Wisconsin Crop Manager

Volume 20 Number 26 --- University of Wisconsin Crop Manager --- September 12, 2013

Crops

Plant Disease

Insects and Mites

Vegetable Crop Update 9/3/13 and 9/11/13

The 19th and 20th issues of the Vegetable Crop Update are now available. These issues contain updates on late blight and cucurbit downy mildew. Click here to view these updates.

Late Planted Drought Stricken Soybean II: More Valuable as a Forage or Green Manure?

Shawn Conley, Soybean and Wheat Extension Specialist

Now that we have checked the label and determined we can legally harvest our soybean crop as a forage now lets consider the calendar for our full suite of options. The average number of days it will take from R6 (full seed) to R7 (beginning maturity) soybean is 15-18 days. If you are in R6 now look at your historic killing frost date and extended weather forecast. If the odds are in your favor roll the dice and cut the beans for grain. If you are not at R6 yet or there is a strong chance of a killing frost in your extended forecast prior to R7 lets realistically consider our options for best utilizing this standing soybean crop.

Option # 1: Soybean haylage considerations

- What is my realistic tonnage expectations?
  - Late planted drought stricken soybean will yield ~1 to 2 tons of dry matter per acre.
- What is it going to cost me to harvest and put this crop up?
  - The average cost on a hourly basis to harvest and ensile a soybean forage according to 2013 Iowa Farm Custom rate survey are as follows:
    - Mowing ($11.45 per hour)
    - Swathing ($13.50 per hour)
    - Haylage (chopping/hour/ ft head width; $12.71)
    - Hauling ($ not listed))
    - Fill silage bags ($10.15 per foot of bag)
- How should I price this crop?
  - Soybean silage pricing will fall between good quality hay ($233.10 per ton) and poor quality hay ($112.50 per ton); personal communications from P. Hoffman and R Shaver. Source: FeedVal 2012 predicted dairy feed prices and rankings for August 2013. V.E. Cabrera, P. Hoffman, and R. Shaver.
  - If you were to price the soybean forage based on expected grain yield (assuming the crop would mature) and CBOT then realistic yield levels would range from 12 - 18 bu per acre at $14.35 per bu. Expected forage value range would be $172.20 to $258.30 per acre.

Option #2: Green manure considerations

- I am tired of throwing money at this crop..........
  - Though you will save on harvest costs the average cost of a plow down disk operation is $16.05 per acre.
- How much will I save on next years fertilizer bill?

- By not harvesting the crop you will not remove the 30# P and 85# K (estimated removal rates of P2O5 and K2O for 15-25 bu per acre soybean grain and straw (A2809)).
- You may contribute 20-40 pounds of N to next years corn or wheat crop.

- I need the feed so this is not an option (please refer back to option #1 above).

Neither of these prove to be particularly attractive options. However I would encourage growers, crop consultants, and nutritionists to weigh the true economical value of each option carefully before proceeding.

Pricing Corn Silage

Joe Lauer and Ryan Sterry, Corn Agronomist and St. Croix County Agent

Pricing corn silage is a difficult decision because it often comes at a time when emotions of sellers and buyers are high. The seller has the opportunity to sell a corn field for either silage or grain and incorporate the fertilizer value of the stover back into the field. The buyer has the opportunity to buy a corn field for silage or buy grain from the market and purchase low quality straw (wheat or corn stover aftermath) to formulate rations.

To read the full article scroll down to the end of this newsletter.

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.

To read the full article scroll down to the end of this newsletter.

Odds my Soybean Crop will Mature Before a Killing Frost Hits

Shawn Conley, Soybean and Wheat Extension Specialist

The Wisconsin soybean crop is slowly starting to mature, however many growers and crop consultants are still concerned about the risk of frost damage to late planted fields. In soybean an extended period (several hours) of temperatures 28 degrees F or lower is required to completely kill a soybean plant, though temperatures 32 degrees or less can still damage top growth. Those growers considering the state of their soybean crop and wondering the odds of making it to maturity before significant yield loss occurs must first correctly identify the soybean growth stage.

