University of Wisconsin · Agronomy Department
1575 Linden Drive · Madison, WI · 53706 · (608) 262-1390

Agronomy Advice

http://corn.agronomy.wisc.edu

August 2013 Field Crops 28.426 - 103

Can yield maps predict future yields?

Hayley Bunselmeyer and Joe Lauer, *Corn Agronomists*

To maximize field productivity and profitability, growers are increasingly using site-specific management rather than whole field management practices. Our objective is to describe spatial and temporal yield variability to predict grain yield of specific land cells (parcels of land). The goal is to determine if yield maps allow accurate delineation of management zones for prescription applications.

Grain yield data for twenty-six years of continuous corn (CC), continuous soybean (SS), and corn-soybean rotations (CS) in no-tillage (NT) and conventional tillage (CT) systems were used in the analysis. Average grain yields for each system are shown in Table 1.

Table 1. Average grain yield (bu/A) of rotation x tillage treatments during 1987-2012 at Arlington, WI.

Rotation	Tillage	Corn Yield	Soybean Yield
CS	**CT**	196 a	54 a
CS	**NT**	197 a	56 a
Continuous	**CT**	176 b	50 b
Continuous	**NT**	162 c	48 b

Table 2 shows ten years of yield data for one treatment (CC-CT) to demonstrate how spatial and temporal variability is calculated. **Spatial variability is the variation of land cells within a field for a given year** (i.e. yield map) and in this example averaged ± 12 bu/A (±5 to ±24 bu/A). **Temporal variability is the variability of a land cell over time** and in this example averaged ± 42 bu/A (±40 to ±43 bu/A).

Table 3 summarizes these temporal and spatial variability calculations for all rotation x tillage treatments. Within corn systems, spatial variability was ±11 to ±15 bu/A and temporal variability was ±42 to ±44 bu/A. Within soybean systems, spatial variability was ±4 to ±5 bu/A, while temporal variability was ±9 to ±13 bu/A.

Table 3. Average grain yield (bu/A), spatial and temporal variability (bu/A) of rotation x tillage treatments during 1987-2012 at Arlington, WI.

Rotation	Tillage	Average yield	Spatial variability	Temporal variability
Corn		bu/A	bu/A	bu/A
CC	**CT**	176	±12	±42
CC	**NT**	162	±13	±44
CS	**CT**	196	±15	±44
CS	**NT**	197	±11	±42
Soybean				
SS	**CT**	50	±4	±13
SS	**NT**	48	±4	±12
CS	**CT**	54	±5	±12
CS	**NT**	56	±4	± 9

Across all tillage-rotation systems, spatial variability was 5.5 to 8.6% of the average grain yield, while temporal variability was 17 to 27%. Temporal

Table 2. An example of land cell grain yield (bu/A) spatial and temporal variation (bu/A) for the rotation x tillage treatment CC-CT (1987-2002 data are not shown).

Rotation	Tillage	Land cell	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	1987-2012 Mean yield		Temporal variability (StD)
CC	**CT**	12	**176**	175	163	215	220	**239**	232	255	**216**	**201**	184	a	±40
CC	**CT**	56	159	**185**	**169**	**235**	210	---	**244**	**268**	191	168	176	ab	±42
CC	**CT**	64	122	180	134	223	**222**	230	213	**268**	193	160	175	bc	±43
CC	**CT**	106	134	186	142	212	219	204	207	250	172	157	169	c	±43
Mean yield			148	181	152	221	218	224	224	260	193	172	176		±42
Spatial variability (StD)			±24	±5	±17	±10	±6	±18	±17	±9	±18	±20		±12	

variability was 2.2 to 3.9 times greater than spatial variability. No-till rotated soybean had the lowest relative temporal variability and no-till continuous corn had the highest relative temporal variability (Table 3).

Each land cell was ranked within its rotation x tillage combination; therefore, to incorporate the CS rotation effect, two years are required for one cycle. Our analysis found that land cells are significantly different for grain yield and could be ranked within a tillage x rotation treatment (Table 4). CC-NT required 2 years (one cycle) before a significant yield difference was first found between land cells, while corn in CS-NT required 20 years (10 cycles). High- and low-yielding land cells were not consistently identified until 16-20 years (8-10 cycles) had passed, with the exception of CC-CT which only required 4 years (2 cycles).

For specific land cells, high corn yield did not always predict high soybean yield and vice-versa (Table 5). For example, land cell 102 was the lowest yielding cell for corn, while yielding statistically the same as the highest land cell for soybean.

In this uniform field, consistent land cell grain yield patterns were observed for tillage x rotation treatments. These patterns did not consistently predict grain yield between corn and soybean. Since spatial variation is lower than temporal variation, prescription predictions remain challenging.

Table 4. Time required to detect significant and consistent differences between land cells for each rotation x tillage treatment combination.

Rotation	Tillage	Years to first significant land cell ranking	Years to consistent high-low land cell patterns	Grain yield difference between high-low land cells
Corn				bu/A
CC	**CT**	4	4	12
CC	**NT**	2	16	11
CS	**CT**	18	18	29
CS	**NT**	14	20	13
Soybean				
SS	**CT**	6	18	4
SS	**NT**	18	18	3
CS	**CT**	10	16	7
CS	**NT**	8	16	5

Table 5. Corn and soybean yield (bu/A) of rotated land cells (1987-2012). Bold values indicate significantly higher grain yield and underlined values indicate significantly lower grain yield.

			Corn			Soybean		
Rotation	**Tillage**	**Land cell**	**Mean yield**		**Temporal variability**	**Mean yield**		**Temporal variability**
CS	**CT**	10	**207**	a	±47	**57**	a	±11
CS	**CT**	24	**191**	abc	±40	**56**	ab	±14
CS	**CT**	32	**209**	a	±46	**57**	a	±10
CS	**CT**	48	**186**	abc	±41	**52**	ab	±14
CS	**CT**	62	<u>189</u>	bc	±48	<u>50</u>	bc	±12
CS	**CT**	82	**199**	ab	±45	**55**	ab	±11
CS	**CT**	94	**205**	a	±50	**56**	a	±14
CS	**CT**	102	<u>181</u>	c	±33	**52**	ab	±13
Mean yield (bu/A)			196			54		
Spatial variability (bu/A)				±15			± 5	
Temporal variability (bu/A)					±44			±12
CS	**NT**	9	<u>193</u>	bc	±46	**57**	abc	± 8
CS	**NT**	23	**196**	ab	±39	**55**	abc	±12
CS	**NT**	31	**205**	a	±46	**58**	ab	± 8
CS	**NT**	47	**197**	ab	±37	**55**	abc	±12
CS	**NT**	61	<u>192</u>	bc	±49	<u>53</u>	cd	± 8
CS	**NT**	81	**198**	ab	±45	**57**	ac	± 9
CS	**NT**	93	**204**	ab	±47	**58**	ab	± 9
CS	**NT**	101	**193**	ab	±30	<u>53</u>	bd	± 9
Mean yield (bu/A)			197			56		
Spatial variability (bu/A)				±11			± 4	
Temporal variability (bu/A)					±42			± 9