

**2015 Agronomic Protocol**  
**Long-Term Ecological Research (LTER) in Row-Crop Agriculture**  
**Kellogg Biological Station, Michigan State University**

January 1, 2015

## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Main Site Treatment 1: Inputs of Commercial Fertilizer/Herbicides, Conventional Tilled Management Summary Sheet

#### Growing Season: 2015

Rotation: Soybeans – Winter Wheat – Corn Tillage: Conventional

Tillable Acres: 13.5 Current Crop: Soybeans Previous Crop: Corn Yield Goal: 45 bu/A

Planting Date: May 2015 Planting Population: 180,000 seeds/A Variety: Pioneer P22T69R

Row Spacing: 15 inches Planting Depth: 1 inches Insecticide Used: None

Cover Crop: None

Harvest Date: September – October 2015

#### Tillage Operations Applied Last Year:

Plots were chisel plowed and soil finished before corn was planted. Corn was harvested in October 2014. Corn stubble was fall mowed.

#### Tillage Operations and Fertilizer Applied This Year:

Tillage: In Spring 2015, Chisel plow after March 15<sup>th</sup>. Soil finish as needed before planting soybeans. Plant soybeans anytime after May 5<sup>th</sup>. After soybean harvest soil finish and plant winter wheat, variety Pioneer 25R39. Plant winter wheat after the Hessian fly-free date, September 20<sup>th</sup> for Kalamazoo County.

Fertilizer: Spring: 92 lbs/A of 0-0-60 (55 lbs/A of K<sub>2</sub>O) (before chisel plowing, if possible).  
 Spring: 60 lbs/A of 11-52-0 (6.6 lbs/A of N, 31.2 lbs/A of P<sub>2</sub>O<sub>5</sub>)

Winter Wheat Fertilizer: Fall 2015: After soybean harvest before soil finishing broadcast 158 lbs/A of 19-19-19 (30 lbs/A of N, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O) on all replications.  
 Spring 2016: Broadcast 28-0-0 at 17 gal/A (50.78 units of N or 181.39 lbs N/A).

Cover Crop: None

#### Weed/Insect Control:

Preemergence: None

Postemergence: Scout for weeds and make herbicide application of Roundup PowerMax at 22 fl oz/Acre and ammonium sulfate at 17 lbs/100 gals of water when weeds are 2-6 inches.

Insect control: Scout for aphids. If needed an insecticide application can be used to control aphids.

#### Soil Sample Analysis: Results from samples taken in the autumn of 2013.

pH:	<u>R1 6.3, R2 6.4, R3 6.5, R4 6.4, R5 6.3, R6 6.3</u>	Magnesium (Mg): ppm	<u>R1 171, R2 218, R3 223, R4 218, R5 200, R6 164</u>
Lime Index:	<u>R1 69, R2 70, R3 69, R4 70, R5 69, R6 69</u>	Calcium (Ca): ppm	<u>R1 906, R2 1087, R3 1139, R4 1197, R5 999, R6 843</u>
Nitrogen (N):	<u></u>	C.E.C.: (meq/100 g)	<u>R1 7.4, R2 7.6, R3 9.2., R4 8.1, R5 8.1, R6 7.0</u>
Phosphorus (P): ppm	<u>R1 24, R2 26, R3 63, R4 23, R5 26, R6 46</u>	% O.M.:	<u></u>
Potassium (K): ppm	<u>R1 113, R2 141, R3 169, R4 132, R5 102, R6 84</u>	Others:	<u></u>

#### Fertility -- Fertilizer Recommendation:

Lime ton/A:	<u>Avg. = .4: R1 .7, R2 0, R3 0, R4 0, R5 .7, R6 .7</u>	K <sub>2</sub> O lb/A:	<u>Avg. = 45.8: R1 70, R2 10, R3 0, R4 45, R5 70, R6 80</u>
Nitrogen lb/A:	<u>Avg. = 0: R1 0, R2 0, R3 0, R4 0, R5 0, R6 0</u>	Other:	<u></u>
P <sub>2</sub> O <sub>5</sub> lb/A:	<u>Avg. = 26.7: R1 40, R2 40, R3 0, R4 40, R5 40, R6 0</u>		

