Soil Health: Yield and Soil Carbon Mapping

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Dr. David Lobb

During the discussion following his presentation (AGFO senate committee, November 30, 2023) Dr. Lobb suggested that only two parameters are required for tracking and assessing soil health: yield maps and soil organic matter.

> “We discussed this: all these soil health indicators for which everyone is generating data, and no one has a clue what they are going to do with them, except for soil organic matter, and if you’re going to track something, **soil organic matter and crop yield**; those are the two I suggest they look at.” *
>
> “Many farmers have yield monitors and don’t use them and don’t look at the data over a series of years to have a better understanding of where they have soil health problems within a field**.” ***
>
> “They are not thinking of that (yield maps) as a soil health indicator. The number one soil health indicator is its ability to produce a crop. That’s more my point — that they should be making more use of that data than they currently are.” *

An example of mapping yield and soil carbon for one farm field is given in the following slides.

* taken from the Thursday, November 30, 2023 AGFO meeting transcripts:

Field Site: Middlesex County, ON

2020

~ 30 acres, a rotation of no-till corn, soybeans and winter wheat since 1988, poultry manure applied after winter wheat. Yield monitor data collected 1995 to 2003

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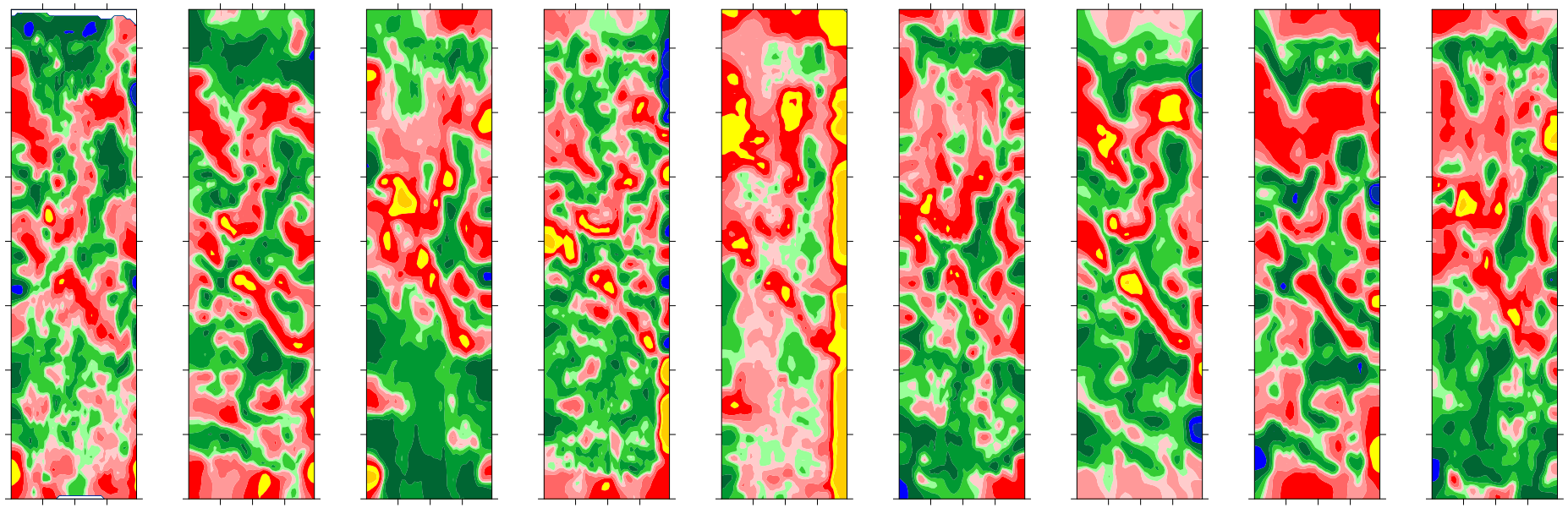

Standardized Yield Maps

9 years of yield monitor data from 1995 to 2003

Data is cleaned and standardized to allow for comparison between crops and years,