Once the crop growth stage has been determined we can estimate the number of days it will take for your field to reach R7 or physiological maturity. Across our Arlington and Hancock field sites it has taken 5-8 days to go from R3 to R4, 7-8 days to go from R4 to R5, 10-14 days from R5 to R6 and 14 days from R6 to R7. Note: we have seen crop development expedited the past few weeks due to heat and drought conditions. Next using the three figures below that show the 10th percentile, median, and 90th percentile date when you can expect a freeze event you can estimate the risk of a frost based on your crop growth stage.

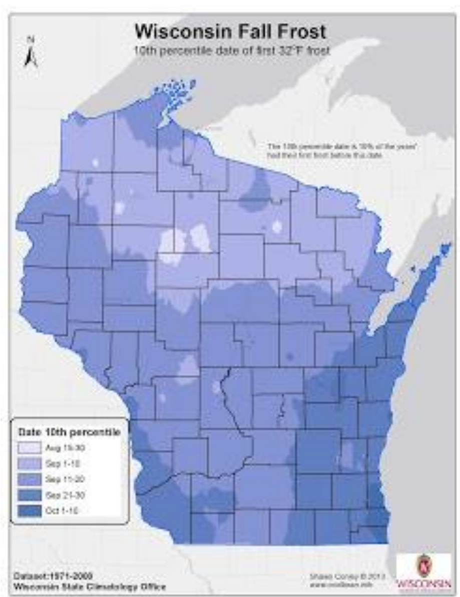
For example: If you lived in SW Marathon county there is a 10% chance that a freeze event would have occurred prior to September 11-20, a 50/50 chance that a freeze event would occur prior to September 21-30, and a 90% chance a freeze event would have occurred prior to October 1-10. So if your soybean crop just entered the R5 crop growth stage today 9/7/13 there is a greater than a 50/50 chance that crop won't make grain based on historical weather data.

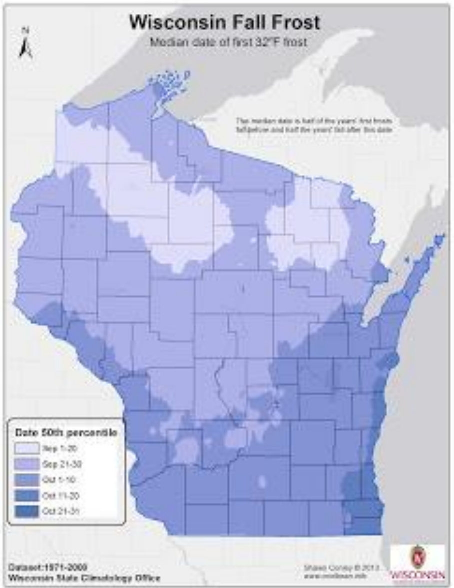
Lastly if you are concerned about a freeze event please refer to Table 1 below that provides yield loss estimates of freeze damage by crop crop stage. This may help you decide whether you should risk taking the late planted soybean field as a grain crop or would that field be more valuable as a forage or green manure?

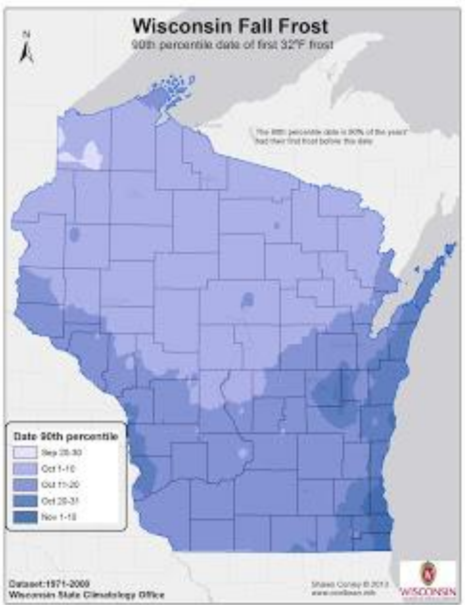
Table 1. Soybean Response to Freeze Damage