#### Differences from Prior Rotations:

#### Comments:

On the LTER protocol soil sample analysis in prior years, up to and including 2007, was reported in lbs/acre. In 2008 and upcoming years soil sample analysis will be reported in ppm on the LTER protocol.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Main Site Treatment 2: Inputs of Commercial Fertilizer/Herbicides, No-Till Management Summary Sheet

**Growing Season: 2015**

Rotation: Soybeans – Winter Wheat – Corn Tillage: No-Till

Tillable Acres: 13.5 Current Crop: Soybeans Previous Crop: Corn Yield Goal: 45 bu/A

Planting Date: May 2015 Planting Population: 180,000 seeds/A Variety: Pioneer P22T69R

Row Spacing: 15 inches Planting Depth: 1 inches Insecticide Used: none

Cover Crop: None

Harvest Date: September – October 2015

**Tillage Operations Applied Last Year:**

Corn was harvested in October 2014. Corn stubble was fall mowed.

**Tillage Operations and Fertilizer Applied This Year:**

Tillage: None (No-Till): Plant soybeans anytime after May 5<sup>th</sup>. After soybean harvest plant winter wheat, variety Pioneer 25R39. Plant winter wheat after the Haessian fly-free date, September 20<sup>th</sup> for Kalamazoo County.

Soybean Fertilizer: Spring 2015: 92 lbs/A of 0-0-60 (55 lbs of K<sub>2</sub>O/A).  
Spring 2015: 60 lbs/A of 11-52-0 (6.6 lbs/A N, and 31.2 lbs P<sub>2</sub>O<sub>5</sub>/A)

Winter Wheat Fertilizer: Fall 2015: After soybean harvest before soil finishing broadcast 158 lbs/A of 19-19-19 (30 lbs/A of N, P<sub>2</sub>O<sub>5</sub>, and K<sub>2</sub>O) on all replications.  
Spring 2016: Broadcast 28-0-0 at 17 gals/A (50.789 units of N or 181.39 lbs N/A).

Cover Crop: None

**Weed/Insect Control:**

Burndown: Roundup PowerMax at 22 fl oz/Acre and 2,4-D ester at 1 pt/A. Application of 2,4-D must be 7 days before planting. If Roundup application is within 7 days of planting do not use 2,4-D in the tank mix.

Preemergence: None

Postemergence: Scout for weeds and make herbicide application of Roundup PowerMax at 22 fl oz/Acre and ammonium sulfate at 17 lbs/100 gals of water when weeds are 2-6 inches.

Insect control: Scout for aphids. If needed an insecticide application can be used to control aphids.

**Soil Sample Analysis: Results from samples taken in the autumn of 2013.**

pH:	<u>R1 6.1, R2 6.3, R3 6.2, R4 6.0, R5 6.1, R6 6.3</u>	Magnesium (Mg): ppm	<u>R1 191, R2 210, R3 214, R4 188, R5 196, R6 167</u>
Lime Index:	<u>R1 69, R2 69, R3 69, R4 68, R5 69, R6 69</u>	Calcium (Ca): ppm	<u>R1 1033, R2 1138, R3 1073, R4 903, R5 901, R6 840</u>
Nitrogen (N):	<u></u>	C.E.C.: (meq/100 g)	<u>R1 8.3, R2 8.9, R3 8.7, R4 8.8, R5 7.6, R6 7.0</u>
Phosphorus (P): ppm	<u>R1 31, R2 26, R3 34, R4 30, R5 19, R6 29</u>	% O.M.:	<u></u>
Potassium (K): ppm	<u>R1 130, R2 112, R3 144, R4 129, R5 106, R6 73</u>	Others:	<u></u>

**Fertility -- Fertilizer Recommendation:**

Lime ton/A: Avg. = 1.0: R1 1.1, R2 .7, R3 1.1, R4 1.1, R5 1.1, R6 .7 K<sub>2</sub>O lb/A: Avg. = 60.8: R1 55, R2 70, R3 10, R4 65, R5 70, R6 95

