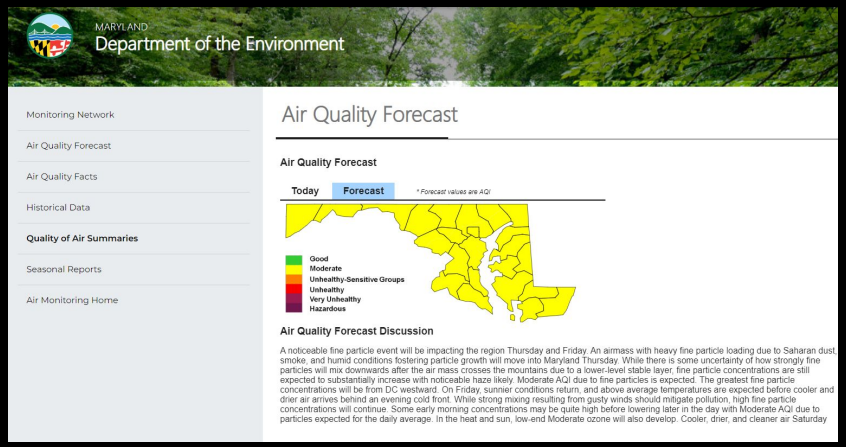
Operational Applications of the VHI for Real-Time Crop Yield Modeling and Assessments at USDA's World Agricultural Outlook Board

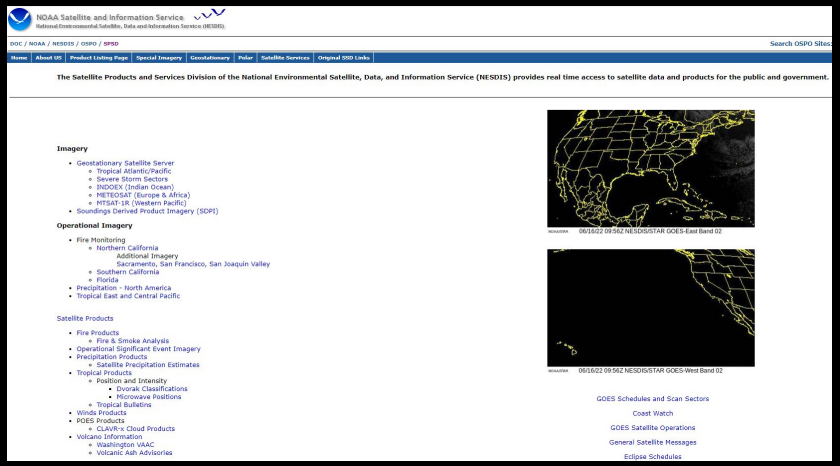
Eric Luebehusen

Meteorologist
USDA/OCE/WAOB

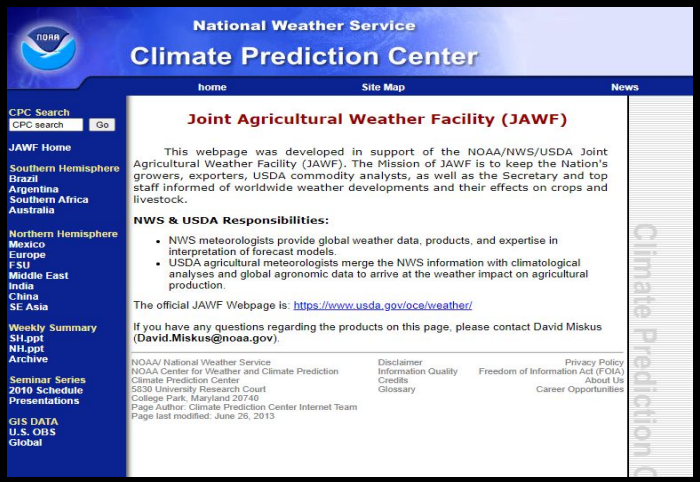
Background & History…



1993-1999; **MDE**: Air Quality Modeling and Forecasting.

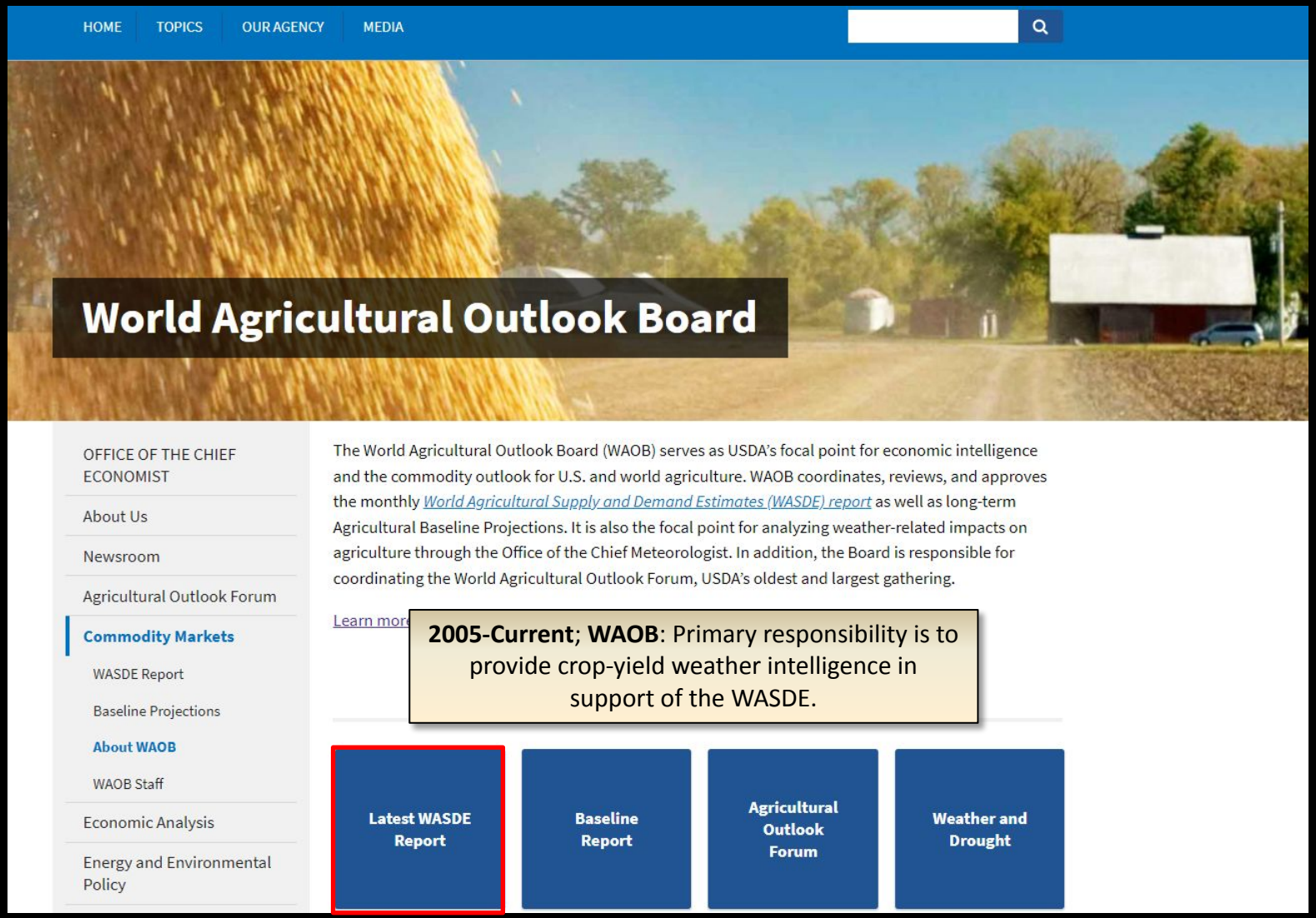


1999; NESDIS-SAB: Operational Meteorologist using satellite imagery for DVORAK, VAAC, Flooding, Special Events.



1999-2005; **NOAA-NWS-CPC**: JAWF (@ USDA) covering weather in SOA, SEA, AUS

2005-Current: USDA-OCE-WAOB



2005-Current: USDA-OCE-WAOB

WASDE: Market-sensitive document released by the 12th of every month detailing the latest US and global crop situational outlook.

"*Trading Places*"

USDA United States Department of Agriculture

World Agricultural Supply and Demand Estimates

ISSN: 1554-9089

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

WASDE - 625 | Approved by the World Agricultural Outlook Board | June 10, 2022

WHEAT: The outlook for 2022/23 U.S. wheat this month is for increased supplies, unchanged domestic use and exports, and higher stocks. Supplies are raised on higher production with all wheat production projected at 1,737 million bushels, up 8 million from last month. NASS raised winter wheat production to 1,182 million bushels as increases for Soft Red Winter and White Winter more than offset a reduction for Hard Red Winter. The all wheat yield is 46.9 bushels per acre, up 0.3 bushels from last month. Projected 2022/23 ending stocks are raised 8 million bushels to 627 million, still down 4 percent from 2021/22. The projected 2022/23 season-average farm price is unchanged at $10.75 per bushel, compared to $7.70 for 2021/22.

The global wheat outlook for 2022/23 is for lower supplies, reduced consumption, fractionally lower trade, and slightly lower ending stocks. Supplies are decreased by 1.7 million tons to 1,052.8 million as lower India production more than offsets an increase for Russia. India's production is lowered 2.5 million tons to 106.0 million as extreme temperatures in March and April reduced yields during grain fill. Russia's production is raised 1.0 million tons to 81.0 million with all of the increase in winter wheat on generally favorable weather conditions to date. Projected 2022/23 world consumption is reduced 1.5 million tons to 786.0 million mainly on lower feed and residual use for India and less food, seed, and industrial use for Sri Lanka and Argentina.

Projected 2022/23 global trade is decreased 0.3 million tons to 204.6 million as lower exports from India are not completely offset by higher exports from Russia and Uzbekistan. India's exports are reduced 2.0 million tons to 6.5 million as the government intends to restrict exports to some destinations to ensure sufficient domestic supplies. Russia's exports are raised 1.0 million tons to 40.0 million, which would be the second largest on record. Russia's supplies are projected higher for 2022/23 and its export prices are more competitive than most other exporters. Projected 2022/23 world ending stocks are lowered 0.2 million tons to 266.9 million, a six-year low.

COARSE GRAINS: This month's 2022/23 U.S. corn outlook is for larger beginning stocks, slightly higher use, and increased ending stocks. Corn area and yield forecasts are unchanged. USDA will release its *Acreage* report on June 30, which will provide survey-based indications of planted and harvested area. Beginning stocks are up 45 million bushels mostly reflecting a forecast decline in exports for 2021/22. Exports are lowered 50 million

- **Weekly weather assessments** and write ups for the WWCB
- Monthly or as-needed **weather briefings** detailing latest crop-weather information
- Operational **yield modeling** updated weekly in support of the WASDE

USDA Agricultural Weather Assessments
World Agricultural Outlook Board

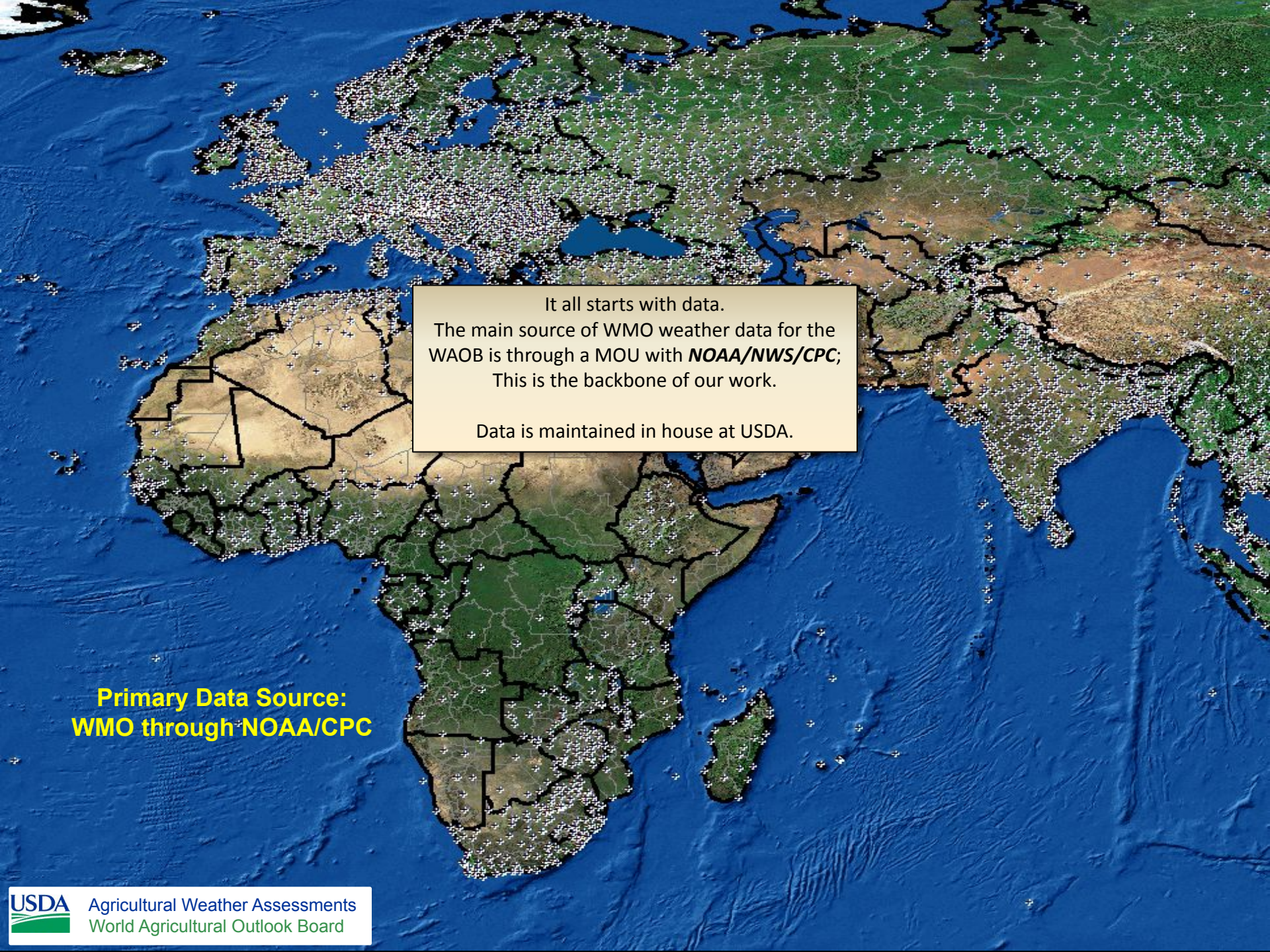
Iran Wheat:	2.50	2.24	2.21	0.94	2.21	2.24	2.21 - 2.28	2006-2020	6/16/2021	2.38	2.28	2.51
Iraq Wheat:	1.93	1.80	1.78	0.86	1.78	1.75	1.72 - 1.78	1999-2020	6/16/2021	1.86	1.86	2.00
Uzbekistan Wheat:	4.65	4.29	4.17	0.82	4.60	4.73	4.17 - 4.87	2011-2020	6/16/2021	5.18	4.68	5.11
Turkey Barley:	2.13	1.35	1.64	0.82	1.62	1.72	1.62 - 1.87	2009-2020	8/26/2021	1.95	1.89	2.19
Syria Barley:	1.27	0.85	0.76	0.99	0.78	0.91	0.76 - 1.24	2014-2020	6/15/2021	1.35	0.98	1.54
Iran Barley:	2.21	1.76	1.73	0.83	1.73	1.83	1.73 - 1.95	1995-2020	6/15/2021	2.03	2.04	2.21
Iraq Barley:	1.29	1.18	1.24	0.99	1.23	1.37	1.23 - 1.42	2010-2020	6/16/2021	1.44	1.29	1.33
Turkey Corn:	11.45								21	11.82	10.68	11.76
Turkey Sunflowers:	2.17								21	2.50	2.30	2.52
Turkey Cotton:	1804.00								21	1715.00	1657.00	1853.00
Uzbekistan Cotton:	782.00								21	729.00	709.00	871.00
Turkmenistan Cotton:	368.00								21	348.00	433.00	710.00
Tajikistan Cotton:	680.00								21	639.00	626.00	939.00
Kazakhstan Cotton:	534.00								21	607.00	568.00	849.00
Morocco Wheat:	0.93								21	1.83	1.66	2.54
Algeria Wheat:	1.88								21	1.77	1.74	1.90
Tunisia Wheat:	2.01								21	2.15	2.03	2.44
Morocco Barley:	0.44								21	1.11	1.02	1.83
Algeria Barley:	1.80								21	1.86	1.61	1.95
Tunisia Barley:	1.28								21	1.42	1.28	1.94

Over the past several years, the ability to quantify crop stages using Growing Degree Days (GDDs) and match them with the VHI and Weather (Wx) data have led to an ever-expanding crop-yield modeling effort at USDA-WAOB.

I am currently running 126 operational international crop-country yield regression forecast suites (7 forecasts each workbook).

I have also added 43 for the US.

5/3/2022		Quick R^2 Stats:				Number at or Above R^2 Thresholds:			
Crop	Total	Avg R^2	Median R^2	Best R^2	Worst R^2	0.50	0.70	0.80	0.90
EUR Barley	12	0.85	0.89	0.96	0.67	12	11	9	5
EUR Corn	14	0.86	0.90	0.96	0.67	14	12	11	7
EUR Rapeseed	13	0.84	0.84	0.98	0.58	13	12	10	5
EUR Soybeans	8	0.84	0.85	0.96	0.76	8	8	6	1
EUR Sunflowers	10	0.85	0.86	0.98	0.66	10	9	7	4
EUR Wheat	17	0.88	0.88	0.95	0.79	17	17	16	6
FSU All	22	0.90	0.91	0.99	0.64	22	21	21	14
MID All	24	0.90	0.92	1.00	0.69	24	23	23	13
NAF All	6	0.90	0.88	0.90	0.74	6	6	5	2
						126	*119*	*108*	*57*
All Regression:	*126*	*0.87*	*0.89*	*1.00*	*0.58*	*100% > 0.5*	*94% > 0.7*	*86% > 0.8*	*45% > 0.9*


It all starts with data.
The main source of WMO weather data for the WAOB is through a MOU with ***NOAA/NWS/CPC***;
This is the backbone of our work.
Data is maintained in house at USDA.
Primary Data Source:
WMO through NOAA/CPC
USDA
Agricultural Weather Assessments
World Agricultural Outlook Board

FID	Shape *	WMO	LATITUDE	LONGITUDE	PRECIP	TAVG	TMAX	TMIN	NPRECIP	NTAVG	TANOM	PNP	PANOM
133	Point	01001	70.93	-8.67	2	-2	2	-6	10	-4	2	20	-8
134	Point	01002	80.02	16.25	0	-10	-8	-13	-9999	-9999	-9999	-9999	-9999
135	Point	01003	77	15.5	0	-9	-5	-12	-9999	-9999	-9999	-9999	-9999
138	Point	01006	78.25	22.83	0	-11	-7	-15	-9999	-9999	-9999	-9999	-9999
139	Point	01007	78.92	11.93	2	-10	-6	-14	-9999	-9999	-9999	-9999	-9999
140	Point	01008	78.25	15.47	0	-10	-6	-16	2	-11	1	0	-2
141	Point	01009	80.67	20.85	0	-11	-5	-13	-9999	-9999	-9999	-9999	-9999
142	Point	01010	69.3	16.15	0	2	6	-2	17	1	1	0	-17
143	Point	01011	80.08	31.38	0	-10	-2	-15	-9999	-9999	-9999	-9999	-9999
145	Point	01015	69.6	17.83	0	2	6	-2	-9999	-9999	-9999	-9999	-9999
147	Point	01017	69.35	18.08	0	-8	-5	-11	13	1	-9	0	-13
148	Point	01023	69.05	18.55	3	0	7	-9	8	0	0	38	-5
149	Point	01025	69.68	18.92	4	1	5	-4	14	1	0	29	-10
150	Point	01026	69.65	18.94	2	1	6	-4	-9999	-9999	-9999	-9999	-9999
151	Point	01028	74.52	19.02	3	-4	-1	-9	6	-5	1	50	-3
153	P												-11
155	P												-10
157	P												-17
158	P												-9999
159	P												-9999
160	P												0
161	P												-3
163	P												-2
165	P												-15
166	P												-9999
167	P												-4
169	P												-7
171	P												-1
174	P												-9999
175	P												-11
177	P												-7
178	P												-9999
179	P												-9999
181	P												-9999
182	P												-4
183	Point	01092	70.7	30.08	0	1	5	-5	8	-1	2	0	-8
185	Point	01098	70.37	31.1	4	1	5	-4	9	-1	2	44	-5
186	Point	01102	65.2	11	0	5	8	1	12	4	1	0	-12
191	Point	01108	65.7	11.85	15	4	8	-4	-9999	-9999	-9999	-9999	-9999
194	Point	01112	65.47	12.22	0	5	10	-1	13	4	1	0	-13
196	Point	01115	66.75	12.48	14	4	7	0	15	4	0	93	-1
197	Point	01116	65.97	12.47	0	4	9	-3	-9999	3	1	-9999	-9999
198	Point	01121	66.37	12.62	0	4	9	0	19	3	1	0	-19
199	Point	01122	65.78	13.22	3	3	9	-7	-9999	2	1	-9999	-9999
204	Point	01139	67.68	12.68	0	3	6	-1	-9999	-9999	-9999	-9999	-9999
205	Point	01141	68.15	13.62	0	3	8	-3	-9999	2	1	-9999	-9999
207	Point	01147	65.52	14.02	8	1	7	-12	-9999	-9999	-9999	-9999	-9999
				14.3	0	2	8	-9	-9999	1	1	-9999	-9999
				14.37	3	4	8	-3	13	2	2	23	-10
				14.65	2	3	6	-1	10	2	1	20	-8
214	Point	01161	68.25	14.67	0	3	8	-2	17	2	1	0	-17

- 10,000+ stations
- Dates back to 1980
- 120,000,000 lines of data and counting
- Additional SQL database server for domestic data
- Global dataset is supplemented with national-level data

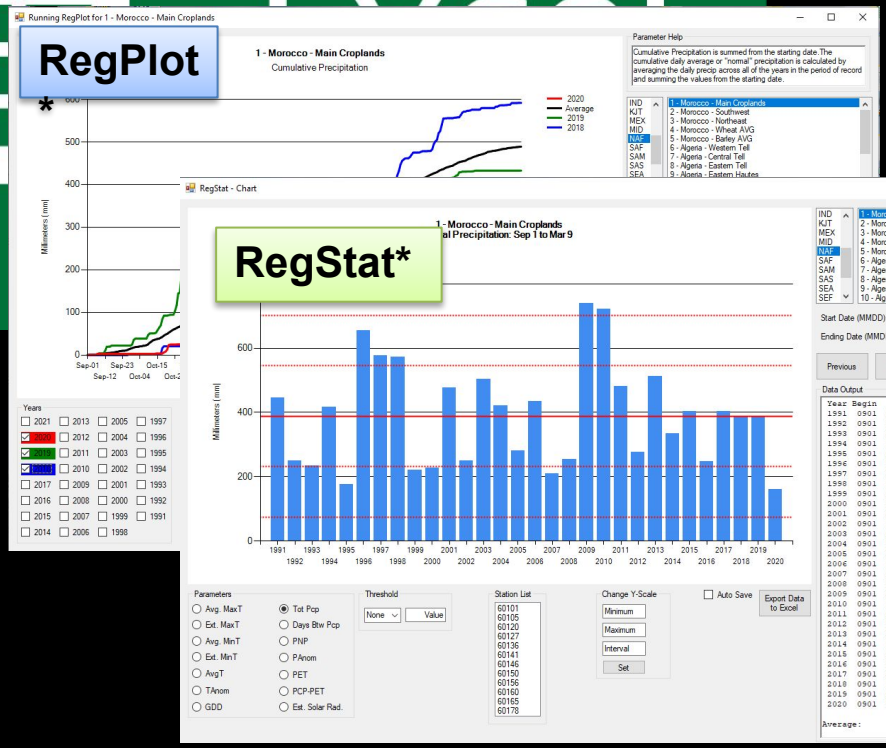
- It's a LOT of daily Wx data!

ORACLE®

ArcG

Much of the data analysis and visualization developmental work has been done in ***Excel***.

Excel

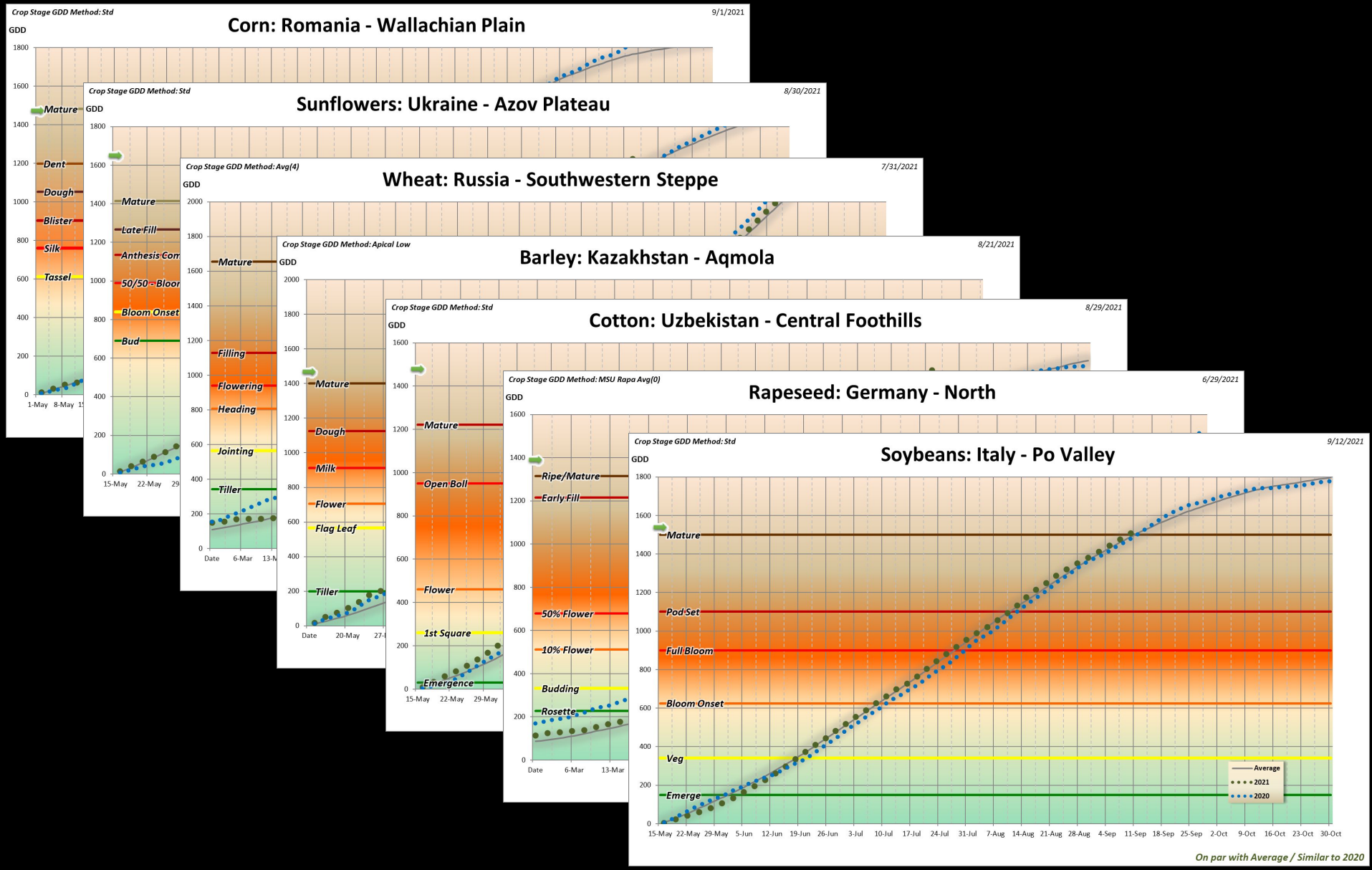


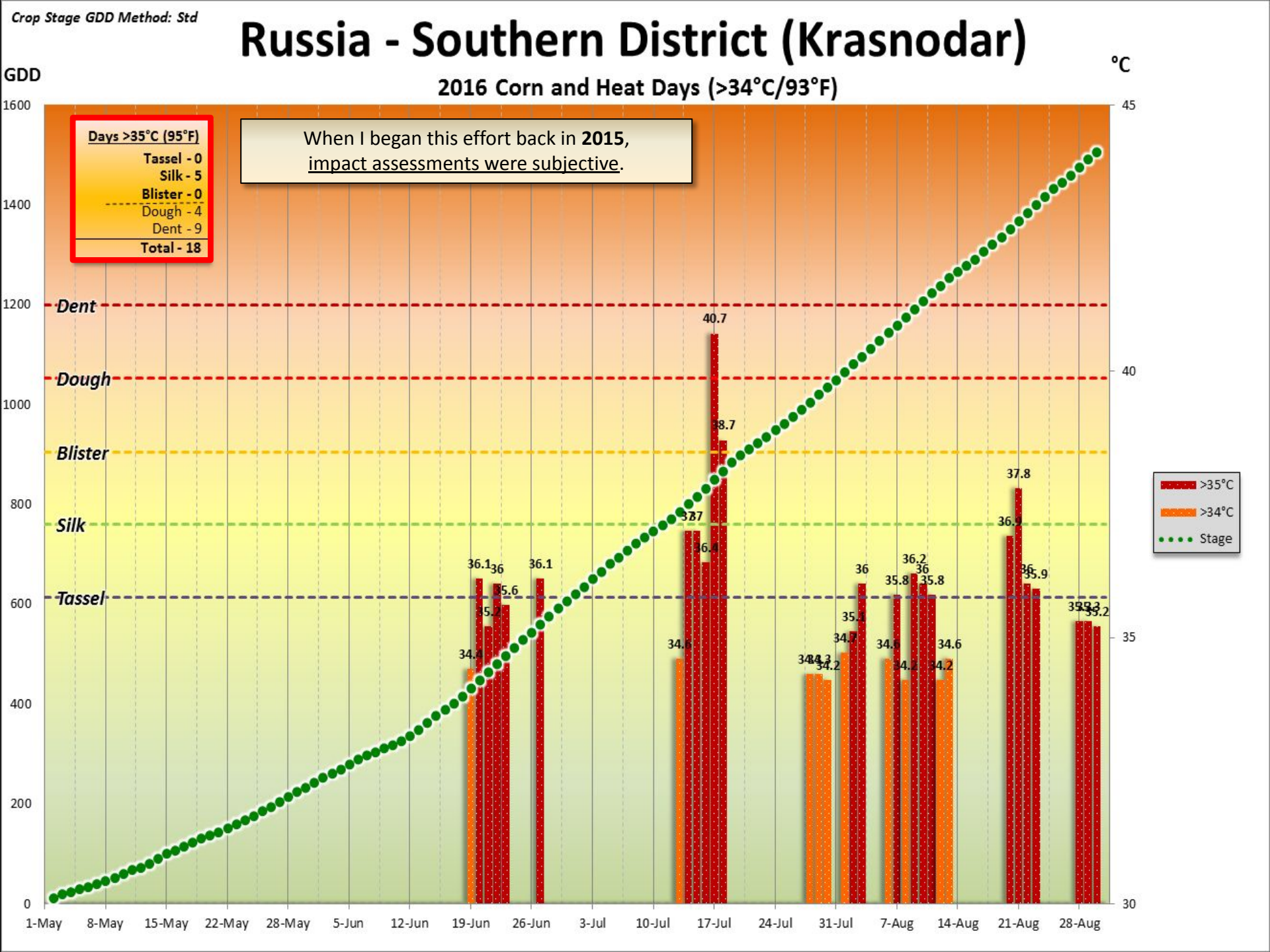
Software for Data Management & Analysis

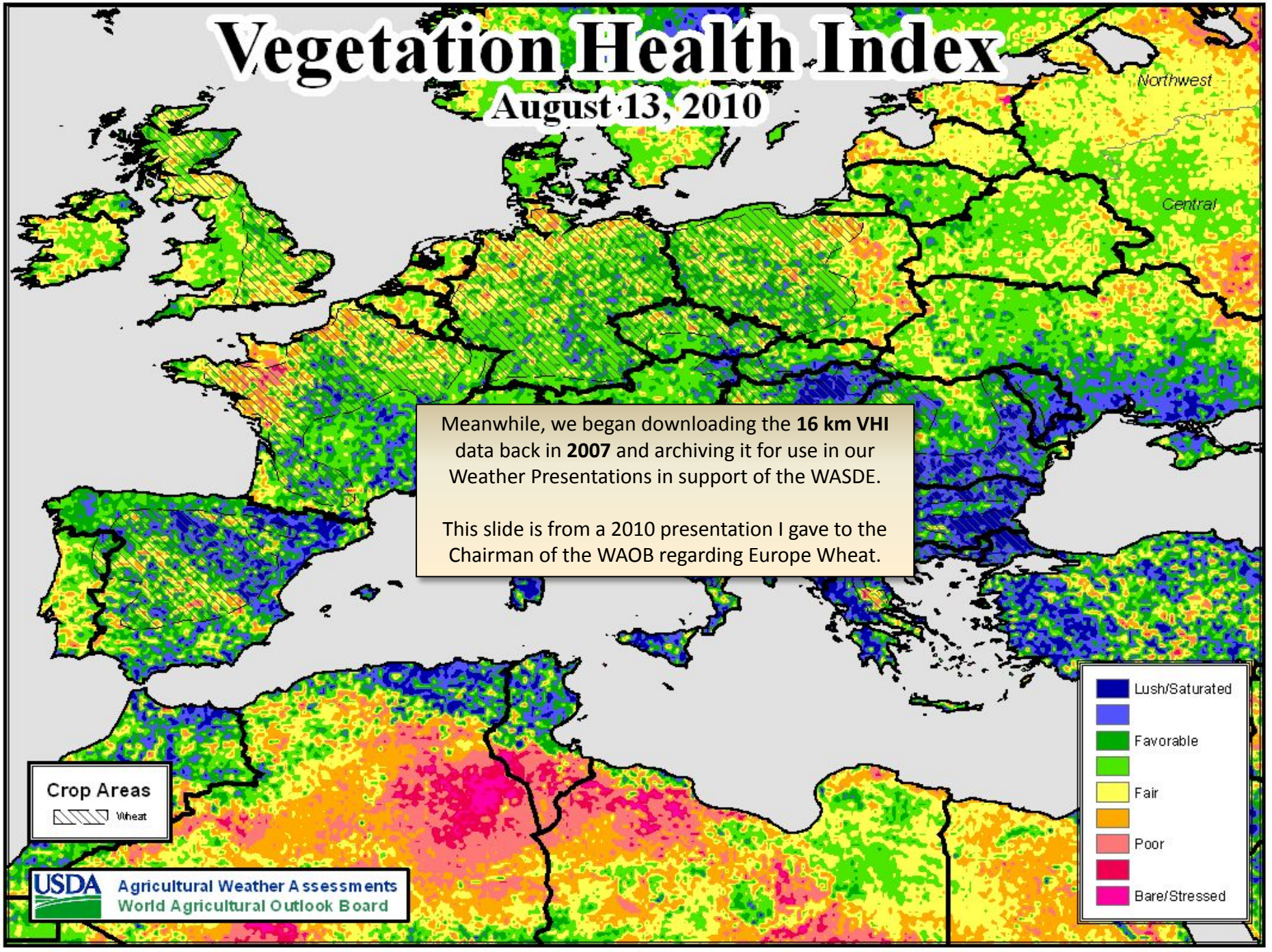
**Software developed, updated, and maintained in-house.*

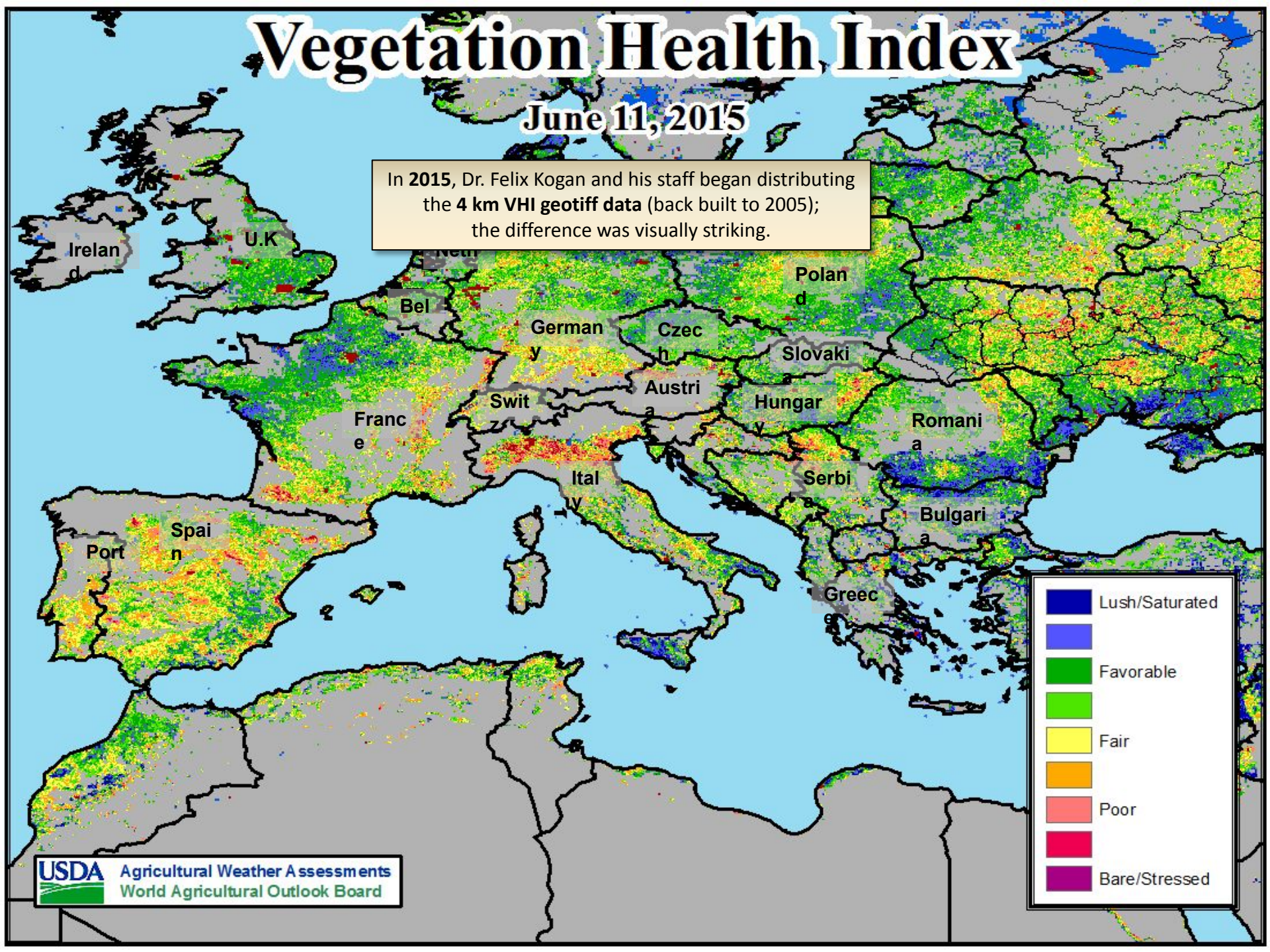
USDA Agricultural Weather Assessments
World Agricultural Outlook Board

Using established **GDD crop-stage cutoffs**, real-time estimates of ***stages of development for crops across the globe*** within Excel are possible using our built-in Wx DB links.




