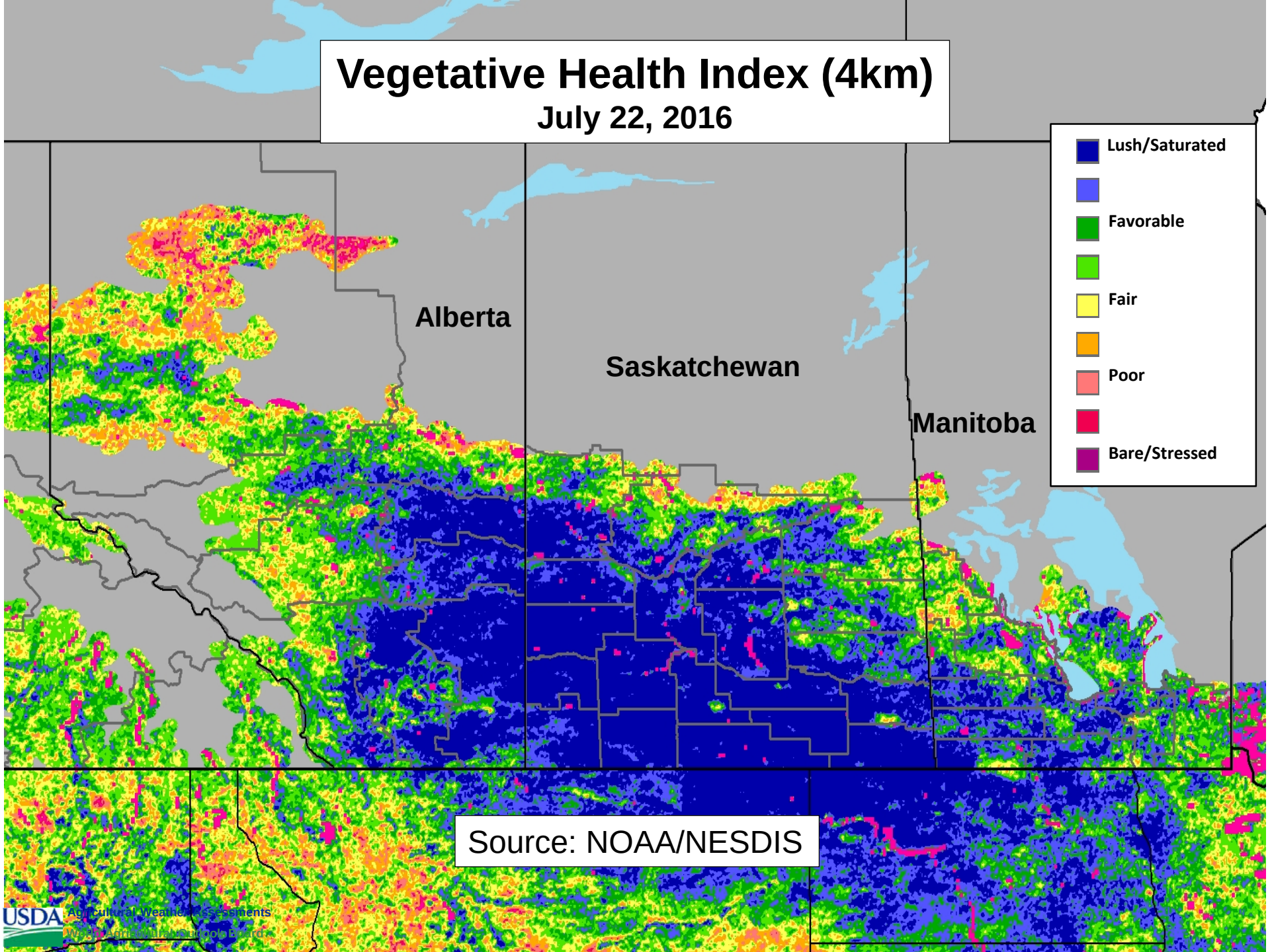
9 - SASKATCHEWAN - SOUTHWEST

Cumulative Precipitation

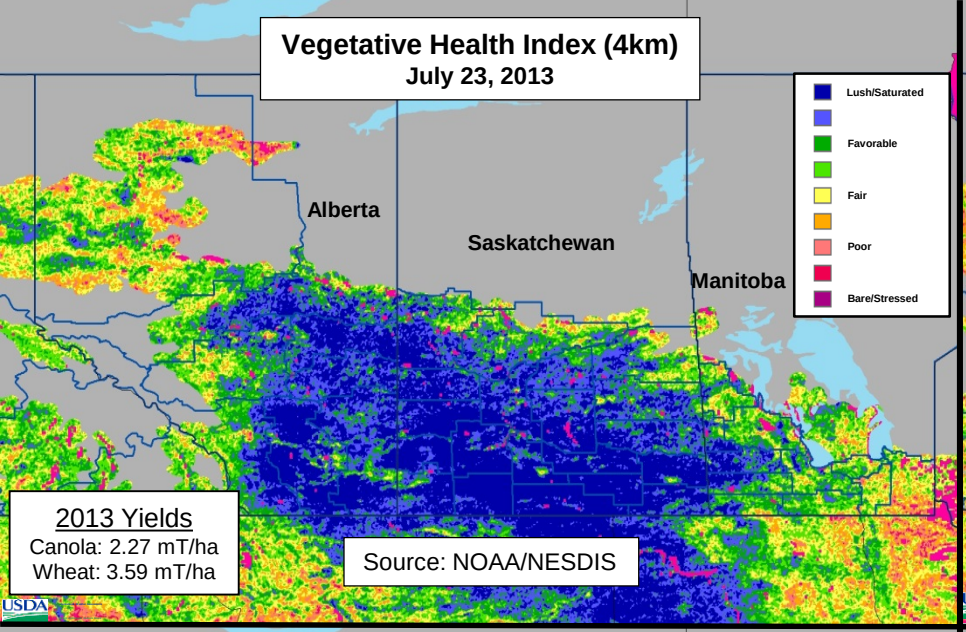


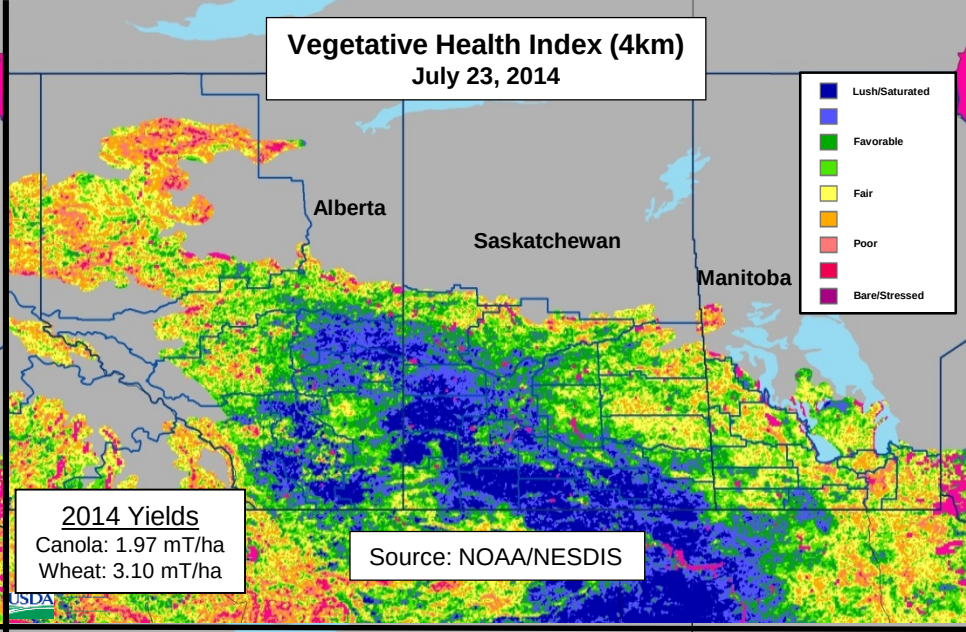
Vegetative Health Index (4km)