Growth Stage	Yield Reduction
R4 - Full pod	70%-80%
R5 - Beginning seed	50%-70%
R6 - Full seed	15%-30%
R7 - Beginning maturity	0%-5%
R8 - Full maturity	0%

Source: Saliba et. at. Kansas State University, 1982







Planting Winter Wheat into Dry Soil

Shawn Conley, Soybean and Wheat Extension Specialist

Dry soil conditions have sparked many questions from growers on how best to establish their winter wheat crop. As we were reminded last year and this there is no substitute for rain (unless you have irrigation), however here are a few ideas to consider to mitigate your risk.

- Conserve soil moisture. If possible no-till your winter wheat. If this is not possible due to equipment limitations, limit your tillage passes across the field.
- Increase your seeding depth (e.g. plant to moisture). As stated in the Top 7 Recommendations for winter Wheat Establishment: Wheat should be planted ~1.0 inch deep **depending upon soil moisture conditions**. Wheat planted more than 1.5 inches deep may result in death due to pre-mature leaf opening or poor tiller development and winter survival.
    - As a grower there is little you can due to prevent pre-mature leaf opening. This phenomenon is rare unless seeded extremely deep and compaction also occurs.
    - You can increase tiller development or effective head number by increasing your seeding rate.
    - I do not have yield loss or winter kill data implicitly from seeding depth experiments however deep seeding will delay emergence which may be similar to delayed planting. Data from our 2009 Lancaster and Arlington WI planting date experiments show that yield and winter survival decreased as planting date was delayed (Table 1.).
    - Deeper planting may expose germinating and emerging wheat seed to greater potential for herbicide carryover. However if you explicitly followed the herbicide label restrictions for rotational crops you have a basis to contact the company if problems occur. **Remember the label is the law**.

Table 1. Planting date effect on grain yield and winter survival at Lancast and Arlington WI, 2009.

	Lancaster, WI	
Planting date	Grain yield (bu/a)	Winter survival (%)
17-Sep	74.9	88.5
30-Sep	68.3	70.0
13-Oct	54.2	58.0
	Arlington, WI	
Planting date	Grain yield (bu/a)	Winter survival (%)
18-Sep	101.9	83.8
1-Oct	93.3	55.3
17-Oct	73.9	30.

- Remember to use a fungicide seed treatment. Even though you are planting into dry soil and the overall pathogen load may be lessened, you are planting deeper and delaying emergence especially as soil temps continue to decrease.
- Remember your crop insurance and planting date restrictions. In a spring seeded crop we would often say wait until it rains to establish the crop however we have a short window to get the crop established and still get your full crop insurance coverage. Please talk to your crop insurance agent for specific dates for your county.

New Video: Cover Crops – Winter Rye after Corn Silage

A new instructional video, *Cover Crops: Winter Rye After Corn Silage*, has been posted on the UW Integrated Pest and Crop Management (IPCM) website and is available for viewing.

The video provides an introduction to the practice of fall planting winter cereal rye as a conservation cover crop following harvest of corn silage to help prevent soil erosion and nutrient runoff. The three minute video focuses on using the rye as an early season forage crop the following spring. Determination of "boot stage," the development stage of rye where forage yield and quality are optimized, is demonstrated. Harvest of rye as forage in mid to late May, in southern Wisconsin, generally allows subsequent planting of a full season crop such as corn, soybeans or alfalfa seeding.

For further information, the video references the NPM publication *Planting Winter Rye After Corn Silage: Managing for Forage.* http://ipcm.wisc.edu/download/pubsNM/Rye_090507_final.pdf

Plant Disease Diagnostic Clinic (PDDC) Update

Brian Hudelson, Ann Joy, Erin DeWinter and Joyce Wu, Plant Disease Diagnostics Clinic

The PDDC receives samples of many plant and soil samples from around the state. The following diseases/disorders have been identified at the PDDC from August 24, 2013 through August 30, 2013.