A “good year”, an “average year” and a “poor year” for each crop

greens and blues represent areas where the yield was above average,

reds and yellows represent areas where the yield was below average,

blue- highest yields,

yellow- lowest yields

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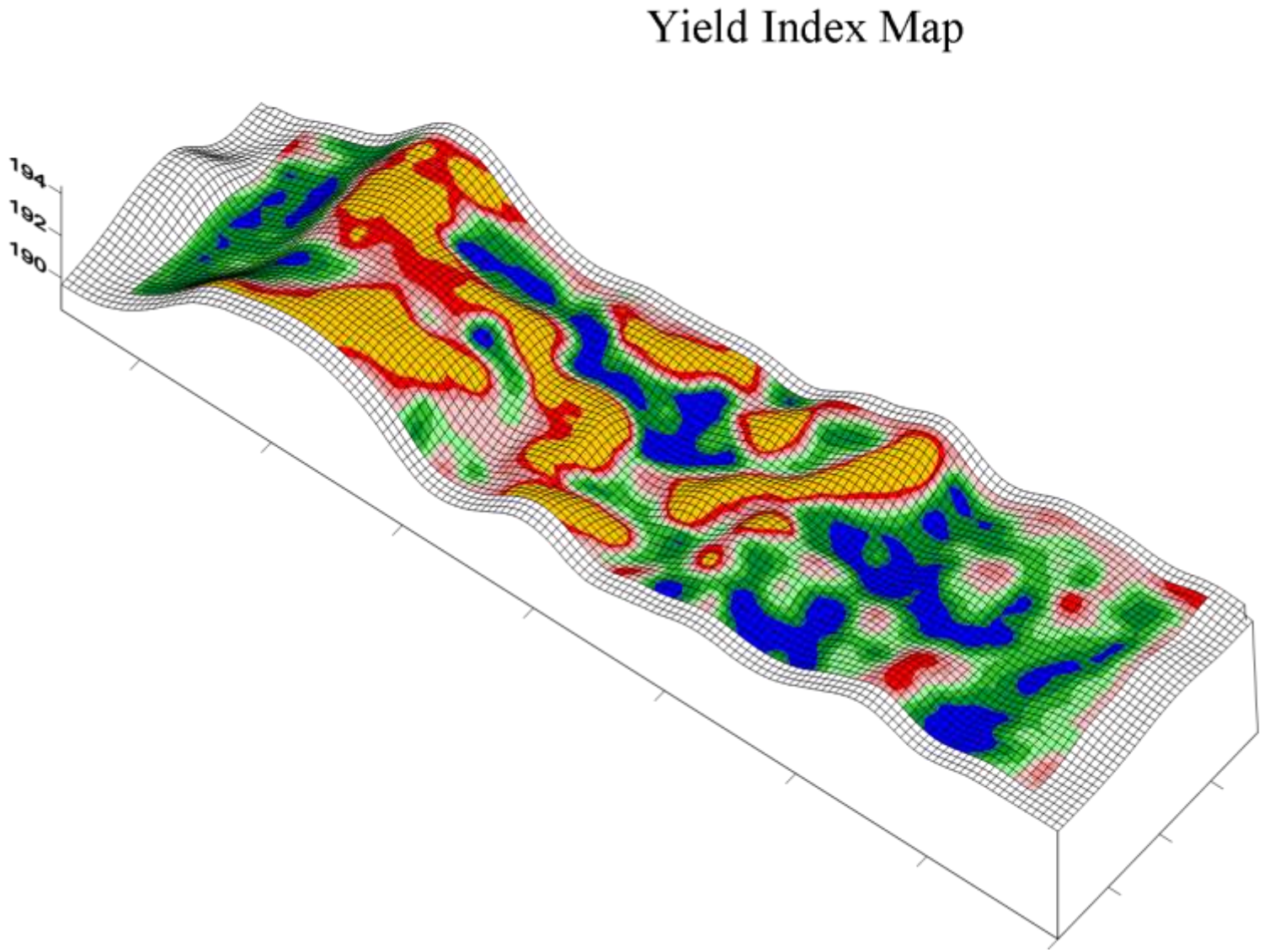
Using GIS raster overlay procedures, the 9 annual individual standardized yield maps are transformed into one map showing the spatial and temporal patterns of yield