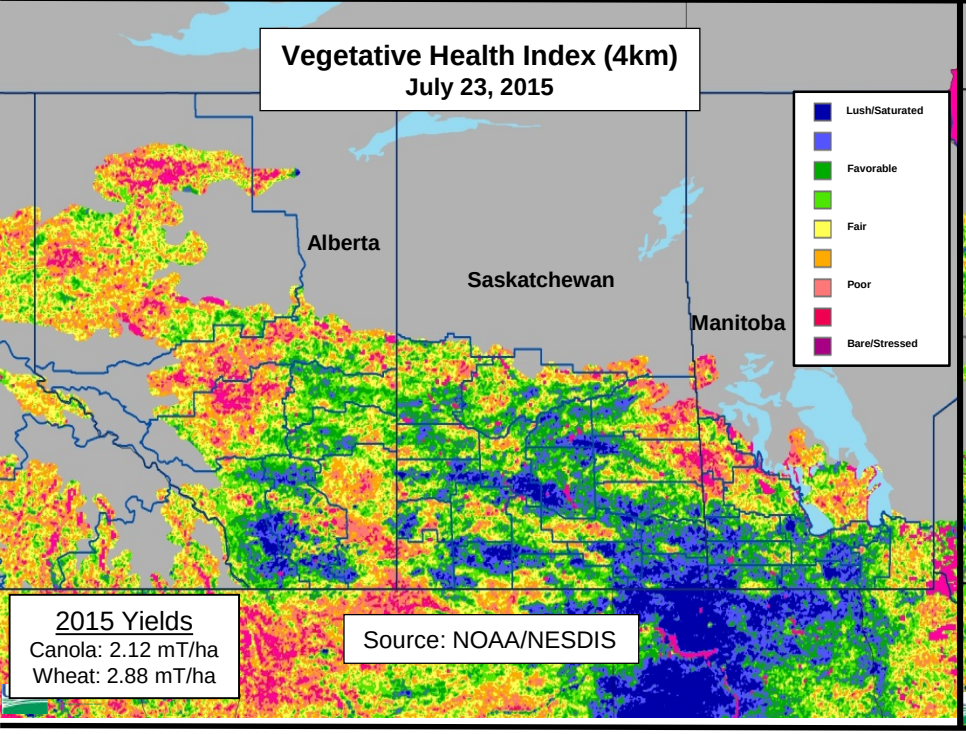
July 22, 2016

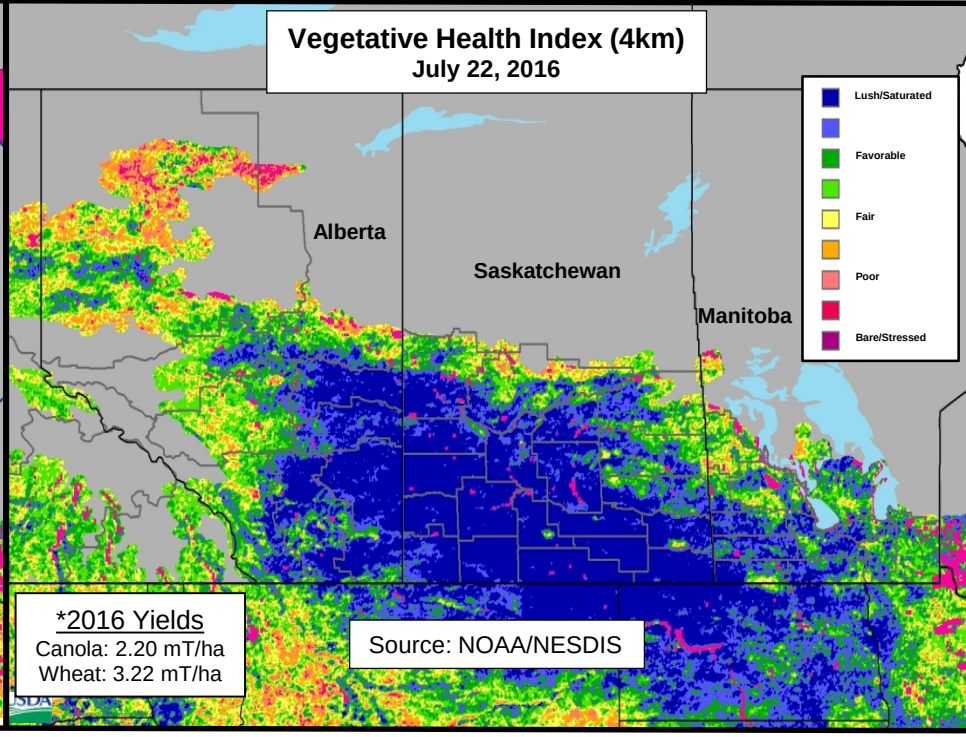


USDA Agricultural Weather Assessments









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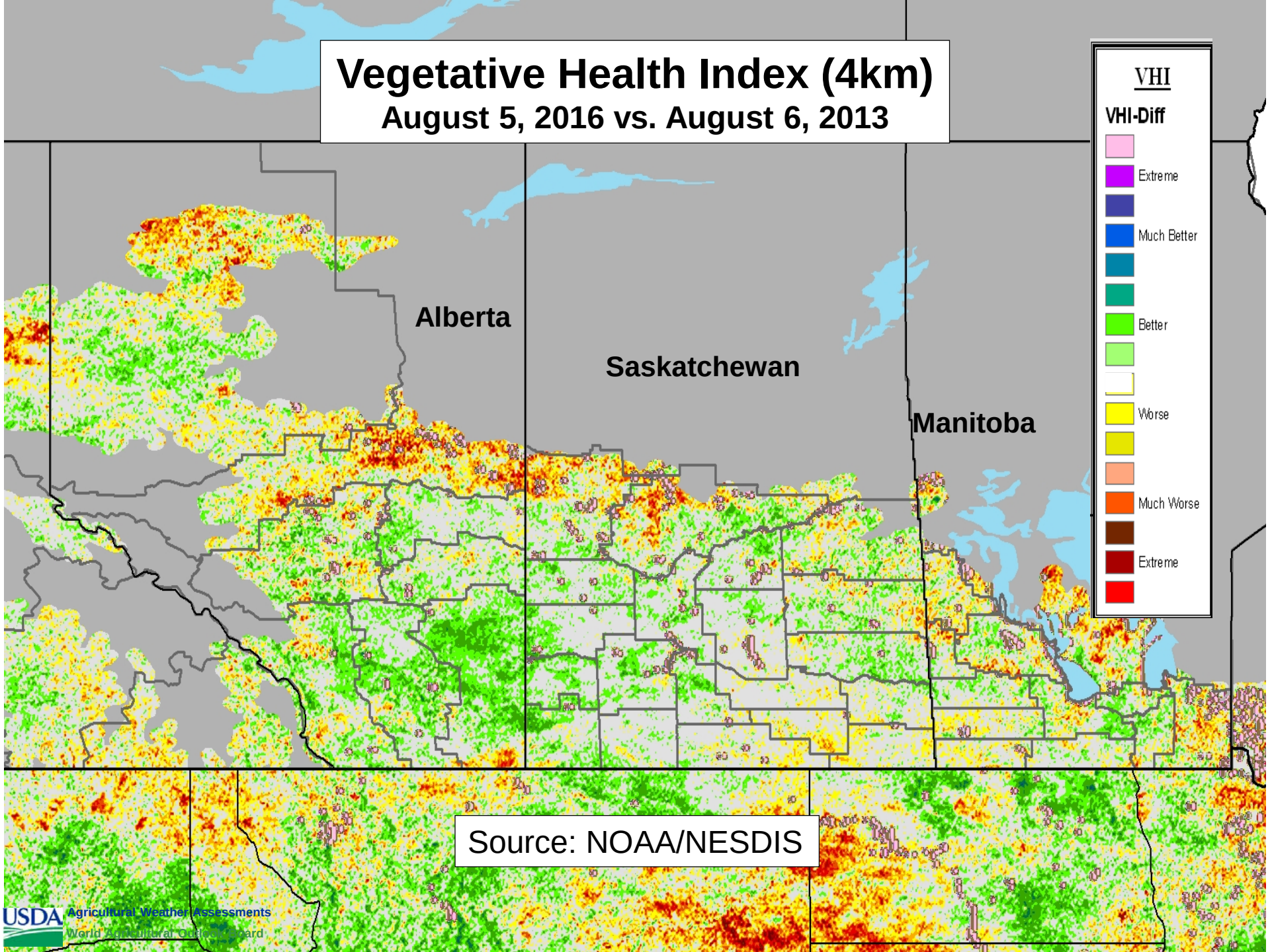
*** Current Proposed Yields**

Vegetative Health Index (4km)

August 5, 2016 vs. August 6, 2013

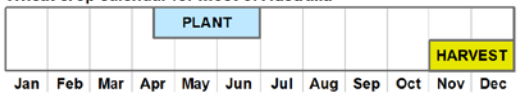


Source: NOAA/NESDIS

Australia: Wheat

United States Department of Agriculture

Wheat crop calendar for most of Australia



Major Crop Area

Minor Crop Area

34

7

17

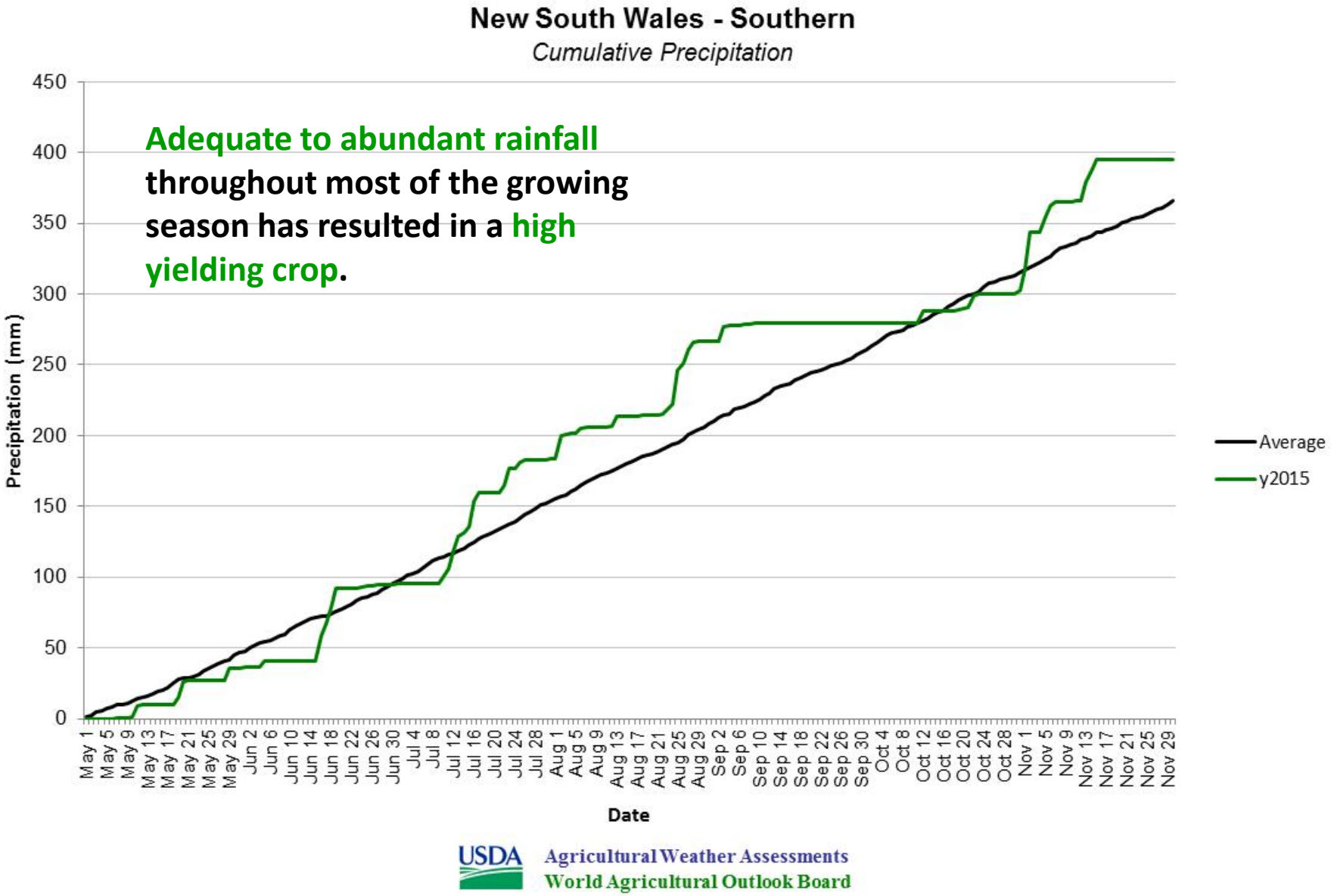
30

13

- Yellow numbers are percentages, representing the average annual contribution of each state to the total national production. States not numbered contribute less than 1% to the national total.
- Major crop areas combined account for approximately 75% of the total national production annually.
- Major and minor crop areas combined account for approximately 99% of the total national production annually.

Source: Major and minor agricultural areas and state percentages are derived from 2010-11 Agricultural Census data, obtained from the Australian Bureau of Statistics (ABS), and data obtained from the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES).

This product was developed by the USDA Office of the Chief Economist (OCE) World Agricultural Outlook Board (WAOB).