Crop Stage GDD Method: Std
Russia - Southern District (Krasnodar)
2016 Corn and Heat Days (>34°C/93°F)
GDD
°C
Days >35°C (95°F)
Tassel - 0
Silk - 5
Blister - 0
Dough - 4
Dent - 9
Total - 18
When I began this effort back in 2015, impact assessments were subjective.
Dent
Dough
Blister
Silk
Tassel
>35°C
>34°C
Stage
1-May
8-May
15-May
22-May
28-May
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul
17-Jul
24-Jul
31-Jul
7-Aug
14-Aug
21-Aug
28-Aug


Vegetation Health Index
August 13, 2010
Northwest
Central
Meanwhile, we began downloading the **16 km VHI** data back in **2007** and archiving it for use in our Weather Presentations in support of the WASDE.
This slide is from a 2010 presentation I gave to the Chairman of the WAOB regarding Europe Wheat.
Lush/Saturated
Favorable
Fair
Poor
Bare/Stressed
Crop Areas
Wheat
USDA
Agricultural Weather Assessments
World Agricultural Outlook Board


Vegetation Health Index
June 11, 2015
In 2015, Dr. Felix Kogan and his staff began distributing the 4 km VHI geotiff data (back built to 2005); the difference was visually striking.
Ireland
U.K
Bel
Germany
Czech
Poland
Slovakia
Austria
Hungary
Switz
France
Romania
Italy
Serbia
Bulgaria
Spain
Portu
Greece
Lush/Saturated
Favorable
Fair
Poor
Bare/Stressed
USDA Agricultural Weather Assessments
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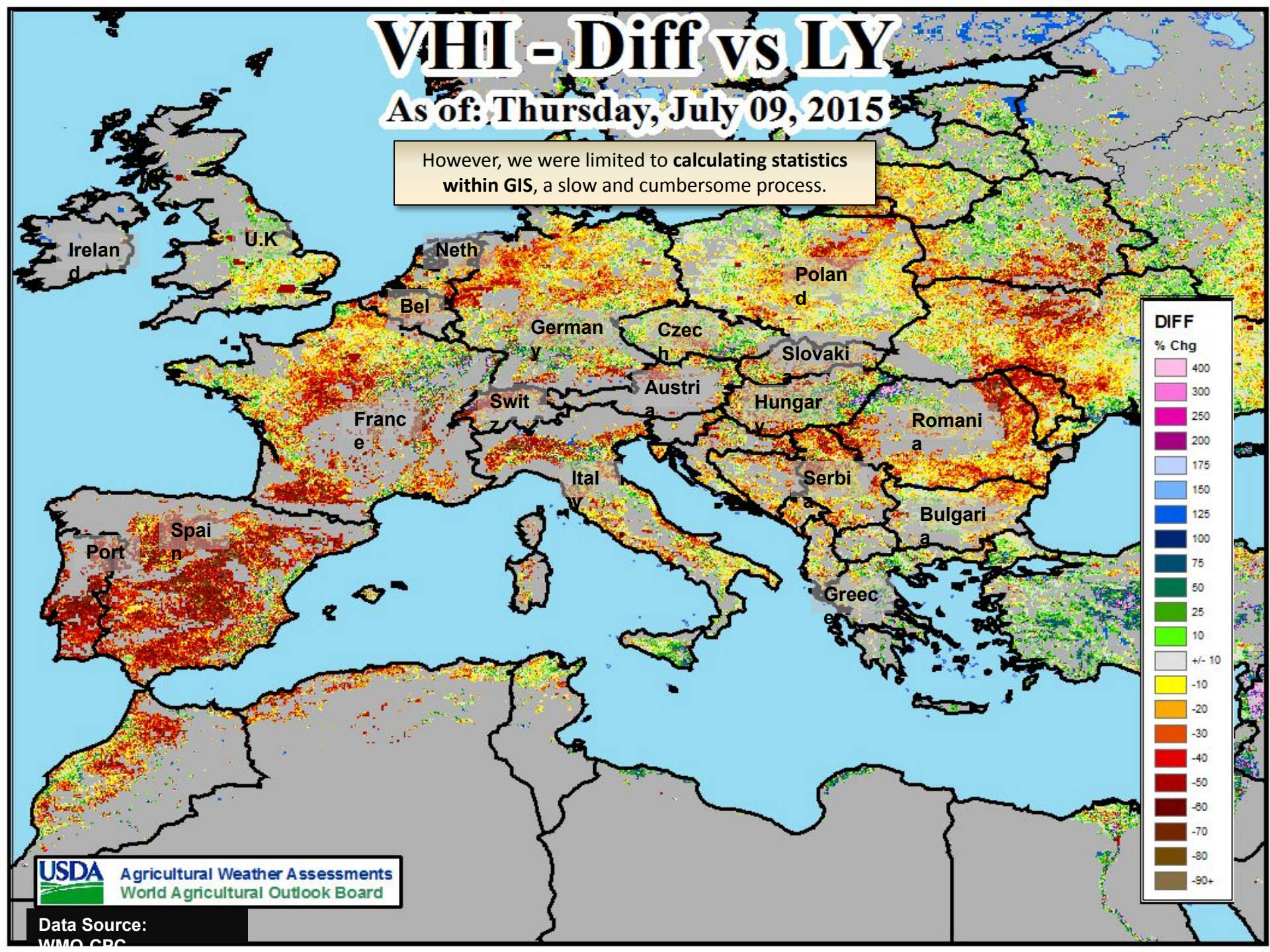
VHI - Diff vs LY
As of: Thursday, July 09, 2015
However, we were limited to **calculating statistics within GIS**, a slow and cumbersome process.
Ireland
U.K
Neth
Bel
Germany
Czech
Poland
Slovakia
Austria
Switz
France
Hungary
Romania
Italy
Serbia
Bulgaria
Spain
Port
Greece
DIFF
% Chg
400
300
250
200
175
150
125
100
75
50
25
10
+/- 10
-10
-20
-30
-40
-50
-60
-70
-80
-90+
USDA
Agricultural Weather Assessments
World Agricultural Outlook Board
Data Source:
WMO GPC

Pogodnie - poc | EUMETNET Rac | phenomena24. | Birleştirilmiş, Sc | MIMIC-TPW2 | STAR - Global \ | IRI – Internatio | STAR - Glo | Index of /pub/\ | EUMETNET Rac

https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/vh_browseByCountry_province.php?country_code=UKR&province_id=1&year1=1981&year2=2019

NOAA STAR CENTER FOR SATELLITE APPLICATIONS AND RESEARCH

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- STAR Home Page
- Vegetation Health Home
- Ancillary Data
- VH from S-NPP/VIIRS Study
- AQUA/MODIS VH
- Validation
- Sensitivity Study

News

NPP first images for land cover was obtained on 11/21/2011

NPP VIIRS 500m GVI data were produced since May 2, 2012 to now

Data and images displayed on STAR sites are provided for experimental use only and are not official operational NOAA products. More information>>

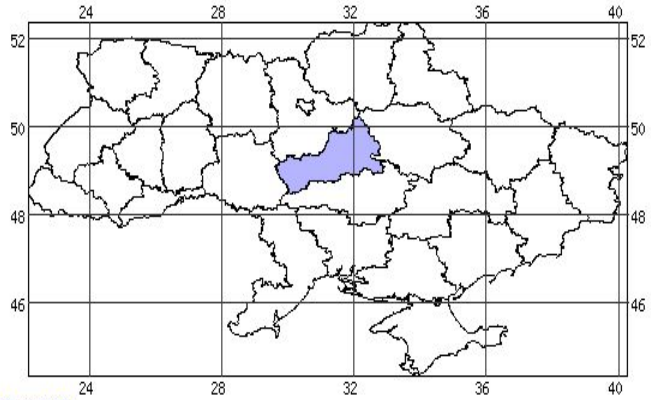
STAR - Global Vegetation Health Products :

You selected the 1th province in *Ukraine*

country/region(191)	province	Year1	Year2
178: Ukraine (UKR)	1: Cherkasy	1981	2019

Cherkasy, Ukraine

Selected Province



Zoom=0.99

The above image highlights the province selected. You may select another province by cursor.

The pictures below show the time series of drought related indices for this province (*Cherkasy, Ukraine*).

The time series of 'Area-Avegaed' and 'Percentage-Of-Area' data for the plots below are avilable in ASCII format.

Note: The information on this page is for selected provinces/countries. Here is the list of selected provinces and countries

The current week' situtation

A significant breakthrough:
In **June of 2017**, the Admin-00 and Admin-01 **VHI ascii data** became available to download.
I began to work with the data that summer;
this would launch the crop yield modeling effort.

Type here to search

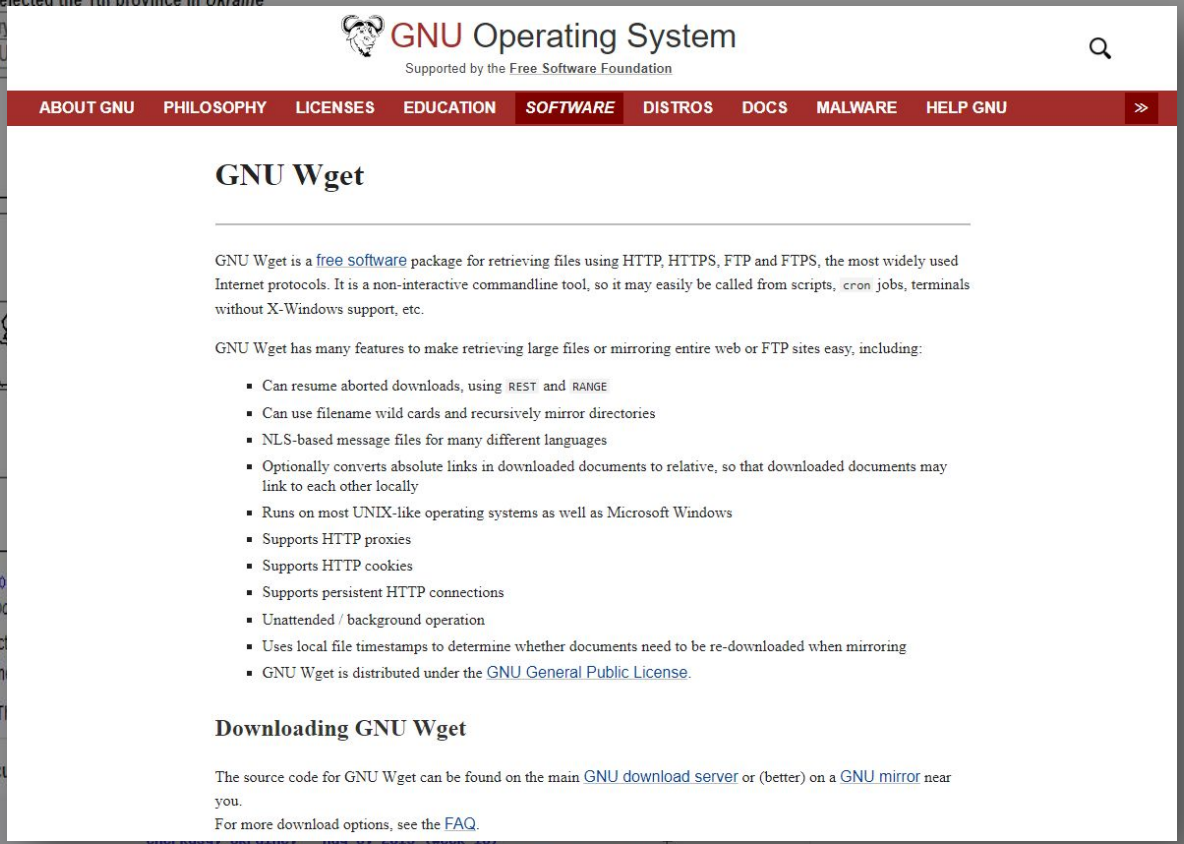
1:15 PM
5/13/2019

NASA/Columbia Univ Croplands-Mask

The final piece: At WAOB's request, NESDIS added a **croplands-masked VHI dataset** in **2019**, working with the weather group to test and implement a consensus global croplands filter that was applied to the entire dataset.

The Process…

Operational note: **Downloading the ascii files** was initially time consuming and labor intensive. However, a vital component to our operations is ***WGET*** download utility…