Nitrogen lb/A: Avg. = 0: R1 0, R2 0, R3 0, R4 0, R5 0, R6 0 Other:

P<sub>2</sub>O<sub>5</sub> lb/A: Avg. = 36.7: R1 35, R2 40, R3 25, R4 40, R5 40, R6 40

**Differences from Prior Rotations:** \_\_\_\_\_**Comments:** \_\_\_\_\_

On the LTER protocol soil sample analysis in prior years, up to and including 2007, was reported in lbs/acre. In 2008 and upcoming years soil sample analysis will be reported in ppm on the LTER protocol.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

## 2015 LTER Agronomic Protocol Kellogg Biological Station

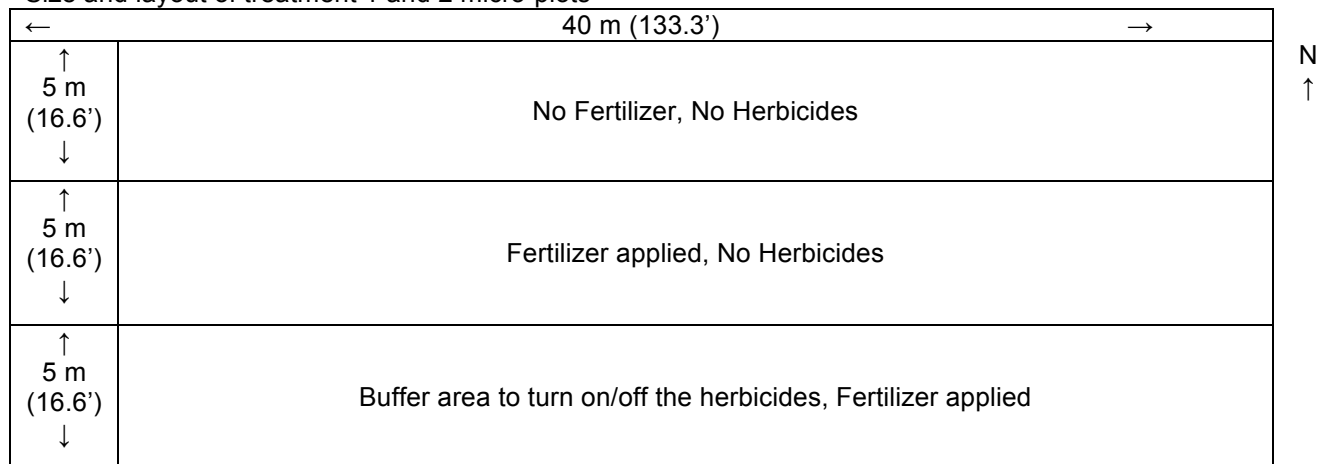
### Micro-plots in Treatments 1 and 2

Since establishment of the LTER, treatments 1 and 2 have contained microplots that have been used to determine long term effects of weed populations without herbicide applications. Treatment 1 and 2 microplots contain two treatments (no herbicide, no fertilizer vs. no herbicide, with fertilizer).

**Micro-plot size and location:** Micro-plot area is 40 m (133.3 ft) wide from the northwest corner towards the east. From the northwest corner going south, total micro-plot area is 15m (50 ft) deep. Each treatment within the micro-plot area is 5m (16.6 ft) i.e. the no fertilizer, no herbicide area is 5m, the fertilizer, no herbicide area is 5m, and the buffer area is 5m. A buffer area was created because of the need for turning the herbicide spraying boom on and off during applications.

Crops/plants inside treatment 1 and 2 micro-plot areas are mowed before crop harvest. The weeds are usually so thick within the micro-plot areas that the crop growth is not enough to harvest. Specifically, treatment 2 micro-plot areas have such a thick grass growing in it that no crop growth occurs in these areas. Treatment 1 micro-plot area usually has a thick density of quackgrass and annual broadleaves that not much crop growth occurs. We mow the micro-plot area in treatments 1 and 2 so that we do not put all the weeds through the combine.