Plant/Sample Type, Disease/Disorder, Pathogen, County

Corn, Common Rust, *Puccinia sorghi*, Dane

Soybean, Anthracnose, *Colletotrichum truncatum*, Rock

Soybean, Brown Spot, *Septoria glycines*, Calumet, Rock

Soybean, Cercospora Leaf Blight, *Cercospora kikuchii*, Sheboygan

Soybean, Frogeye Leaf Spot, *Cercospora sojina*, Rock

Soybean, Ozone Injury, None, Calumet

Soybean, Stem Canker, *Diaporthe phaseolorum*, Rock

Soybean, Target Spot, *Corynespora cassiicola*, Rock

FRUIT CROPS,

Apple, Brown Rot, *Monilinia* sp., Columbia

Grape, Berry Rot, Miscellaneous yeasts, Vernon

Grape, Bird's Eye Rot, *Sphaceloma ampelinum*, Vernon

Grape, Blue Mold, *Penicillium* sp., Vernon

Raspberry, Anthracnose, *Sphaceloma necator*, Pierce

Raspberry, Root/Crown Rot, *Phytophthora* sp., *Pythium* sp., *Fusarium* sp.,*Cylindrocarpon* sp., Dane, Lincoln

VEGETABLES,

Garlic, Stem and Bulb/Bloat Nematode, *Ditylenchus dipsaci*, Dane

Melon, Alternaria Leaf Spot, *Alternaria* sp., Crawford

Melon, Cercospora Leaf Spot, *Cercospora* sp., Crawford

Melon, Fusarium Wilt, *Fusarium oxysporum*, Waushara

Parsnip, Pseudocercosporella Leaf Blight, *Pseudocercosporella* sp., Crawford

Tomato, Septoria Leaf Spot, *Septoria lycopersici*, La Crosse

Zucchini, Fusarium Wilt, *Fusarium oxysporum*, Green Lake

SPECIALTY CROPS,

Hop, Gray Mold, *Botrytis* sp., Dodge

SOIL,

Alfalfa Soil, Aphanomyces Seedling Blight, *Aphanomyces euteiches* race 1, Manitowoc

Soybean Soil, Soybean Cyst Nematode, *Heterodera glycines*, Buffalo, Jefferson, Rock, Walworth, Washington

For additional information on plant diseases and their control, visit the PDDC website at pddc.wisc.edu.

New Video: Sudden Death Syndrome of Soybean

Damon Smith, Extension Field Crops Plant Pathologist

Dr. Damon Smith talks about sudden death syndrome (SDS) of soybean. SDS can be a significant problem in years where the spring is wet and cool resulting in infection by the fungus Fusarium virguliforme soon after emergence. However, SDS is often not noticed until the reproductive growth stages when foliar symptoms typically develop. The discussion here includes tips on spotting SDS, determining the difference between SDS and brown stem rot and how to manage the disease.

For more information about SDS visit the Soybean Plant Health Topics webpage at http://fyi.uwex.edu/fieldcroppathology/soybean_pests_diseases/ and scroll down to the “Sudden Death Syndrome” section.

Wisconsin Pest Bulletin 8/29/13

A new issue of the Wisconsin Pest Bulletin from the Wisconsin Department of Agriculture, Trade and Consumer Protection is now available. The Wisconsin Pest Bulletin provides up-to-date pest population estimates, pest distribution and development data, pest survey and inspection results, alerts to new pest finds in the state, and forecasts for Wisconsin’s most damaging plant pests.

Issue No. 17 of the Wisconsin Pest Bulletin is now available at:

http://datcpservices.wisconsin.gov/pb/index.jsp

http://datcpservices.wisconsin.gov/pb/pdf/08-29-13.pdf

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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 28.5 - 104

Pricing Corn Silage

Joe Lauer and Ryan Sterry, *Corn Agronomist and St. Croix County Agent*

Pricing corn silage is a difficult decision because it often comes at a time when emotions between sellers and buyers are high. The seller has the opportunity to sell a corn field for either silage or grain and incorporate the fertilizer value of the stover back into the field. The buyer has the opportunity to buy a corn field for silage or buy grain from the market and purchase low quality straw (wheat or corn stover aftermath) to formulate rations.