VHI-EU1-CropLands.bat - Notepad

File Edit Format View Help

```
mkdir Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-0-ESP.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=0&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-1-Andalucia.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=1&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-2-Aragon.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=2&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-3-Cantabria.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=3&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
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wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-5-Castilla-LaMancha.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=5&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-6-Cataluna.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=6&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-7-CeutayMelilla.txt
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-8-ComunidaddeMadrid
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-9-ComunidadForaldeN
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-10-ComunidadValenci
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-11-Extremadura.txt
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-12-Galicia.txt "htt
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-13-IslasBaleares.t
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-14-IslasCanarias.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=14&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-15-LaRioja.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=15&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
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wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-17-PrincipadodeAsturias.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=17&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\SPAIN\Spain-18-RegiondeMurcia.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=18&country=ESP&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"


mkdir Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-0-FRA.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=0&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-1-Alsace.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=1&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-2-Aquitaine.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=2&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-3-Auvergne.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=3&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-4-Basse-Normandie.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=4&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-5-Bourgogne.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=5&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-6-Bretagne.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=6&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-7-Centre.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=7&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
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wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-12-Ile-de-France.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=12&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
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wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-15-Lorraine.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=15&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-16-Midi-Pyrenees.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=16&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-17-Nord-Pas-de-Calais.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=17&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
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wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-19-Picardie.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=19&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
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wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\FRANCE\France-22-Rhone-Alpes.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=22&country=FRA&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"


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wget -O Y:\VegetativeIndex\VHI-4km\ASCII\EUROPE\GERMANY\Germany-8-Mecklenburg-Vorpommern.txt "https://www.star.nesdis.noaa.gov/smcd/emb/vci/VH/get_TS_admin.php?provinceID=8&country=DEU&yearlyTag=Weekly&type=Mean&TagCropland=crop&year1=1982&year2=2022"
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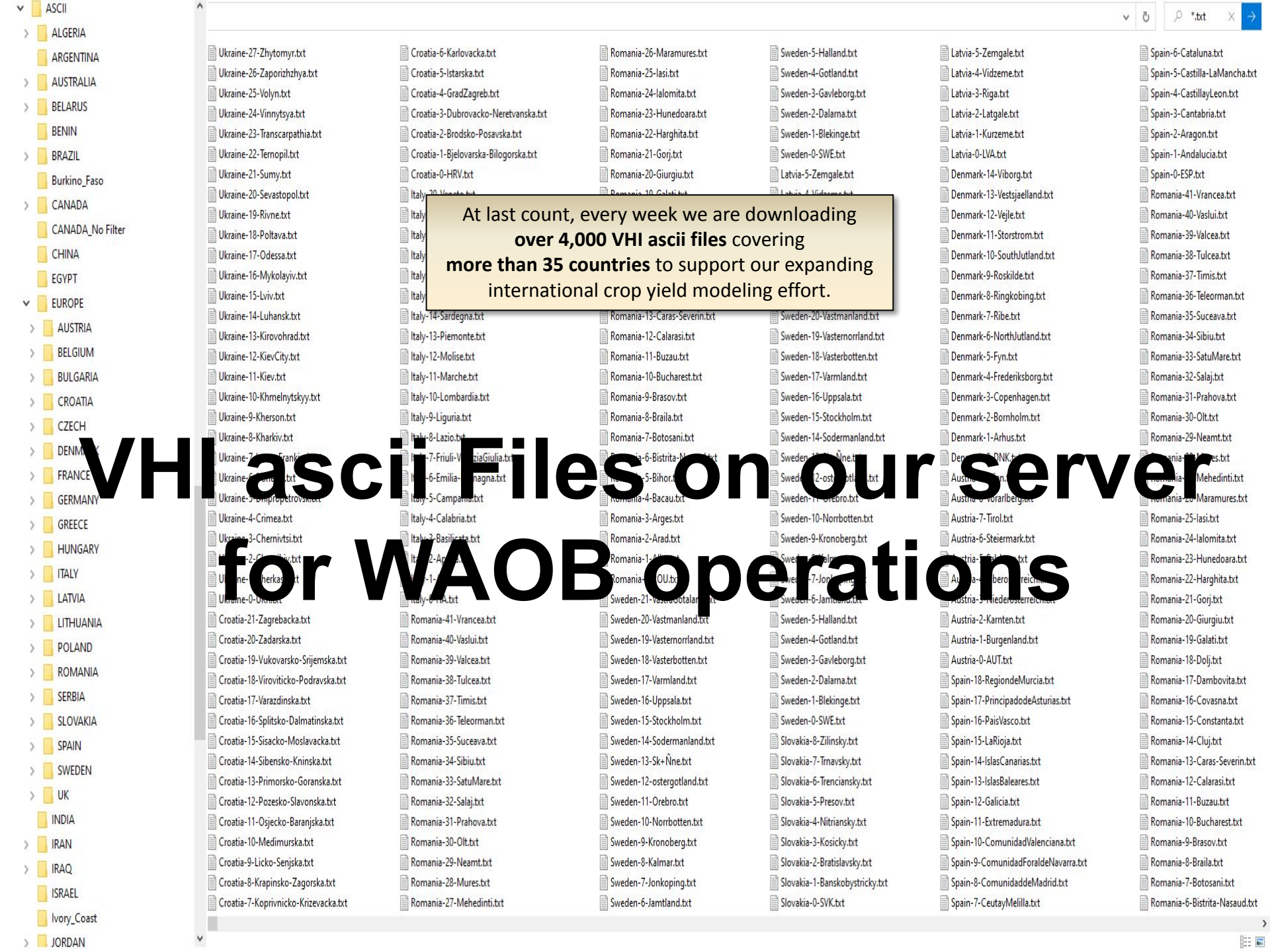
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BELARUS
BENIN
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CANADA
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Ukraine-25-Volyn.txt
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Ukraine-22-Ternopil.txt
Ukraine-21-Sumy.txt
Ukraine-20-Sevastopol.txt
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Ukraine-16-Mykolayiv.txt
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Ukraine-12-KievCity.txt
Ukraine-11-Kiev.txt
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Ukraine-8-Kharkiv.txt
Ukraine-4-Crimea.txt
Ukraine-3-Chernivtsi.txt
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Croatia-20-Zadarska.txt
Croatia-19-Vukovarsko-Srijemska.txt
Croatia-18-Viroviticko-Podravska.txt
Croatia-17-Varazdinska.txt
Croatia-16-Splitsko-Dalmatinska.txt
Croatia-15-Sisacko-Moslavacka.txt
Croatia-14-Sibensko-Kninska.txt
Croatia-13-Primorsko-Goranska.txt
Croatia-12-Pozesko-Slavonska.txt
Croatia-11-Osjecko-Baranjska.txt
Croatia-10-Medimurska.txt
Croatia-9-Licko-Senjska.txt
Croatia-8-Krapinsko-Zagorska.txt
Croatia-7-Koprivnicko-Krizevacka.txt
Croatia-6-Karlovacka.txt
Croatia-5-Istarska.txt
Croatia-4-GradZagreb.txt
Croatia-3-Dubrovacko-Neretvanska.txt
Croatia-2-Brodsko-Posavska.txt
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Romania-40-Vaslui.txt
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Sweden-17-Varmland.txt
Sweden-16-Uppsala.txt
Sweden-15-Stockholm.txt
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Sweden-10-Norrbotten.txt
Sweden-9-Kronoberg.txt
Sweden-5-Halland.txt
Sweden-4-Gotland.txt
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Sweden-0-SWE.txt
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Latvia-3-Riga.txt
Latvia-2-Latgale.txt
Latvia-1-Kurzeme.txt
Latvia-0-LVA.txt
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Denmark-12-Vejle.txt
Denmark-11-Storstrom.txt
Denmark-10-SouthJutland.txt
Denmark-9-Roskilde.txt
Denmark-8-Ringkobing.txt
Denmark-7-Ribe.txt
Denmark-6-NorthJutland.txt
Denmark-5-Fyn.txt
Denmark-4-Frederiksborg.txt
Denmark-3-Copenhagen.txt
Denmark-2-Bornholm.txt
Denmark-1-Arhus.txt
Austria-7-Tirol.txt
Austria-6-Steiermark.txt
Austria-2-Karnten.txt
Austria-1-Burgenland.txt
Austria-0-AUT.txt
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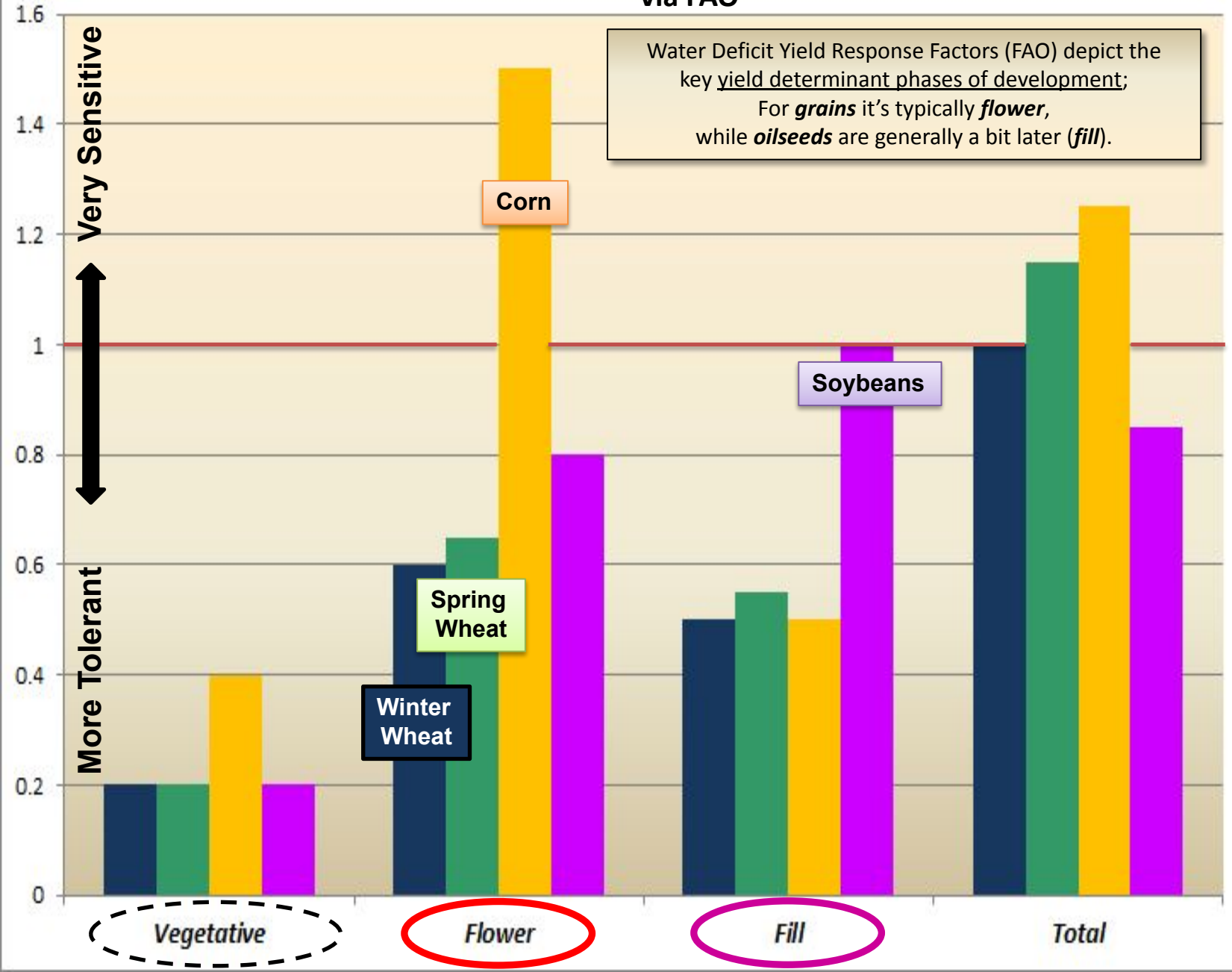
Spain-17-PrincipadodeAsturias.txt
Spain-16-PaisVasco.txt
Spain-15-LaRioja.txt
Spain-14-IslasCanarias.txt
Spain-13-IslasBaleares.txt
Spain-12-Galicia.txt
Spain-11-Extremadura.txt
Spain-10-ComunidadValenciana.txt
Spain-9-ComunidadForaldeNavarra.txt
Spain-8-ComunidaddeMadrid.txt
Spain-7-CeutayMelilla.txt
Spain-6-Cataluna.txt
Spain-5-Castilla-LaMancha.txt
Spain-4-CastillayLeon.txt