New South Wales - Southern
Cumulative Precipitation
Adequate to abundant rainfall throughout most of the growing season has resulted in a high yielding crop.
Precipitation (mm)
450
400
350
300
250
200
150
100
50
0
May 1
May 5
May 9
May 13
May 17
May 21
May 25
May 29
Jun 2
Jun 6
Jun 10
Jun 14
Jun 18
Jun 22
Jun 26
Jun 30
Jul 4
Jul 8
Jul 12
Jul 16
Jul 20
Jul 24
Jul 28
Aug 1
Aug 5
Aug 9
Aug 13
Aug 17
Aug 21
Aug 25
Aug 29
Sep 2
Sep 6
Sep 10
Sep 14
Sep 18
Sep 22
Sep 26
Sep 30
Oct 4
Oct 8
Oct 12
Oct 16
Oct 20
Oct 24
Oct 28
Nov 1
Nov 5
Nov 9
Nov 13
Nov 17
Nov 21
Nov 25
Nov 29
Date
Average
y2015
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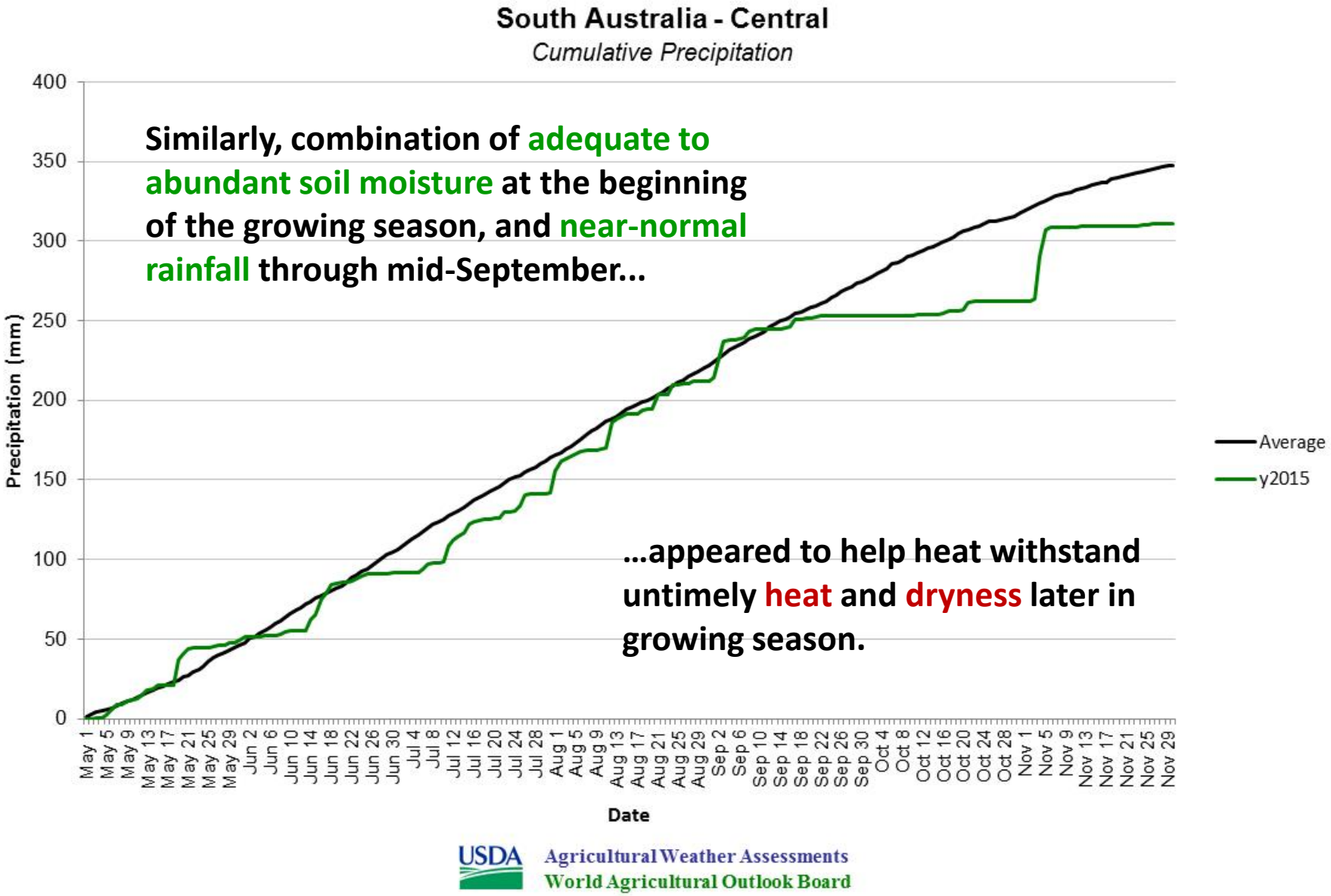
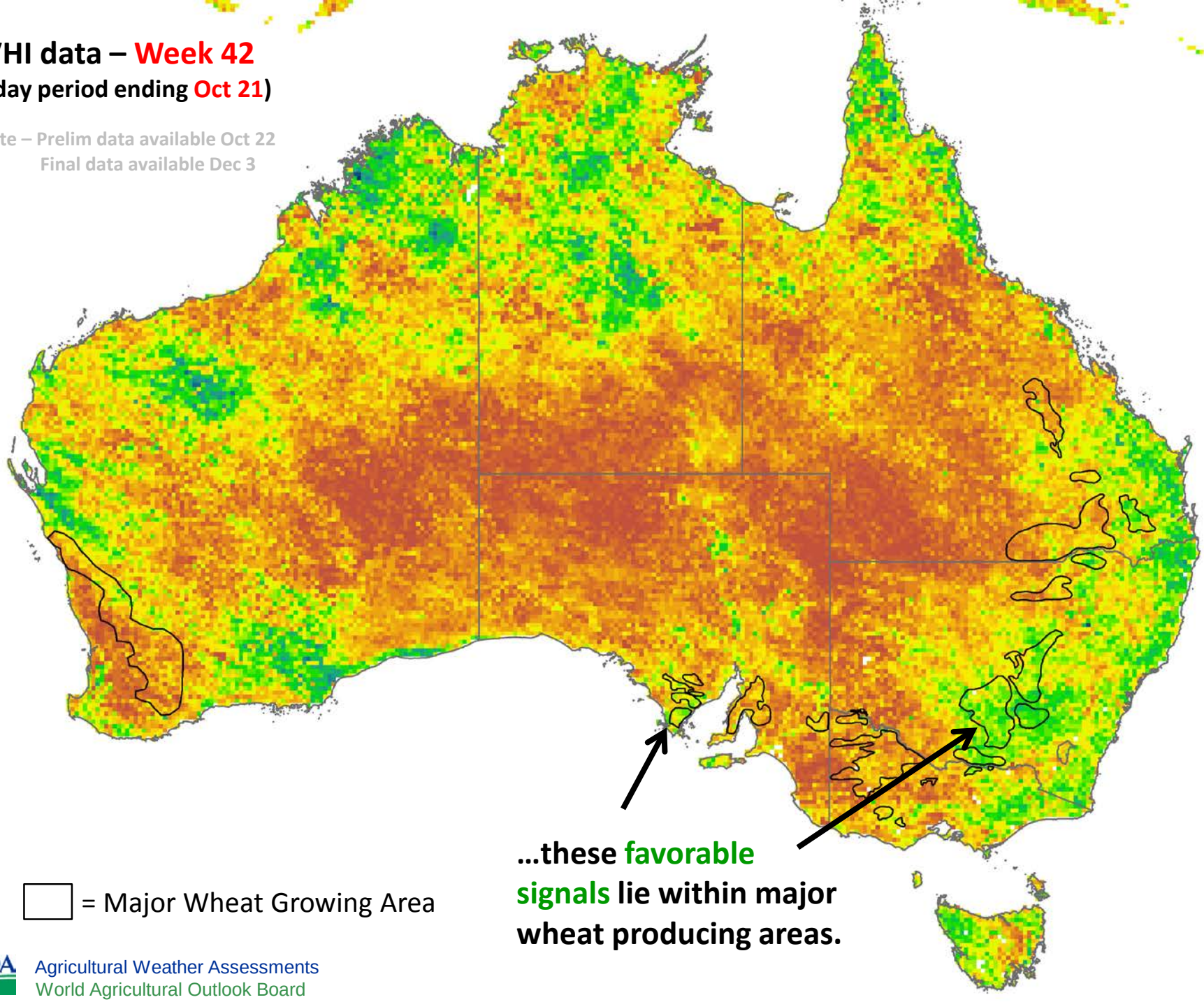

South Australia - Central
Cumulative Precipitation
Similarly, combination of adequate to abundant soil moisture at the beginning of the growing season, and near-normal rainfall through mid-September...
…appeared to help heat withstand untimely heat and dryness later in growing season.
Precipitation (mm)
400
350
300
250
200
150
100
50
0
May 1
May 5
May 9
May 13
May 17
May 21
May 25
May 29
Jun 2
Jun 6
Jun 10
Jun 14
Jun 18
Jun 22
Jun 26
Jun 30
Jul 4
Jul 8
Jul 12
Jul 16
Jul 20
Jul 24
Jul 28
Aug 1
Aug 5
Aug 9
Aug 13
Aug 17
Aug 21
Aug 25
Aug 29
Sep 2
Sep 6
Sep 10
Sep 14
Sep 18
Sep 22
Sep 26
Sep 30
Oct 4
Oct 8
Oct 12
Oct 16
Oct 20
Oct 24
Oct 28
Nov 1
Nov 5
Nov 9
Nov 13
Nov 17
Nov 21
Nov 25
Nov 29
Date
Average
y2015
USDA
Agricultural Weather Assessments
World Agricultural Outlook Board

VHI data – Week 42

(7 day period ending Oct 21)

Note – Prelim data available Oct 22
Final data available Dec 3



= Major Wheat Growing Area

…these favorable signals lie within major wheat producing areas.

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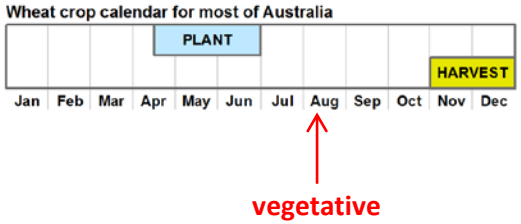
Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 32

(7 day period ending Aug 12)

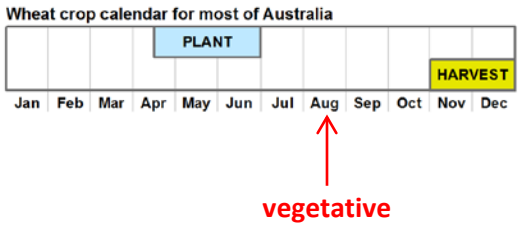
Note – Prelim data available Aug 13
Final data available Sep 24

$R^2 = 0.10$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 33

(7 day period ending Aug 19)

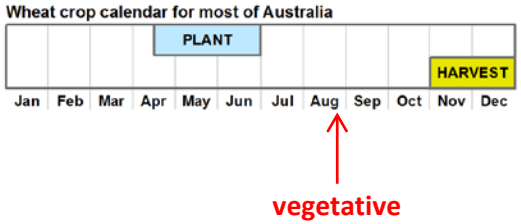
Note – Prelim data available Aug 20
Final data available Oct 1

$R^2 = 0.19$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 34

(7 day period ending Aug 26)

Note – Prelim data available Aug 27
Final data available Oct 8

$R^2 = 0.35$

Based on 13 years of data (2002-2014)

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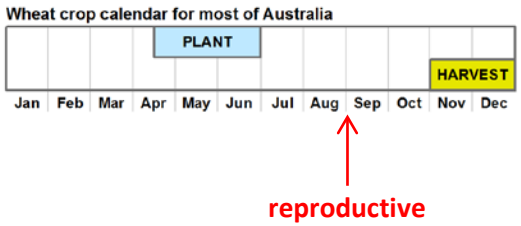
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 35

(7 day period ending Sep 2)

Note – Prelim data available Sep 3
Final data available Oct 15

$R^2 = 0.49$

Based on 13 years of data (2002-2014)

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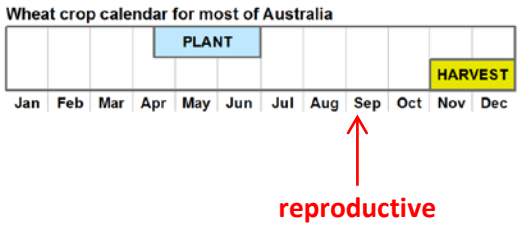
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 36

(7 day period ending Sep 9)