Size and layout of treatment 1 and 2 micro-plots



This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Main Site Treatment 3: Reduced Inputs of Commercial Fertilizer/Herbicide Management Summary Sheet

#### Growing Season: 2015

Rotation: Soybeans – Winter Wheat – Corn Tillage: Conventional

Tillable Acres: 13.5 Current Crop: Soybeans Previous Crop: Corn Yield Goal: 45 bu/A

Planting Date: May 2015 Planting Population: 180,000 seeds/A Variety: Pioneer P22T69R

Row Spacing: 15 inches Planting Depth: 1 inches Insecticide Used: none

Cover Crop: Cereal Rye

Harvest Date: September – October 2015

#### Tillage Operations Applied Last Year:

Plots were chisel plowed and soil finished before corn was planted. Corn was harvested in November 2014. Corn stubble was fall mowed. Cereal rye was planted after corn harvest.

#### Tillage Operations and Fertilizer Applied This Year:

Tillage: Spring chisel plow: Soil finish as needed before planting. Plant soybeans anytime after May 5<sup>th</sup>. After soybean harvest soil finish and plant winter wheat, variety Pioneer 25R39. Plant winter wheat after the Hessian fly-free date, September 20<sup>th</sup> for Kalamazoo County.

Soybean Fertilizer: Spring 2015: 92 lbs/A of 0-0-60 (55 lbs of K<sub>2</sub>O/A) (before chisel plowing, if possible).  
Spring 2015: 60 lbs/A of 11-52-0 (6.6 lbs/A N, and 31.2 lbs P<sub>2</sub>O<sub>5</sub>/A) before chisel plowing.

Winter Wheat Fertilizer: Fall 2015: No fertilizer will be applied in the fall of 2015.

Spring 2016: Broadcast **To Be Determined** of 28% nitrogen.

The amount on nitrogen applied to treatment 3 should be 3/5 of the total amount applied to treatment 1.

The 3/5 rate of nitrogen should be based on the total amount applied to treatment 1. i.e. The amount of nitrogen applied in the fall of 2015 and spring of 2016, not just the amount applied in the spring of 2016.

Cover Crop: None

#### Weed/Insect Control:

Preemergence: None

Postemergence: Scout for weeds and make a 10-12 inch band application of Roundup PowerMax at 22 fl oz/Acre and ammonium sulfate at 17 lbs/100 gals of water when weeds are 2-6 inches.

Insect control: Scout for aphids. If needed an insecticide application can be used to control aphids.

#### Soil Sample Analysis: Results from samples taken in the autumn of 2013.

pH:	<u>R1 6.5, R2 6.4, R3 6.4, R4 6.3, R5 6.3, R6 6.3</u>	Magnesium (Mg): ppm	<u>R1 184, R2 180, R3 177, R4 191, R5 204, R6 168</u>
Lime Index:	<u>R1 70, R2 69, R3 70, R4 69, R5 69, R6 69</u>	Calcium (Ca): ppm	<u>R1 902, R2 846, R3 930, R4 984, R5 1029, R6 970</u>
Nitrogen (N):	<u></u>	C.E.C.: (meq/100 g)	<u>R1 6.3, R2 7.2, R3 6.4, R4 8.0, R5 8.4, R6 7.7</u>
Phosphorus (P): ppm	<u>R1 16, R2 46, R3 28, R4 17, R5 19, R6 28</u>	% O.M.:	<u></u>
Potassium (K): ppm	<u>R1 92, R2 106, R3 116, R4 113, R5 119, R6 89</u>	Others:	<u></u>

#### Fertility -- Fertilizer Recommendation:

Lime ton/A:	<u>Avg. = .5: R1 .7, R2 .7, R3 0, R4 .7, R5 .7, R6 .7</u>	K <sub>2</sub> O lb/A:	<u>Avg. = 70.8: R1 70, R2 70, R3 70, R4 70, R5 70, R6 75</u>
Nitrogen lb/A:	<u>Avg. = 0: R1 0, R2 0, R3 0, R4 0, R5 0, R6 0</u>	Other:	<u></u>
P <sub>2</sub> O <sub>5</sub> lb/A:	<u>Avg. = 33.3: R1 40, R2 0, R3 40, R4 40, R5 40, R6 40</u>		

#### Differences from Prior Rotations:

#### Comments:

On the LTER protocol soil sample analysis in prior years, up to and including 2007, was reported in lbs/acre. In 2008 and upcoming years soil sample analysis will be reported in ppm on the LTER protocol.