Spain-3-Cantabria.txt
Spain-2-Aragon.txt
Spain-1-Andalucia.txt
Spain-0-ESP.txt
Romania-41-Vrancea.txt
Romania-40-Vaslui.txt
Romania-39-Valcea.txt
Romania-38-Tulcea.txt
Romania-37-Timis.txt
Romania-36-Teleorman.txt
Romania-35-Suceava.txt
Romania-34-Sibiu.txt
Romania-33-SatuMare.txt
Romania-32-Salaj.txt
Romania-31-Prahova.txt
Romania-30-Olt.txt
Romania-29-Neamt.txt
Romania-28-Mehedinti.txt
Romania-25-Iasi.txt
Romania-24-Ialomita.txt
Romania-23-Hunedoara.txt
Romania-22-Harghita.txt
Romania-21-Gorj.txt
Romania-20-Giurgiu.txt
Romania-19-Galati.txt
Romania-18-Dolj.txt
Romania-17-Dambovita.txt
Romania-16-Covasna.txt
Romania-15-Constanta.txt
Romania-14-Cluj.txt
Romania-13-Caras-Severin.txt
Romania-12-Calarasi.txt
Romania-11-Buzau.txt
Romania-10-Bucharest.txt
Romania-9-Brasov.txt
Romania-8-Braila.txt
Romania-7-Botosani.txt
Romania-6-Bistrita-Nasaud.txt
At last count, every week we are downloading
over 4,000 VHI ascii files covering
more than 35 countries to support our expanding
international crop yield modeling effort.
VHI ascii Files on our server
for WAOB operations

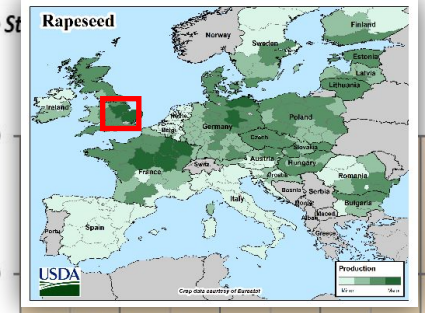
Water Deficit Yield Response Factors ($ET_{actual}/ET_{measured}$)

via FAO



6/7/2022

Rapeseed: England - Southeast

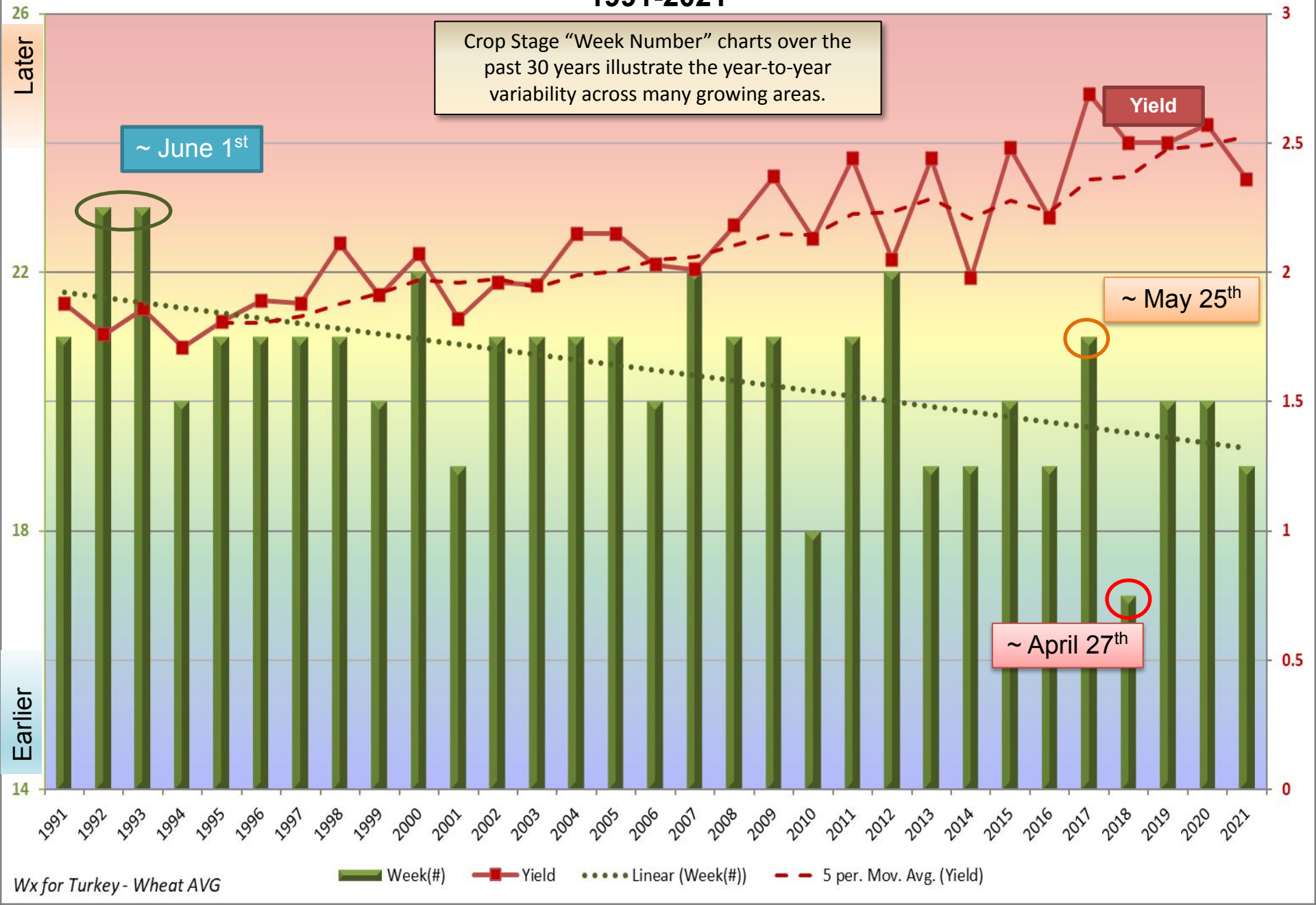


Note: **It is very important at WAOB to use crop stages versus week numbers**.

i.e. In 2022, winter rapeseed over England developed 1-2 weeks ahead of average and well ahead of last year, illustrating the utility of GDDs.

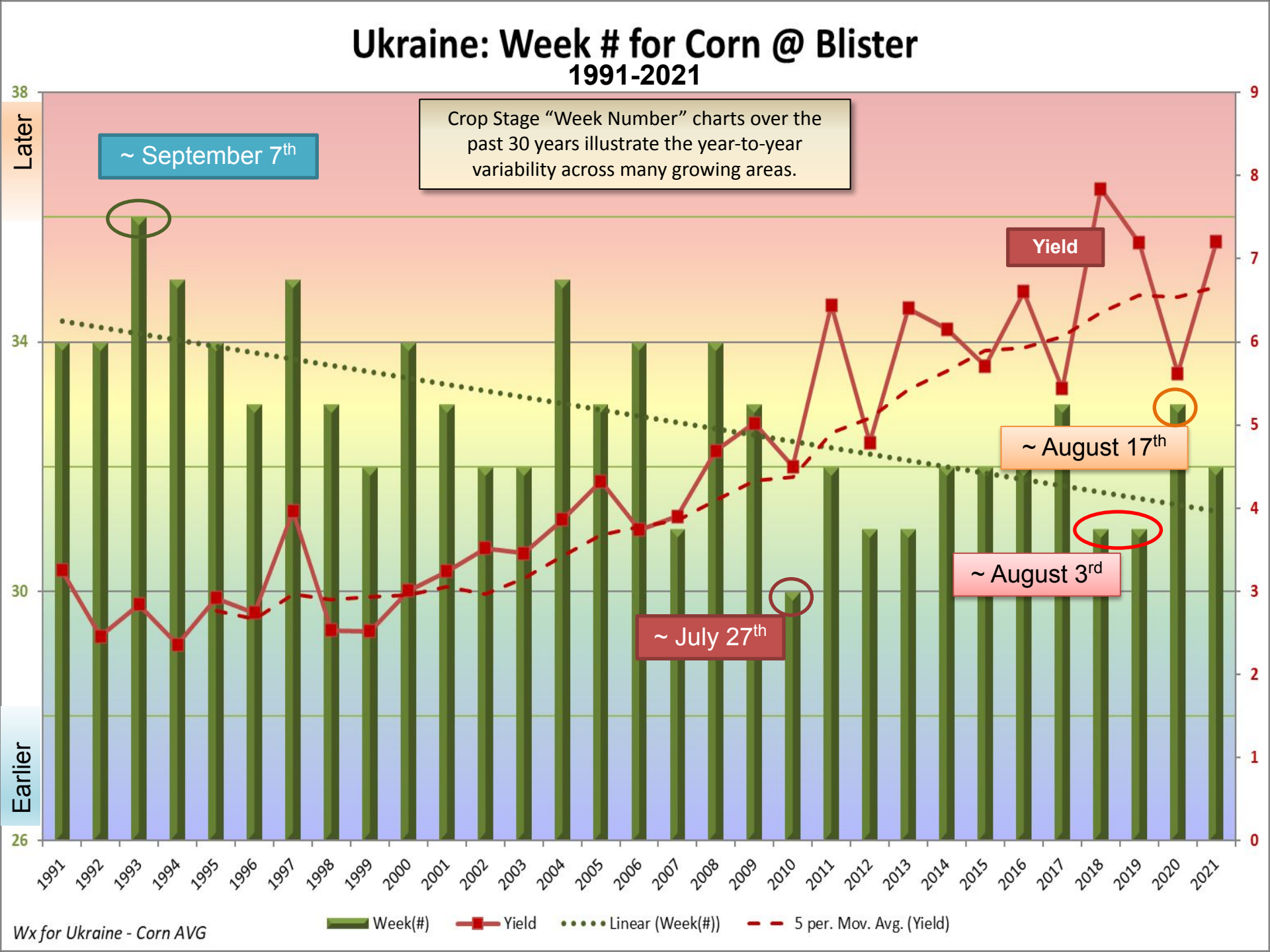
8 days ahead of Avg / 12 days ahead of 2021

Turkey: Week # for Wheat @ Flowering
1991-2021

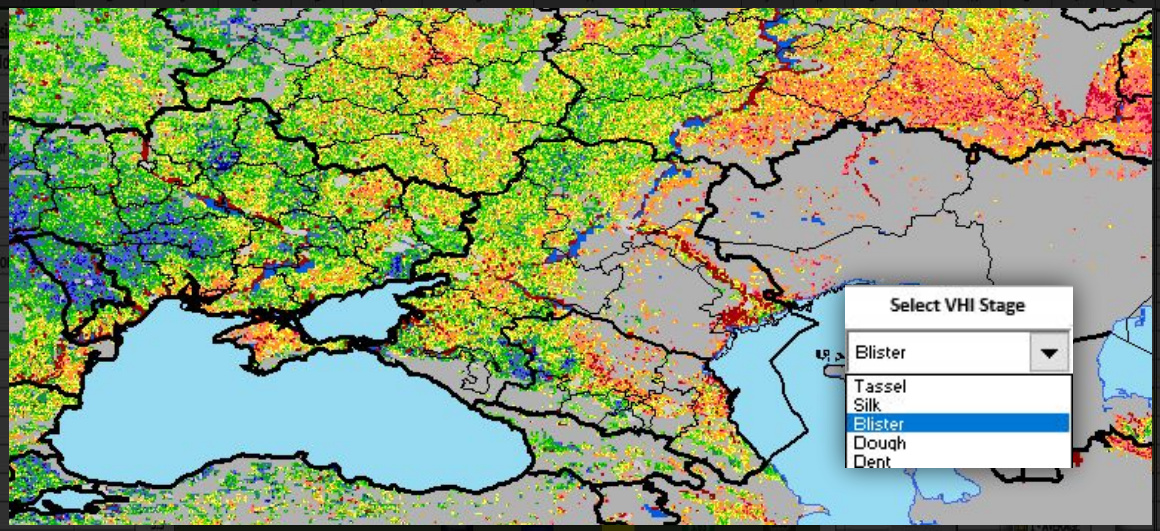


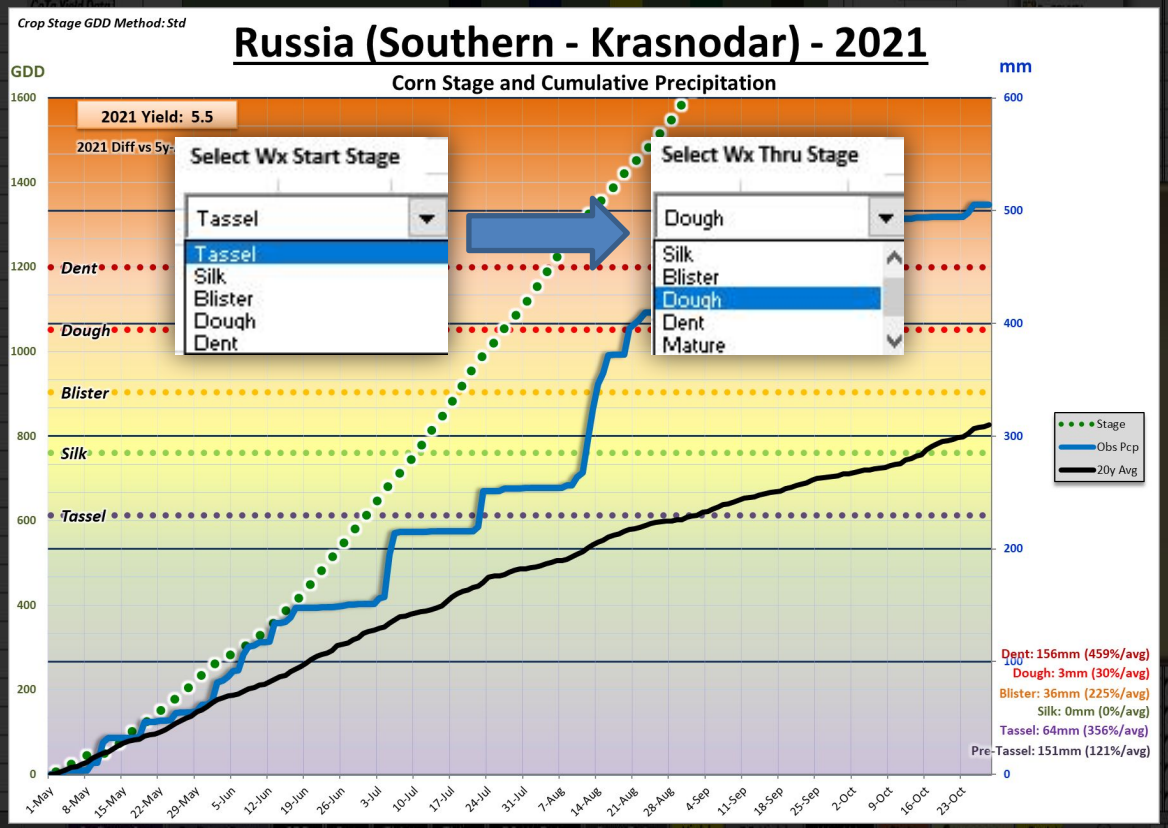
Wx for Turkey - Wheat AVG

Ukraine: Week # for Corn @ Blister
1991-2021



Wx for Ukraine - Corn AVG





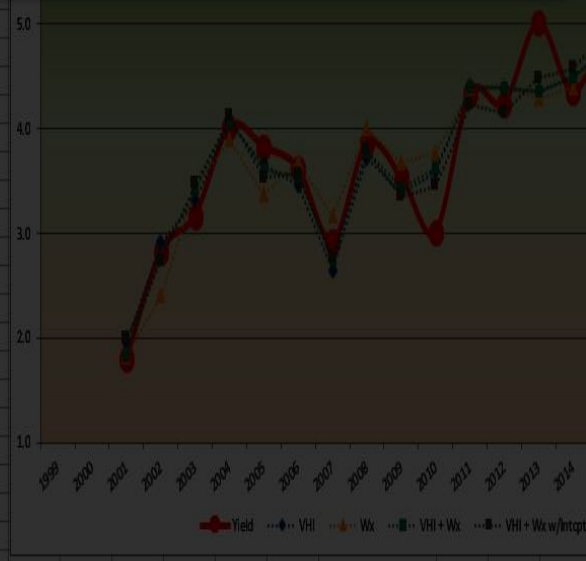
Year	Yield	Russia Corn: Regression Hindcast vs Observed	Region	FSU
1987	2.7	Russia Corn	SubReg #	11
1988	3.03	Regression: 2001-2018	Year	2019
1989	3.27	VHI for Corn @ Blister	Start Date	0501
1990	3.14	Wx for Russia (Southern - Krasnodar)	GDD Base	10
1991	2.9	Wx Begin @ Tassel	PSD Crop (Yield):	Corn
1992	2.89	Wx thru Dough	*Chart Title (region):	Russia (Southern - Krasnod
1993	3.22	VHI data for RUS (Kras/Stav/Rost/Volg)	Chart Title (crop):	Corn
1994	1.96		Current DB Region:	SOUTHERN DISTRICT (KRASN
1995	2.88			
1996	2.35		Yield Area Name:	Russia
1997	3.12			
1998	1.63			
1999	1.99			
2000	2.13			
2001	1.8			

GoTo Yield Data

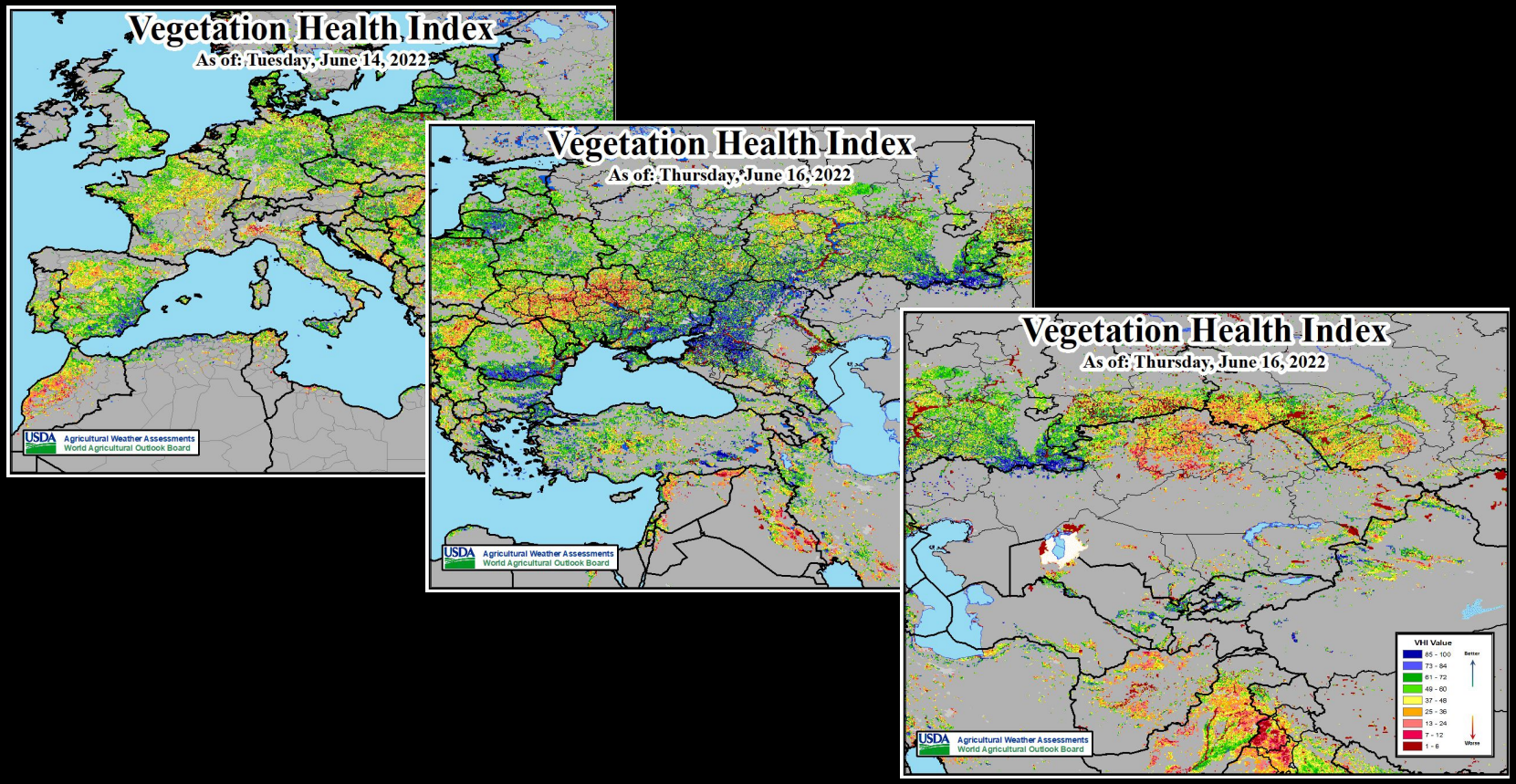
Yield Charts

Within Excel,
Crop-Stage-Specific VHI & Weather are extracted for yield forecasting using regression analysis.

Using crop stages versus static week numbers ensures year-to-year consistency & allows easy testing of different scenarios.



VHI Yield Regression….



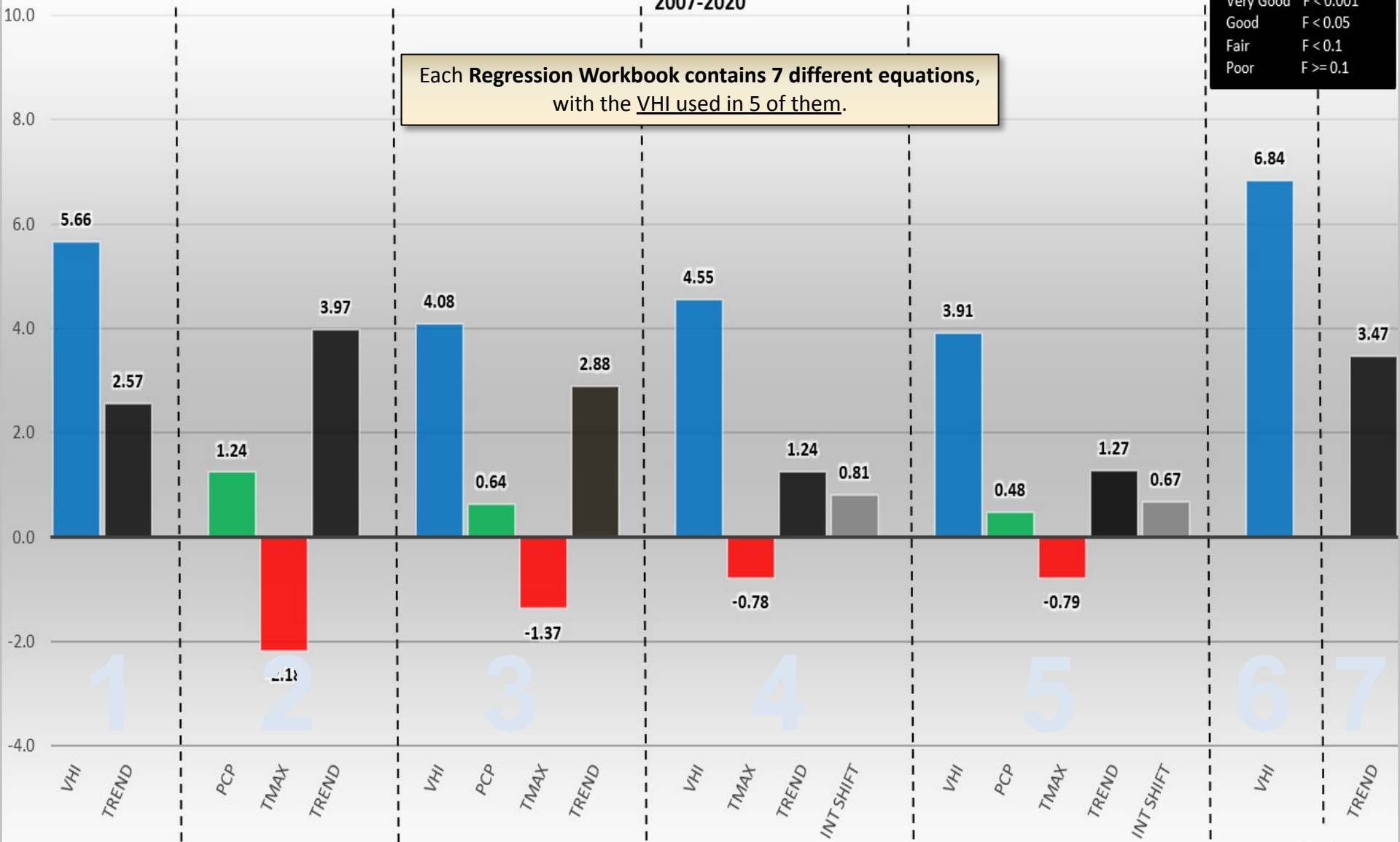
Ukraine Corn Regression Stats

2007-2020

T-Stat

Significance-F (Objective Assessment)	
Excellent	F < 0.0001
Very Good	F < 0.001
Good	F < 0.05
Fair	F < 0.1
Poor	F >= 0.1

Each **Regression Workbook contains 7 different equations**, with the VHI used in 5 of them.



Fcst-VHI
R^2=0.87
Adj R^2=0.85
Excellent

Fcst-Wx
R^2=0.71
Adj R^2=0.62
Good

Fcst-VHI+Wx
R^2=0.9
Adj R^2=0.85
Very Good

Fcst-VHI+Wx Intcpt
R^2=0.9
Adj R^2=0.86
Very Good

Incpt Year: 2018

Fcst-VHI+Wx2 Intcpt
R^2=0.9
Adj R^2=0.84
Very Good

Stand Alone
R^2=0.8
Adj R^2=0.78
Excellent

R^2=0.5
0.46
Good

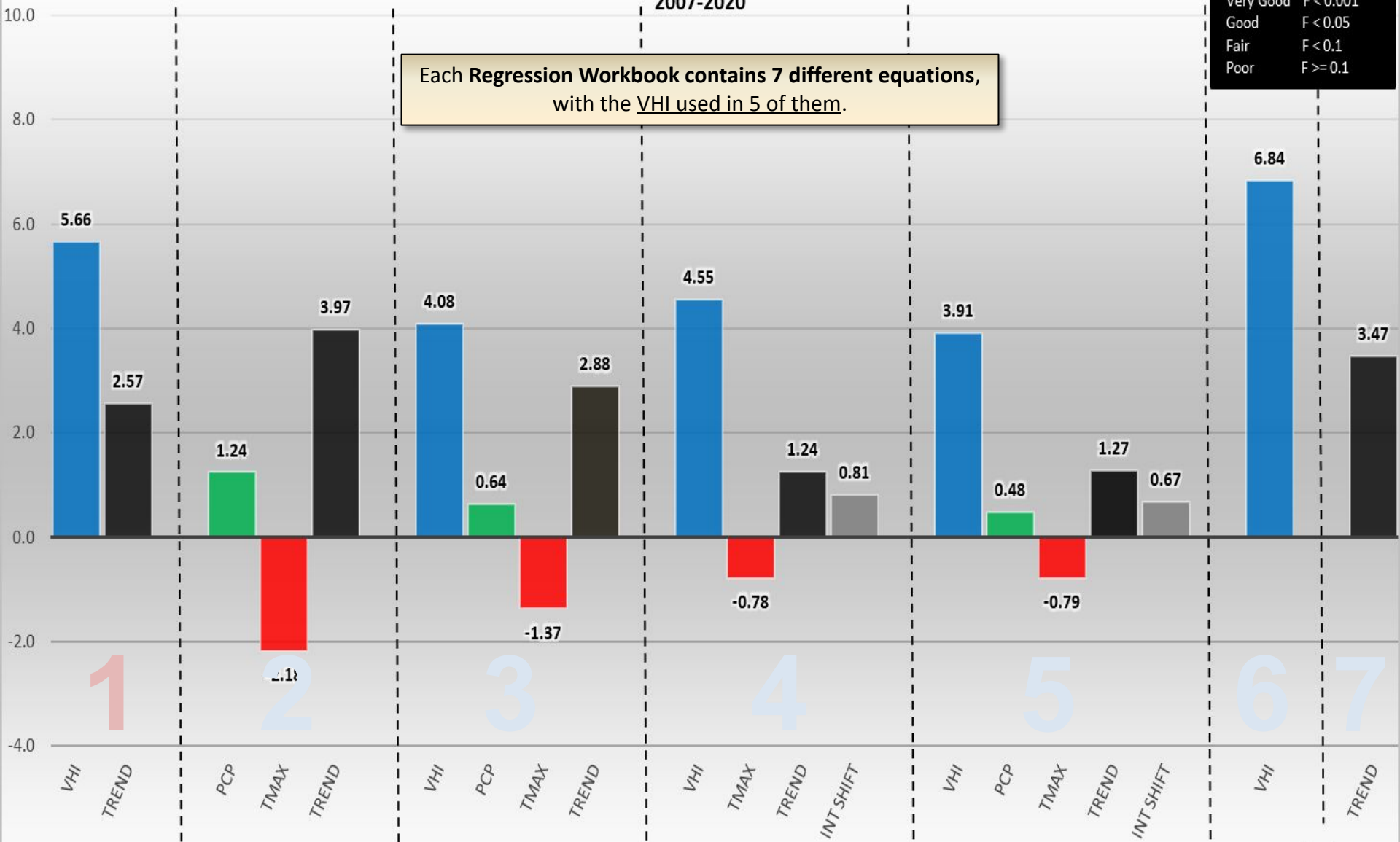
Ukraine Corn Regression Stats

2007-2020

T-Stat

Each **Regression Workbook contains 7 different equations**, with the VHI used in 5 of them.

Significance-F (Objective Assessment)	
Excellent	F < 0.0001
Very Good	F < 0.001
Good	F < 0.05
Fair	F < 0.1
Poor	F >= 0.1



Fcst-VHI
R^2=0.87
Adj R^2=0.85
Excellent

Fcst-Wx
R^2=0.71
Adj R^2=0.62
Good

Fcst-VHI+Wx
R^2=0.9
Adj R^2=0.85
Very Good

Fcst-VHI+Wx Intcpt
R^2=0.9
Adj R^2=0.86
Very Good

Incpt Year: 2018

Fcst-VHI+Wx2 Intcpt
R^2=0.9
Adj R^2=0.84
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Stand Alone
R^2=0.8
Adj R^2=0.78
Excellent

R^2=0.5
0.46
Good

The first order of business is to go into the **VHI Forecast** worksheet within the modeling workbook and select an expected "high impact" VHI crop stage wrt to yields to see if there are any disconnects or other issues.

Year	Yield	VHI	Trend
1987	3.43	#N/A	1
1988	3.71	#N/A	2
1989	3.79	#N/A	3
1990	3.84	#N/A	4
1991	3.25	59.5168	5
1992	2.46	24.8372	6
1993	2.84	67.2994	7
1994	2.36	49.2306	8
1995	2.92	56.988	9
1996	2.74	48.592	10
1997	3.96	79.3976	11
1998	2.53	65.6634	12
1999	2.52	45.1628	13
2000	3.01	64.621	14
2001	3.24	53.6046	15
2002	3.52	42.442	16
2003	3.46	67.7936	17
2004	3.86	74.0558	18
2005	4.32	62.5666	19
2006	3.74	60.2242	20
2007	3.9	35.6022	21
2008	4.69	53.3186	22
2009	5.02	51.3278	23
2010	4.5	44.1862	24
2011	6.44	71.2892	25
2012	4.79	45.5302	26
2013	6.4	59.6546	27
2014	6.15	56.9398	28
2015	5.71	56.7148	29
2016	6.6	62.5652	30
2017	5.44	56.442	31
2018	7.84	69.0072	32
2019	7.19	64.0702	33
2020	5.62	57.6256	34
2021	7.2	68.1158	35
#VALUE!	######	#VALUE!	36
#VALUE!	######	#VALUE!	37
#VALUE!	######	#VALUE!	38
#VALUE!	######	#VALUE!	39

Last Run→ Regression: 2007-2020

	0.87	0.87	0.0%	R^2
Blister	0.85	0.85	0.0%	Adj R^2
2007	0.43	0.43	0.0%	Std Err
	5.66	5.66	0.0%	T-Stat

SetVHI Stats

	Default	Using:	Row
Begin:	1987	2007	22
End:	2020	2020	35

Select VHI Stage: Silk

>> SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.93397
R Square	0.8723
Adjusted R Squa	0.84908
Standard Error	0.4296
Observations	14

Regress This | GoTo Regression | GoTo VHI | GoTo Front

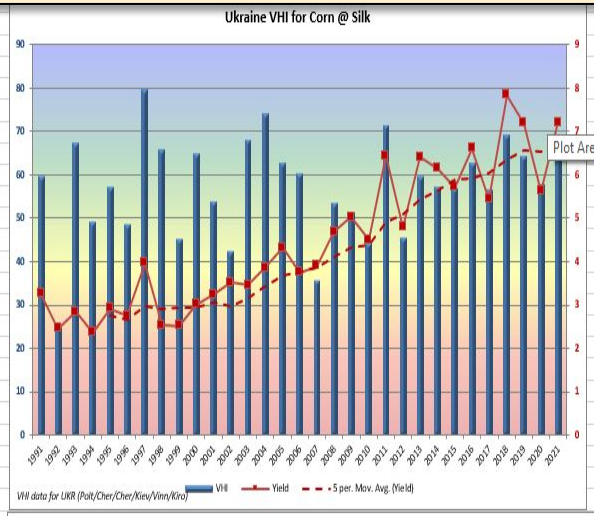
ANOVA

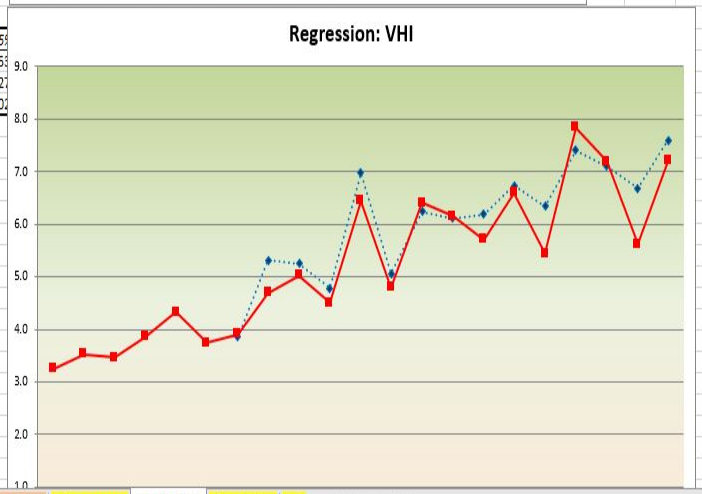
	df	SS	MS	F	gnificance F
Regression	2	13.8672	6.93361	37.5689	1.2E-05
Residual	11	2.03013	0.18456		
Total	13	15.8974			

		Coefficient	tandard Err	t Stat	P-value	ower 95%	pper 95
	Intercept	-0.73446	0.82553	-0.88968	0.39268	-2.55145	1.08253
VHI	X Variable 1	0.07794	0.01378	5.65567	0.00015	0.04761	0.10827
Trend	X Variable 2	0.08624	0.0336	2.56619	0.02623	0.01227	0.1602

RESIDUAL OUTPUT

Observation	Predicted Y	Residuals
1	3.98362	-0.08362
2	4.17794	0.51206
3	4.90093	0.11907
4	4.55257	-0.05257
5	7.0496	-0.6096
6	5.21501	-0.42501
7	6.133	0.267
8	5.86145	0.28855
9	5.87463	-0.16463
10	6.54063	0.05937
11	5.97877	-0.53877





Year		
2007	3.85	3.9
2008	5.32	4.69
2009	5.25	5.02
2010	4.78	4.5
2011	6.98	6.44
2012	5.06	4.79
2013	6.24	6.4
2014	6.12	6.15
2015	6.19	5.71
2016	6.73	6.6
2017	6.34	5.44
2018	7.40	7.84
2019	7.10	7.19
2020	6.69	5.62
2021	7.59	7.2

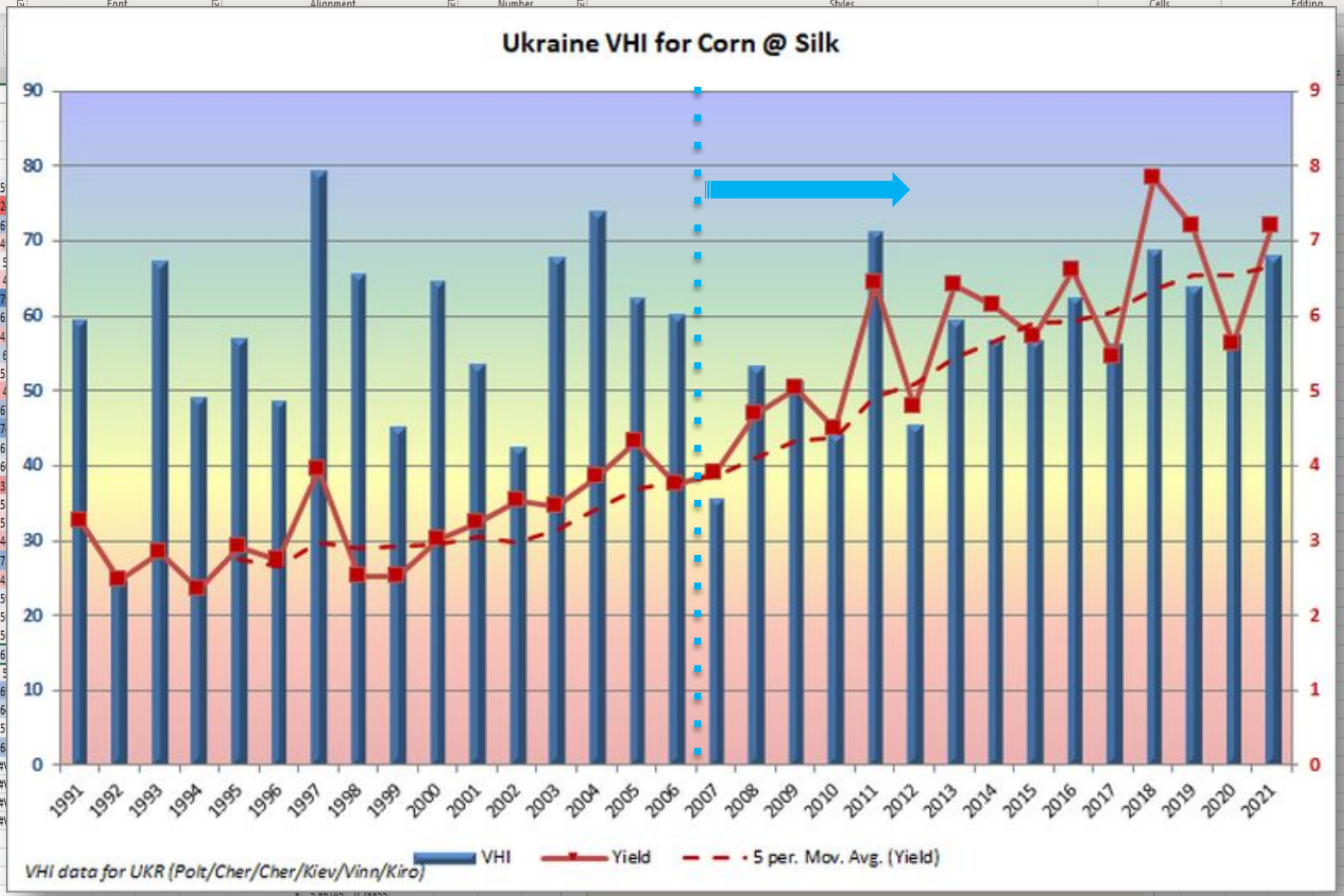
GDD | Pcp | TMax | TMin | DB WxData | FormData | Yield | DB Yield | Wx-ALL | WxStats | Stats | Summary | Fcst-VHI | Fcst-Wx | Fc ...

Ready

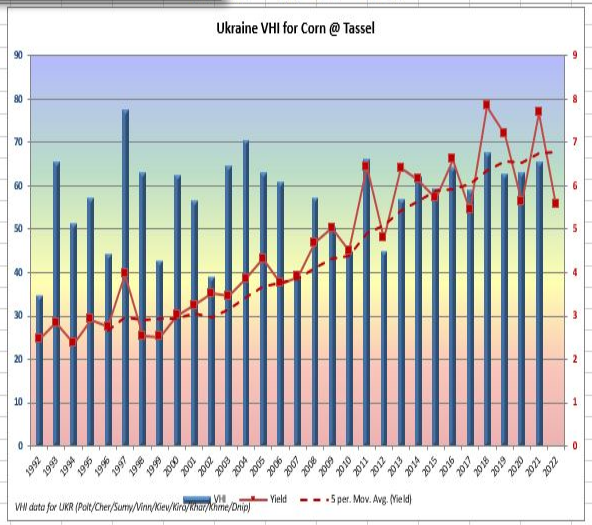
Type here to search

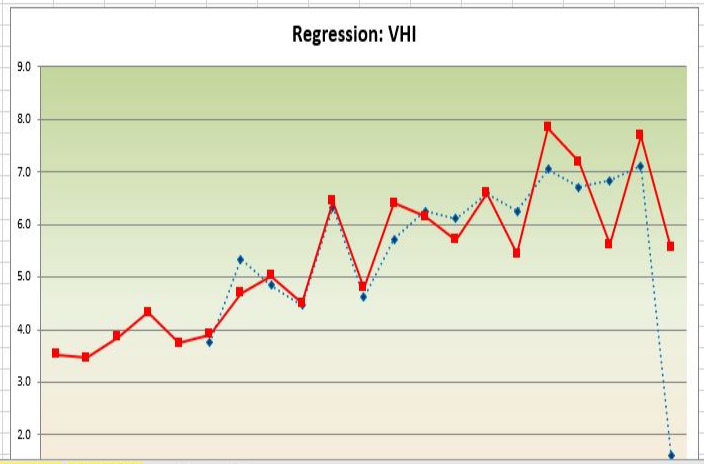
4:04 PM 9/14/2021

In this case, a cursory view of **Ukraine Corn Yield** and **VHI @ Silk** shows a good correlation from 2007 onward, but prior to 2007 the fit does not appear to be strong.
We can easily adjust Start and End Years for the modeling.

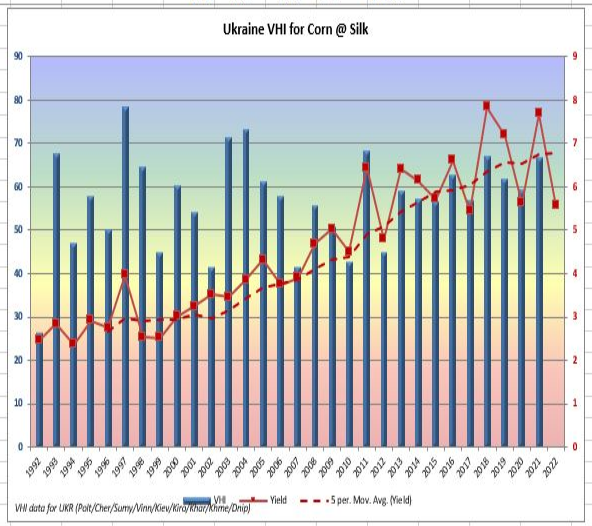


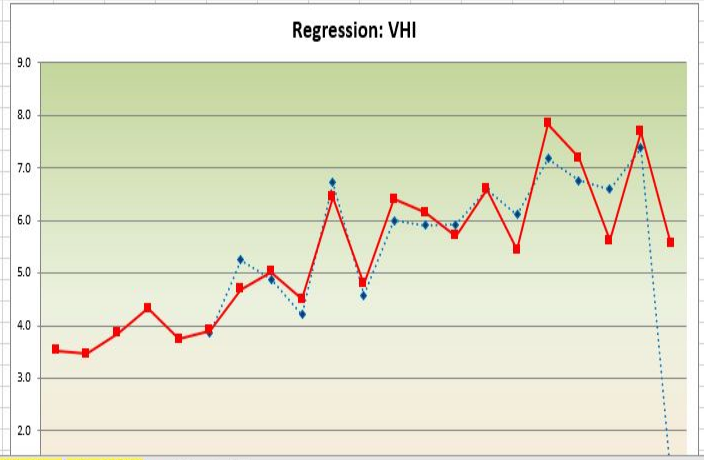
Each stage is tested, starting with **Tassel**.





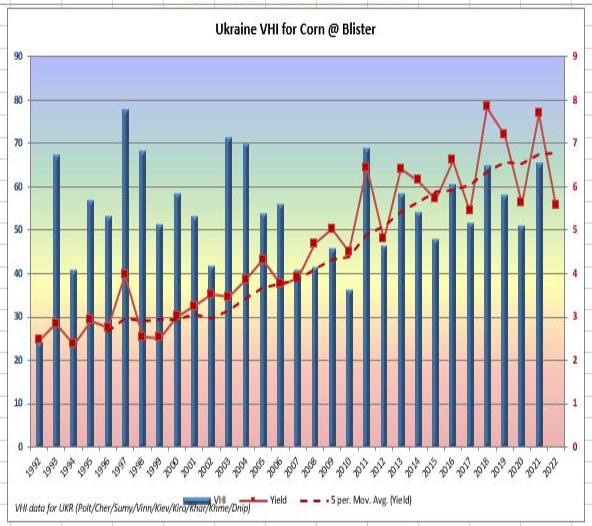
Next up, test **Silk** stage VHI.



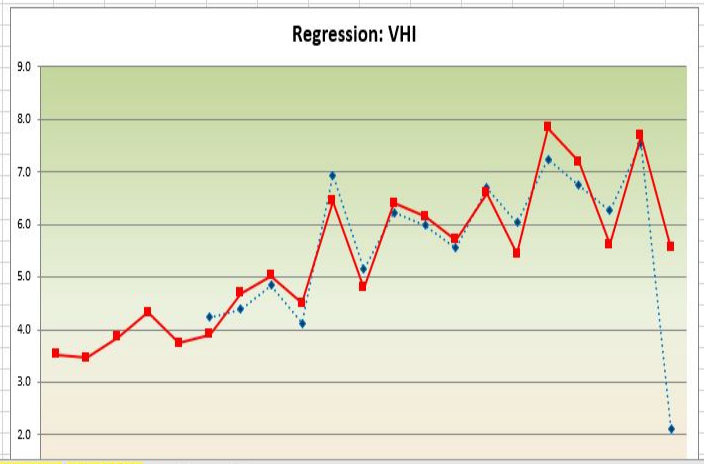


Blister,
slightly better stats than Silk.

Ukraine VHI for Corn @ Blister



Regression: VHI



	Tassel	Silk	Blister	Dough	Dent
R^2	0.77	0.85	0.89	0.81	0.68
Adj R^2	0.73	0.82	0.87	0.78	0.63