Note – Prelim data available Sep 10
Final data available Oct 22

$R^2 = 0.61$

Based on 13 years of data (2002-2014)

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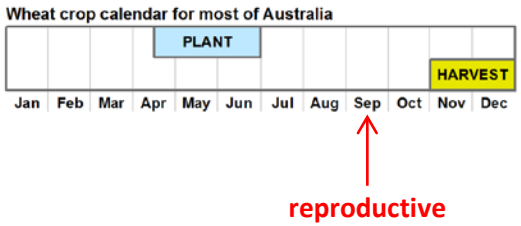
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 37

(7 day period ending Sep 16)

Note – Prelim data available Sep 17
Final data available Oct 29

$R^2 = 0.74$

Based on 13 years of data (2002-2014)

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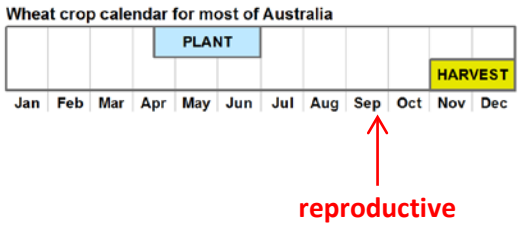
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 38

(7 day period ending Sep 23)

Note – Prelim data available Sep 24
Final data available Nov 5

$R^2 = 0.84$

Based on 13 years of data (2002-2014)

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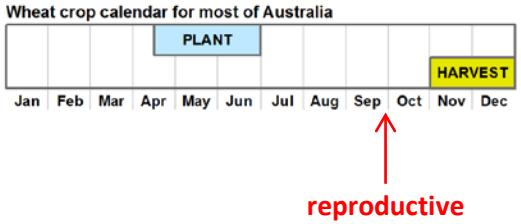
World Agricultural Outlook Board

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 39

(7 day period ending Sep 30)

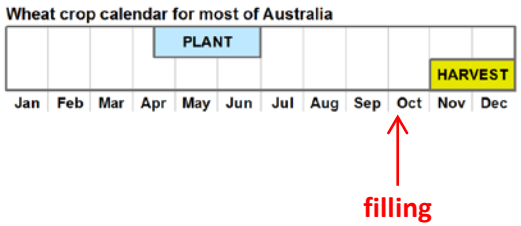
Note – Prelim data available Oct 1
Final data available Nov 12

$R^2 = 0.88$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 40

(7 day period ending Oct 7)

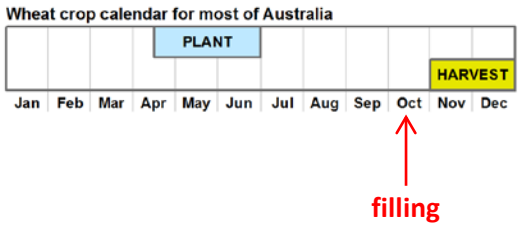
Note – Prelim data available Oct 8
Final data available Nov 19

$R^2 = 0.91$

Based on 13 years of data (2002-2014)

Vegetation Health Index vs. Wheat Yields

South Australia



VHI data – Week 41

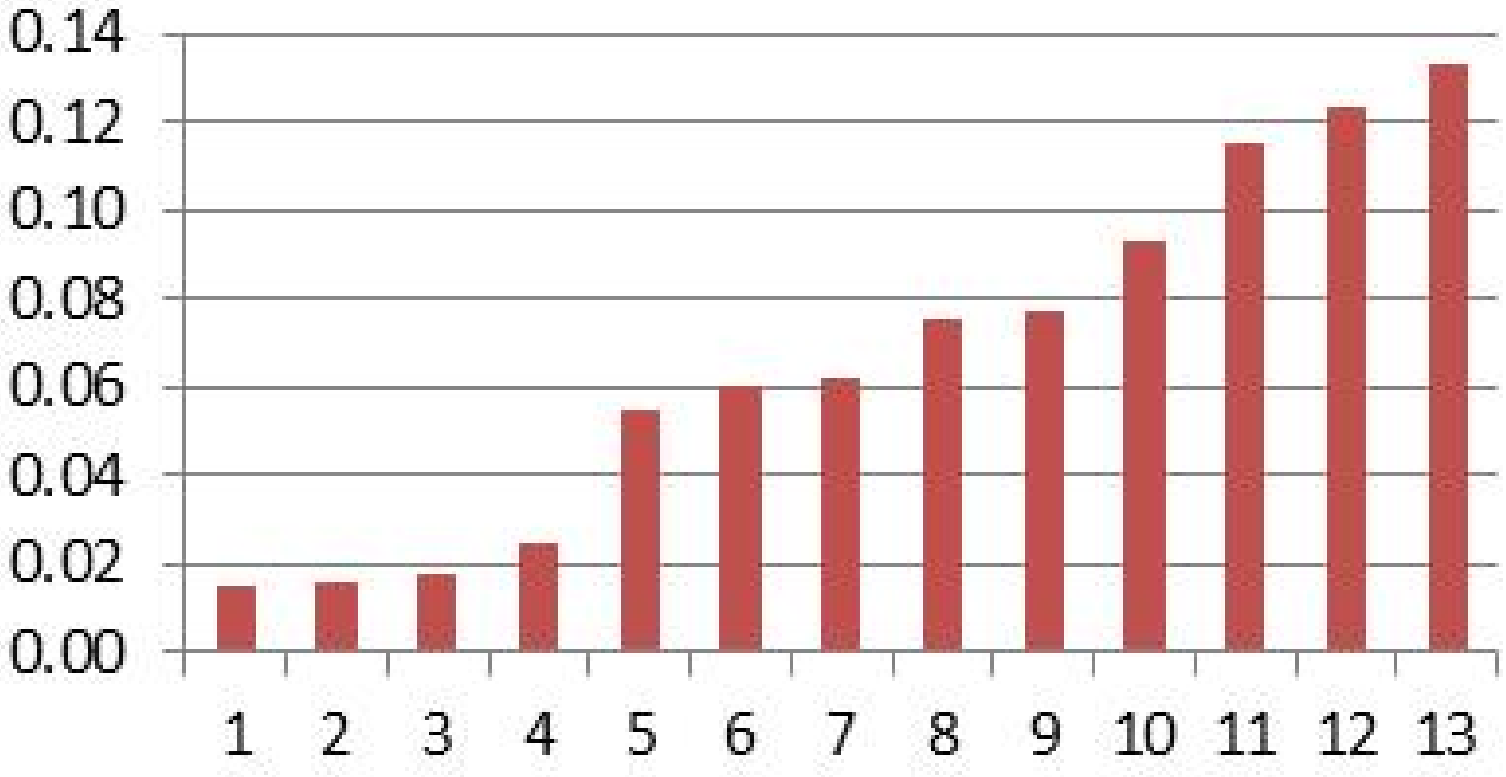
(7 day period ending Oct 14)

Note – Prelim data available Oct 15
Final data available Nov 25

$R^2 = 0.92$

Based on 13 years of data (2002-2014)

Difference between VHI-based and final yield estimates



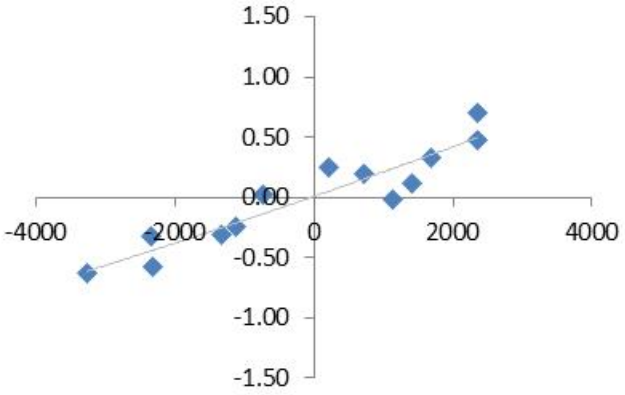
Diff ≤ 0.02 t/ha, 31% (4/13 years)
Diff ≤ 0.08 t/ha, 70% (9/13 years)
Diff ≤ 0.13 t/ha, 100% (13/13 years)

Current VHI-based estimate = 1.87 t/ha

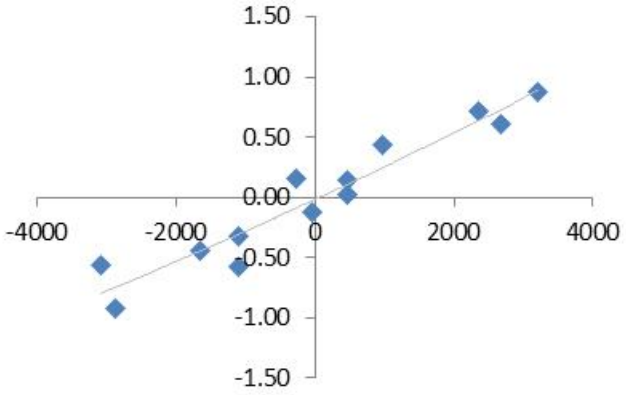
Vegetation Health Index vs. Wheat Yields

The relationship between VHI and wheat yields is strong in these states as well…

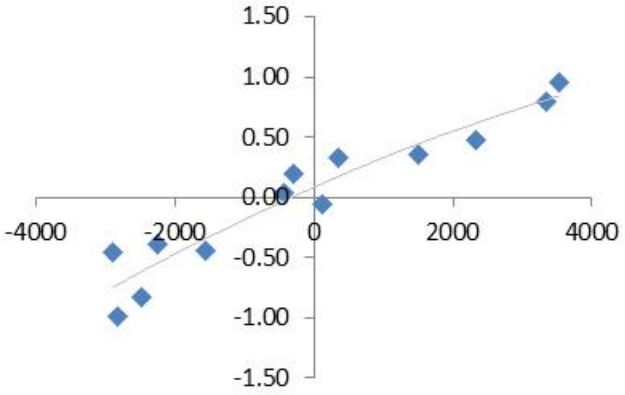
Western Australia: $R^2 = 0.87$ (week 44)



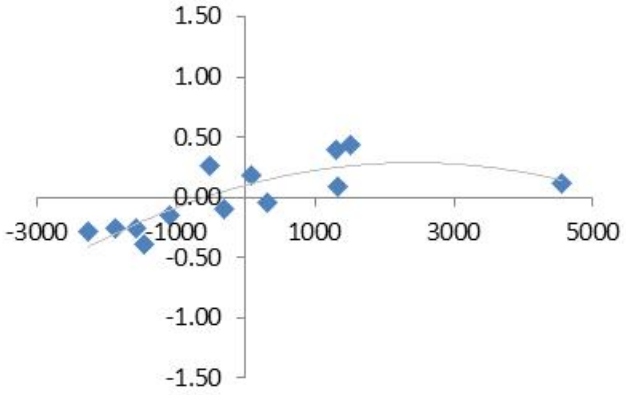
Victoria: $R^2 = 0.92$ (week 42)



New South Wales: $R^2 = 0.91$ (week 42)



Queensland: $R^2 = 0.70$ (week 42)