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## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Micro-plots in Treatment 3

In 2006 a new experiment was established within the LTER main site treatment 3 plots to determine how crop yield is influenced by weed populations and nitrogen availability. Six treatments were established as split-plots within the LTER main site treatments 3 and 4: three weed control treatments (business-as-usual vs. none vs. complete) x two fertilizer levels (none vs. same rate as T1).

Micro-plot definition: A sub plot or split plot treated differently from the LTER main site plots. The size of the LTER main site plots are one hectare.

Micro-plot size and location: Micro-plots were 15 feet wide by 50 feet long, only 40 feet of each plot was harvested; we removed 5 feet from both ends of each plot before harvest. Micro-plots were located in the northwest corner of all treatment 3 and 4 main site plots.

Descriptions of the six treatments used within the micro-plots follow:

Business as usual (normal) weed control + Fertilizer (BAU + Fert): if the main plot was rotary hoed, row cultivated, or band sprayed these plots received the same field operation and fertilizer was applied at the same rate as applied to the LTER main site treatment 1 plots.

Business as usual (normal) weed control – Fertilizer (BAU – Fert): if the main plot was rotary hoed, row cultivated, or band sprayed these plots received the same field operation and no fertilizer was applied.

Weed Free (complete) weed control + Fertilizer (WF + Fert): no weeds were allowed to become established and fertilizer was applied at the same rate as applied to the LTER main site treatment 1 plots.

Weed Free (complete) weed control – Fertilizer (WF – Fert): no weeds were allowed to become established and no fertilizer was applied.

No Weed Control + Fertilizer (NWC + Fert): plots were allowed to grow without any form of weed control and fertilizer was applied at the same rate as applied to the LTER main site treatment 1 plots.

No Weed Control – Fertilizer (NWC – Fert): plots were allowed to grow without any form of weed control and no fertilizer was applied.

2015 Treatment 3 randomization of micro-plots

Rep 1	BAU + Fert	NWC - Fert	NWC + Fert	WF + Fert	BAU - Fert	WF - Fert	N ↑
Rep 2	WF + Fert	NWC - Fert	BAU + Fert	NWC + Fert	BAU - Fert	WF - Fert	
Rep 3	BAU + Fert	NWC - Fert	WF + Fert	WF - Fert	NWC + Fert	BAU - Fert	
Rep 4	NWC - Fert	WF - Fert	WF + Fert	BAU + Fert	BAU - Fert	NWC + Fert	
Rep 5	NWC + Fert	BAU + Fert	NWC - Fert	WF + Fert	BAU - Fert	WF - Fert	
Rep 6	BAU - Fert	BAU + Fert	WF + Fert	NWC + Fert	WF - Fert	NWC - Fert	

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Main Site Treatment 4: Zero Inputs of Commercial Fertilizer/Herbicide Management Summary Sheet

**Growing Season: 2015**

Rotation: Soybeans – Winter Wheat – Corn Tillage: Conventional  
 Tillable Acres: 13.5 Current Crop: Soybeans Previous Crop: Corn Yield Goal: 45 bu/A  
 Planting Date: Late May or early June 2015 Planting Population: 180,000 seeds/A Variety: Blue River Hybrid 19AR1  
 Row Spacing: 30 inches Planting Depth: 1 inches Insecticide Used: None  
 Cover Crop: Cereal Rye  
 Harvest Date: September – October 2015

**Tillage Operations Applied Last Year:**

Plots were chisel plowed and soil finished before corn was planted. Corn was harvested in November 2014. Corn stubble was fall mowed. Cereal rye was planted after corn harvest.

**Tillage Operations and Fertilizer Applied This Year:**

Tillage: Spring 2015. Spring chisel plow. Soil finish as needed before planting. Plant soybeans in late May or early June (late planting date will help control weed in the organic treatment). After soybean harvest plant winter wheat, variety Pioneer 25R39 (untreated). Plant winter wheat after the Hessian fly-free date, September 20<sup>th</sup> for Kalamazoo County.