		Yield Stability Class
		Stable, below average yields
		Stable, above average yields
		Unstable, average yields



Yield reductions due to one or more soil issues: Low %OM, thin plow layer, loss of solum, high pH or low pH, excessive stoniness, droughtiness, poor soil structure

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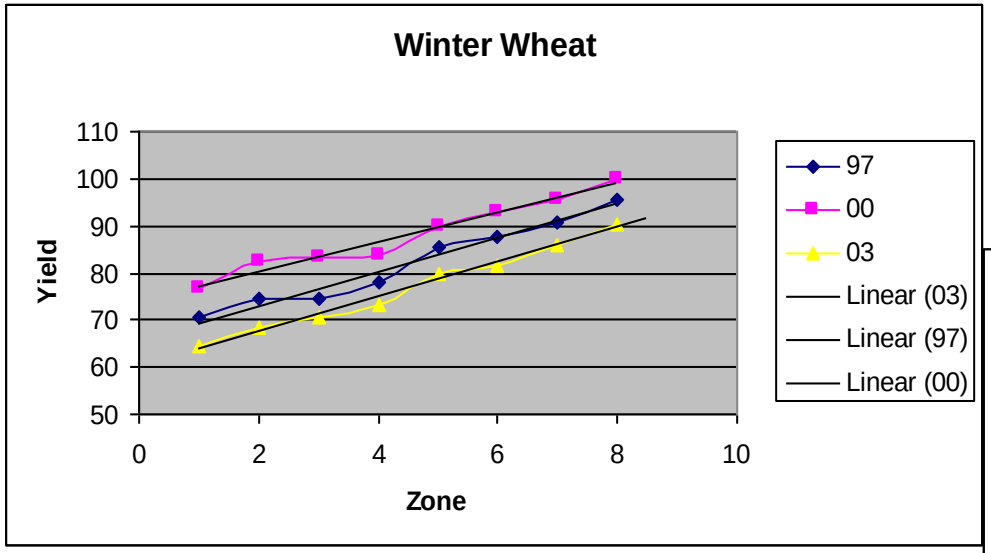
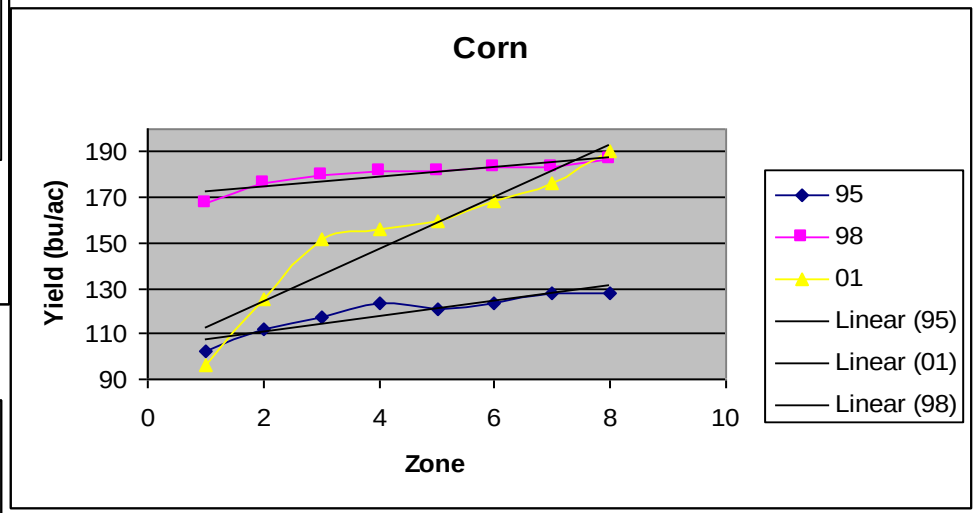
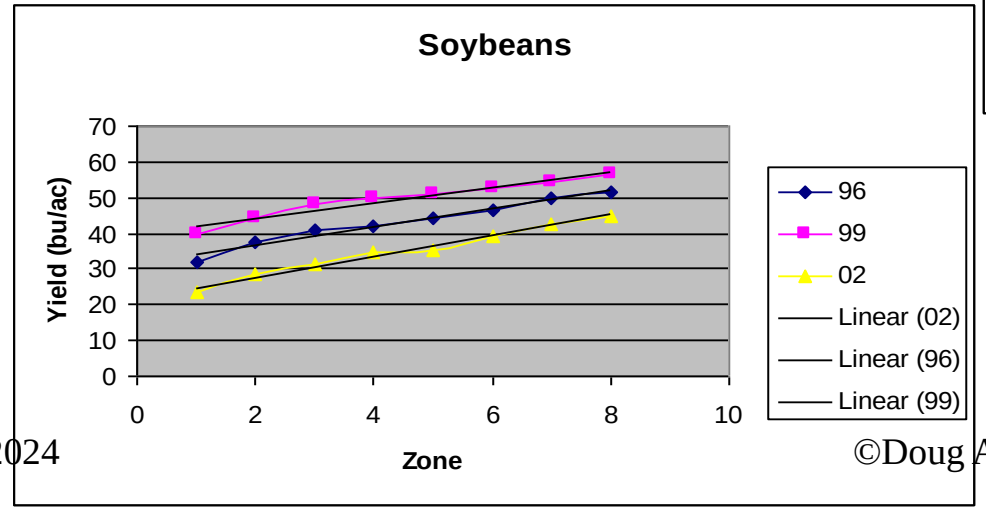
Zone Yields (crop x year)