VHI-derived and ABARES Yield Estimates

Winter Wheat

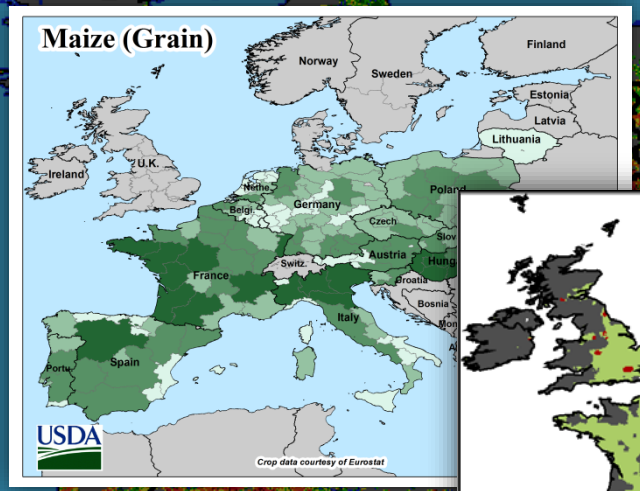
	ABARES area (ha)	VHI yield (t/ha) prod (Mt)	ABARES yield (t/ha) prod (Mt)
Western Australia	5,150,000	**1.71** 8.8	**1.69** 8.7
South Australia	2,360,000	**2.09** 4.9	**1.85** 4.4
Victoria	1,625,000	**1.61** 2.6	**1.54** 2.5
New South Wales	3,900,000	**2.08** 8.1	**1.82** 7.1
Queensland	750,000	**1.69** 1.3	**1.67** 1.3
National Estimate	13,785,000	***1.87*** 25.7	***1.74*** 24.0

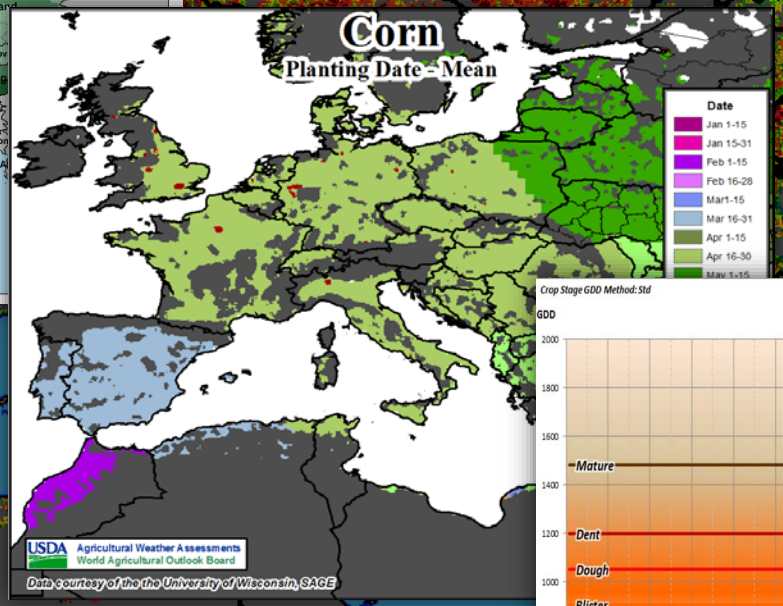
USDA **Agricultural Weather Assessments**
World Agricultural Outlook Board

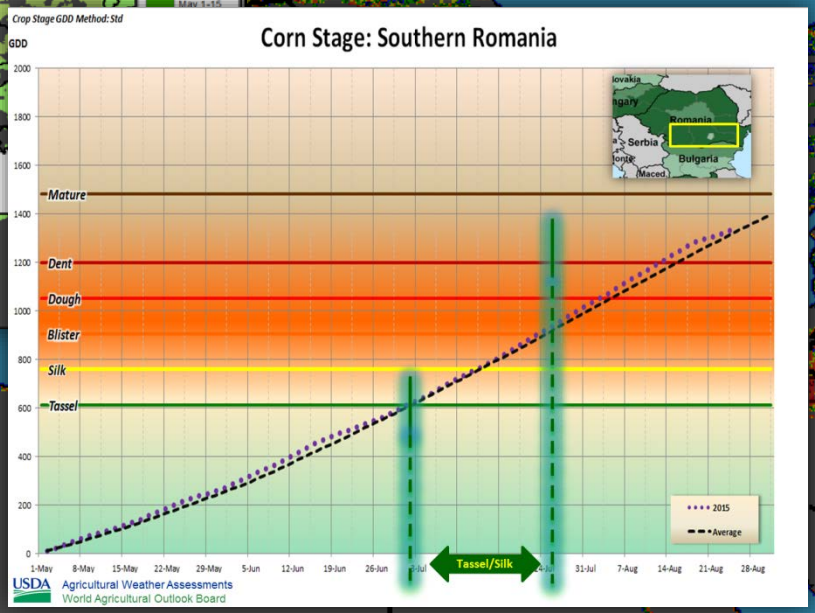
Vegetation Health Index

August 13, 2015

In order to accurately interpret satellite-derived imagery, it is imperative to know the crop-growing regions, crop calendars, and development stage.
WAOB meteorologists have acquired crop-production data, planting dates, and proven GDD-based methodology to assist this effort.







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Vegetation Health Index

June 17, 2017

Russia

Central

Volga

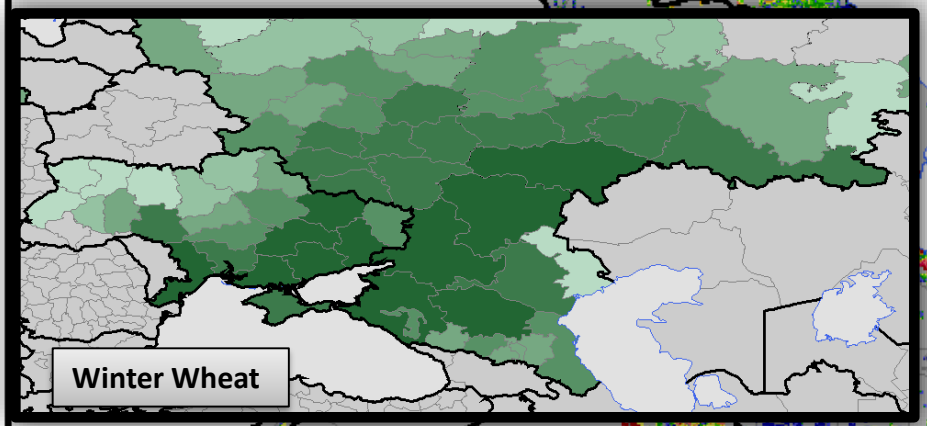
Ukraine

Southern

N. Caucasus

From the August 2017 Lockup:

"In mid- to late –June, as the crop was flowering (north) to filling (south), the VHI supported excellent – perhaps even record-setting – winter wheat yields for a second straight year."



VHI Value

85 - 100	Better
73 - 84	
61 - 72	
49 - 60	
37 - 48	
25 - 36	
13 - 24	
7 - 12	
1 - 6	Worse

Crop areas are unmasked

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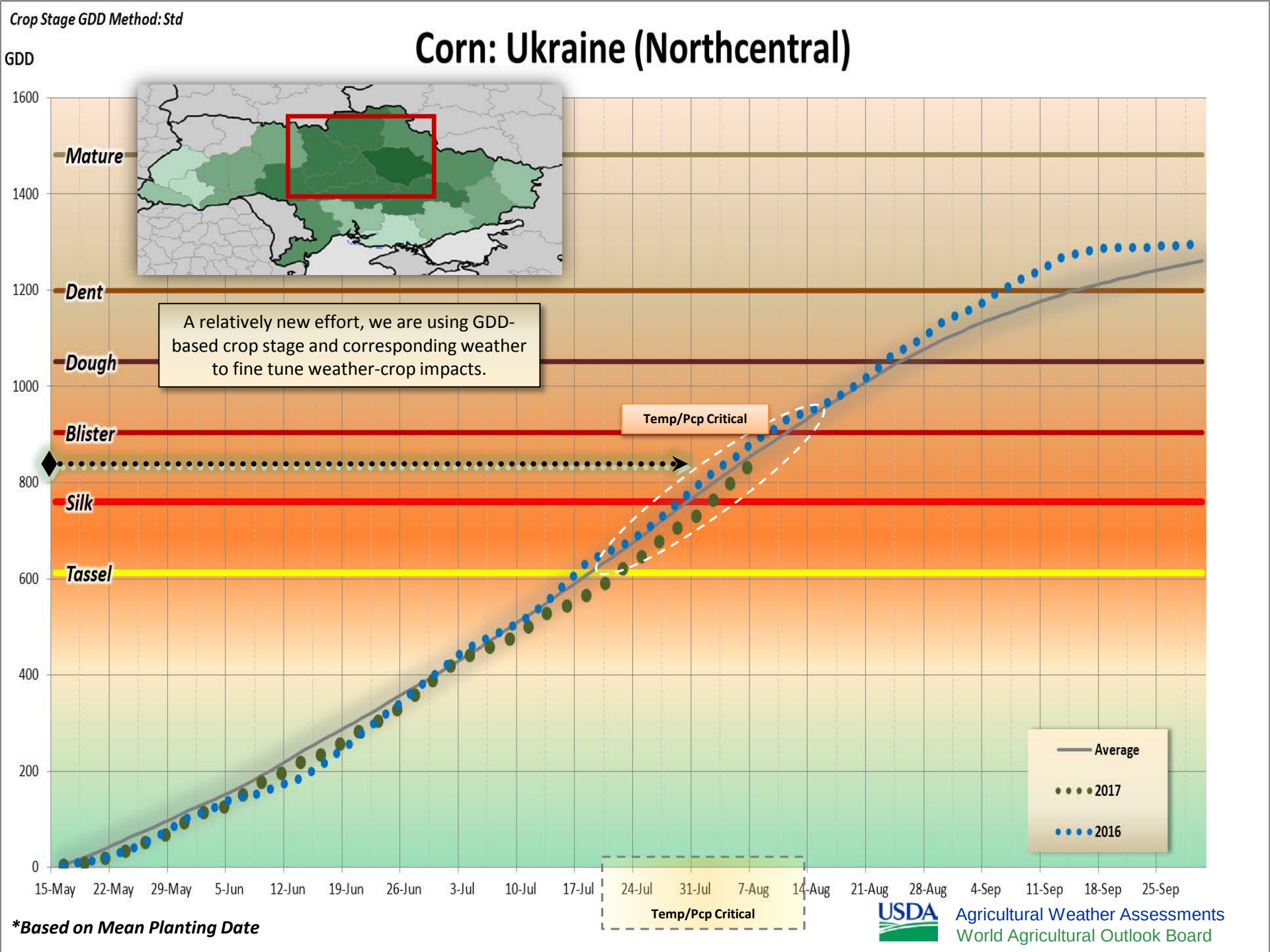
Crop Stage GDD Method: Std

Corn: Ukraine (Northcentral)