Fertilizer: **No fertilizer or pesticide applications will be applied to treatment 4.**

Cover Crop: None Plant to winter wheat

**Weed/Insect Control:** No herbicides will be used to control weeds. No insecticides will be applied to control insects.

Rotary hoe and cultivate as needed to control weeds.

**No herbicides will be used to control weeds. No insecticides will be applied to control insects**

**Soil Sample Analysis: Results from samples taken in the autumn of 2013.**

pH:	<u>R1 6.0, R2 6.3, R3 6.2, R4 6.5, R5 6.2, R6 6.3</u>	Magnesium (Mg): ppm	<u>R1 168, R2 185, R3 183, R4 181, R5 206, R6 189</u>
Lime Index:	<u>R1 69, R2 69, R3 69, R4 70, R5 69, R6 69</u>	Calcium (Ca): ppm	<u>R1 1039, R2 918, R3 955, R4 1084, R5 1025, R6 877</u>
Nitrogen (N):	<u></u>	C.E.C.: (meq/100 g)	<u>R1 8.1, R2 7.6, R3 7.7, R4 7.2, R5 8.3, R6 7.3</u>
Phosphorus (P): ppm	<u>R1 19, R2 25, R3 22, R4 20, R5 14, R6 32</u>	% O.M.:	<u></u>
Potassium (K): ppm	<u>R1 113, R2 89, R3 91, R4 107, R5 88, R6 45</u>	Others:	<u></u>

**Fertility -- Fertilizer Recommendation:**

Lime ton/A:	<u>Avg. = .8: R1 1.1, R2 .7, R3 1.1, R4 0, R5 1.1, R6 .7</u>	K <sub>2</sub> O lb/A:	<u>Avg. = 84.2: R1 70, R2 75, R3 75, R4 70, R5 80, R6 135</u>
Nitrogen lb/A:	<u>Avg. = 0: R1 0, R2 0, R3 0, R4 0, R5 0, R6 0</u>	Other:	<u></u>
P <sub>2</sub> O <sub>5</sub> lb/A:	<u>Avg. = 40: R1 40, R2 40, R3 40, R4 40, R5 45, R6 35</u>		

**Differences from Prior Rotations:**

Comments: No nitrogen will be applied to treatment 4.

**No fertilizer or pesticide applications will be made to treatment 4.**

On the LTER protocol soil sample analysis in prior years, up to and including 2007, was reported in lbs/acre. In 2008 and upcoming years soil sample analysis will be reported in ppm on the LTER protocol.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Micro-plots in Treatment 4

In 2006 a new experiment was established within the LTER main site treatment 4 plots to determine how crop yield is influenced by weed populations and nitrogen availability. Six treatments were established as split-plots within the LTER main site treatments 3 and 4: three weed control treatments (business-as-usual vs. none vs. complete) x two fertilizer levels (none vs. same rate as T1).

Micro-plot definition: A sub plot or split plot treated differently from the LTER main site plots. The size of the LTER main site plots are one hectare.

Micro-plot size and location: Micro-plots were 15 feet wide by 50 feet long, only 40 feet of each plot was harvested; we removed 5 feet from both ends of each plot before harvest. Micro-plots were located in the northwest corner of all treatment 3 and 4 main site plots.

Descriptions of the six treatments used within the micro-plots follow:

Business as usual (normal) weed control + Fertilizer (BAU + Fert): if the main plot was rotary hoed, row cultivated, or band sprayed these plots received the same field operation and fertilizer was applied at the same rate as applied to the LTER main site treatment 1 plots.

Business as usual (normal) weed control – Fertilizer (BAU – Fert): if the main plot was rotary hoed, row cultivated, or band sprayed these plots received the same field operation and no fertilizer was applied.

Weed Free (complete) weed control + Fertilizer (WF + Fert): no weeds were allowed to become established and fertilizer was applied at the same rate as applied to the LTER main site treatment 1 plots.

Weed Free (complete) weed control – Fertilizer (WF – Fert): no weeds were allowed to become established and no fertilizer was applied.