Std Err	0.61	0.49	0.43	0.55	0.72
T-Stat	3.17	4.62	5.70	3.81	1.96

Regression Statistics	
Multiple R	0.94165
R Square	0.8867
Adjusted R Squa	0.86782
Standard Error	0.42829
Observations	15

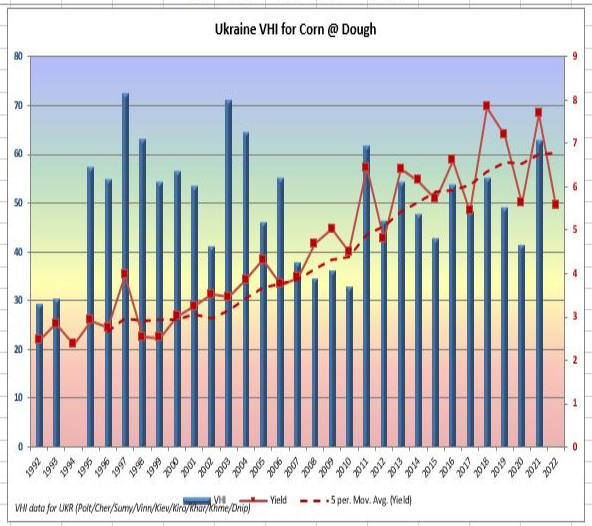
ANOVA	df	SS	MS	F	gnificance F
Regression	2	17.227	8.61348	46.9565	2.1E-06
Residual	12	2.20122	0.18344		
Total	14	19.4282			

	Coefficient	tandard Err	t Stat	P-value	ower 95%	pper 95%	Pearson
Intercept	-1.04893	0.75997	-1.38023	0.19269	-2.70477	0.6069	
VHI X Variable 1	0.08338	0.01463	5.69762	1E-04	0.05149	0.11526	0.902
Trend X Variable 2	0.08995	0.03213	2.79915	0.01607	0.01993	0.15996	0.762

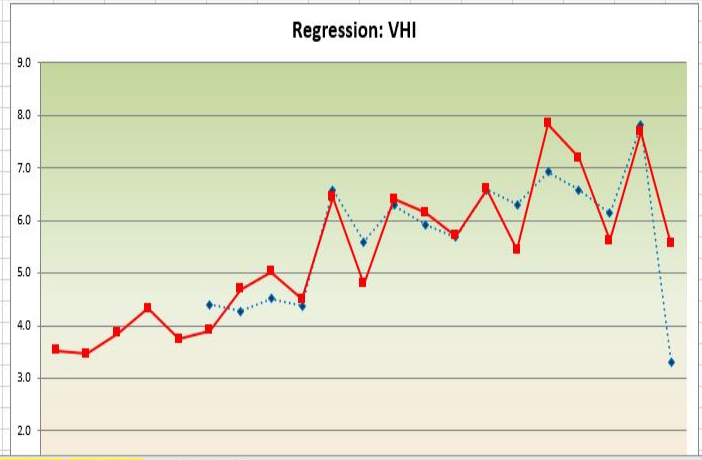
Observation	Predicted \	Residuals
1	4.2374	-0.3374
2	4.38695	0.30305
3	4.8411	0.1789
4	4.11961	0.38039
5	6.9394	-0.4994
6	5.14435	-0.35435
7	6.22894	0.17106
8	5.98039	0.16961
9	5.55057	0.15943
10	6.70177	-0.10177
11	6.0414	-0.6014

Dough,
Stats start to slip.

Ukraine VHI for Corn @ Dough



Regression: VHI



Year	Yield	VHI	Trend
1987	3.43	#N/A	1
1988	3.71	#N/A	2
1989	3.79	#N/A	3
1990	3.84	#N/A	4
1991	3.25	#N/A	5
1992	2.46	29.38	6
1993	2.84	30.39	7
1994	2.36	-1.00	8
1995	2.92	57.21	9
1996	2.74	54.75	10
1997	3.96	72.24	11
1998	2.53	63.08	12
1999	2.52	54.17	13
2000	3.01	56.50	14
2001	3.24	53.35	15
2002	3.52	41.21	16
2003	3.46	71.06	17
2004	3.86	64.39	18
2005	4.32	46.18	19
2006	3.74	55.15	20
2007	3.9	37.90	21
2008	4.69	34.61	22
2009	5.02	36.24	23
2010	4.5	32.85	24
2011	6.44	61.76	25
2012	4.79	46.42	26
2013	6.4	54.42	27
2014	6.15	47.75	28
2015	5.71	42.91	29
2016	6.6	53.74	30
2017	5.44	48.36	31
2018	7.84	55.23	32
2019	7.19	49.00	33
2020	5.62	41.31	34
2021	7.68	62.84	35
2022	5.56	-1.00	36
#VALUE!	######	#VALUE!	37
#VALUE!	######	#VALUE!	38
#VALUE!	######	#VALUE!	39

Current: 5.56 | Ukraine Corn Yiel: 3.31 | VHI: -1 | Trend: 36 | Dough

Last Run→ Regression: 2007-2021

	0.77	0.81	5.0%	R^2
Tassel	0.73	0.78	6.2%	Adj R^2
2007	0.61	0.55	8.9%	Std Err
	3.17	3.81	20.4%	T-Stat

SetVHI Stats

	Default	Using:	Row
Begin:	1992	2007	22
End:	2021	2021	36

>> SUMMARY OUTPUT

Select VHI Stage: Dough (Tassel, Silk, Blister, Dough, Dent)

Regress This | GoTo Regression

GoTo VHI | GoTo Front

Regression Statistics

Multiple R	0.90013
R Square	0.81024
Adjusted R Squa	0.77861
Standard Error	0.55428
Observations	15

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	2	15.7415	7.87074	25.6189	4.7E-05
Residual	12	3.68669	0.30722		
Total	14	19.4282			

	Coefficient	*tandard Err*	*t Stat*	*P-value*	*.ower 95%*	*Jpper 95%*	*Pearson*
Intercept	-0.76108	0.97495	-0.78063	0.45014	-2.8853	1.36315	
VHI X Variable 1	0.07235	0.01897	3.81412	0.00247	0.03102	0.11367	0.824
Trend X Variable 2	0.11513	0.04	2.87846	0.01387	0.02798	0.20228	0.762

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	4.39901	-0.49901
2	4.2759	0.4141
3	4.50906	0.51094
4	4.37874	0.12126
5	6.58571	-0.14571
6	5.59105	-0.80105
7	6.28481	0.11519
8	5.91694	0.23306
9	5.68217	0.02783
10	6.58068	0.01932
11	6.30685	-0.86685

VHI: 1052 | Year | VHI | Trend

VHI	Observed
#N/A	3.52
#N/A	3.46
#N/A	3.86
#N/A	4.32
#N/A	3.74
4.40	3.9
4.28	4.69
4.51	5.02
4.38	4.5
6.59	6.44
5.59	4.79
6.28	6.4
5.92	6.15
5.68	5.71
6.58	6.6
6.31	5.44
6.92	7.84
6.58	7.19
6.14	5.62
7.81	7.68
3.31	5.56

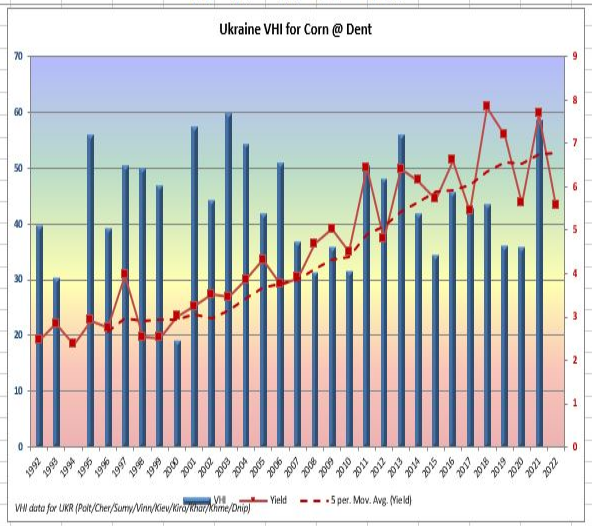
	Tassel	Silk	Blister	Dough	Dent
R^2	0.77	0.85	0.89	0.81	0.68
Adj R^2	0.73	0.82	0.87	0.78	0.63
Std Err	0.61	0.49	0.43	0.55	0.72
T-Stat	3.17	4.62	5.70	3.81	1.96

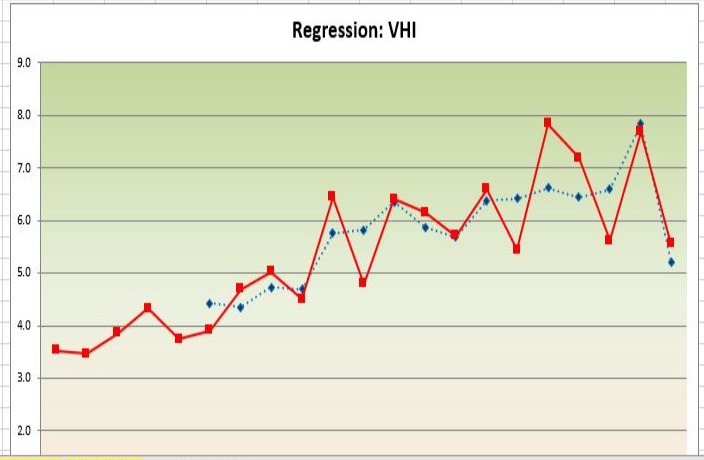
Sheet tabs: TMin | DB WxData | FormData | Yield | DB Yield | Wx-ALL | WxStats | Stats | Summary | Fcst-VHI | Fcst-Wx | Fcst-VHI+Wx | Fcst-VHI+V ...

Ready

Rain coming 3:42 PM 6/22/2022

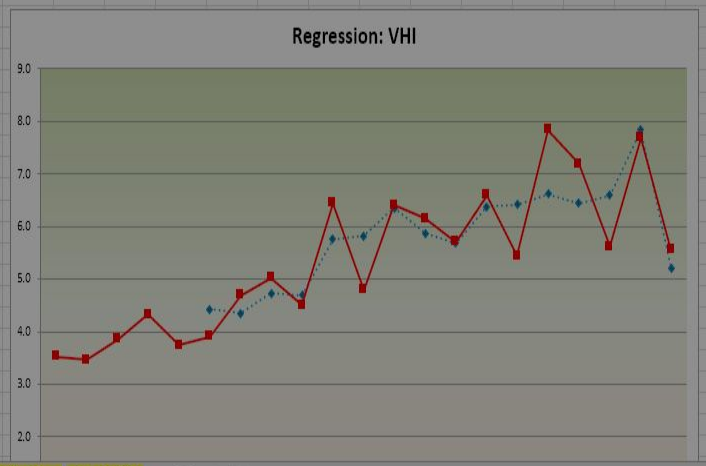
Dent,
Worse stats still.





There are other Excel tricks, bells, and whistles, but the gist:
All stages are tested, and for Ukraine Corn, the best VHI stats are during ***Blister***

	Tassel	Silk	Blister	Dough	Dent
R^2	0.77	0.85	0.89	0.81	0.68
Adj R^2	0.73	0.82	0.87	0.78	0.63
Std Err	0.61	0.49	0.43	0.55	0.72
T-Stat	3.17	4.62	5.70	3.81	1.96



The VHI stage is set to **Blister** and rerun to set that as the VHI forecast parameter moving forward.

Year	Yield	VHI	Trend
1987	3.43	#N/A	1
1988	3.71	#N/A	2
1989	3.79	#N/A	3
1990	3.84	#N/A	4
1991	3.25	57.612	5
1992	2.46	18.044	6
1993	2.84	67.264	7
1994	2.36	46.907	8
1995	2.92	56.169	9
1996	2.74	52.1164	10
1997	3.96	80.056	11
1998	2.53	68.4466	12
1999	2.52	50.7358	13
2000	3.01	61.2144	14
2001	3.24	51.1034	15
2002	3.52	43.6746	16
2003	3.46	67.4354	17
2004	3.86	75.098	18
2005	4.32	58.579	19
2006	3.74	57.633	20
2007	3.9	37.3004	21
2008	4.69	38.6872	22
2009	5.02	46.8572	23
2010	4.5	41.281	24
2011	6.44	72.2132	25
2012	4.79	47.5676	26
2013	6.4	58.2396	27
2014	6.15	53.649	28
2015	5.71	52.7116	29
2016	6.6	60.1504	30
2017	5.44	51.8348	31
2018	7.84	66.7368	32
2019	7.19	59.781	33
2020	5.62	49.1066	34
2021	7.2	67.3218	35
#VALUE!	######	#VALUE!	36
#VALUE!	######	#VALUE!	37
#VALUE!	######	#VALUE!	38
#VALUE!	######	#VALUE!	39

Current	Ukraine Corn Yiel	VHI	Trend
7.2	7.53	67.3218	35

Last Run→ Regression: 2007-2020

	0.87	0.87	0.0%	R^2
Blister	0.85	0.85	0.0%	Adj R^2
2007	0.43	0.43	0.0%	Std Err
	5.66	5.66	0.0%	T-Stat

SetVHI Stats

	Default	Using:	Row
Begin:	1987	2007	22
End:	2020	2020	35

>> SUMMARY OUTPUT

Select VHI Stage: Blister

Regress This | GoTo Regression | GoTo VHI | GoTo Front

Regression Statistics

Multiple R	0.93397
R Square	0.8723
Adjusted R Squa	0.84908
Standard Error	0.4296
Observations	14

ANOVA

	df	SS	MS	F	gnificance F
Regression	2	13.8672	6.93361	37.5689	1.2E-05
Residual	11	2.03013	0.18456		
Total	13	15.8974			

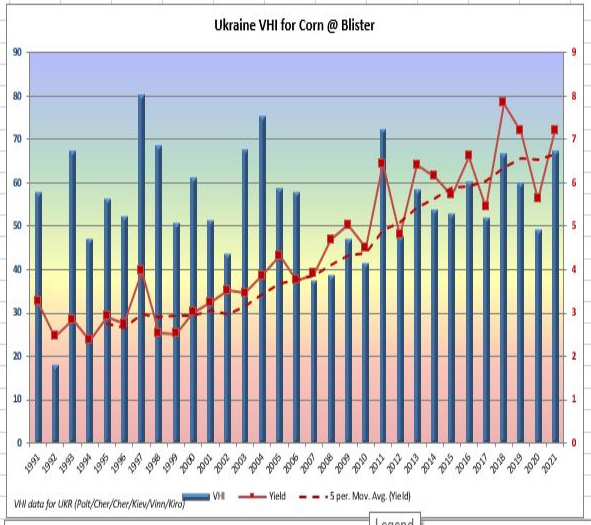
	Coefficient	tandard Err	t Stat	P-value	ower 95%	pper 95
Intercept	-0.73446	0.82553	-0.88968	0.39268	-2.55145	1.08253
VHI X Variable 1	0.07794	0.01378	5.65567	0.00015	0.04761	0.10827
Trend X Variable 2	0.08624	0.0336	2.56619	0.02623	0.01227	0.1602

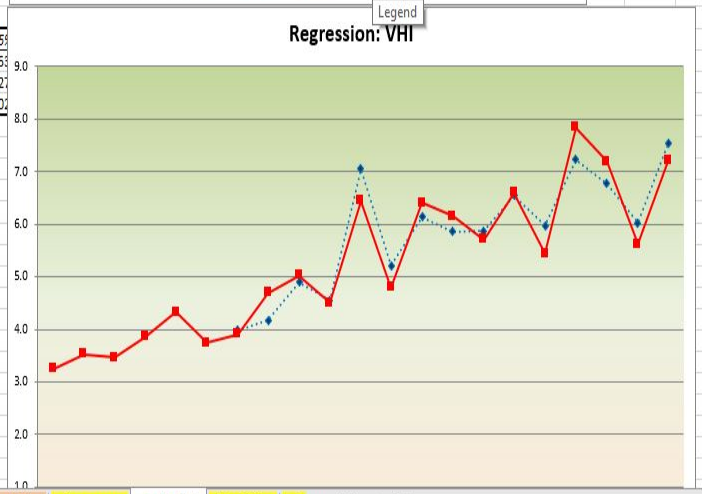
RESIDUAL OUTPUT

Observation	Predicted Y	Residuals
1	3.98362	-0.08362
2	4.17794	0.51206
3	4.90093	0.11907
4	4.55257	-0.05257
5	7.0496	-0.6096
6	5.21501	-0.42501
7	6.133	0.267
8	5.86145	0.28855
9	5.87463	-0.16463
10	6.54063	0.05937
11	5.97877	-0.53877

VHI: 904 Year VHI Trend

VHI	Observed
#N/A	3.24
#N/A	3.52
#N/A	3.46
#N/A	3.86
#N/A	4.32
#N/A	3.74
3.98	3.9
4.18	4.69
4.90	5.02
4.55	4.5
7.05	6.44
5.22	4.79
6.13	6.4
5.86	6.15
5.87	5.71
6.54	6.6
5.98	5.44
7.23	7.84
6.77	7.19
6.02	5.62
7.53	7.2





Sheet tabs: GDD | Pcp | TMax | TMin | DB WxData | FormData | Yield | DB Yield | Wx-ALL | WxStats | Stats | Summary | Fcst-VHI | Fcst-Wx | Fc ...

Ready

AutoSave Off | Corn-Yield-Wx-VHI-Ukraine.xlsm | Search | Luebehusen, Eric - OCE, Washington, DC

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H12 | SUMMARY OUTPUT

	A	B	C	D	G	H	I	J	K	L	M
1	Year	Yield	VHI	Trend	Current	Ukraine Corn Yiel	VHI	Trend			Blister
2	1987	3.43	#N/A	1	7.2	7.53	67.3218	35			
3	1988	3.71	#N/A	2	Last Run→	Regression: 2007-2020					
4	1989	3.79	#N/A	3			0.87	0.87	0.0%	R²	
5	1990	3.84	#N/A	4		Blister	0.85	0.85	0.0%	Adj R²	SetVHI Stats
6	1991	3.25	57.612	5		2007	0.43	0.43	0.0%	Std Err	
7	1992	2.46	18.044	6			5.66	5.66	0.0%	T-Stat	
8	1993	2.84	67.264	7							
9	1994	2.36	46.907	8		Default	Using:	Row			
10	1995	2.92	56.169	9	Begin:	1987	2007	22			
11	1996	2.74	52.1164	10	End:	2020	2020	35			
12	1997	3.96	80.056	11	>>	SUMMARY OUTPUT					
13	1998	2.53	68.4466	12							
14	1999	2.52	50.7358	13		Regression Statistics					
15	2000	3.01	61.2144	14		Multiple R	0.93397				
16	2001	3.24	51.1034	15		R Square	0.8723				