***Based on Mean Planting Date**

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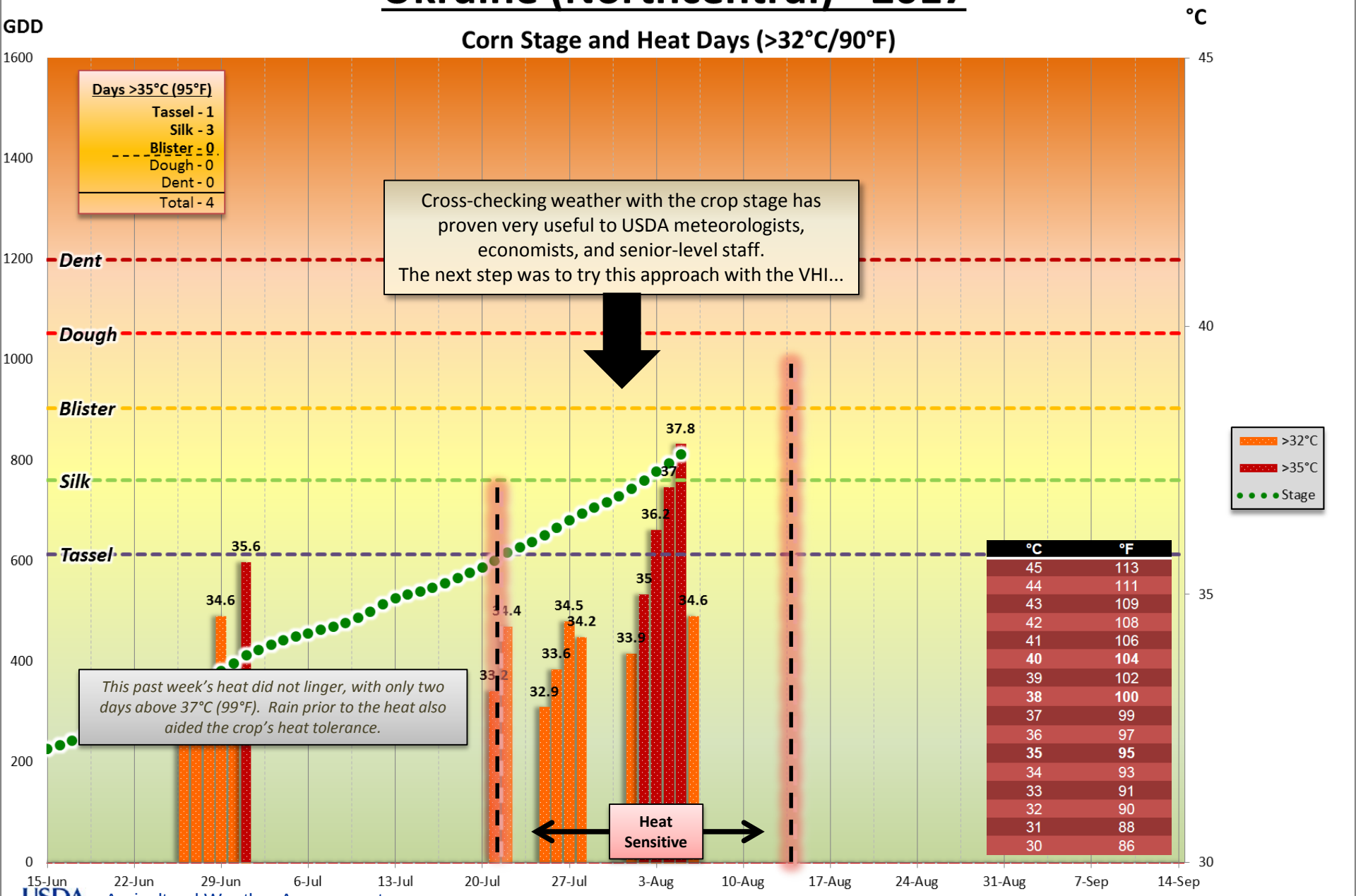
Crop Stage GDD Method: 0

Ukraine (Northcentral) - 2017



°C	°F
45	113
44	111
43	109
42	108
41	106
40	**104**
39	102
38	**100**
37	99
36	97
35	**95**
34	93
33	91
32	90
31	88
30	86

GDD data NC Ukraine

Date	2017	Average	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994
Years Back >			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
15-May-17	0.0	0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-May-17	4.5	5.9	4.4	1.9	11.2	11.2	10.2	5.6	9.5	2.2	4.1	9.9	3.4	5.3	0	9.5	6.8	5.2	5.7	1.7	1.7	11.9	10	0	6.2
17-May-17	[illegible]	[illegible]	[illegible]	[illegible]	23.1	22.4	17.7	11.5	16.4	6.8	11.1	20	9	12	1.4	12.3	12.6	12	7.8	2.2	6	19.6	20.8	1.4	14.5
18-May-17	[illegible]	[illegible]	[illegible]	[illegible]	33.1	33.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	18.1	20	13.6	2.2	11.7	24.3	31.8	5.3	25.7
19-May-17	[illegible]	[illegible]	[illegible]	[illegible]	44.9	45	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	26.8	21.1	3	17.8	30.9	43.5	10.9	37.6
20-May-17	[illegible]	[illegible]	[illegible]	[illegible]	55.8	56.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30.5	25.3	7.6	24.2	40	55.9	18.3	49.1
21-May-17	[illegible]	[illegible]	[illegible]	[illegible]	66.9	68.1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20	33.4	31.1	11.1	28.9	46	68.3	24.8	58.6
22-May-17	[illegible]	[illegible]	[illegible]	[illegible]	77.8	77.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35.8	34.2	16.2	34.3	53.7	71.1	32.3	63.4
23-May-17	28.7	53.1	32	51.8	89.9	86.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	35.8	39.9	22.1	34.8	63	73.7	39.1	65.7
24-May-17	37.9	59.8	38	62.7	103.2	98	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	36.5	46	28.5	34.8	65	77.4	49.7	71.5
25-May-17	45.5	66.5	45	73.8	116.7	106.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	43	52.9	36.1	37.3	65.3	82.2	58.5	76.3
26-May-17	52.5	73.2	53.3	86	130.1	114.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27-May-17	58.9	80.1	62.4	97.1	142.8	124	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
28-May-17	65.4	87.3	72.2	104.2	155.1	130.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
29-May-17	74.8	94.5	82.4	109.3	166.2	137.3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	84	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

VHI data (Poltava)

YEAR	VEE	SMN	SMT	VCI	TCI	VHI
1981	35	0.238	291.57	11.48	2238:14:24	52.37
1981	36	0.244	291.61	19.94	82.23	51.08
1981	37	0.25	291.4	31.42	66.43	48.92
1981	38	0.254	290.75	43.65	54.65	49.15
1981	39	0.254	289.5	53.91	46.28	50.1
1981	40	0.249	287.54	62.42	42.35	52.39
1981	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56.65
1981	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	62.33
1981	43	0.197	278.33	74.28	56.38	65.33
1981	44	0.168	274.71	70.1	56.26	63.18
1981	45	0.135	270.2	60.35	63.15	61.75
1981	46	0.11	266.14	53.81	67.08	60.44
1981	47	0.091	262.73	49.77	68.47	59.12
1981	48	0.079	260.21	49	69.83	59.41
1981	49	0.069	257.97	46.06	72.3	59.18
1981	50	0.063	256.36	46.99	70.76	58.87
1981	51	0.057	255.15	47.33	69.52	58.43
1981	52	0.049	254.76	46.37	66.55	56.46
1982	1	0.044	255.31	46.66	61.44	54.05
1982	2	0.042	257.37	45.34	51.39	48.37
1982	3	0.041	259.08	43.25	45.76	44.5
1982	4	0.039	260.68	41.6	41.89	41.74
1982	5	0.037	261.76	37	41.55	39.27

GDD Cutoffs

Tassel	Silk	Blister	Dough	Dent	Mature
613	760	[illegible]	[illegible]	1199	1482

Expanding on this technique, we are using Wx data & corresponding GDD-based **crop stage** in conjunction with VHI admin-level ascii data and extracting a **stage-specific VHI**.

Stage-specific VHI & Wx

A	B	C	D	E	F	G	H	I	J	K
Date	2017	Avg	2016	2015	2014	2013	2012	2011	2010	2009
Years Back >			1	2	3	4	5	6	7	8
Week @ Stage	32	33	32	32	31	31	31	32	30	32
VHI @ Stage	#N/A	#N/A	71.22	68.63	51.43	56.32	43.58	70.75	38.03	57.39
SumPcp @ Stages	1854.80	15529.49	9943.40	8197.00	10601.20	8490.70	6733.30	13816.90	5593.70	9571.70
AvgPcp @ Stages	109.11	218.73	194.97	167.29	216.35	139.19	143.26	255.87	164.52	159.53
AvgTmax @ Stages	33.02	27.22	31.00	31.82	31.33	28.49	32.09	29.92	36.02	28.53
AvgTmin @ Stages	15.38	10.71	12.95	12.43	12.93	11.84	14.16	13.06	17.88	11.27
QC [illegible]	[illegible]	8/14	8/8	8/10	8/5	8/5	8/1	8/6	7/29	8/11
QC [illegible]	[illegible]	33	32	32	31	31	31	32	30	32
QC - VHI @ Stage (prev Row)	#N/A	#N/A	71.22	68.63	51.43	56.32	43.58	70.75	38.03	57.39
QC Week# (Compute via GDD!)	32	33	32	32	31	31	31	32	30	32