No Weed Control + Fertilizer (NWC + Fert): plots were allowed to grow without any form of weed control and fertilizer was applied at the same rate as applied to the LTER main site treatment 1 plots.

No Weed Control – Fertilizer (NWC – Fert): plots were allowed to grow without any form of weed control and no fertilizer was applied.

2015 Treatment 4 randomization of micro-plots

Rep 1	NWC + Fert	BAU - Fert	WF + Fert	BAU + Fert	WF - Fert	NWC - Fert	N ↑
Rep 2	WF + Fert	WF - Fert	NWC - Fert	BAU + Fert	BAU - Fert	NWC + Fert	
Rep 3	NWC - Fert	BAU + Fert	BAU - Fert	WF + Fert	NWC + Fert	WF - Fert	
Rep 4	BAU + Fert	BAU - Fert	WF + Fert	WF - Fert	NWC - Fert	NWC + Fert	
Rep 5	NWC - Fert	BAU + Fert	WF - Fert	WF + Fert	BAU - Fert	NWC + Fert	
Rep 6	WF - Fert	BAU + Fert	NWC + Fert	WF + Fert	NWC - Fert	BAU - Fert	

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.



## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Main Site Treatment 5: Perennial Biomass Poplar Trees Management Summary Sheet

**Growing Season: 2015 Poplar trees planted in May 2009.**

Rotation: Continuous Poplar Trees – Rotation 1 – planted 1988, harvested 1999 and 2008; Rotation 2 – planted May 2009

Tillage: None

Variety: Poplar clones: Rotation 1 – DN-34 C.V. Eugenei (*P. nigra* x *P. deltoids*); Rot. 2 – NM-6 *Populus nigra* x *Populus maximowiczii*

A good source for information or questions on the poplar trees is Ray Miller from the MSU Forest Biomass Innovation Center (906) 786-1575, [rmiller@msu.edu](mailto:rmiller@msu.edu), [www.maes.msu.edu/fbic/](http://www.maes.msu.edu/fbic/)

**Operations Applied Last Year:**

Fertilizer: Broadcast ammonium nitrate Ammonium Sulfate (21-0-0-24) N4 (50 lbs N/A) – N5 (100 lbs N/A)

**Operations and Fertilizer Applied This Year:**

Tillage: None

Fertilizer: Ammonium Sulfate (21-0-0-24) N will be applied to the N4 and N5 micro-plot areas of T5 (Please see next page for micro-plot area in T5 plots).

**Weed/Insect Control:**

Preemergence: None

**Soil Sample Analysis:** Results are from samples taken in the autumn of 2013.

pH: <u>R1 5.9, R2 5.9, R3 6.0, R4 6.1, R5 5.8, R6 5.7</u>	Magnesium (Mg): ppm <u>R1 170, R2 184, R3 170, R4 203, R5 182, R6 142</u>
Lime Index: <u>R1 68, R2 67, R3 68, R4 69, R5 68, R6 67</u>	Calcium (Ca): ppm <u>R1 895, R2 947, R3 849, R4 1118, R5 881, R6 955</u>
Nitrogen (N): _____	C.E.C.: (meq/100 g) <u>R1 8.6, R2 10.2, R3 8.4, R4 9.0, R5 8.7, R6 9.8</u>
Phosphorus (P): ppm <u>R1 42, R2 33, R3 57, R4 51, R5 34, R6 52</u>	% O.M.: _____
Potassium (K): ppm <u>R1 136, R2 125, R3 147, R4 197, R5 134, R6 103</u>	Others: _____

**Fertility -- Fertilizer Recommendation:** (soil analysis lab) Recommendations based on *Trees, deciduous – nursery*.

Lime ton/A: <b>Avg. = 1.2: R1 1.3, R2 2.2, R3 0, R4 0, R5 1.3, R6 2.2</b>	K <sub>2</sub> O lb/A: <b>Avg. = 157.5: R1 165, R2 185, R3 145, R4 55, R5 170, R6 225</b>
Nitrogen lb/A*: <b>Avg. = 240: R1 240, R2 240, R3 240, R4 240, R5 240, R6 240</b>	Other: _____
P <sub>2</sub> O <sub>5</sub> lb/A: <b>Avg. = 0: R1 0, R2 0, R3 0, R4 0, R5 0, R6 0</b>	

\*NOTE Maximum suggested single nitrogen application is 50 lbs per acre. Fertilizer application in August is not recommended

**Differences from Prior Rotations:** \_\_\_\_\_

**Comments:** \_\_\_\_\_

We will talk about adding fertilizer after the next tree harvest.