17	2002	3.52	43.6746	16		Adjusted R Squa	0.84908				
18	2003	3.46	67.4354	17		Standard Error	0.4296				
19	2004	3.86	75.098	18		Observations	14				
20	2005	4.32	58.579	19							
21	2006	3.74	57.633	20		ANOVA					
22	2007	3.9	37.3004	21			df	SS	MS	F	gnificance F
23	2008	4.69	38.6872	22		Regression	2	13.8672	6.93361	37.5689	1.2E-05
24	2009	5.02	46.8572	23		Residual	11	2.03013	0.18456		
25	2010	4.5	41.281	24		Total	13	15.8974			
26	2011	6.44	72.2132	25							
27	2012	4.79	47.5676	26			Coefficients	tandard Err	t Stat	P-value	ower 95%	pper 95
28	2013	6.4	58.2396	27		Intercept	-0.73446	0.82553	-0.88968	0.39268	-2.55145	1.08253
29	2014	6.15	53.649	28	VHI	X Variable 1	0.07794	0.01378	5.65567	0.00015	0.04761	0.10827
30	2015	5.71	52.7116	29	Trend	X Variable 2	0.08624	0.0336	2.56619	0.02623	0.01227	0.1602
31	2016	6.6	60.1504	30								
32	2017	5.44	51.8348	31								
33	2018	7.84	66.7368	32								
34	2019	7.19	59.781	33		RESIDUAL OUTPUT						
35	2020	5.62	49.1066	34								
36	2021	7.2	67.3218	35		Observation	Predicted Y	Residuals				
37	#VALUE!	######	#VALUE!	36		1	3.98362	-0.08362				
38	#VALUE!	######	#VALUE!	37		2	4.17794	0.51206				
39	#VALUE!	######	#VALUE!	38		3	4.90093	0.11907				
40	#VALUE!	######	#VALUE!	39		4	4.55257	-0.05257				
41						5	7.0496	-0.6096				
42						6	5.21501	-0.42501				
43						7	6.133	0.267				
44						8	5.86145	0.28855				
45						9	5.87463	-0.16463				
46						10	6.54063	0.05937				
47						11	5.97877	-0.53877				

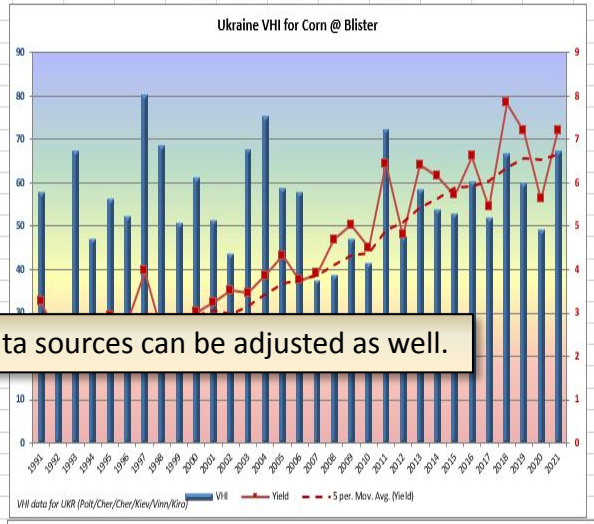
Select VHI Stage: Blister

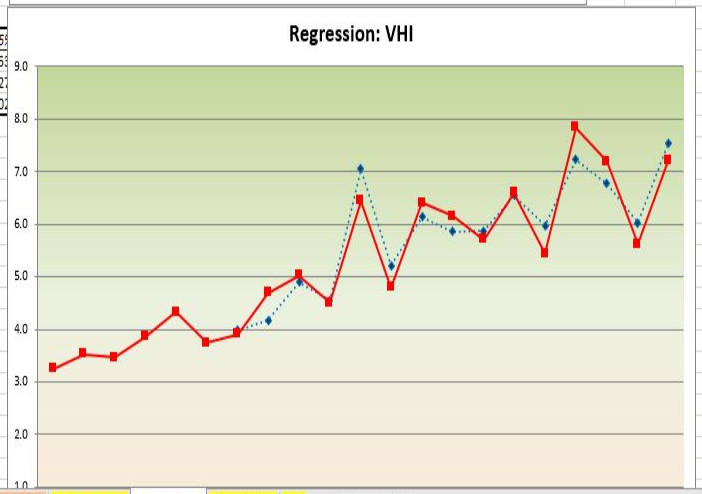
Regress This | GoTo Regression | GoTo VHI

VHI data sources can be adjusted as well.

	R	S	T	U	V
	VHI:	904	Year	VHI	Trend

	AA	AB
	VHI	Observed
	#N/A	3.24
	#N/A	3.52
	#N/A	3.46
	#N/A	3.86
	#N/A	4.32
	#N/A	3.74
	3.98	3.9
	4.18	4.69
	4.90	5.02
	4.55	4.5
	7.05	6.44
	5.22	4.79
	6.13	6.4
	5.86	6.15
	5.87	5.71
	6.54	6.6
	5.98	5.44
	7.23	7.84
	6.77	7.19
	6.02	5.62
	7.53	7.2





GDD | Pcp | TMax | TMin | DB WxData | FormData | Yield | DB Yield | Wx-ALL | WxStats | Stats | Summary | Fcst-VHI | Fcst-Wx | Fc ...

Ready | 80%

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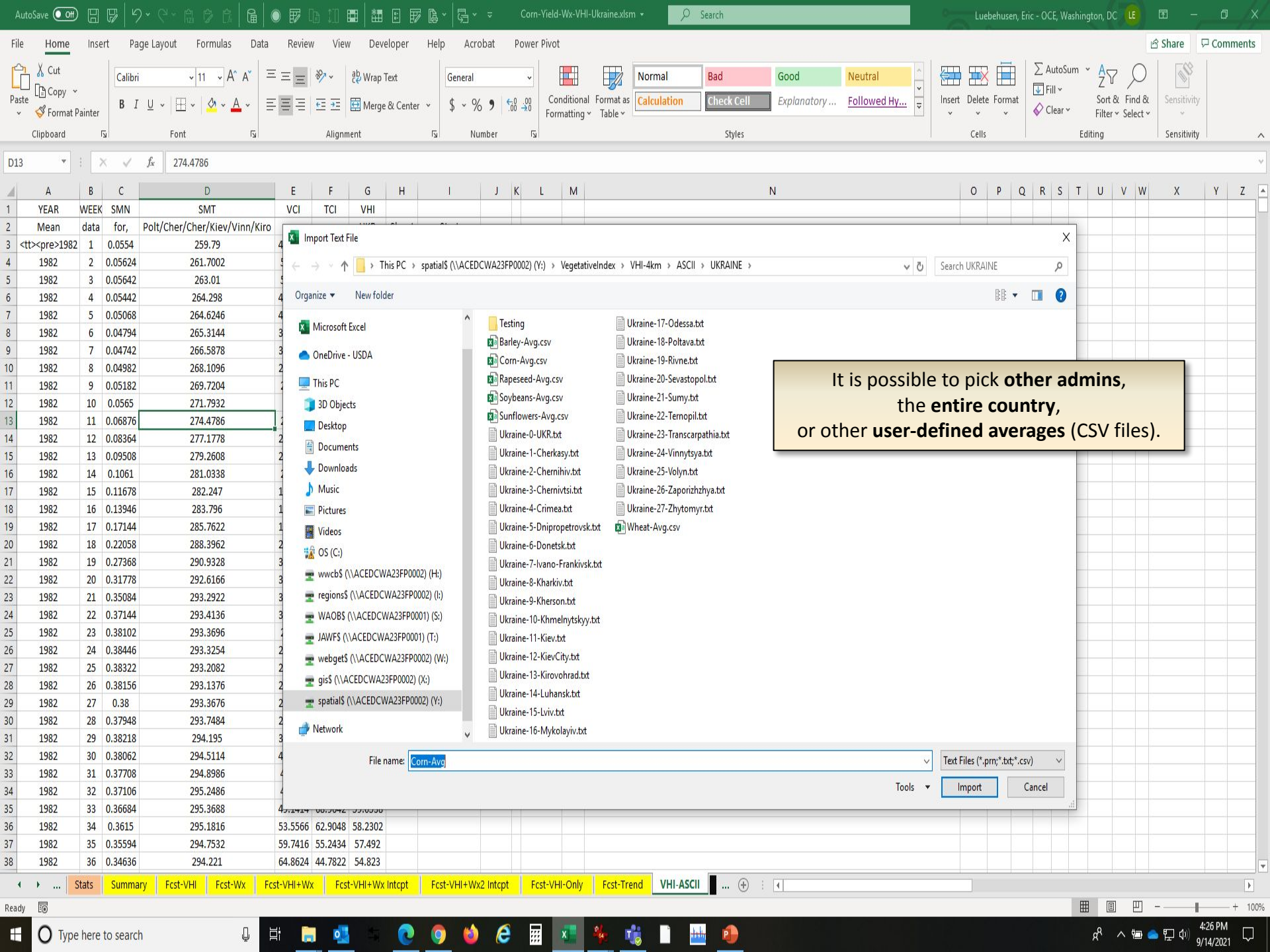

	A	B	C	D	E	F	G
1	YEAR	WEEK	SMN	SMT	VCI	TCI	VHI
2	Mean	data	for,	Polt/Cher/Cher/Kiev/Vinn/Kiro			
3	<tt><pre>1982	1	0.0554	259.79			
4	1982	2	0.05624	261.7002			
5	1982	3	0.05642	263.01			
6	1982	4	0.05442	264.298			
7	1982	5	0.05068	264.6246			
8	1982	6	0.04794	265.3144			
9	1982	7	0.04742	266.5878			
10	1982	8	0.04982	268.1096			
11	1982	9	0.05182	269.7204			
12	1982	10	0.0565	271.7932			
13	1982	11	0.06876	274.4786			
14	1982	12	0.08364	277.1778			
15	1982	13	0.09508	279.2608			
16	1982	14	0.1061	281.0338			
17	1982	15	0.11678	282.247			
18	1982	16	0.13946	283.796			
19	1982	17	0.17144	285.7622			
20	1982	18	0.22058	288.3962			
21	1982	19	0.27368	290.9328			
22	1982	20	0.31778	292.6166			
23	1982	21	0.35084	293.2922			
24	1982	22	0.37144	293.4136			
25	1982	23	0.38102	293.3696			
26	1982	24	0.38446	293.3254			
27	1982	25	0.38322	293.2082			
28	1982	26	0.38156	293.1376			
29	1982	27	0.38	293.3676			
30	1982	28	0.37948	293.7484			
31	1982	29	0.38218	294.195			
32	1982	30	0.38062	294.5114			
33	1982	31	0.37708	294.8986			
34	1982	32	0.37106	295.2486			
35	1982	33	0.36684	295.3688			
36	1982	34	0.3615	295.1816	53.5566	62.9048	58.2302
37	1982	35	0.35594	294.7532	59.7416	55.2434	57.492
38	1982	36	0.34636	294.221	64.8624	44.7822	54.823

Stats | Summary | Fcst-VHI | Fcst-Wx | Fcst-VHI+Wx | Fcst-VHI+Wx Intcpt | Fcst-VHI+Wx2 Intcpt | Fcst-VHI-Only | Fcst-Trend | VHI-ASCII

The VHI ascii data is VITAL to our operations!!

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NPP first images for land cover was obtained on 11/21/2011

NPP VIIRS 500m GVI data were produced since May 2, 2012 to now

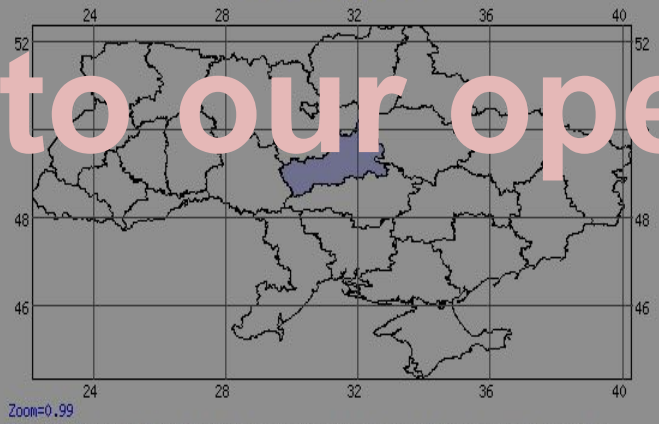
Data and images displayed on STAR sites are provided for experimental use only and are not official operational NOAA products. More information>>

STAR - Global Vegetation Health Products :

You selected the 1th province in *Ukraine*

country/region(191)	province	Year1	Year2
Ukrain	Cherkasy	1981	2019

Selected Province



Zoom=0.99

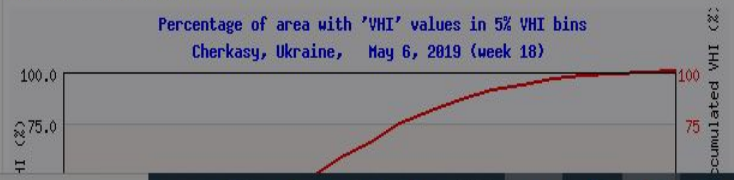
The above image highlights the province selected. You may select another province by cursor.

The pictures below show the time series of drought related indices for this province (*Cherkasy, Ukraine*).

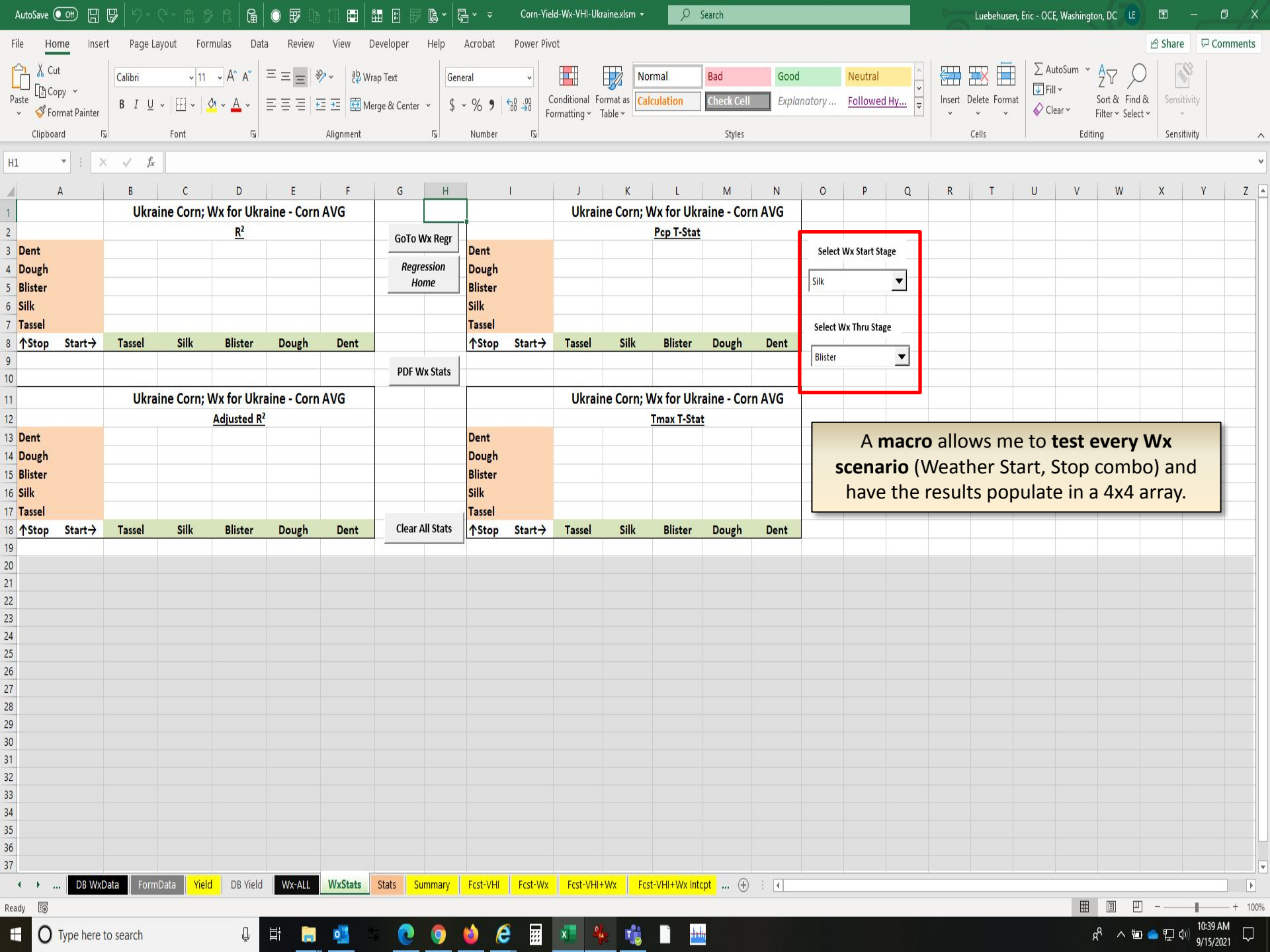
The time series of 'Area-Avegaed' and 'Percentage-Of-Area' data for the plots below are avilable in ASCII format.

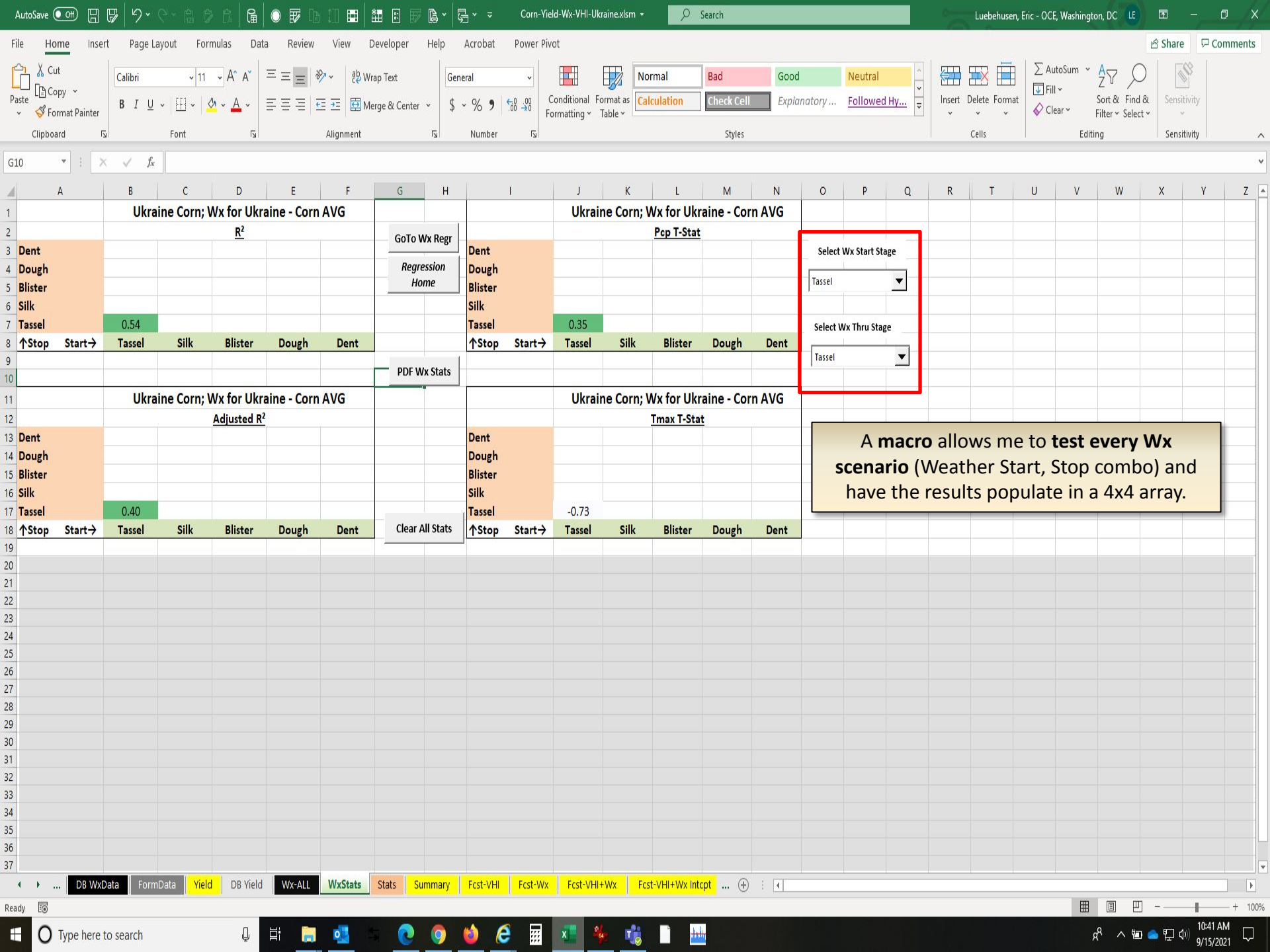
Note: The information on this page is for selected provinces/countries. Here is the list of selected provinces and countries

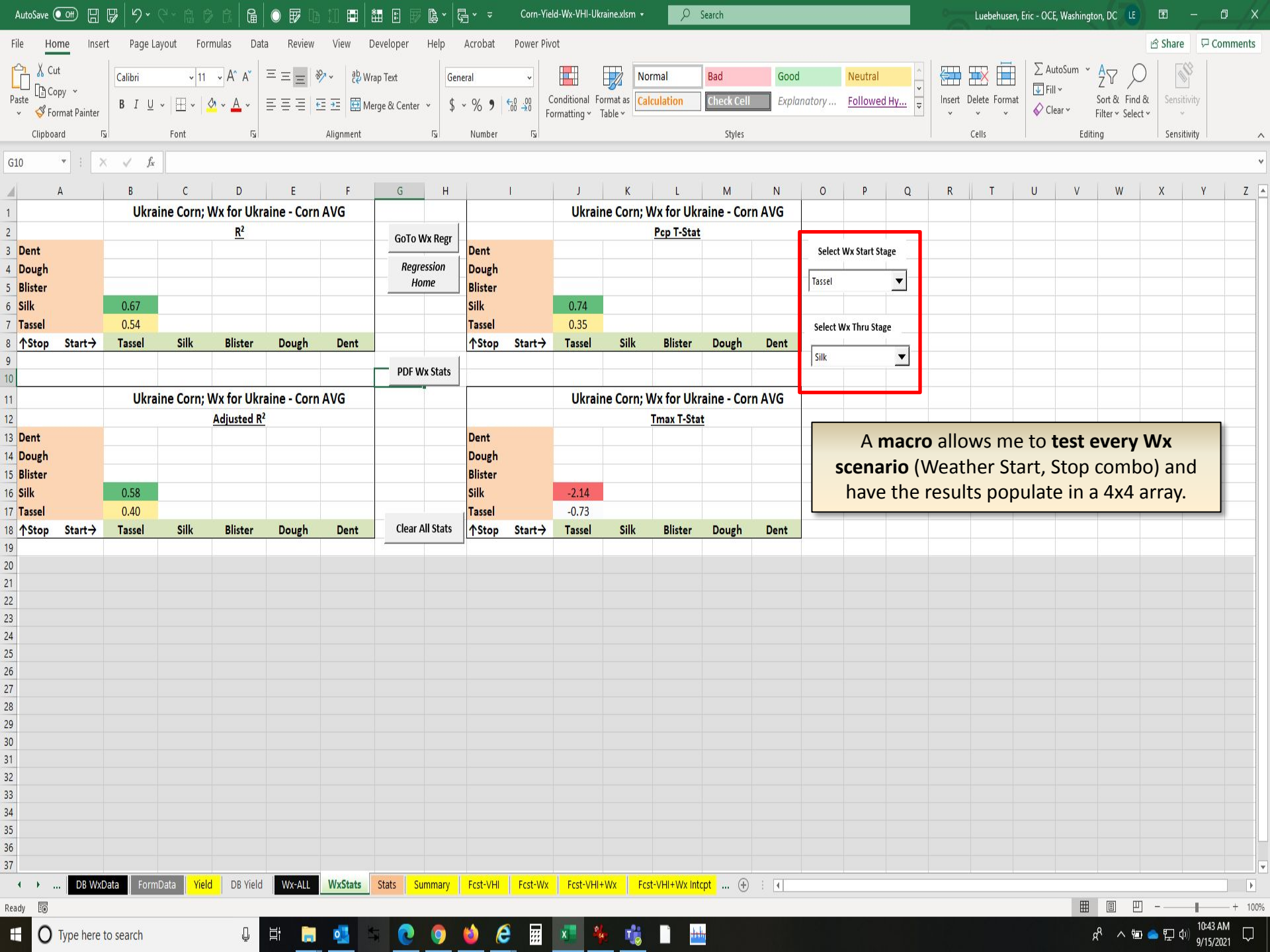
The current week' situtation

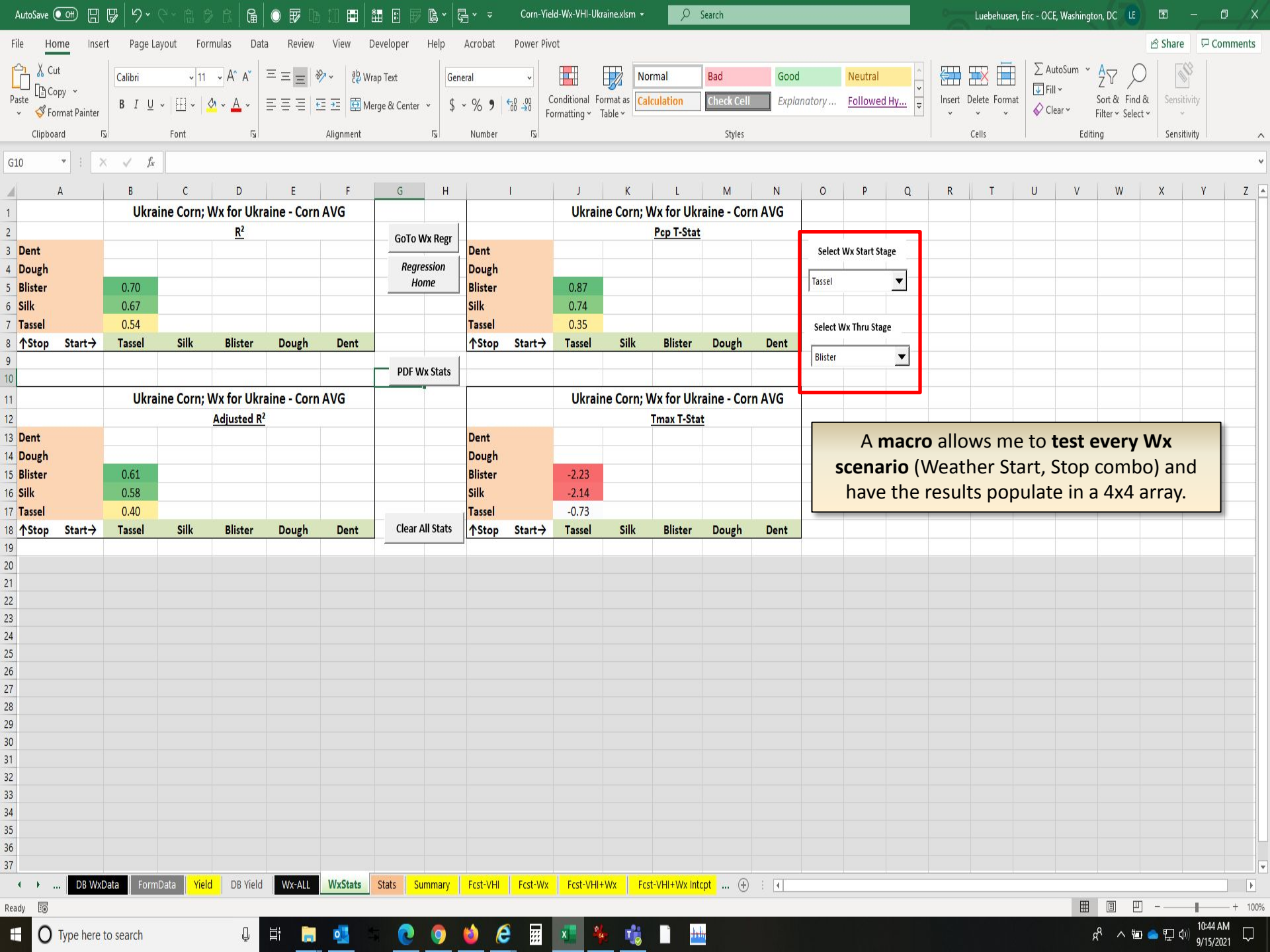


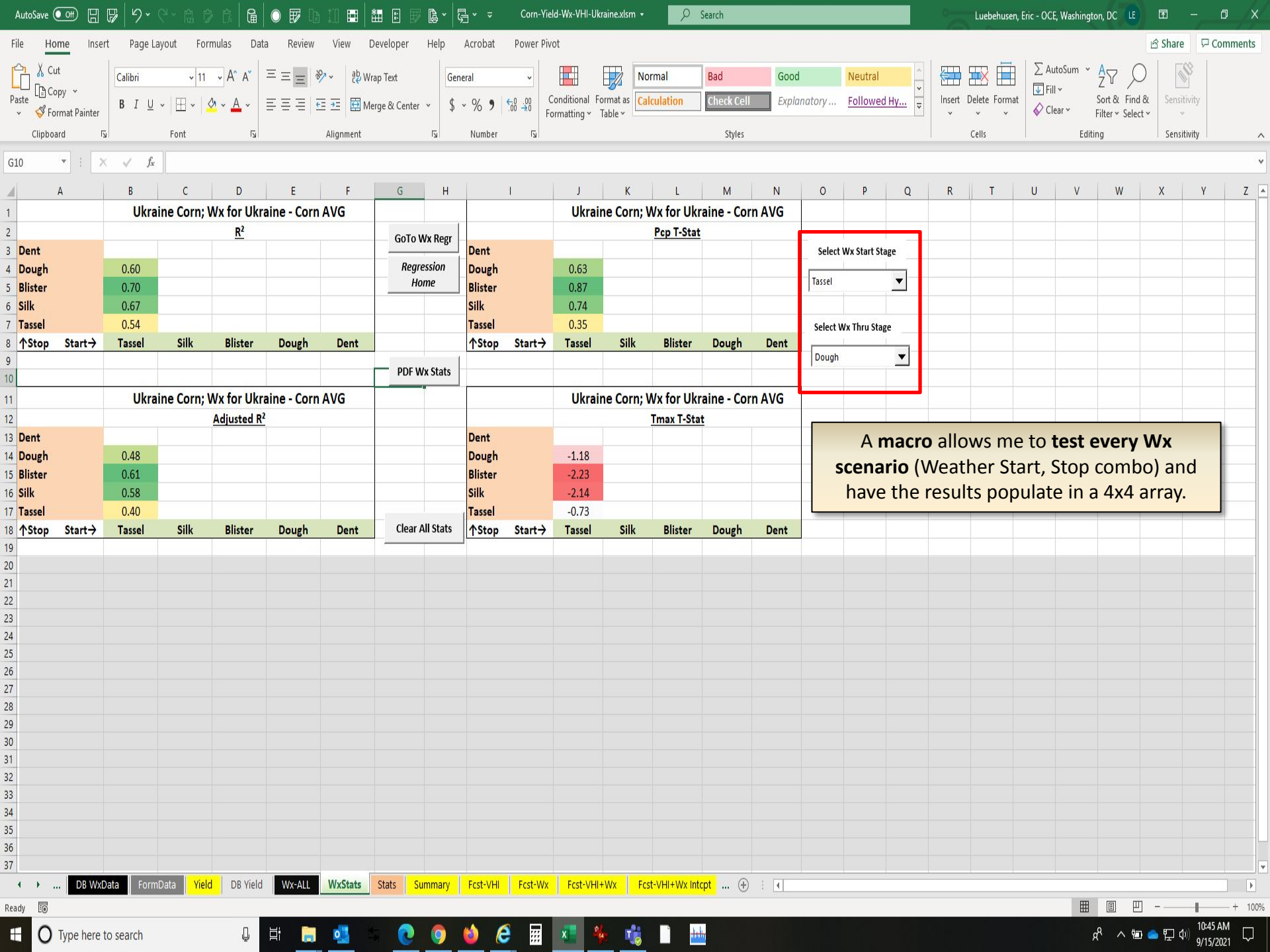
Wx Regression….

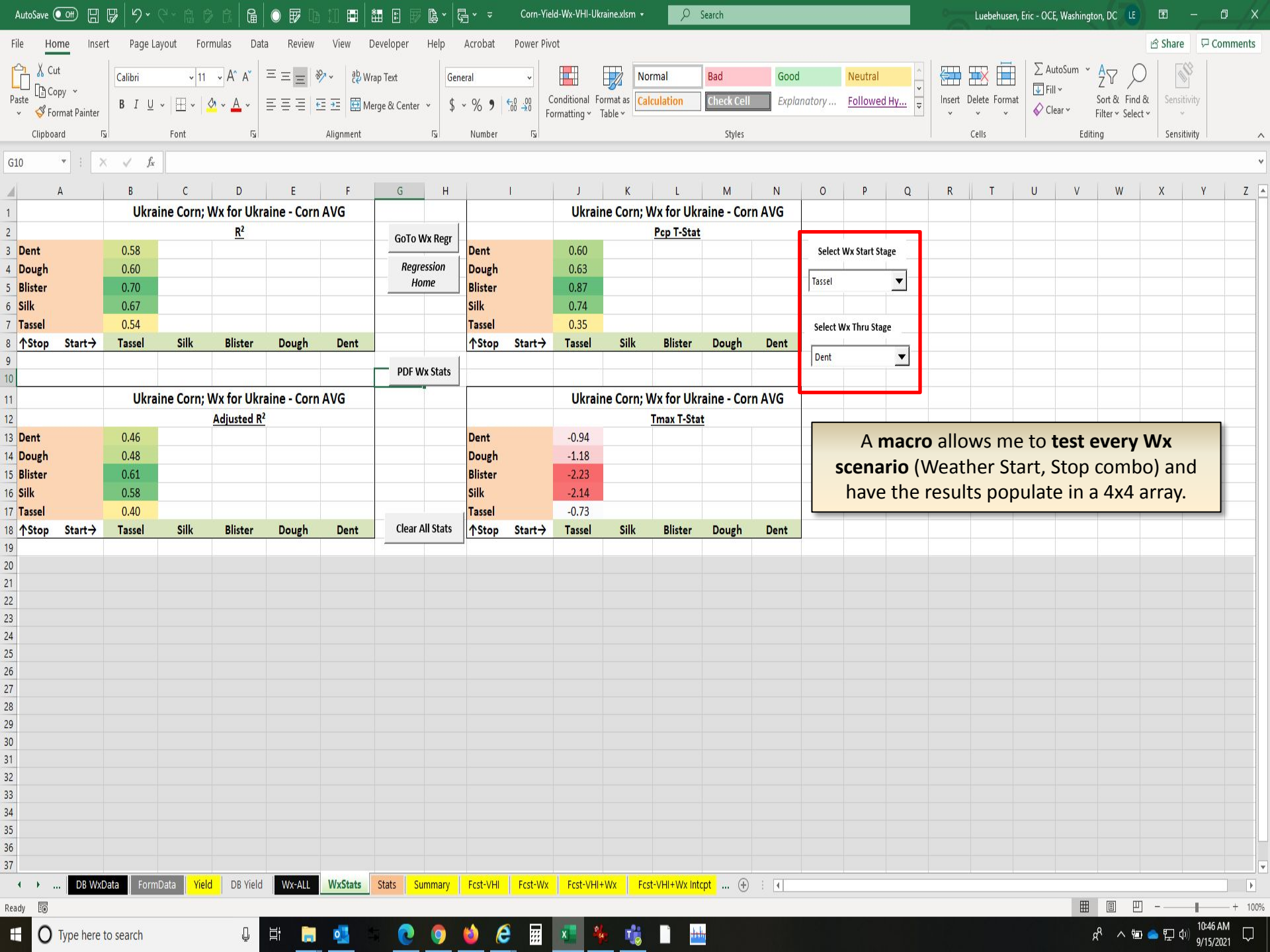

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent
Dough
Blister
Silk
Tassel
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent
Dough
Blister
Silk
Tassel
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Silk
Select Wx Thru Stage
Blister
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent
Dough
Blister
Silk
Tassel
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent
Dough
Blister
Silk
Tassel
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

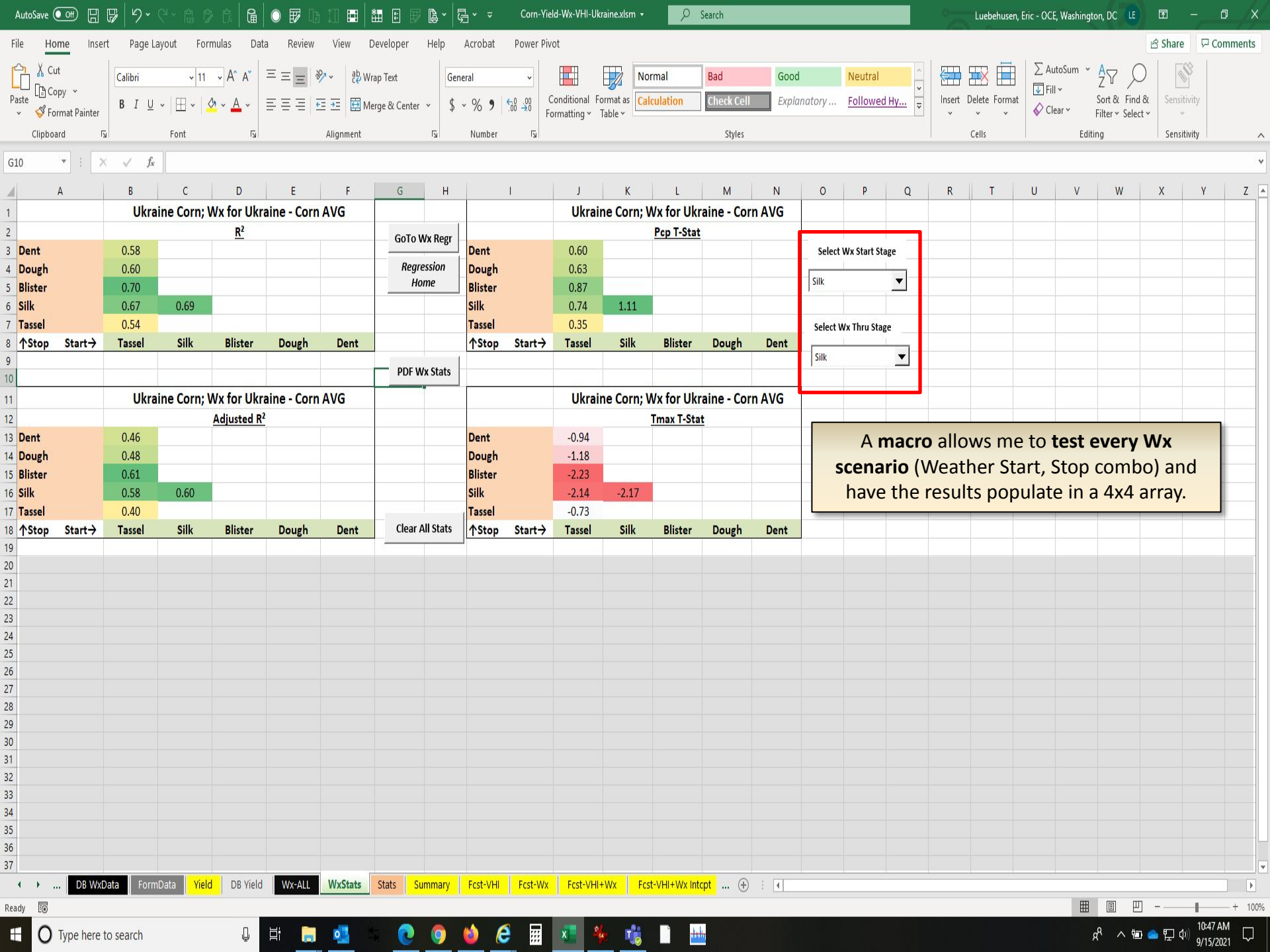

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent
Dough
Blister
Silk
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Tassel 0.35
Select Wx Start Stage
Tassel
Select Wx Thru Stage
Tassel
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Tassel 0.40
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Tassel -0.73
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

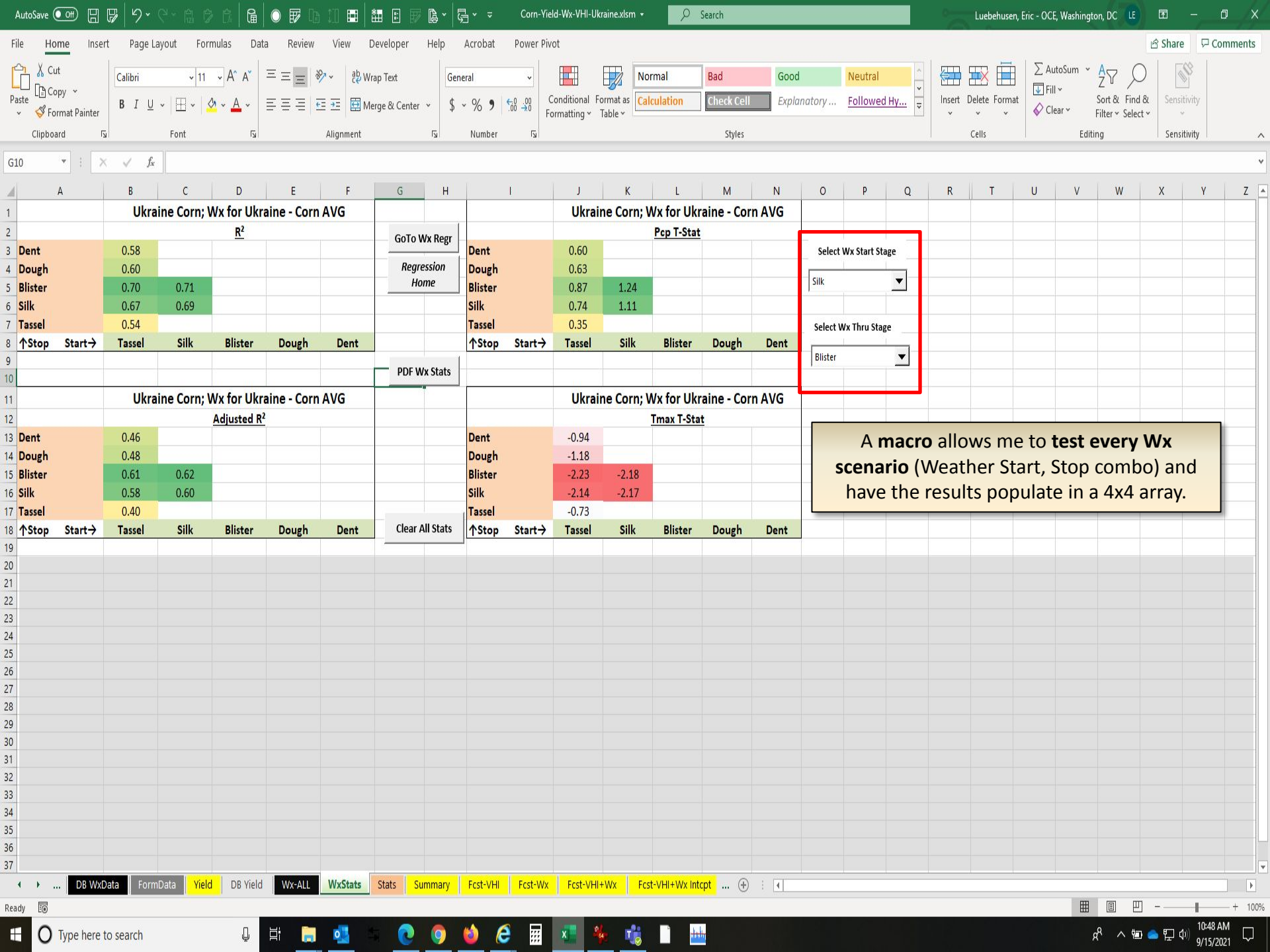

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent
Dough
Blister
Silk 0.67
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent
Dough
Blister
Silk 0.74
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Tassel
Select Wx Thru Stage
Silk
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent
Dough
Blister
Silk 0.58
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent
Dough
Blister
Silk -2.14
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

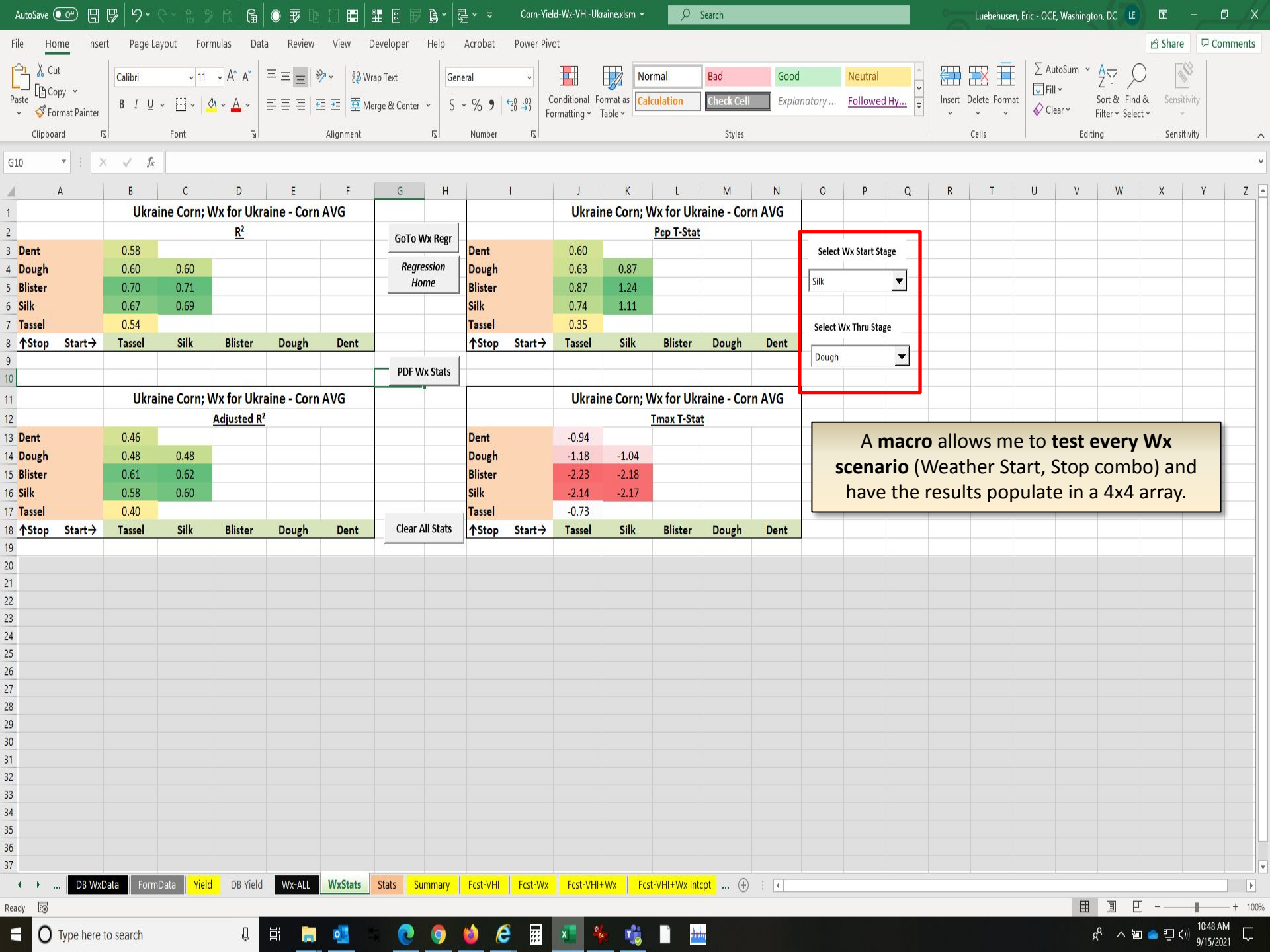

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent
Dough
Blister 0.70
Silk 0.67
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent
Dough
Blister 0.87
Silk 0.74
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Tassel
Select Wx Thru Stage
Blister
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent
Dough
Blister 0.61
Silk 0.58
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent
Dough
Blister -2.23
Silk -2.14
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

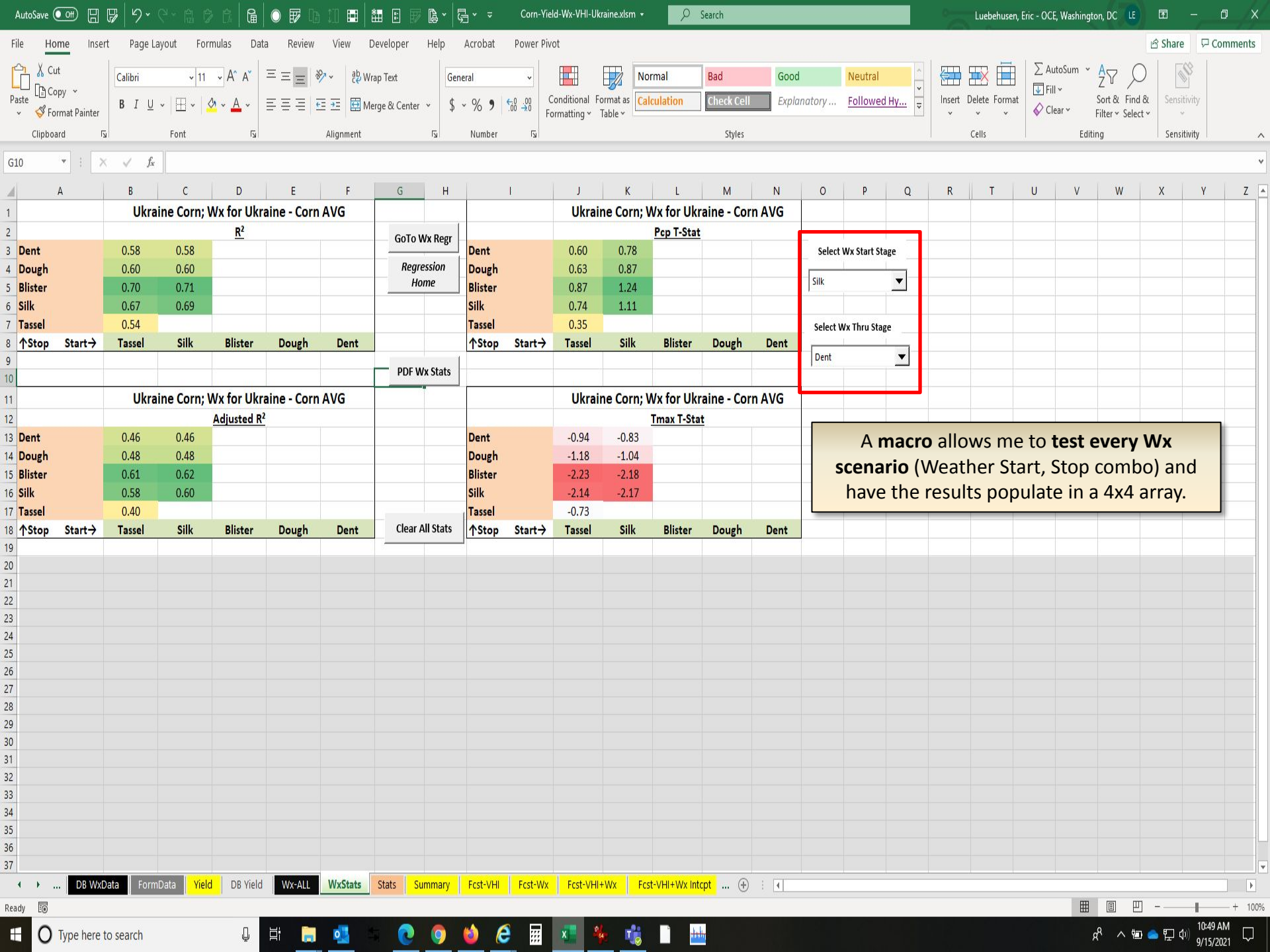

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent
Dough 0.60
Blister 0.70
Silk 0.67
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent
Dough 0.63
Blister 0.87
Silk 0.74
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Tassel
Select Wx Thru Stage
Dough
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent
Dough 0.48
Blister 0.61
Silk 0.58
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent
Dough -1.18
Blister -2.23
Silk -2.14
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

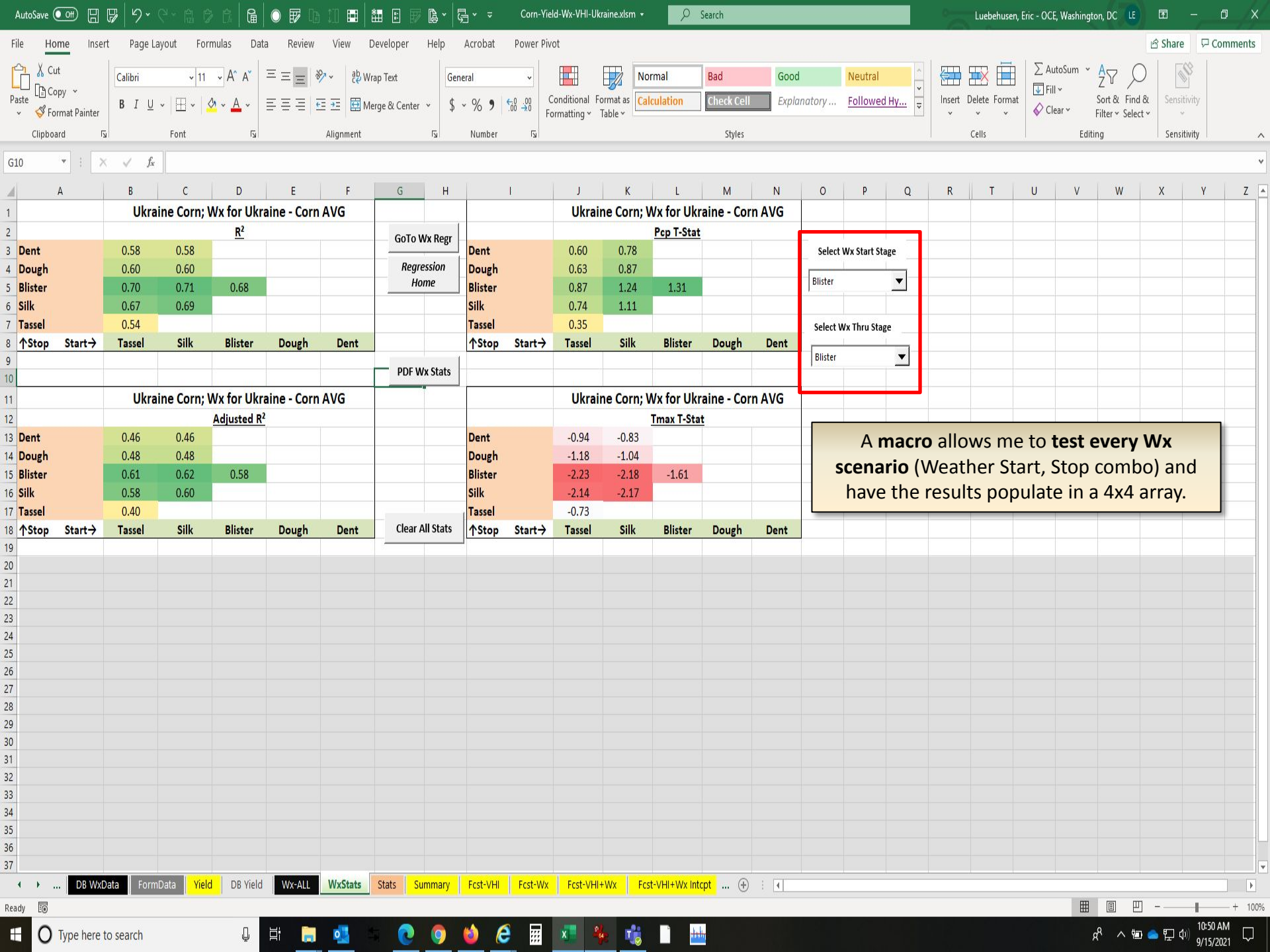