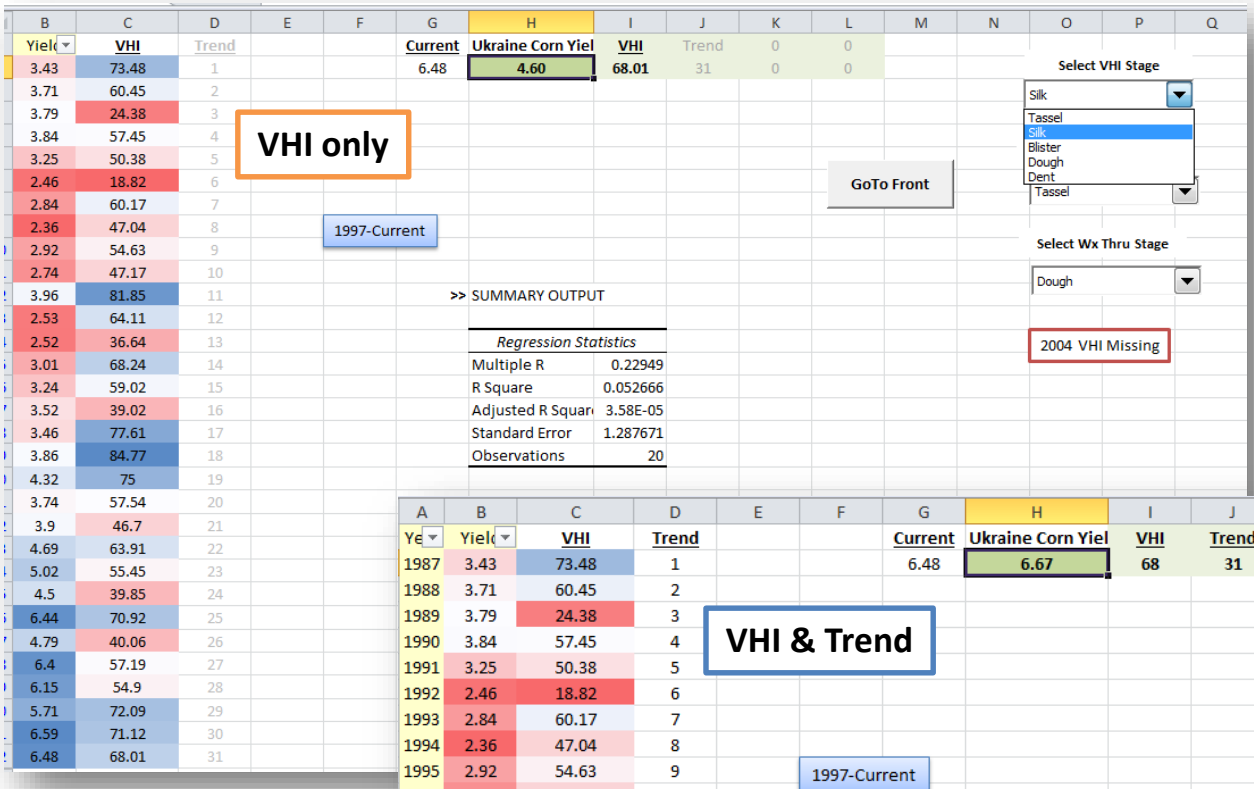
Select VHI Stage

Blister

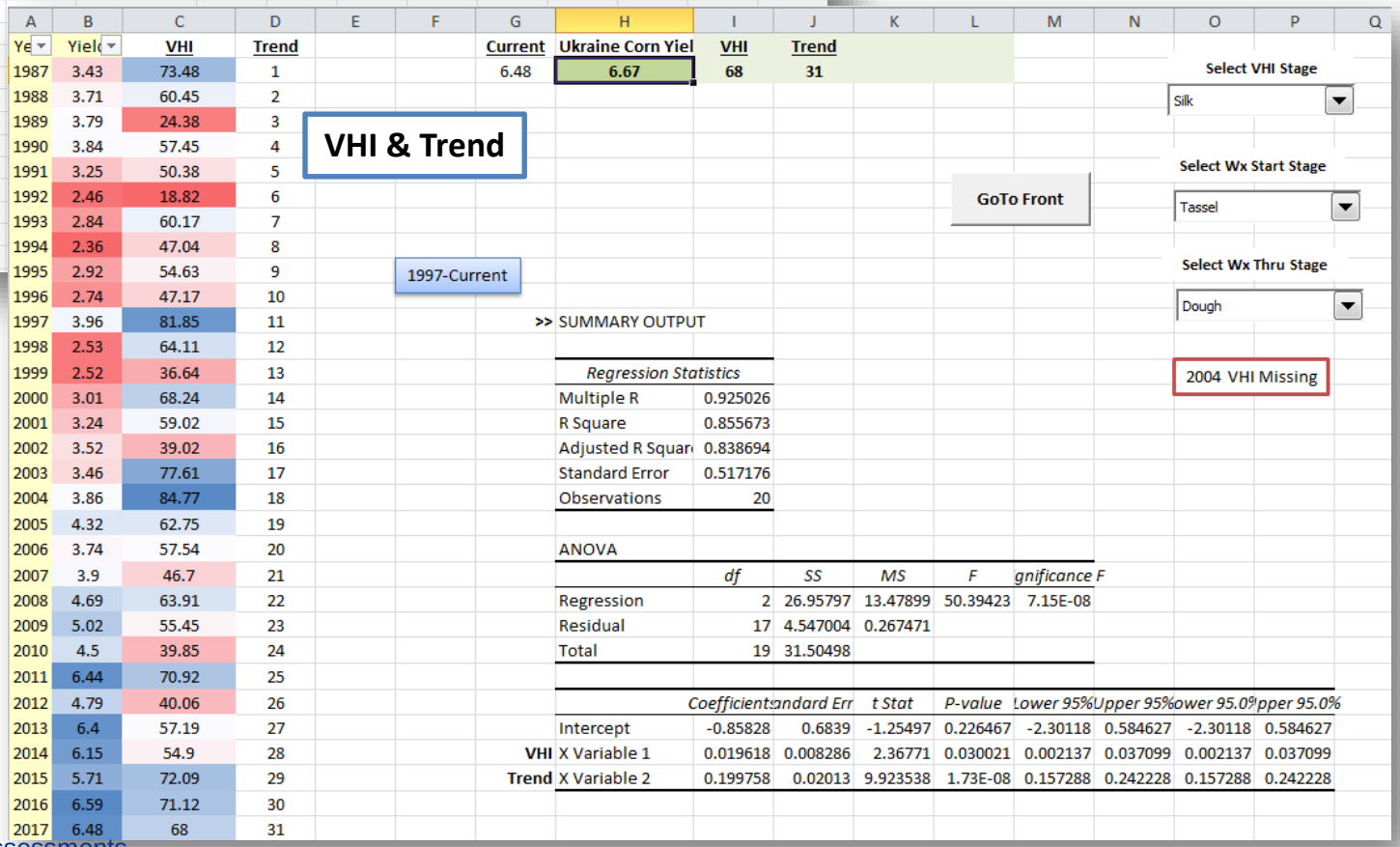
- Tassel
- Silk
- Blister
- Dough
- Dent

Select Wx Thru Stage

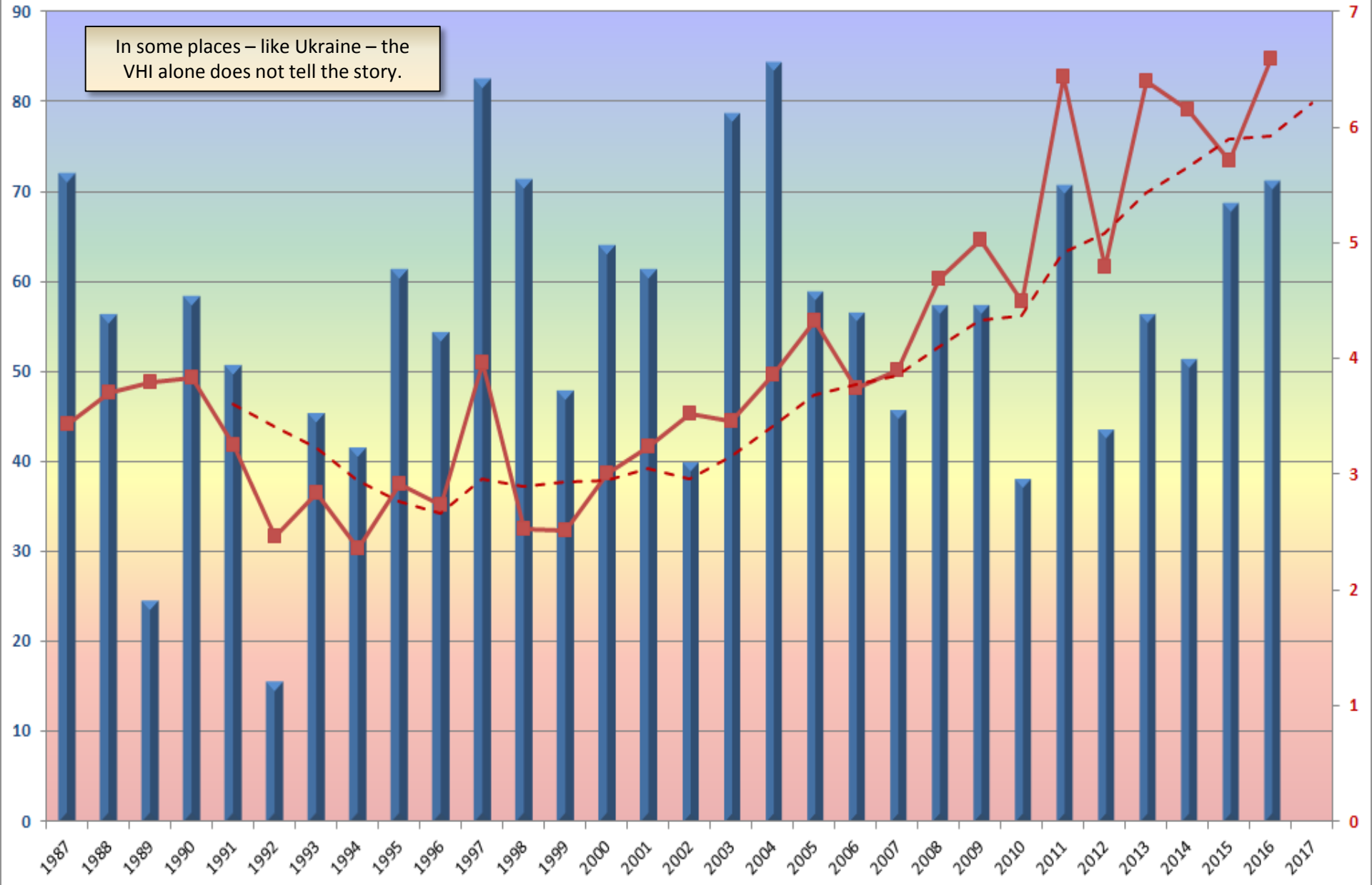
Dough



Scenarios (VHI @ various crop stages) are tested, looking for the best fit. In the case of Ukraine, the VHI alone (left) does not score well, but when paired with trend (below) it scores very high at Silk and Blister.