By improving soil health can we change the graph for each crop to one level line?



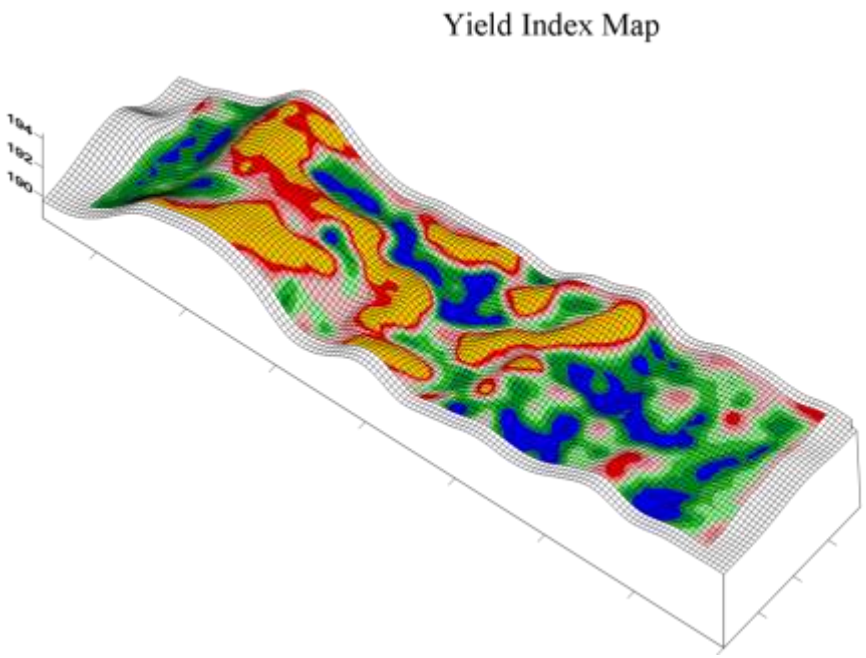


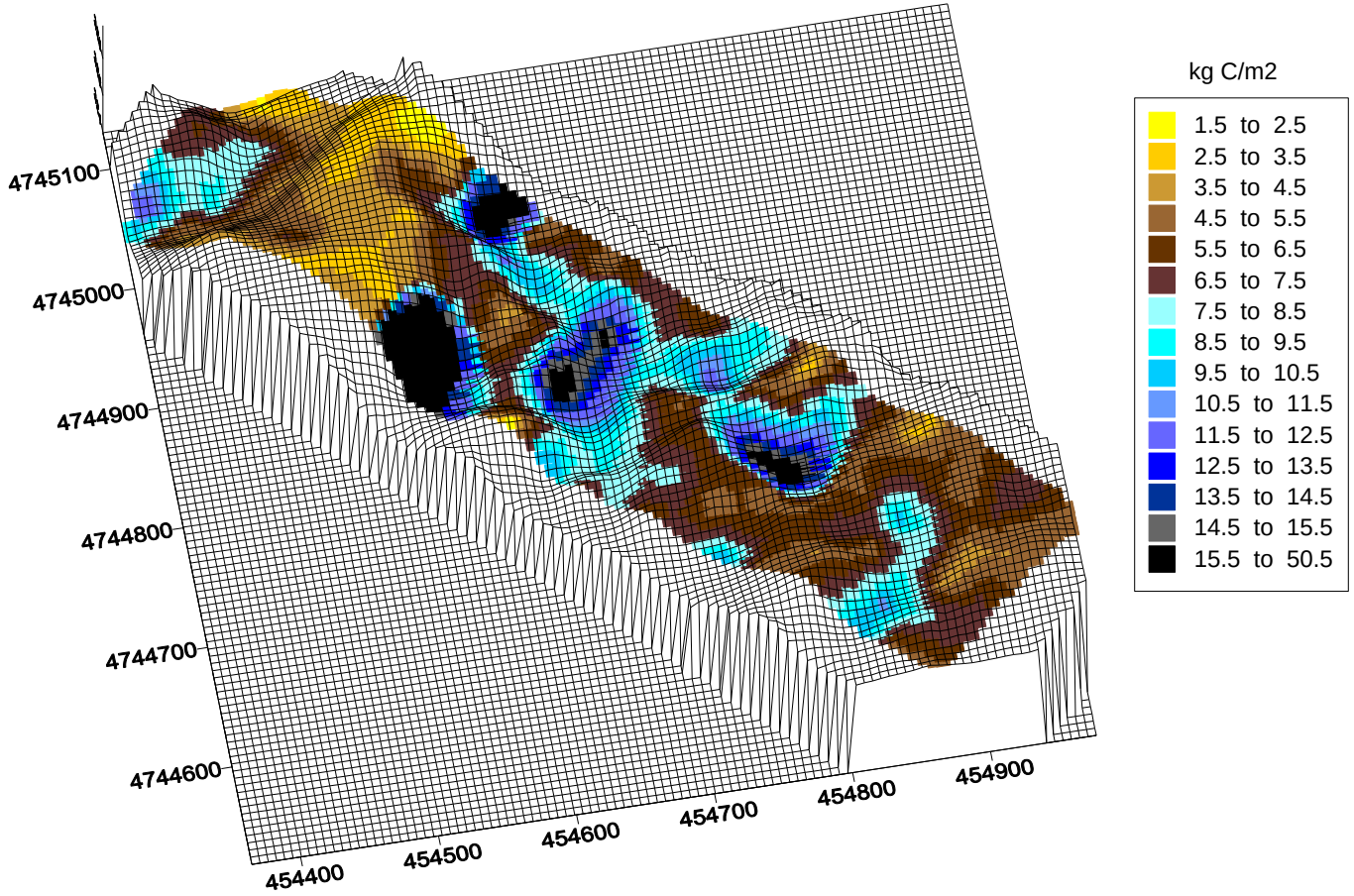


Zone 1= yellow
Zone 8 = blue

A Comparison of the Yield Index Map to a Soil Carbon (kgC/m^2) Map

In 2001 144 soil samples (30x30 m spacing) were collected. Soil properties measured included: Ap depth, solum depth, OD soil bulk density, % organic matter, P, K, soil pH and particle size distribution