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58
Dough 0.60
Blister 0.70
Silk 0.67
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60
Dough 0.63
Blister 0.87
Silk 0.74
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Tassel
Select Wx Thru Stage
Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46
Dough 0.48
Blister 0.61
Silk 0.58
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94
Dough -1.18
Blister -2.23
Silk -2.14
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

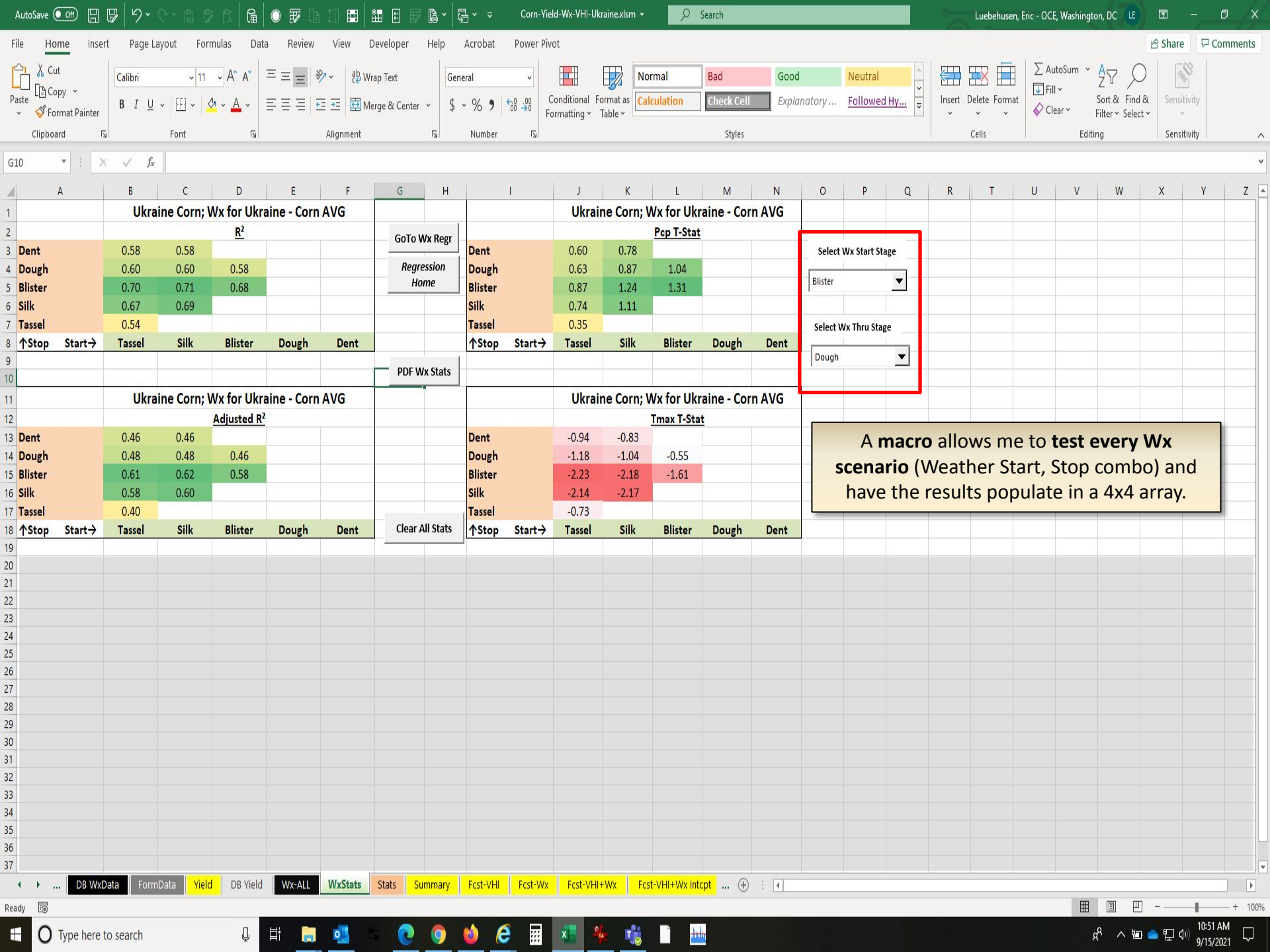

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58
Dough 0.60
Blister 0.70
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60
Dough 0.63
Blister 0.87
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Silk
Select Wx Thru Stage
Silk
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46
Dough 0.48
Blister 0.61
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94
Dough -1.18
Blister -2.23
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

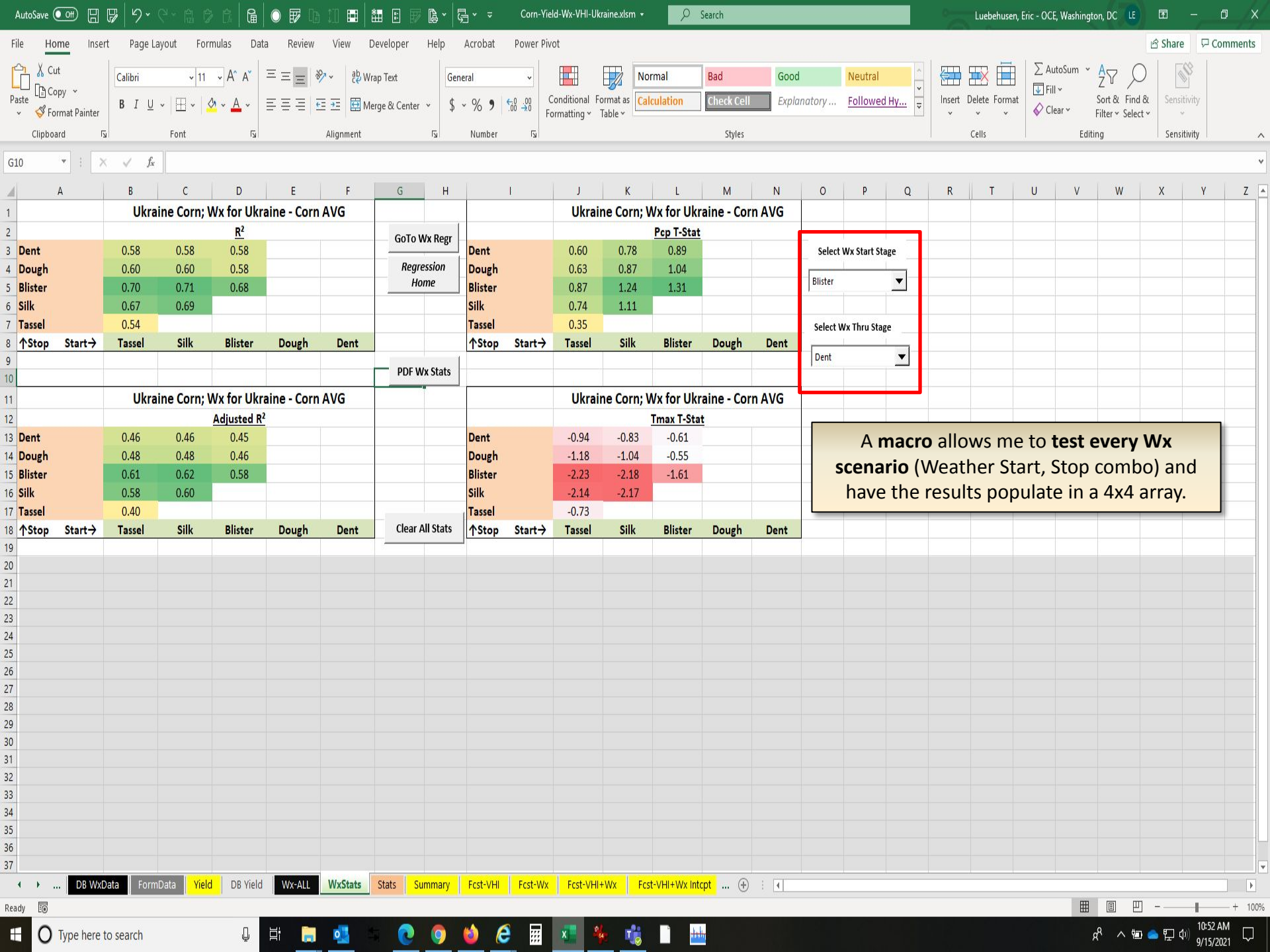

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58
Dough 0.60
Blister 0.70 0.71
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60
Dough 0.63
Blister 0.87 1.24
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Silk
Select Wx Thru Stage
Blister
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46
Dough 0.48
Blister 0.61 0.62
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94
Dough -1.18
Blister -2.23 -2.18
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

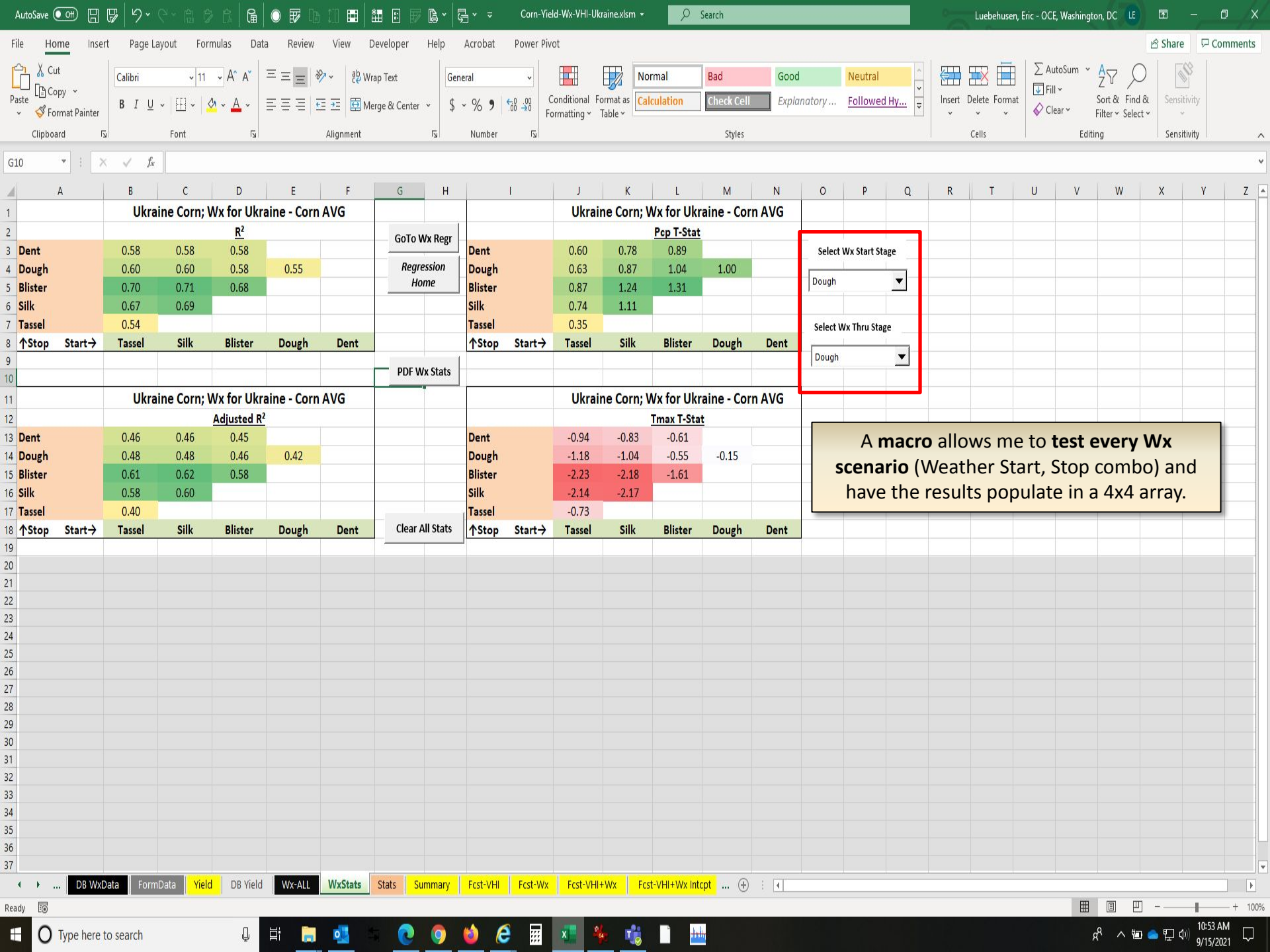

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58
Dough 0.60 0.60
Blister 0.70 0.71
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60
Dough 0.63 0.87
Blister 0.87 1.24
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Silk
Select Wx Thru Stage
Dough
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46
Dough 0.48 0.48
Blister 0.61 0.62
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94
Dough -1.18 -1.04
Blister -2.23 -2.18
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

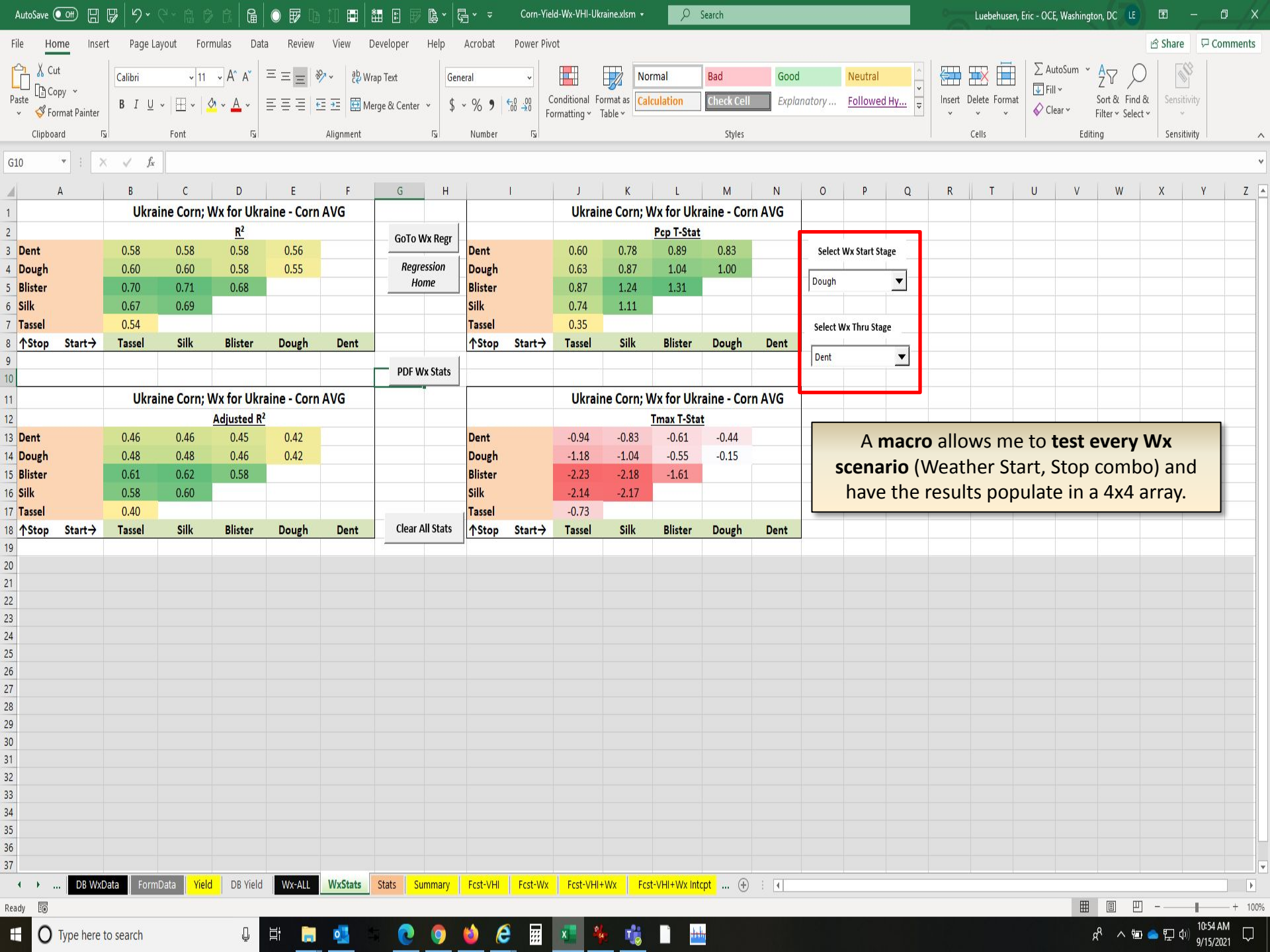

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58
Dough 0.60 0.60
Blister 0.70 0.71
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78
Dough 0.63 0.87
Blister 0.87 1.24
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Silk
Select Wx Thru Stage
Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46
Dough 0.48 0.48
Blister 0.61 0.62
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83
Dough -1.18 -1.04
Blister -2.23 -2.18
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

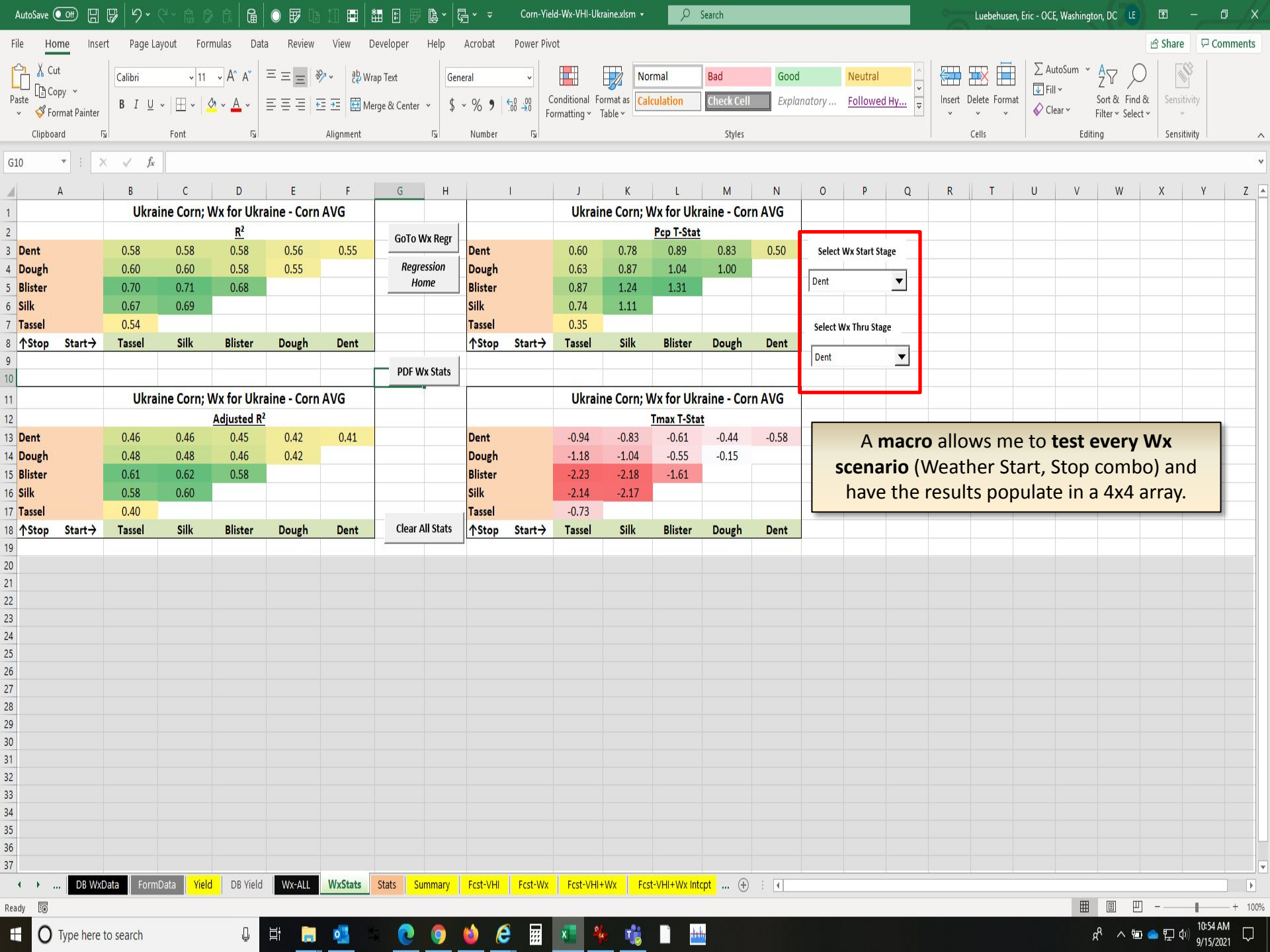

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58
Dough 0.60 0.60
Blister 0.70 0.71 0.68
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78
Dough 0.63 0.87
Blister 0.87 1.24 1.31
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Blister
Select Wx Thru Stage
Blister
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46
Dough 0.48 0.48
Blister 0.61 0.62 0.58
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83
Dough -1.18 -1.04
Blister -2.23 -2.18 -1.61
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.

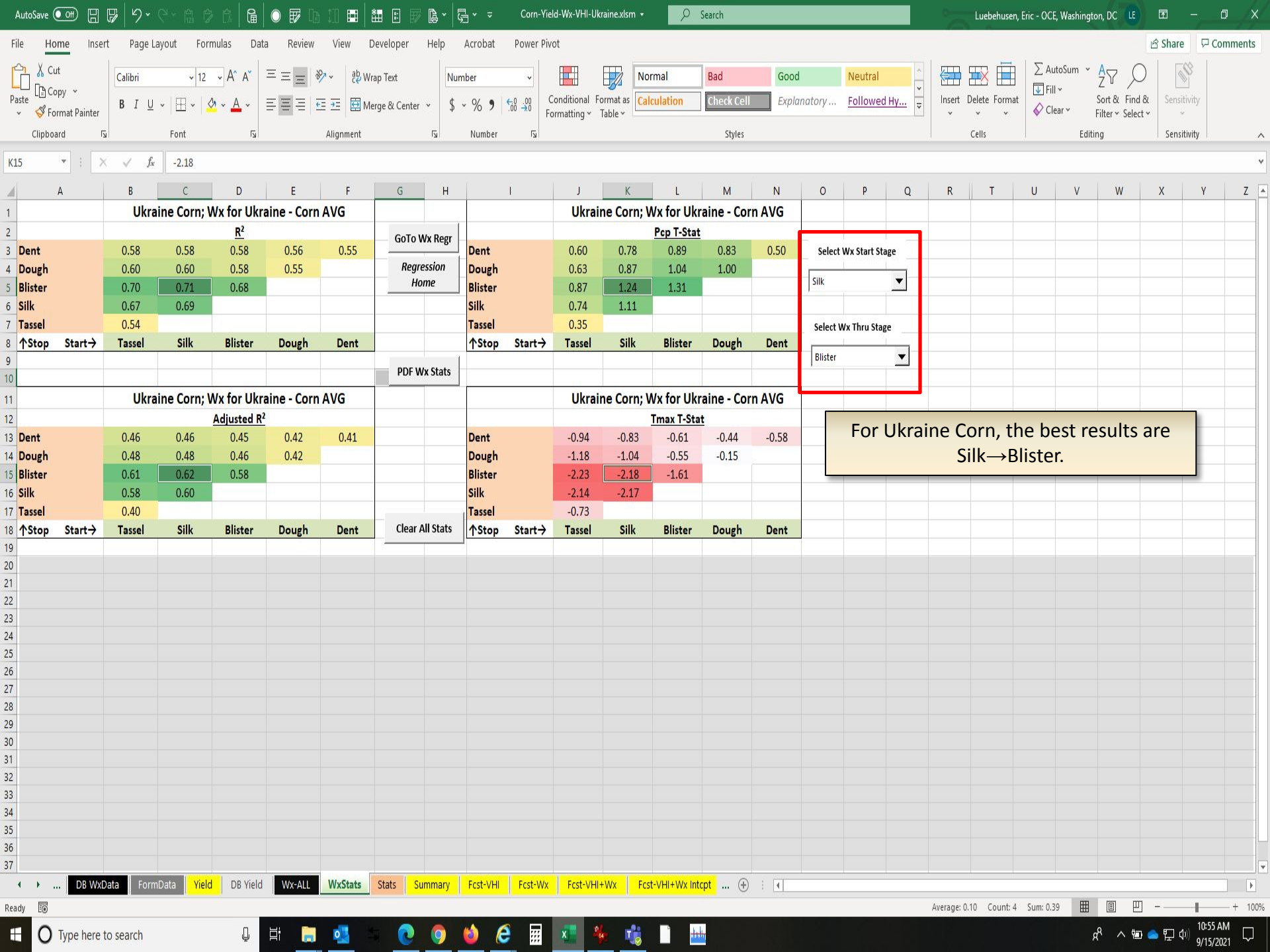

Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58
Dough 0.60 0.60 0.58
Blister 0.70 0.71 0.68
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78
Dough 0.63 0.87 1.04
Blister 0.87 1.24 1.31
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Blister
Select Wx Thru Stage
Dough
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46
Dough 0.48 0.48 0.46
Blister 0.61 0.62 0.58
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83
Dough -1.18 -1.04 -0.55
Blister -2.23 -2.18 -1.61
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.


Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58 0.58
Dough 0.60 0.60 0.58
Blister 0.70 0.71 0.68
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78 0.89
Dough 0.63 0.87 1.04
Blister 0.87 1.24 1.31
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Blister
Select Wx Thru Stage
Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46 0.45
Dough 0.48 0.48 0.46
Blister 0.61 0.62 0.58
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83 -0.61
Dough -1.18 -1.04 -0.55
Blister -2.23 -2.18 -1.61
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.


Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58 0.58
Dough 0.60 0.60 0.58 0.55
Blister 0.70 0.71 0.68
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78 0.89
Dough 0.63 0.87 1.04 1.00
Blister 0.87 1.24 1.31
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Dough
Select Wx Thru Stage
Dough
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46 0.45
Dough 0.48 0.48 0.46 0.42
Blister 0.61 0.62 0.58
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83 -0.61
Dough -1.18 -1.04 -0.55 -0.15
Blister -2.23 -2.18 -1.61
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.


Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58 0.58 0.56
Dough 0.60 0.60 0.58 0.55
Blister 0.70 0.71 0.68
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78 0.89 0.83
Dough 0.63 0.87 1.04 1.00
Blister 0.87 1.24 1.31
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Dough
Select Wx Thru Stage
Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46 0.45 0.42
Dough 0.48 0.48 0.46 0.42
Blister 0.61 0.62 0.58
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83 -0.61 -0.44
Dough -1.18 -1.04 -0.55 -0.15
Blister -2.23 -2.18 -1.61
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.


Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58 0.58 0.56 0.55
Dough 0.60 0.60 0.58 0.55
Blister 0.70 0.71 0.68
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78 0.89 0.83 0.50
Dough 0.63 0.87 1.04 1.00
Blister 0.87 1.24 1.31
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Dent
Select Wx Thru Stage
Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46 0.45 0.42 0.41
Dough 0.48 0.48 0.46 0.42
Blister 0.61 0.62 0.58
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83 -0.61 -0.44 -0.58
Dough -1.18 -1.04 -0.55 -0.15
Blister -2.23 -2.18 -1.61
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
A macro allows me to test every Wx scenario (Weather Start, Stop combo) and have the results populate in a 4x4 array.


Ukraine Corn; Wx for Ukraine - Corn AVG
R²
Dent 0.58 0.58 0.58 0.56 0.55
Dough 0.60 0.60 0.58 0.55
Blister 0.70 0.71 0.68
Silk 0.67 0.69
Tassel 0.54
↑Stop Start→ Tassel Silk Blister Dough Dent
GoTo Wx Regr
Regression Home
PDF Wx Stats
Clear All Stats
Ukraine Corn; Wx for Ukraine - Corn AVG
Pcp T-Stat
Dent 0.60 0.78 0.89 0.83 0.50
Dough 0.63 0.87 1.04 1.00
Blister 0.87 1.24 1.31
Silk 0.74 1.11
Tassel 0.35
↑Stop Start→ Tassel Silk Blister Dough Dent
Select Wx Start Stage
Silk
Select Wx Thru Stage
Blister
Ukraine Corn; Wx for Ukraine - Corn AVG
Adjusted R²
Dent 0.46 0.46 0.45 0.42 0.41
Dough 0.48 0.48 0.46 0.42
Blister 0.61 0.62 0.58
Silk 0.58 0.60
Tassel 0.40
↑Stop Start→ Tassel Silk Blister Dough Dent
Ukraine Corn; Wx for Ukraine - Corn AVG
Tmax T-Stat
Dent -0.94 -0.83 -0.61 -0.44 -0.58
Dough -1.18 -1.04 -0.55 -0.15
Blister -2.23 -2.18 -1.61
Silk -2.14 -2.17
Tassel -0.73
↑Stop Start→ Tassel Silk Blister Dough Dent
For Ukraine Corn, the best results are Silk→Blister.

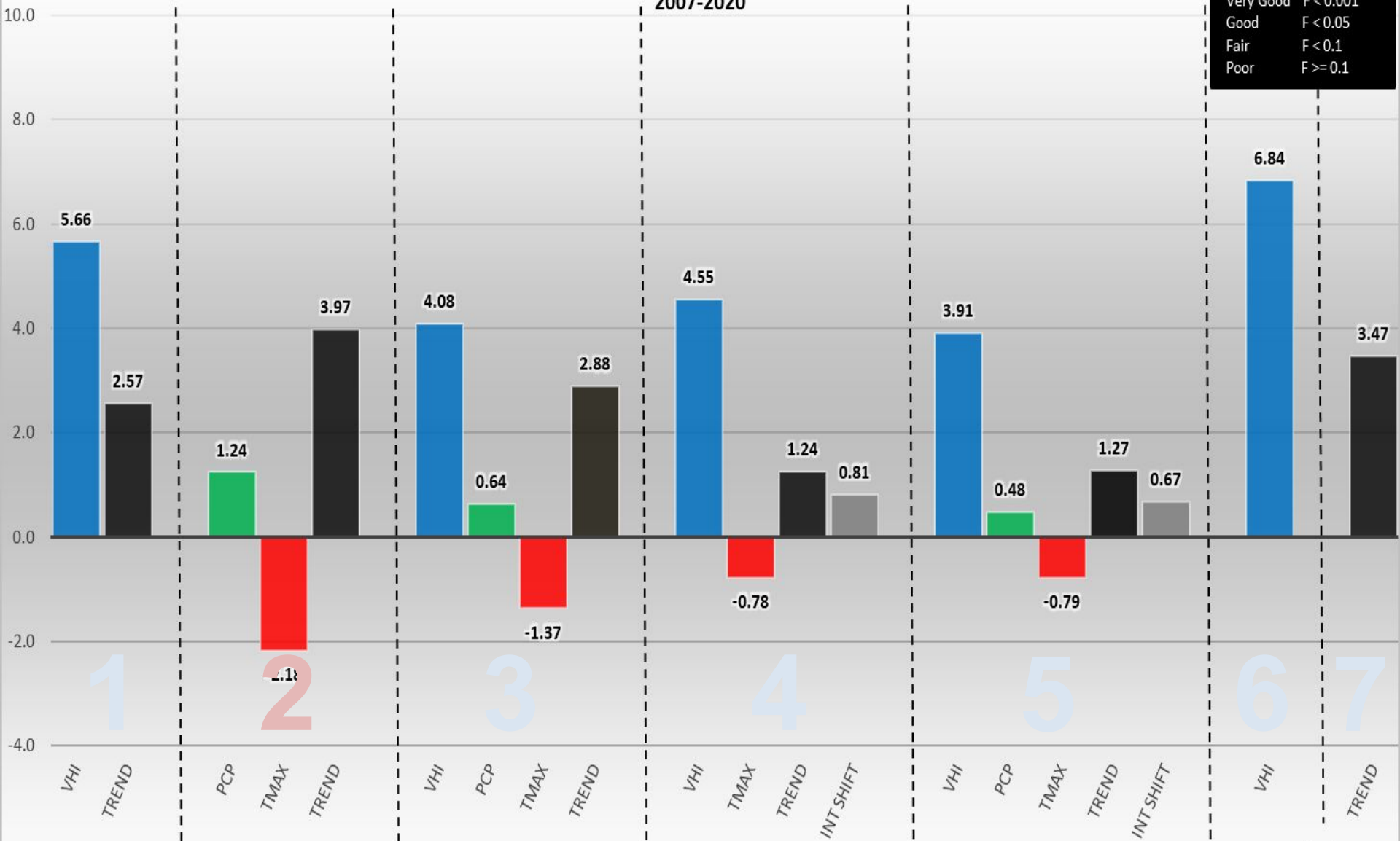
Other Regression….

Ukraine Corn Regression Stats

2007-2020

T-Stat

Significance-F (Objective Assessment)	
Excellent	F < 0.0001
Very Good	F < 0.001
Good	F < 0.05
Fair	F < 0.1