Ukraine VHI for Corn @ Blister



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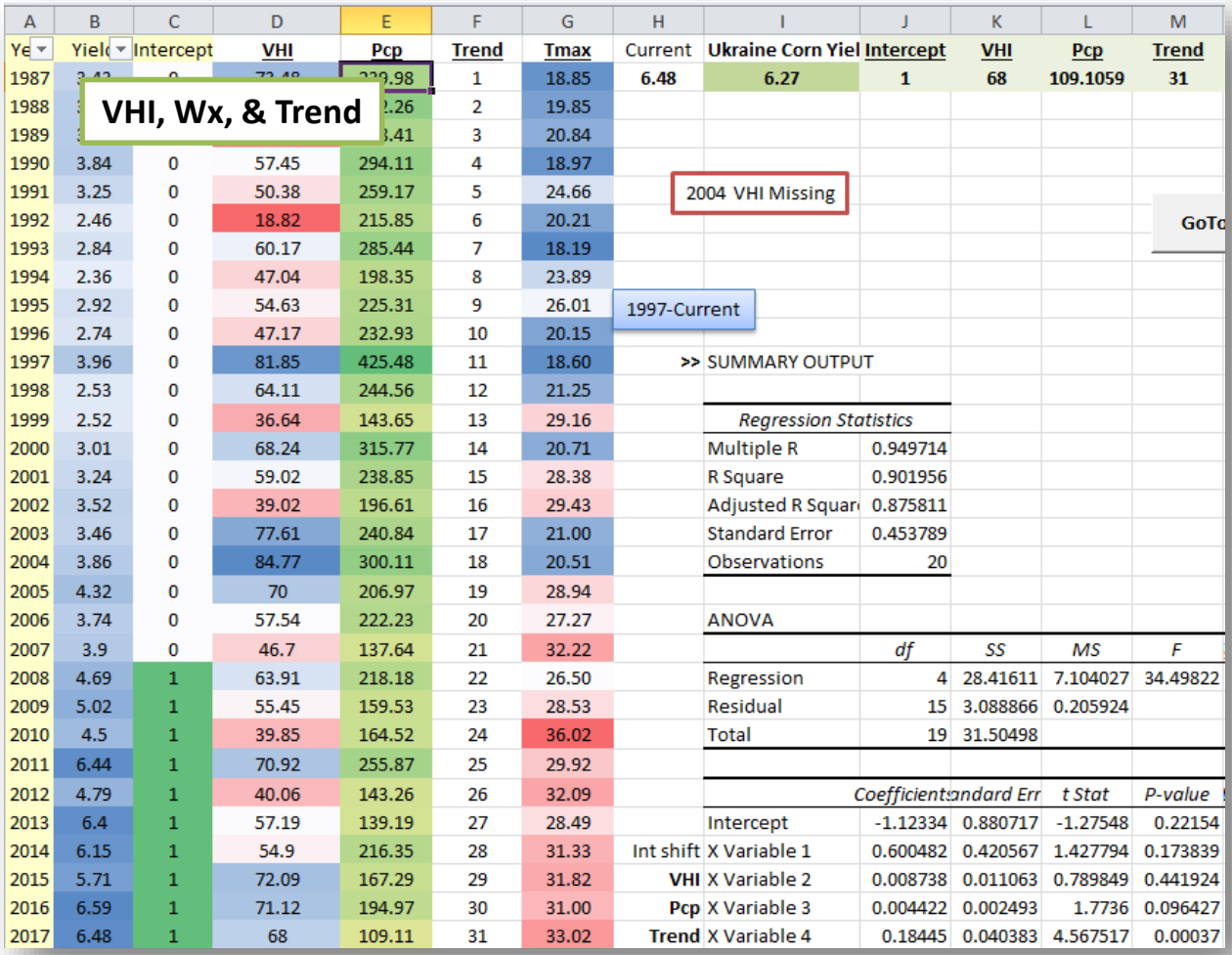
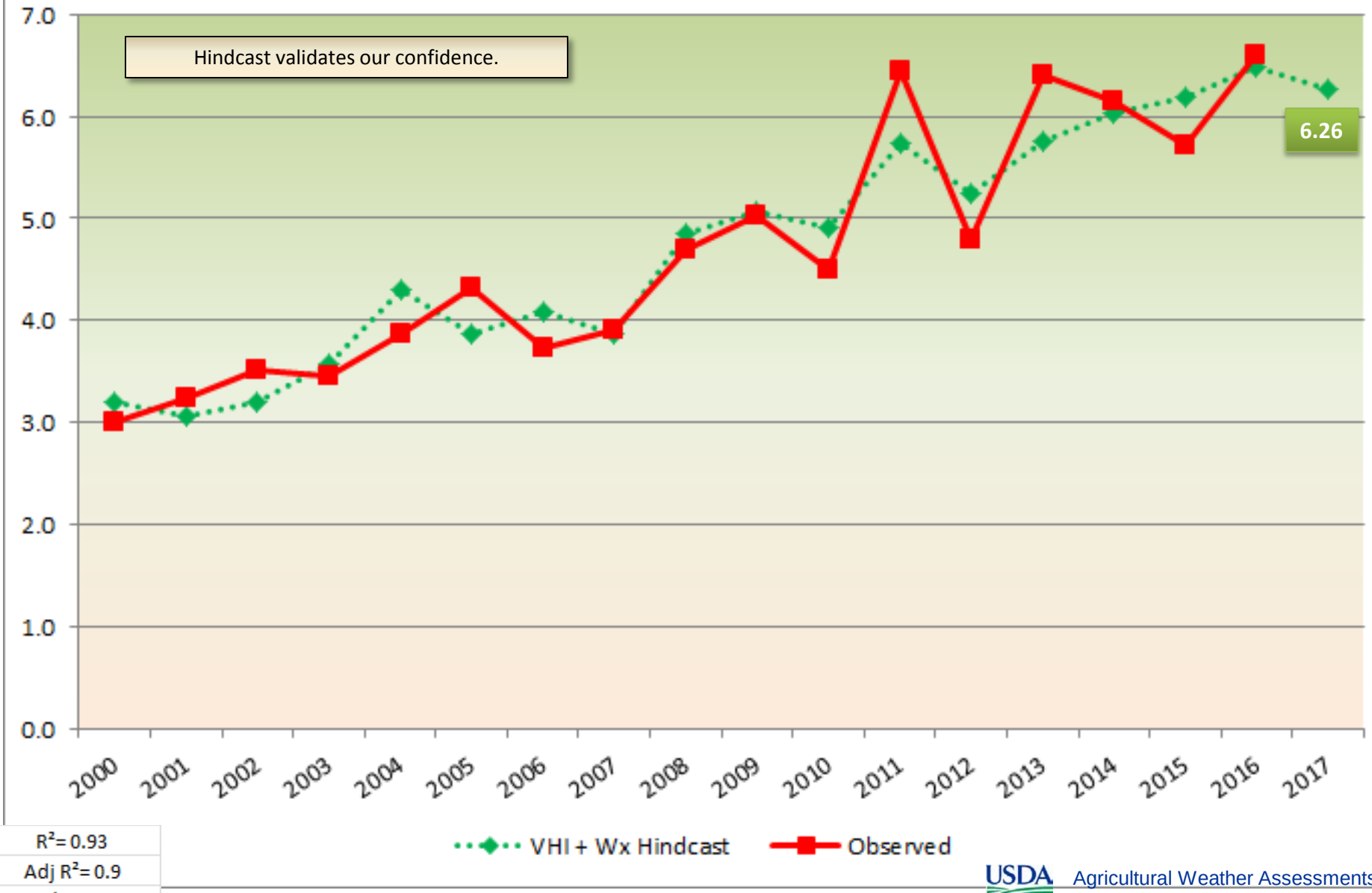


Ye	Yield	Intercept	VHI	Pcp	Trend	Tmax	Current	Ukraine Corn Yiel	Intercept	VHI	Pcp	Trend
1987	[illegible]	0	[illegible]	[illegible]98	1	18.85	6.48	6.27	1	68	109.1059	31
1988	[illegible]	0	[illegible]	[illegible].26	2	19.85						
1989	[illegible]	0	[illegible]	[illegible].41	3	20.84						
1990	3.84	0	57.45	294.11	4	18.97						
1991	3.25	0	50.38	259.17	5	24.66						
1992	2.46	0	18.82	215.85	6	20.21						
1993	2.84	0	60.17	285.44	7	18.19						
1994	2.36	0	47.04	198.35	8	23.89						
1995	2.92	0	54.63	225.31	9	26.01						
1996	2.74	0	47.17	232.93	10	20.15						
1997	3.96	0	81.85	425.48	11	18.60						
1998	2.53	0	64.11	244.56	12	21.25						
1999	2.52	0	36.64	143.65	13	29.16						
2000	3.01	0	68.24	315.77	14	20.71						
2001	3.24	0	59.02	238.85	15	28.38						
2002	3.52	0	39.02	196.61	16	29.43						
2003	3.46	0	77.61	240.84	17	21.00						
2004	3.86	0	84.77	300.11	18	20.51						
2005	4.32	0	70	206.97	19	28.94						
2006	3.74	0	57.54	222.23	20	27.27						
2007	3.9	0	46.7	137.64	21	32.22						
2008	4.69	1	63.91	218.18	22	26.50						
2009	5.02	1	55.45	159.53	23	28.53						
2010	4.5	1	39.85	164.52	24	36.02						
2011	6.44	1	70.92	255.87	25	29.92						
2012	4.79	1	40.06	143.26	26	32.09						
2013	6.4	1	57.19	139.19	27	28.49						
2014	6.15	1	54.9	216.35	28	31.33						
2015	5.71	1	72.09	167.29	29	31.82						
2016	6.59	1	71.12	194.97	30	31.00						
2017	6.48	1	68	109.11	31	33.02						

The VHI (@ onset of Blister) paired with Wx, Trend, as well as an adjustment for a technology shift ~ 2007, shows significant skill.

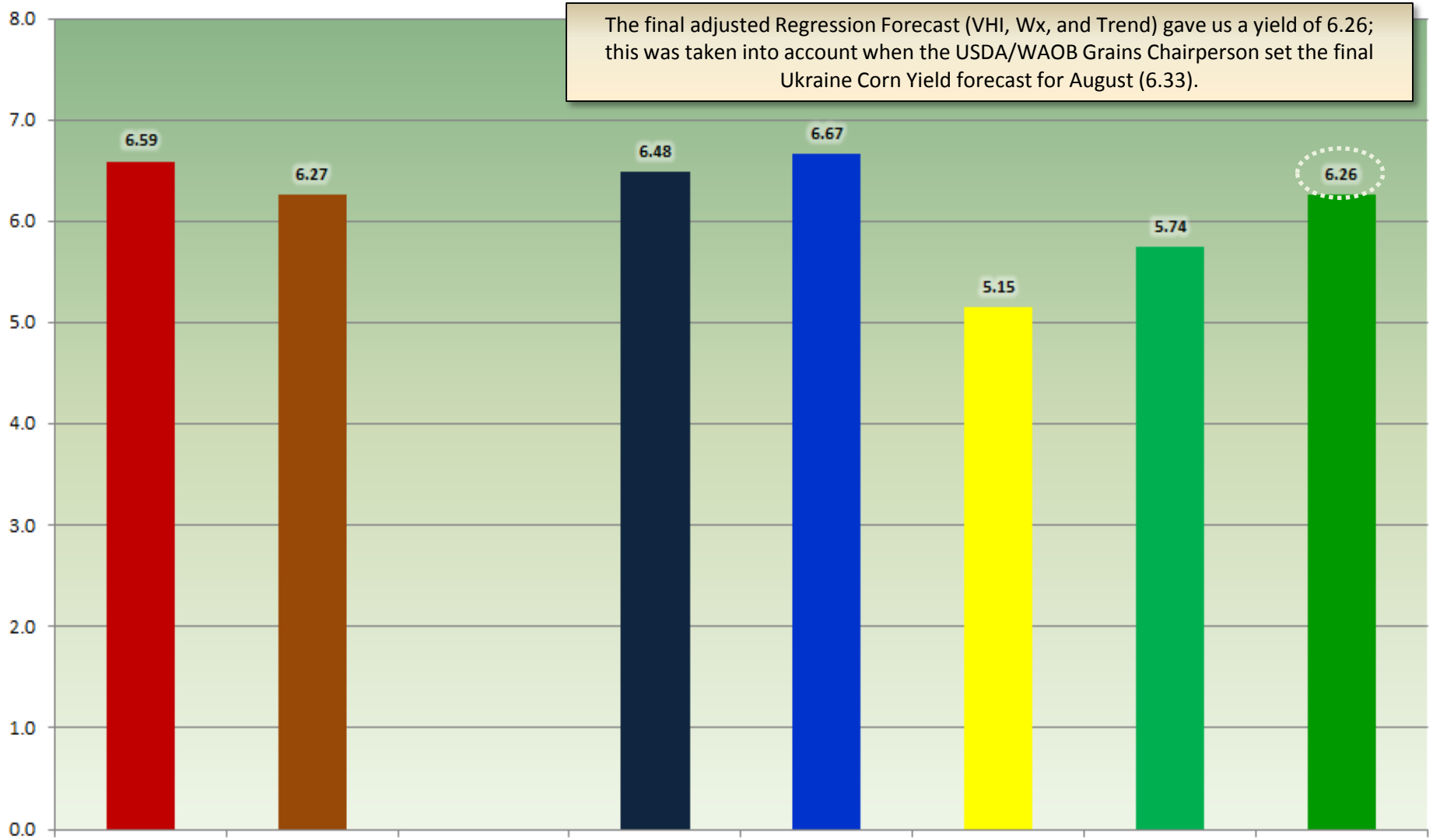
Regression: VHI & Wx (Intercept Adjustment)



$R^2 = 0.93$
Adj $R^2 = 0.9$
+/- 0.41

Ukraine Corn Yield

The final adjusted Regression Forecast (VHI, Wx, and Trend) gave us a yield of 6.26; this was taken into account when the USDA/WAOB Grains Chairperson set the final Ukraine Corn Yield forecast for August (6.33).



*Includes Trend

Thank You !

mbrusberg@oce.usda.gov