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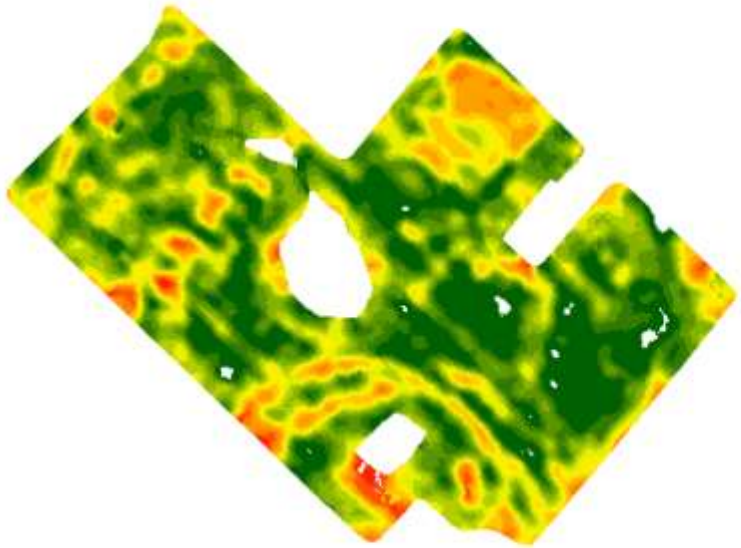
Yield stability Index map and Erosion Class map for a farm located in Wellington County



YSI
Several years of yield data

Erosion class /yield

Erosion Class	Ha	% Area
1	24.9	53.6
2	14.2	30.7
3	7.3	15.7
Field	46.4	100

A yield stability index map is created from several years of yield monitor data for corn, soybeans and winter wheat crops. Red indicates where the yield is consistently below average (stable) whereas dark green is where crop yield is always above average (stable). The lighter yellows and greens indicate areas where yields flip flop (not stable)

The erosion class map was derived from a google satellite image (9/1/21). Class 1 (dark green) consists of non-eroded soil types, Class 2 (light brown) shows the location of somewhat eroded soil types and class 3 consists of severely eroded soil types. Note the high correlation with the yield index map.

Severely eroded soil profiles: a thin plow layer with a low %OM on a gravelly sandy parent material. The former profile has been removed by tillage, water and wind erosion.

The Impact of Soil Erosion on Crop Yields

Yield X Year X Crop X Erosion class

Year	Crop	1 Noneroded buac	2 Somewhat Buac	3 Severe buac	Delta(2-1) buac/%	Delta (3-1) buac/%	Field avg. buac
2011	Soybean	37.3	28.2	19.1	-9.1 (-24.0%)	-18.2 (-48.8%)	31.7
2013	Soybean	38.7	34.9	25.7	-3.5 (-9.0%)	-13.0 (-33.6%)	35.2
2014	Corn	151.8	147.0	128.2	-4.8 (-3.1%)	-23.6 (-15.5%)	141.2
2015	Soybean	33.4	22.3	14.6	-11.1 (-33.2%)	-18.8 (-56.2%)	26.6
2016	Winter Wheat	88.0	57.0	37.1	-31.0 (-35.2%)	-50.9 (-57.8%)	65.8
2018	Corn	175.2	152.2	125.1	-23.0 (-13.1%)	-50.1 (-28.5%)	158.8
2019	Soybean	53.1	47.7	40.8	-5.4 (-10.1%)	-12.3 (-23.1%)	49.4
2020	Winter Wheat	90.1	76.0	61.9	-14.1 (-15.6%)	-28.2 (-31.3%)	79.9
2021	Soybean	57.8	49.0	37.1	-8.8 (-15.2%)	-20.7 (-35.8%)	55.3
2022	Corn	172.4	103.2	59.0	-69.2 (-40.1%)	-113.4 (-65.8%)	143.3
2023	Soybean*	55.6	54.7	48.2	-0.9 (-1.6%)	-7.4 (-13.3%)	53.5
Average % loss					-16.4%	-32.4%	

Yield monitor data were used to calculate the yield statistics in the above table. Average crop yields for each crop for each year and erosion class are given in columns 1, 2 and 3. The differences in crop yields between non-eroded and somewhat eroded and non-eroded and severely eroded are found in the delta columns. Annual field averages are found in the last column.
Adequate and timely rains in 2023 tempered the yield differences.