Poor	F >= 0.1



Fcst-VHI	Fcst-Wx	Fcst-VHI+Wx	Fcst-VHI+Wx Intcpt	Fcst-VHI+Wx2 Intcpt	Stand Alone	
R^2=0.87	R^2=0.71	R^2=0.9	R^2=0.9	R^2=0.9	R^2=0.8	R^2=0.5
Adj R^2=0.85	Adj R^2=0.62	Adj R^2=0.85	Adj R^2=0.86	Adj R^2=0.84	Adj R^2=0.78	0.46
Excellent	Good	Very Good	Very Good	Very Good	Excellent	Good

Incpt Year: 2018

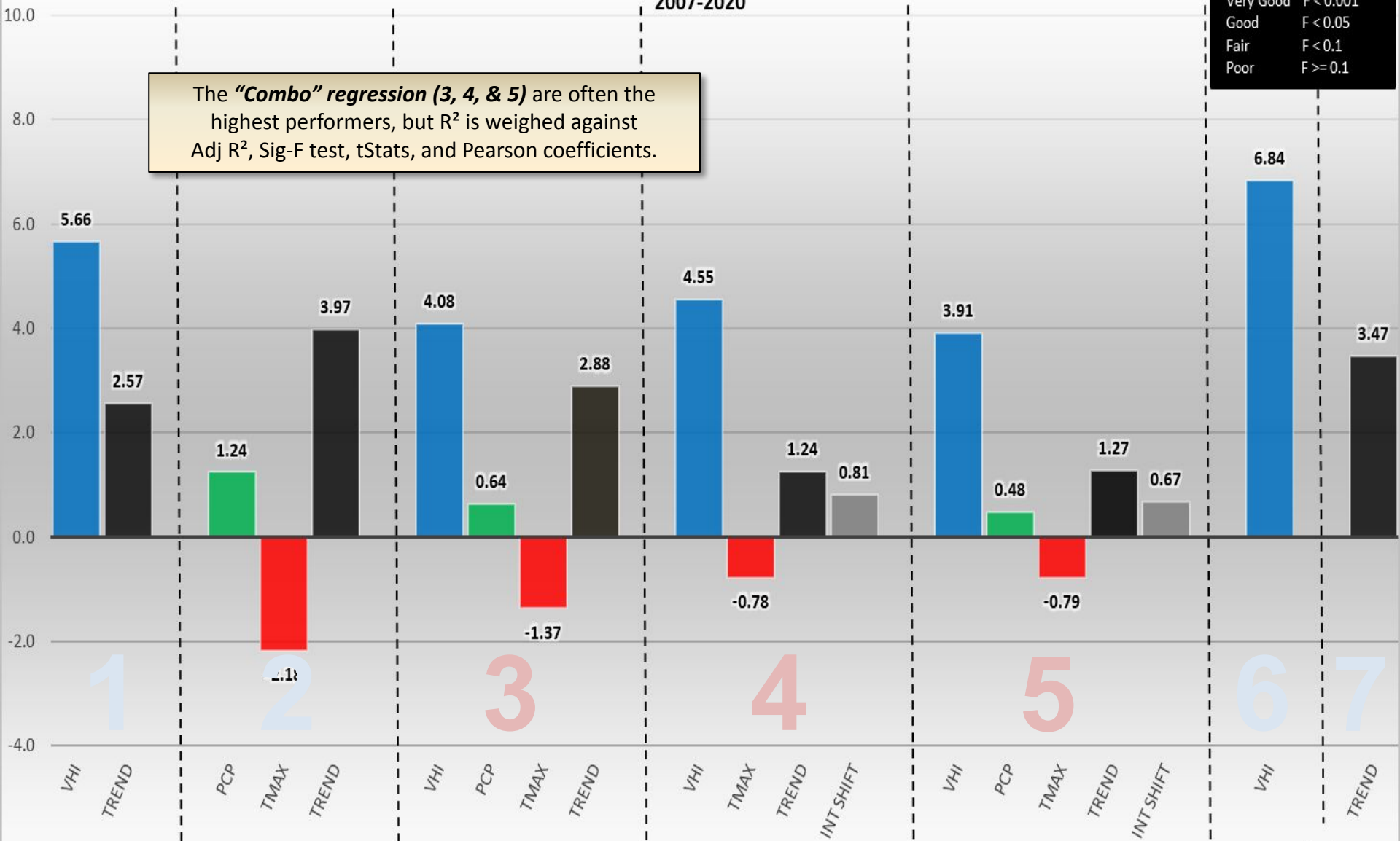
Ukraine Corn Regression Stats

2007-2020

T-Stat

Significance-F (Objective Assessment)	
Excellent	F < 0.0001
Very Good	F < 0.001
Good	F < 0.05
Fair	F < 0.1
Poor	F >= 0.1

The ***"Combo" regression (3, 4, & 5)*** are often the highest performers, but R^2 is weighed against Adj R^2, Sig-F test, tStats, and Pearson coefficients.



Fcst-VHI	Fcst-Wx	Fcst-VHI+Wx	Fcst-VHI+Wx Intcpt	Fcst-VHI+Wx2 Intcpt	Stand Alone	
R^2=0.87	R^2=0.71	R^2=0.9	R^2=0.9	R^2=0.9	R^2=0.8	R^2=0.5
Adj R^2=0.85	Adj R^2=0.62	Adj R^2=0.85	Adj R^2=0.86	Adj R^2=0.84	Adj R^2=0.78	0.46
Excellent	Good	Very Good	Very Good	Very Good	Excellent	Good

Incpt Year: 2018

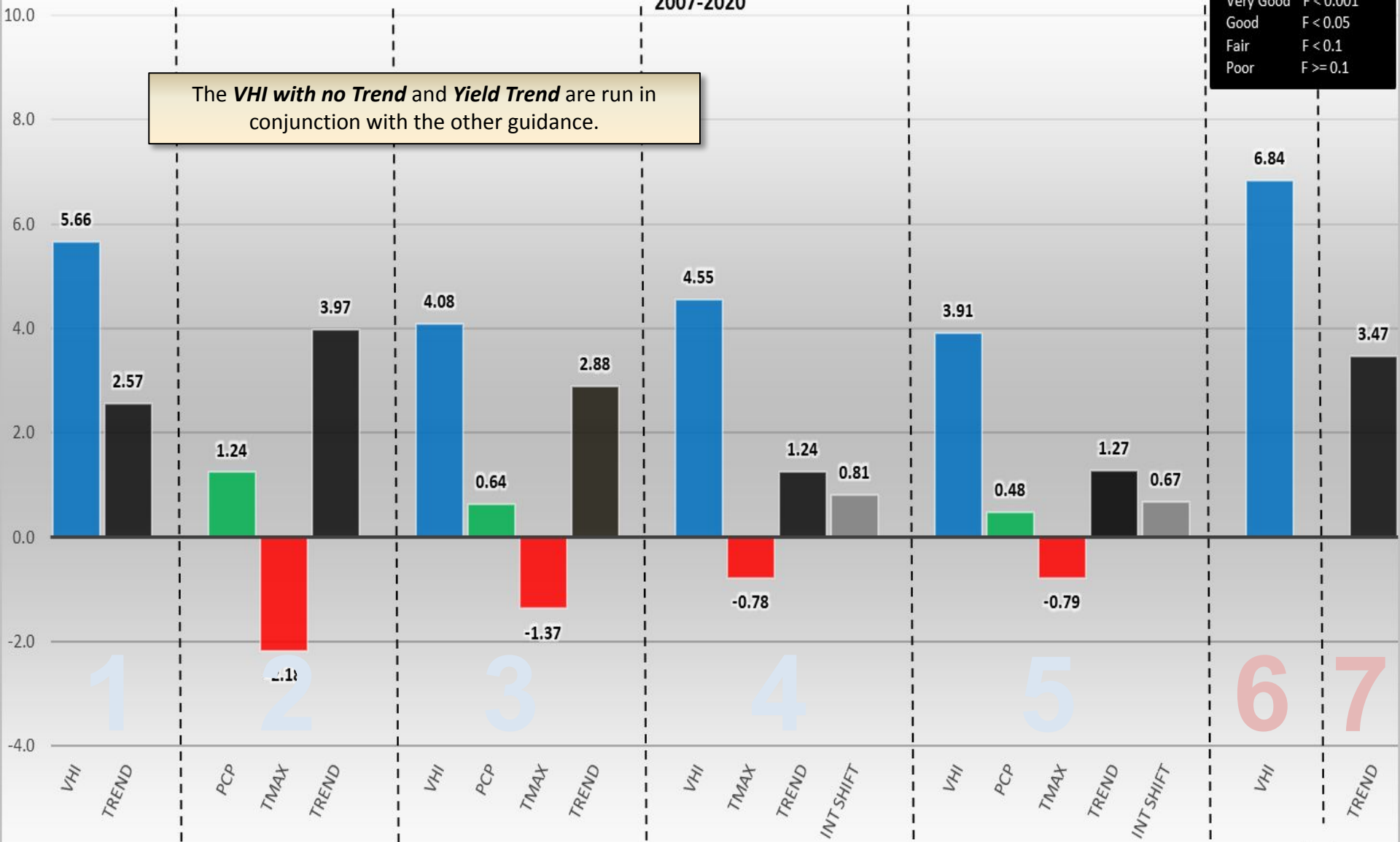
Ukraine Corn Regression Stats

2007-2020

T-Stat

Significance-F (Objective Assessment)	
Excellent	F < 0.0001
Very Good	F < 0.001
Good	F < 0.05
Fair	F < 0.1
Poor	F >= 0.1

The ***VHI with no Trend*** and ***Yield Trend*** are run in conjunction with the other guidance.



Fcst-VHI	Fcst-Wx	Fcst-VHI+Wx	Fcst-VHI+Wx Intcpt	Fcst-VHI+Wx2 Intcpt	Stand Alone	
R^2=0.87	R^2=0.71	R^2=0.9	R^2=0.9	R^2=0.9	R^2=0.8	R^2=0.5
Adj R^2=0.85	Adj R^2=0.62	Adj R^2=0.85	Adj R^2=0.86	Adj R^2=0.84	Adj R^2=0.78	0.46
Excellent	Good	Very Good	Very Good	Very Good	Excellent	Good

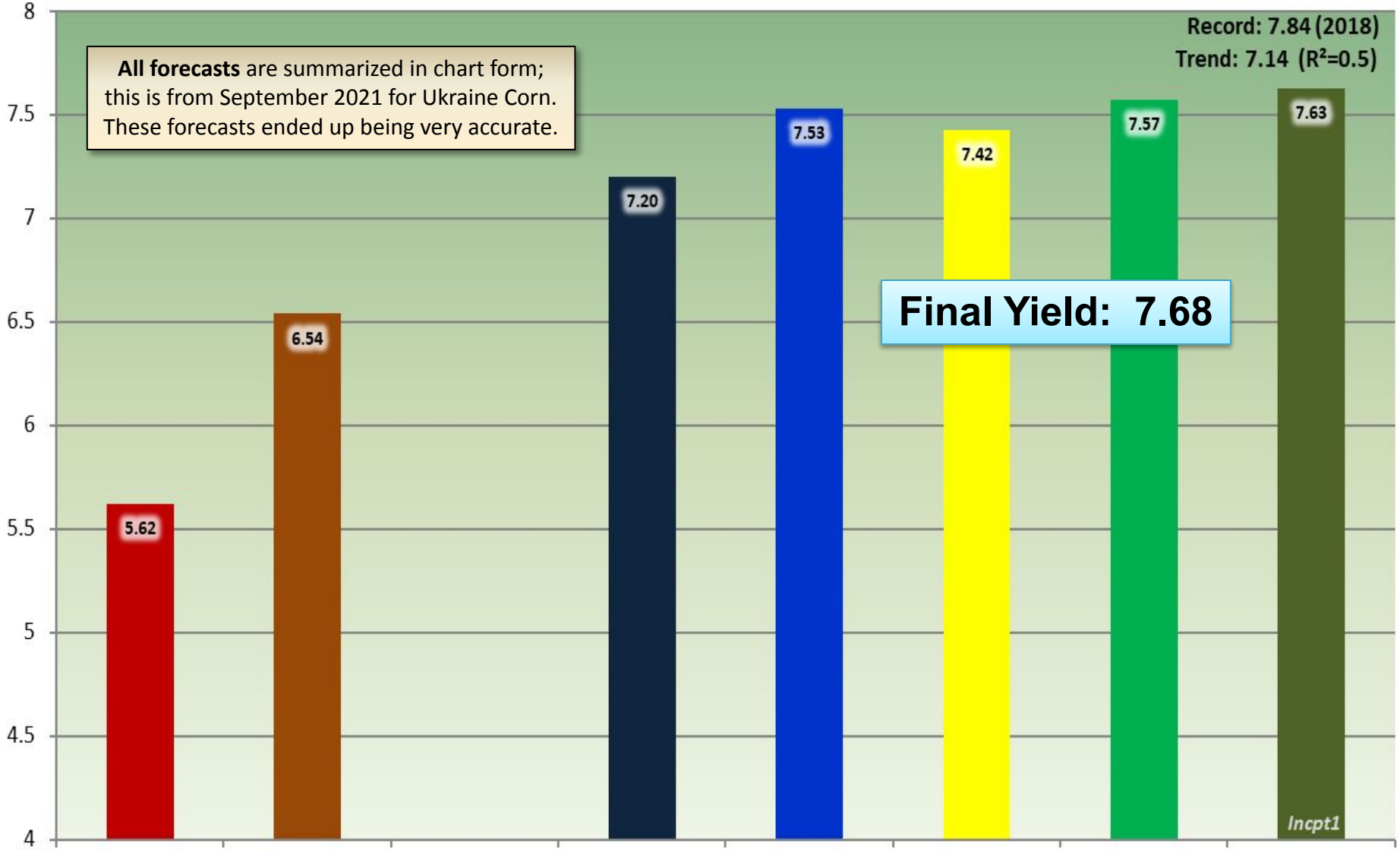
Incpt Year: 2018

Output….

9/15/2021

Ukraine Corn Regression

Regression: 2007-2020
Median Regression Yield: 7.55



*Includes Trend

Ukraine Corn Regression Stats

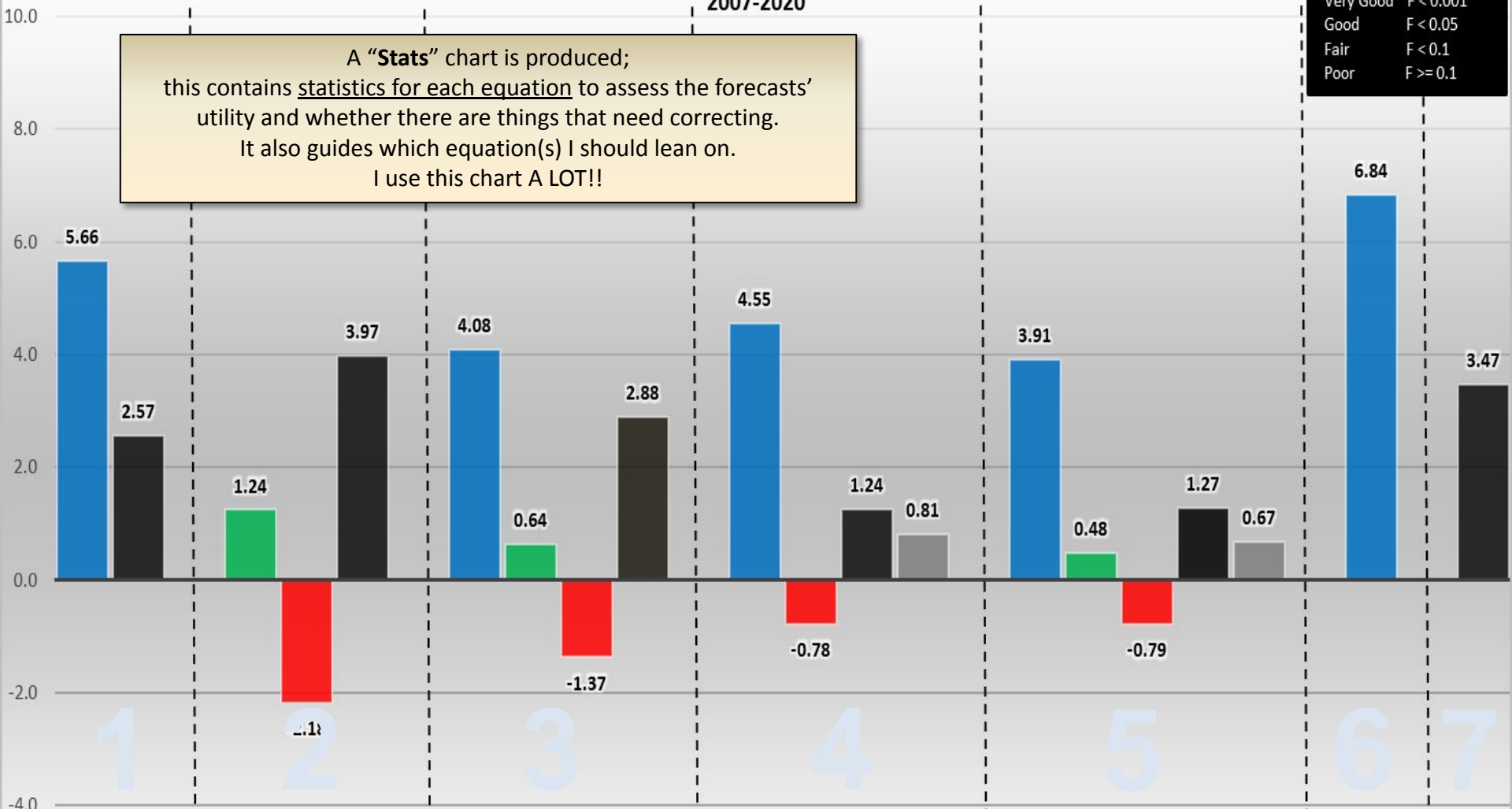
2007-2020

T-Stat

A "**Stats**" chart is produced;
this contains statistics for each equation to assess the forecasts' utility and whether there are things that need correcting.
It also guides which equation(s) I should lean on.
I use this chart A LOT!!

Significance-F
(Objective Assessment)

Excellent	F < 0.0001
Very Good	F < 0.001
Good	F < 0.05
Fair	F < 0.1
Poor	F >= 0.1

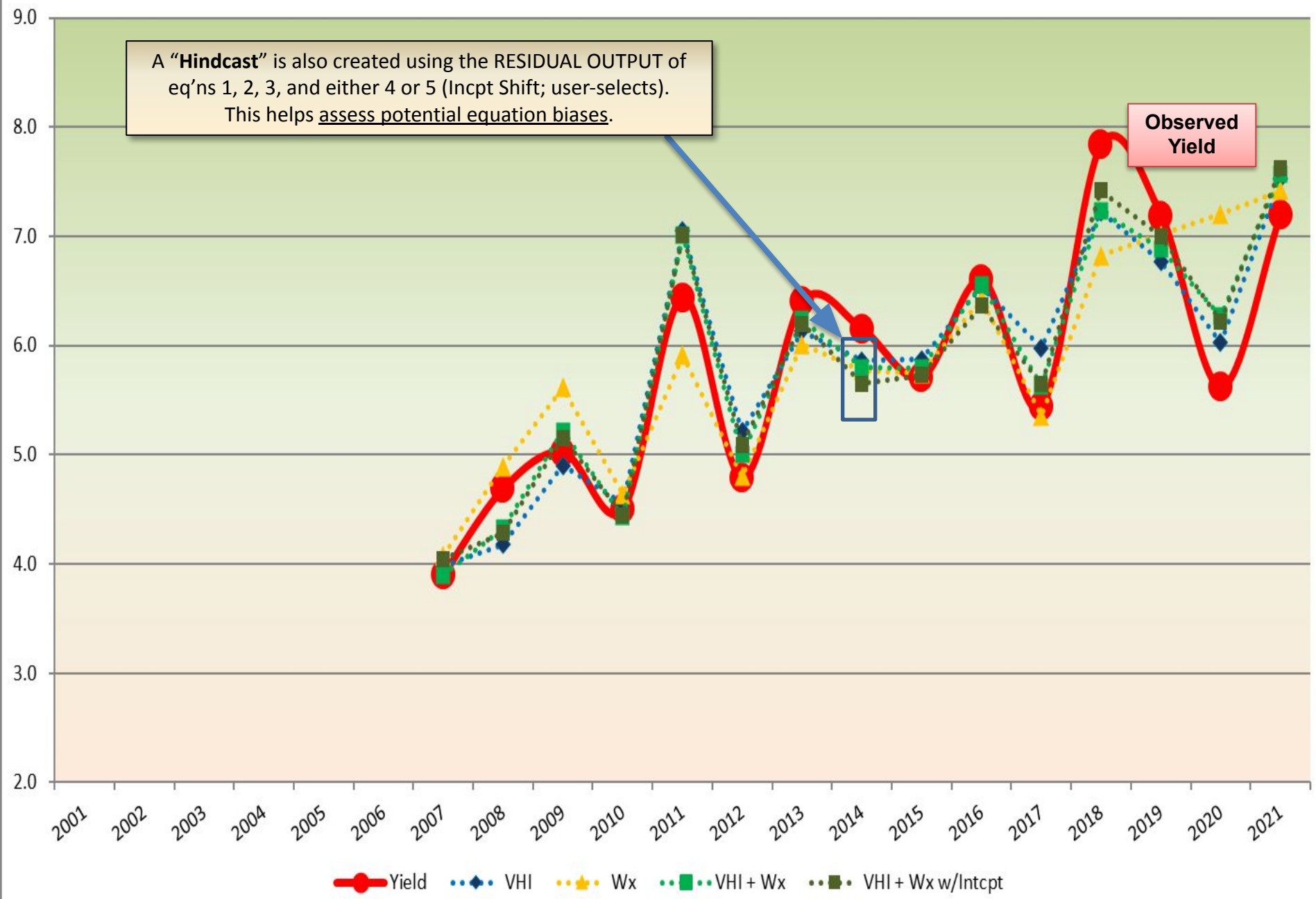


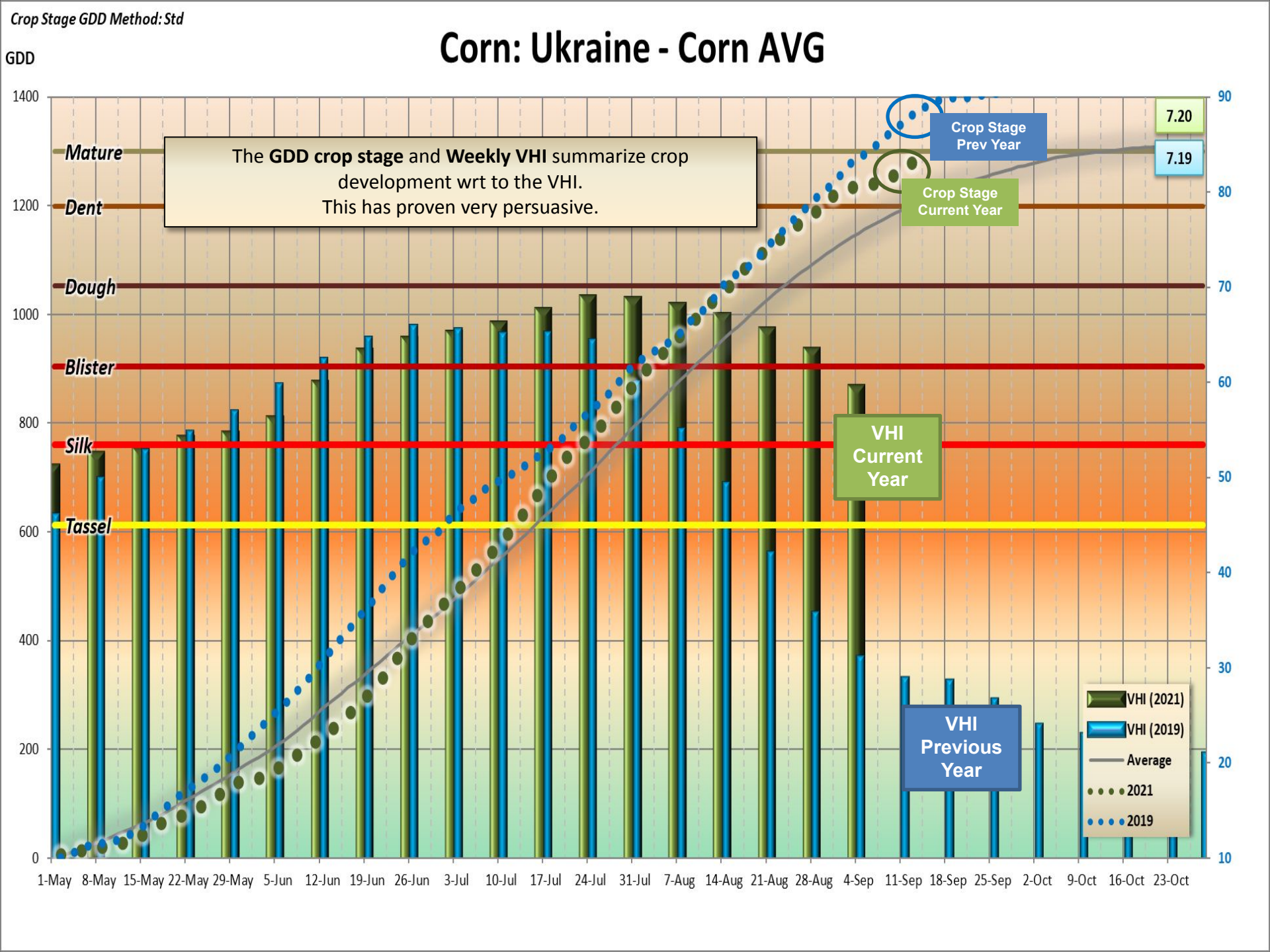
Fcst-VHI	Fcst-Wx	Fcst-VHI+Wx	Fcst-VHI+Wx Intcpt	Fcst-VHI+Wx2 Intcpt	Stand Alone	
R^2=0.87	R^2=0.71	R^2=0.9	R^2=0.9	R^2=0.9	R^2=0.8	R^2=0.5
Adj R^2=0.85	Adj R^2=0.62	Adj R^2=0.85	Adj R^2=0.86	Adj R^2=0.84	Adj R^2=0.78	0.46
Excellent	Good	Very Good	Very Good	Very Good	Excellent	Good

Incpt Year: 2018

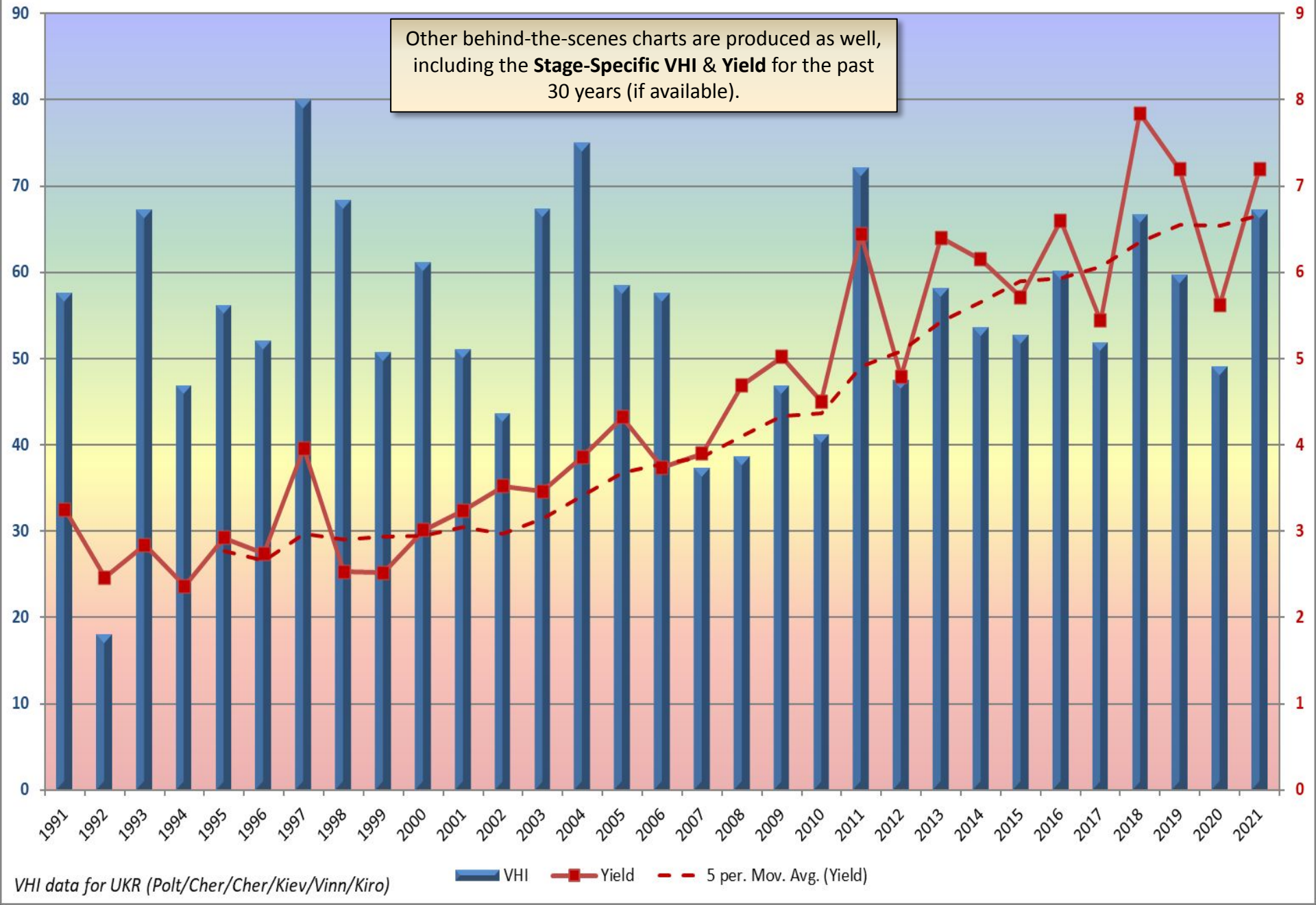
9/15/2021

Ukraine Corn: Regression Hindcast vs Observed




Crop Stage GDD Method: Std
Corn: Ukraine - Corn AVG
GDD
1400
1200
1000
800
600
400
200
0
90
80
70
60
50
40
30
20
10
Mature
Dent
Dough
Blister
Silk
Tassel
The GDD crop stage and Weekly VHI summarize crop development wrt to the VHI.
This has proven very persuasive.
Crop Stage Prev Year
Crop Stage Current Year
7.20
7.19
VHI Current Year
VHI Previous Year
VHI (2021)
VHI (2019)
Average
2021
2019
1-May
8-May
15-May
22-May
29-May
5-Jun
12-Jun
19-Jun
26-Jun
3-Jul
10-Jul
17-Jul
24-Jul
31-Jul
7-Aug
14-Aug
21-Aug
28-Aug
4-Sep
11-Sep
18-Sep
25-Sep
2-Oct
9-Oct
16-Oct
23-Oct

Ukraine VHI for Corn @ Blister



VHI data for UKR (Polt/Cher/Cher/Kiev/Vinn/Kiro)

9/15/2021	PSD				Peak	Regression	Regression	Regression	Regression	Last				Wx	Suggestion
	Last Year	Last Month	Suggestion (E)		(R^2)	(Peak R^2)	Median	Range	Years	Updated	Trend (R^2)	5y	Record	Set?	vs Trend
Wheat															
Russia Wheat (Winter):	3.77	3.32	3.60	↑	0.89	3.99	3.94	3.8 - 4.05	1993-2020	8/22/21	3.72 (0.65)	3.73	4.17 (2017)	Yes	-3.2%
Ukraine Wheat:	3.71	4.46	4.60	↑	0.94	4.59	4.68	4.59 - 4.79	2003-2020	8/22/21	4.30 (0.63)	3.96	4.46 (2021)	Yes	7.0%
Moldova Wheat:	1.89	4.00	4.25	↑	0.96	4.23	4.39	4.21 - 4.59	2003-2020	8/22/21	3.30 (0.29)	3.10	4.03 (1993)	Yes	28.8%
Russia Wheat (Spring):	1.88	1.72	1.70	=	0.83	1.69	1.65	1.55 - 1.72	1998-2020	9/15/21	1.75 (0.47)	1.76	1.89 (2017)	Yes	-2.9%
Kazakhstan Wheat:	1.18	0.98										1.17	1.66 (2011)	Yes	-25.2%
Barley															
Ukraine Barley (Winter):	3.08	3.89										3.20	3.89 (2021)	Yes	11.3%
Moldova Barley:	2.25	3.83										2.86	3.83 (2021)	Yes	22.9%
Russia Barley (Spring):	2.53	2.32	2.30	=	0.89	2.33	2.28	2.24 - 2.33	2007-2020	9/15/21	2.41 (0.22)	2.38	2.62 (2017)	Yes	-4.6%
Kazakhstan Barley:	1.34	1.14	1.15	=	0.88	1.17	1.24	1.17 - 1.29	1997-2020	9/15/21	1.53 (0.36)	1.50	1.71 (2011)	Yes	-24.8%
Corn															
Russia Corn:	5.08	5.54	5.60	=	0.95	5.69	5.72	5.55 - 5.76	2001-2020	9/15/21	5.63 (0.75)	5.20	5.70 (2019)	Yes	-0.5%
Ukraine Corn:	5.62	7.20	7.55	↑	0.90	7.57	7.55	7.42 - 7.63	2007-2020	9/15/21	7.14 (0.5)	6.54	7.84 (2018)	Yes	5.7%
Moldova Corn:	2.65	4.80	5.05	↑	0.88	5.07	5.05	4.16 - 5.96	2004-2020	9/15/21	3.48 (0.09)	3.58	5.02 (1989)	Yes	45.1%
Belarus Corn:	6.00	5.31	5.35	=	0.72	5.67	5.38	5.22 - 5.67	2010-2020	9/15/21	5.95 (0.09)	5.91	6.59 (2011)	Yes	-10.1%
Oilseeds															
Russia Sunflowers:	1.59	1.67	1.65	=	0.99	1.65	1.66	1.64 - 1.72	2005-2020	9/15/21	1.71 (0.78)	1.60	1.83 (2019)	Yes	-3.5%
Ukraine Sunflowers:	2.01	2.50	2.55	=	0.93	2.39	2.48	2.39 - 2.64	2006-2020	9/15/21	2.48 (0.77)	2.23	2.58 (2019)	Yes	2.8%
Moldova Sunflowers:	1.31	2.33	2.50	↑	0.97	2.32	2.50	2.32 - 2.58	2006-2020	9/15/21	2.26 (0.65)	1.94	2.33 (2021)	Yes	10.6%
Kazakhstan Sunflowers:	1.23	1.20	1.20	=	0.90	1.06	0.99	0.94 - 1.06	1997-2020	9/15/21	0.99 (0.65)	1.04	1.23 (2020)	Yes	21.2%
Ukraine Rapeseed:	2.31	2.70	2.95	↑	0.96	2.92	3.22	2.92 - 3.34	2000-2020	9/15/21	3.01 (0.86)	2.67	2.85 (2018)	Yes	-2.0%
Ukraine Soybeans:	2.05	2.43	2.57	↑	0.93	2.56	2.58	2.37 - 2.69	2007-2020	9/15/21	2.45 (0.66)	2.24	2.58 (2018)	Yes	4.9%
Russia Soybeans:	1.59	1.59	1.55	↓	0.94	1.56	1.61	1.56 - 1.62	2005-2020	9/15/21	1.64 (0.89)	1.50	1.59 (2020)	Close	-5.5%

A **summary** of **all forecast data** broken down by region (FSU shown here) is published and sent to the different commodity groups.

This contains a great deal of information; many columns were added as a direct result of questions I have heard during the Commodity meetings.

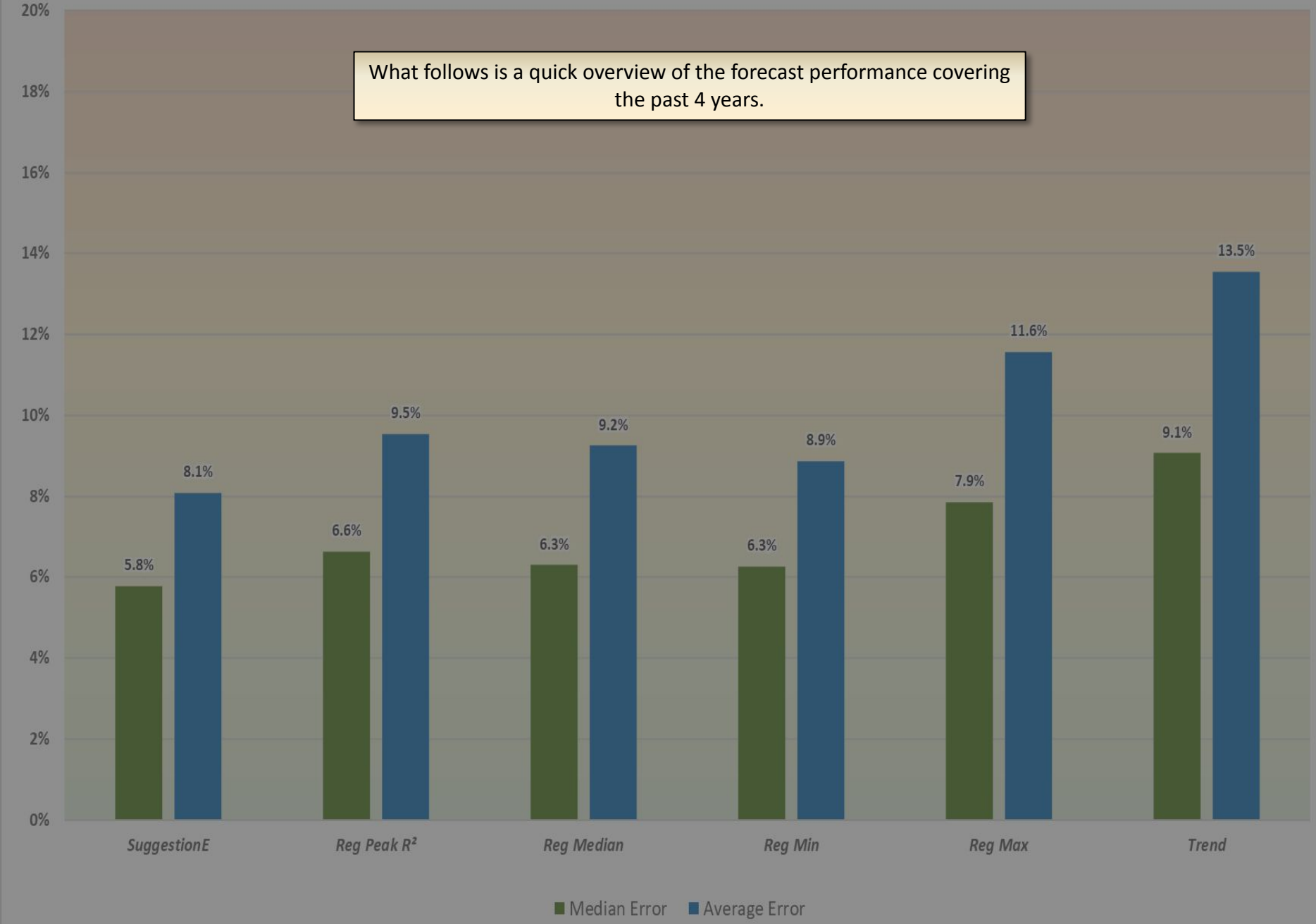
Pct Diff Tolerance: 2.5

Red = Record

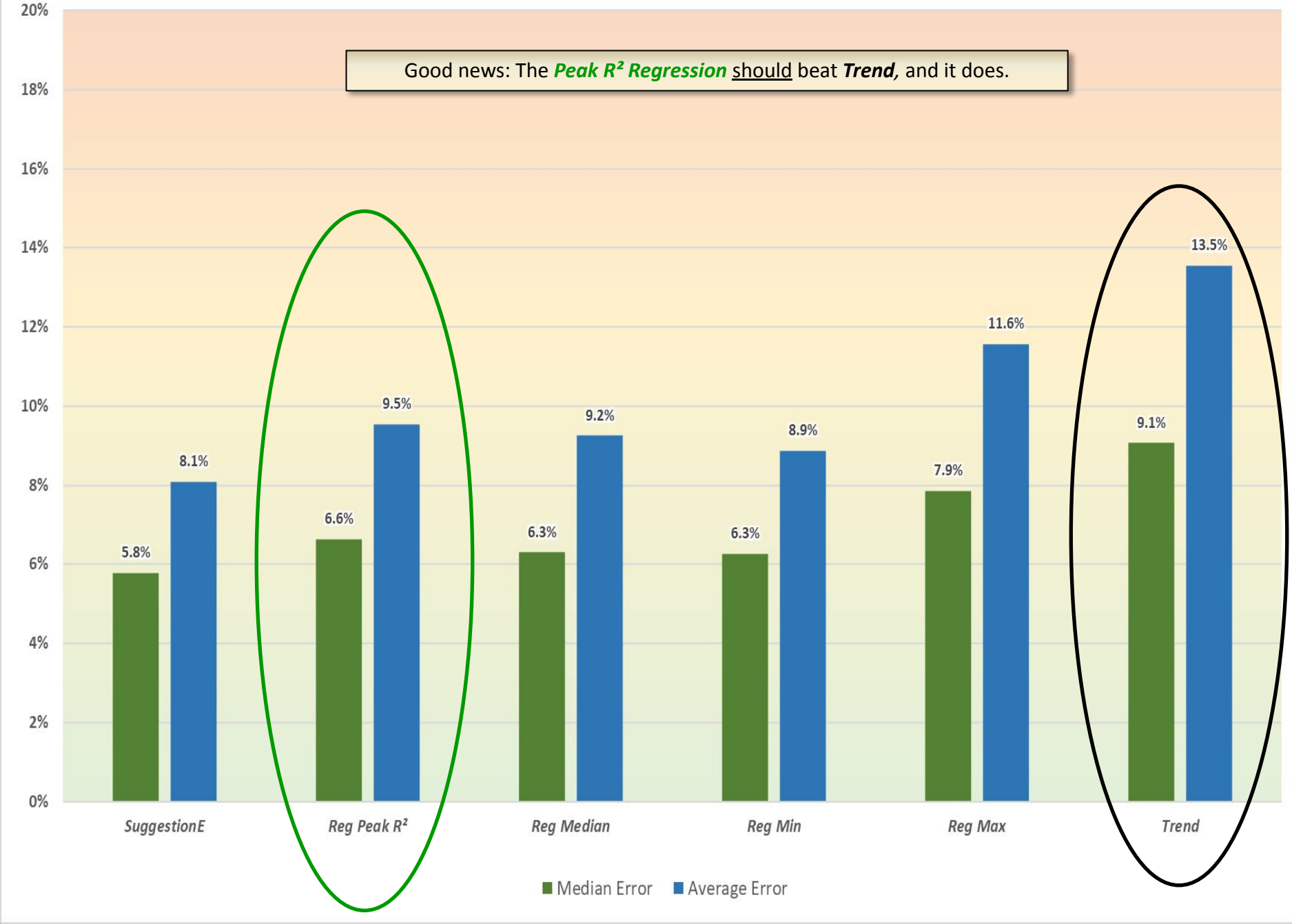
Results….

Errors - All Areas, All Crops, 2018-2021

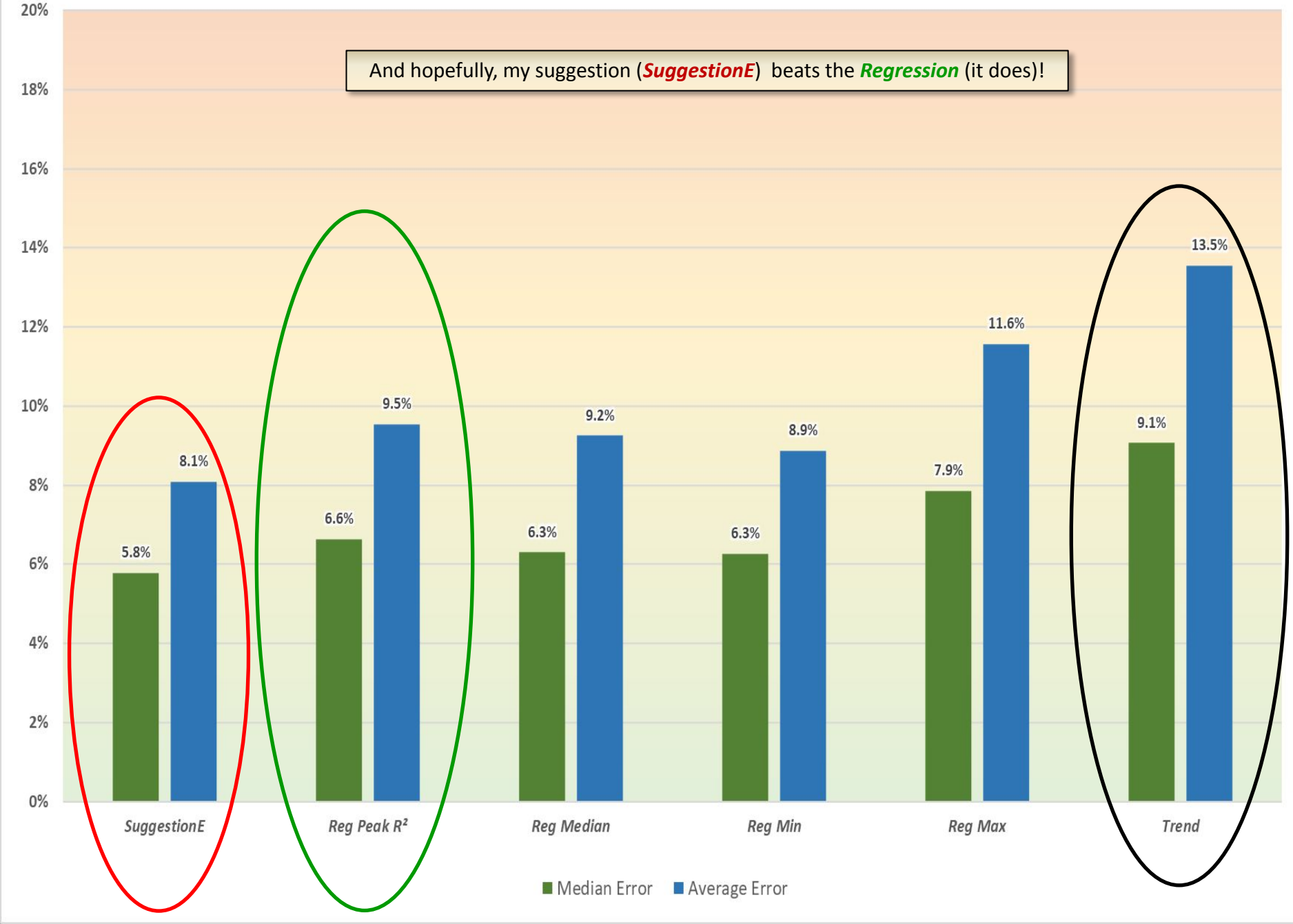
What follows is a quick overview of the forecast performance covering the past 4 years.



Errors - All Areas, All Crops, 2018-2021



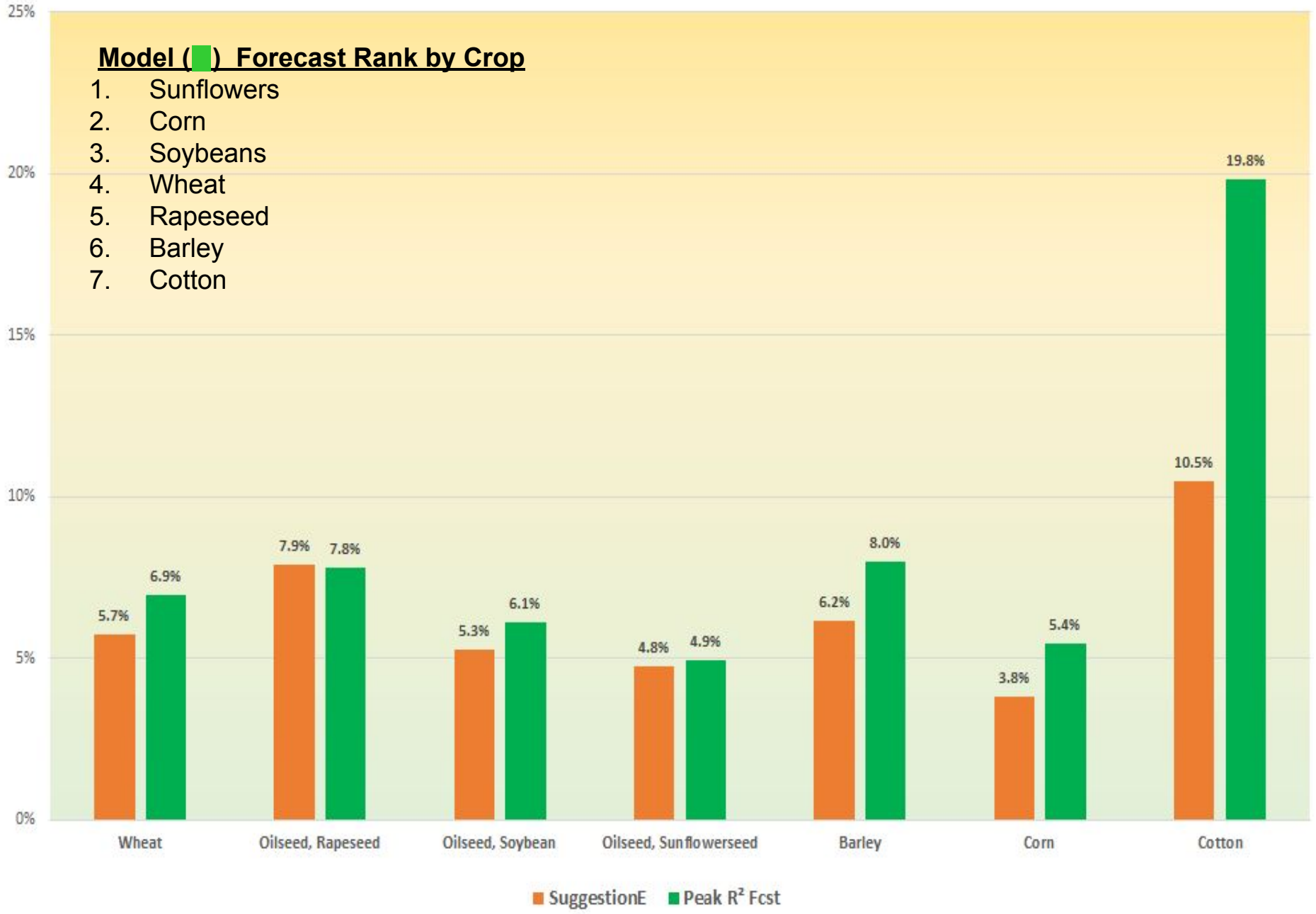
Errors - All Areas, All Crops, 2018-2021



2018-21 Median Forecast Error - By Crop

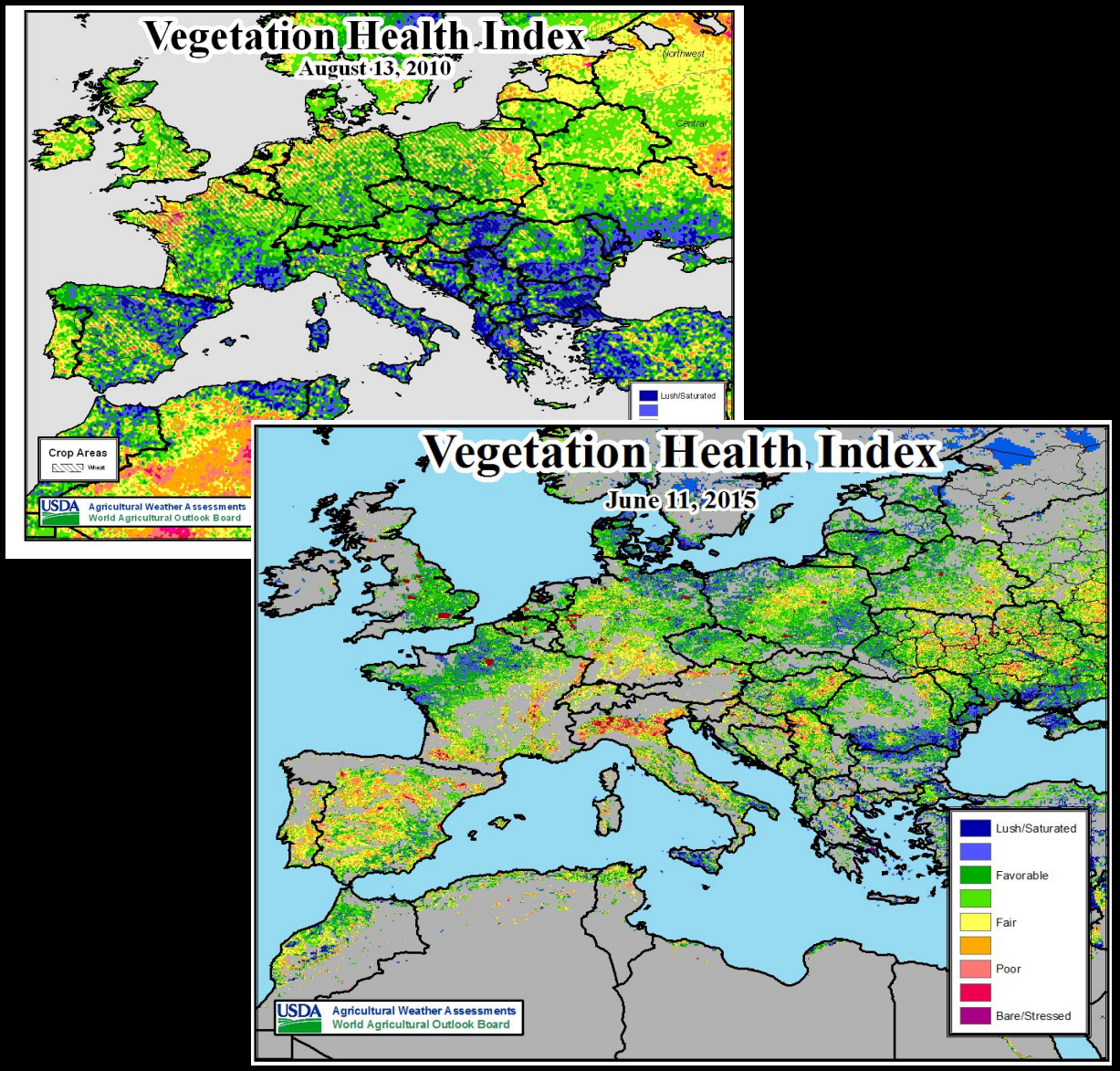
Model ( ) Forecast Rank by Crop

1. Sunflowers
2. Corn
3. Soybeans
4. Wheat
5. Rapeseed
6. Barley
7. Cotton

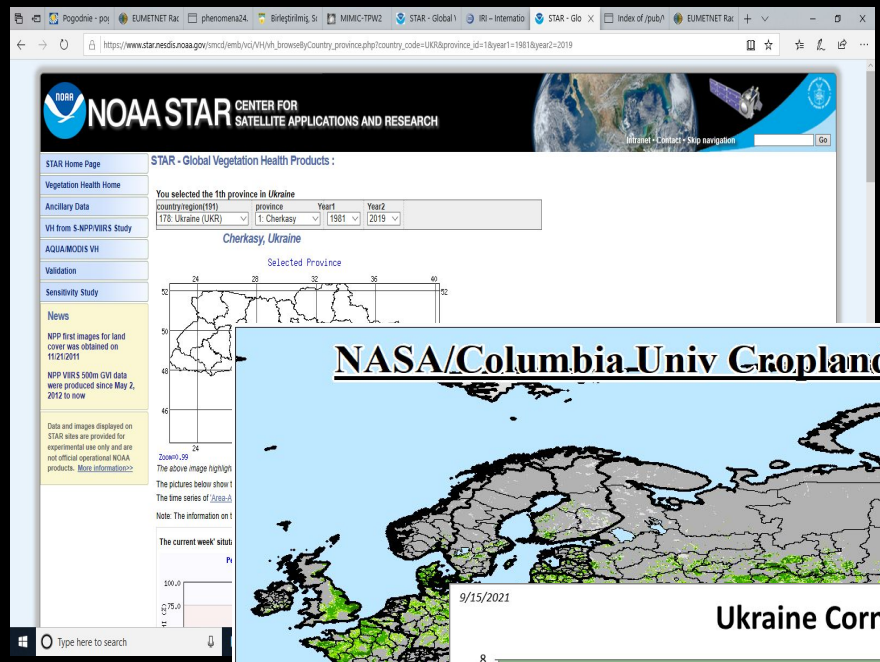


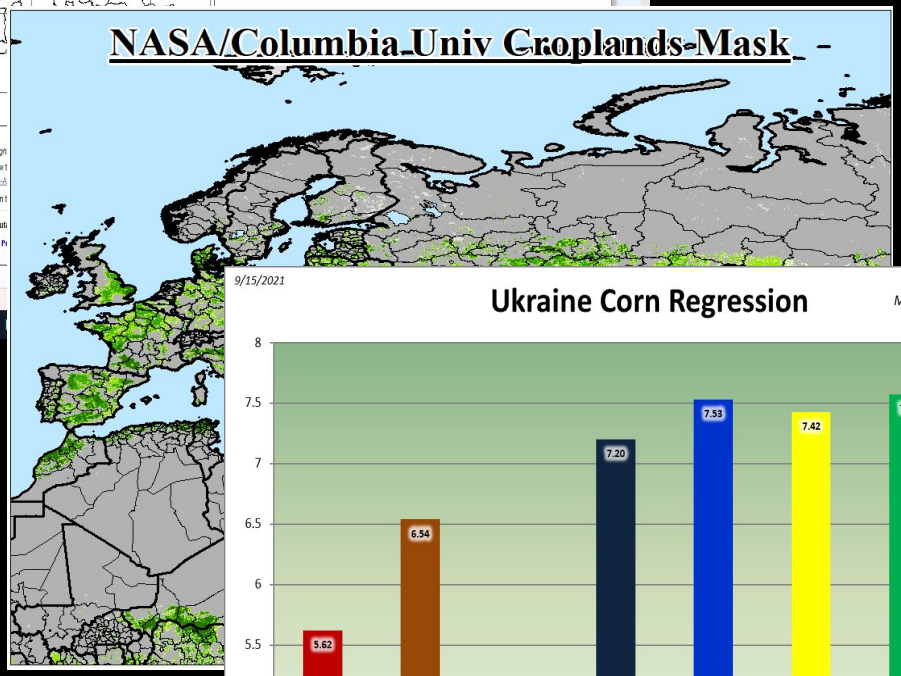
Conclusions….

We have been using the VHI in some form operationally since 2007.



The VHI ascii data and croplands masked ascii data were game changers for USDA-WAOB operations.






2/1/2019
Russia Corn Regression
Regression: 2001-2017
Median Regression Yield: 4.95
Record: 5.51 (2016)
Trend: 5.3 (R²=0.7)
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
4.90
4.94
4.79
5.11
4.69
5.02
4.88
Thank You!
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(202) 720-3361
Last Year
5-Year Avg
Last Month
VHI*
Wx*
VHI+Wx*
VHI+Wx/Intcpt* (2013)
R²= 0.91 +/- 0.3
R²= 0.87 +/- 0.37
R²= 0.92 +/- 0.31
R²= 0.93 +/- 0.29
*Includes Trend