Arriving at a fair price and being able to take into account the markets (grain, straw, milk and silage), fertilizer, harvesting and quality costs is a difficult decision. Somewhere in the middle of the seller and buyer perspectives negotiations should be able to arrive at a fair price. The Sterry et al. spreadsheet (see http://corn.agronomy.wisc.edu/Season/DSS.aspx) accounts for both the seller and buyer perspectives to arrive at a fair price for corn silage. This article performs a sensitivity analysis of this spreadsheet.

The assumptions and initial values typical for the market conditions heading into the 2013 harvest are shown on page 2. To produce the sensitivity analysis in Table 1, one input value at a time was changed on the spreadsheet for grain price, milk price, grain yield, starch content, straw price and NDFD. This can lead to somewhat ambiguous conclusions. For example, often the seller receives a lower price than what the buyer must pay for grain, however, in this example the seller and buyer grain prices are held the same. Also, when one quality measure moves in a certain direction (i.e. starch content) other measures (i.e. grain yield or NDFD) are affected as well. In 2013 many corn fields were late late-planted and affected by drought which affects yield, starch content and NDFD.

Grain prices between $4 and $7 per bushel affect corn silage price from $28 to $51 per Ton wet. Milk price affects the buyer decision much more than the seller. Low grain yields reduce the price of standing corn silage as does lower starch content. Straw price does not affect the seller perspective, but does affect the buyer perspective of a standing corn silage field because he has the option to buy wheat straw. NDFD had little effect on corn silage price in this spreadsheet. Users of this spreadsheet need to input their own data for the values used in the calculations.

Table 1. Sensitivity analysis of seller and buyer perspectives using the Sterry et al. spreadsheet for calculating the value of standing corn silage ($/T) with quality adjustments.

	Wet Basis (65%)		Dry Matter Basis	
	Seller	Buyer	Seller	Buyer
Grain price ($/bu)				
$7.00	50	51	143	145
$6.00	43	45	122	128
*** $5.00**	35	39	101	111
$4.00	28	33	80	94
Milk price ($/cwt)				
$24	36	39	103	113
*** $18**	35	39	101	111
$12	35	38	99	108
Grain yield (bu/A)				
175	35	39	99	110
*** 150**	35	39	101	111
125	35	38	99	108
100	33	36	93	103
75	29	32	83	93
50	23	27	65	76
25	12	17	35	48
Straw price ($/T)				
$100	35	42	101	120
*** $75**	35	39	101	111
$50	35	35	101	101
Starch content (%)				
34%	40	43	113	123
*** 29%**	35	39	101	111
24%	31	34	88	98
NDFD (%)				
68%	36	39	102	112
*** 58%**	35	39	101	111
48%	35	38	100	109

* The normal 2013 assumptions used in the spreadsheet example shown on page 2.

2013 Corn Silage Pricing Decision Aid

by Ryan Sterry, Lee Milligan and Joe Lauer (2007, Revised 2013)

Please enter your input values into the shaded cells. Red letters refer to explanations or guidelines at bottom. Use actual costs when possible, or refer to guidelines.

Yield Information

	Estimated	Actual	*To use estimated yield
Grain Yield Bushels/Acre		150	
Silage % DM		35%	
Corn Silage/Tons Acre (Wet Basis)	19.97		19.97

Price Perspective

	Seller	Buyer	
Local Market Price for No.2 Corn at 15.5% moisture as Buyer or Seller	$5.00	$5.00	/bushel
Local Market Price per ton for poor quality/low protein forage to Buyer (a)		$75	/Ton
Average grain loss for harvest before black layer (Bushels/Acre) (b)		14	bu/A
Gross Value of Corn Crop/Acre	$750	$918	
Gross Value of Corn Crop/Wet Ton		$46	
Gross Value of Corn Crop/Dry Ton		$131	

Grain Harvest Costs (c)

Combining Cost/Acre					$50.00
Trucking Cost/Acre = Grain yield (bu/A) x $/bushel	150 bu/A x	$0.15	$/bu		$22.50
Drying Cost/Acre = Grain yield (bu/A) x $/bushel	150 bu/A x	$0.20	$/bu		$30.00
Storage Cost/Acre = Grain yield (bu/A x $/bu/month x Time (months)	150 bu/A x	$0.02	$/bu/m(	9 months	$27.00
Harvest and Storage Loss (d) = Estimated % loss	150 bu/A x	2.50%			$18.75
Total Harvest Costs/Acre					$148.25
Value/Acre of Corn Silage to **Seller** Adjusted for Grain Harvest Costs (Gross Value of Crop - Grain Harvest Expenses)					$601.75
Value/Wet Ton of Corn Silage to **Seller** Adjusted for Grain Harvest Costs					$30.14

Silage Harvest Costs (e)

Chopping $/Acre							$55.00
Hauling $/Acre							$15.00
Harvest and Storage Loss (f)	**Estimated**	Concrete tower	13%	**Actual (if known) =**		13%	$119.39
Silage Harvest Costs/Acre							$189.39

Fertilizer Value of Harvested Stover

Phosphorus Value = Pounds P205/Ton Dry Matter (from pub A2809)	Tons Stover DM/acre (See estimate to right)			Price per lb P205		Estimated stov
4.6		3.55	3.55	$0.50	$8.16	3.55
Potassium Value = Pounds K20/Ton Dry Matter (from pub A2809)	Tons Stover DM/acre (See estimate to right)			Price per lb K20		
32		3.55	3.55	$0.45	$51.11	

	Seller	Buyer
Total Stover Value/Acre	$59.27	
Value/Acre of Corn Silage to **Seller** Adjusted for Grain Harvest Cost and Fertilizer Value of Harvested Stover (Minimum Value to Acc	$661.02	
Value/Acre Corn Silage to **Buyer** Minus Silage Harvest Costs		$728.98
Value of Standing Corn/Ton of Silage W/O Quality Adjustment (Wet Basis)	**$33.10**	**$36.51**
Value of Standing Corn/Ton of Silage W/O Quality Adjustment (DryMatter Basis)	**$94.58**	**$104.31**

Quality Adjustments for Silage (g)

	Seller	Buyer
Starch Adjustment/ton DM Silage	$0.00	$0.00
% Starch (DM basis)	29	29
Local Corn Price/Bushel	$5.00	$5.00
NDF Digestibility Adjustment/ton DM Silage	$6.26	$6.26
Silage NDFD (48 Hour invitro)	58%	58%
Milk Price/Cwt	$18.00	$18.00
Quality Adjustment (per ton DM)	$6.26	$6.26
Silage Base Price Estimate (per ton DM)	$94.58	$104.31
Value of Standing Corn/Ton of Silage With Quality Adjustment (Wet Basis)	**$35.30**	**$38.70**
Value of Standing Corn/Ton of Silage With Quality Adjustment (DryMatter Basis)	**$100.85**	**$110.57**

Value of Corn Silage Based on Harvest and Storage (Cost Responsibility Between Seller and Buyer).

Please indicate below which costs are the responsibility of the buyer. Silage harvest costs can be changed in lines 35-38.

Buyer Pays For (unchecked means seller assumes cost): ☐ Chopping ☐ Hauling ☐ Storage

	Seller	Buyer
Chopping $/Acre	$ 55.00	
Hauling $/Acre	$ 15.00	
Harvest and Storage Loss	$119.39	
Silage Harvest Costs/Acre	$189.39	$0.00
Harvesting & Storage Costs of Buyer & Seller/Ton of Silage (Dry Matter)	$27.10	$0.00
Value of Corn Silage /Ton with All Adjustments (Wet Basis)	**$44.78**	**$48.19**
Value of Corn Silage/Ton with All Adjustments (Dry Matter)	**$127.95**	**$137.67**

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

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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.

Rotation	Tillage	Land cell	Corn Mean yield		Corn Temporal variability	Soybean Mean yield		Soybean 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