Dr. Donald Dickmann, from the MSU Forestry Department, was involved with the first planting of the poplar trees in 1988 so he understands the LTER and more specifically the treatment 5 protocol. Dr Dickmann's contact info: (517) 353-5199, [dickman1@msu.edu](mailto:dickman1@msu.edu), Dr Dickmann is retired but still checks e-mail and phone messages.

A good source for information or questions on the poplar trees is Ray Miller from the MSU Forest Biomass Innovation Center (906) 786-1575, [rmiller@msu.edu](mailto:rmiller@msu.edu), [www.maes.msu.edu/fbic/](http://www.maes.msu.edu/fbic/)

Sources for replanting sticks: **1.** Randy or Paul from the MSU Forestry Department on campus. (517) 353-2036.or **2. Hramor Nursery** 2267 Merkey Rd. Manistee, MI (231) 723-4846

First nitrogen applications in the micro-plots were applied in 2011.

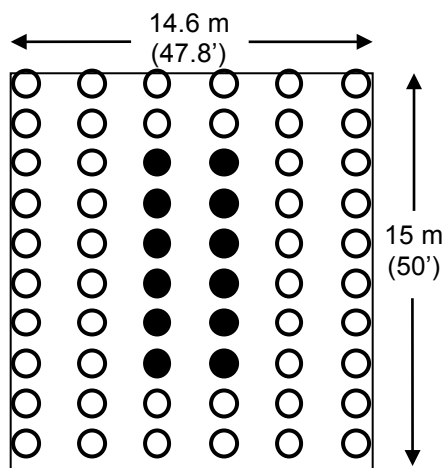
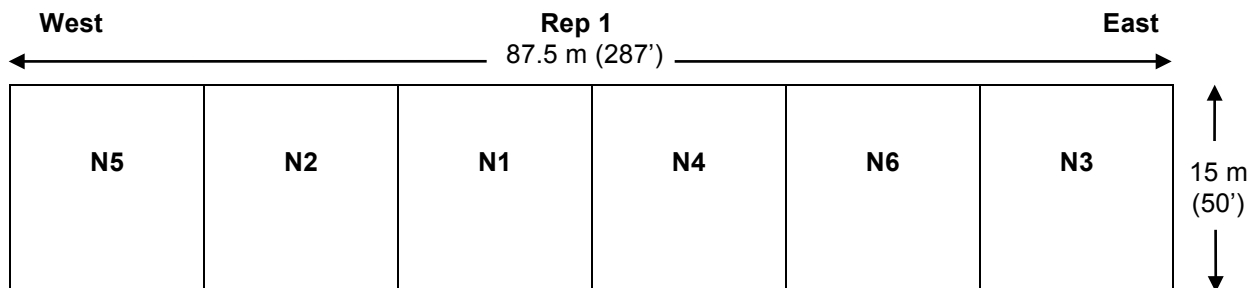
This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Microplots in Treatment 5 (T5)

The microplot region of all T5 replicate plots will be subdivided into six different 14.6 m x 15 m microplots (see diagram below). Microplots will be marked with permanent corner posts. Fertilizer will be applied to microplots in each T5 replicate as follows: (N1) 0 lb N/acre; (N2) 50 lb N/acre, single application in 2011; (N3) 100 lb N/acre, single application in 2011; (N4) 50 lb N/acre, annual application; (N5) 100 lb N/acre, annual application and (N6) 100 lb N/acre, single application in the year prior to harvest (expected to be applied in 2015). Fertilizer treatments will be randomly assigned to individual microplots within each T5 replicate (see table below). Microplots will receive a broadcast application of granular ammonium nitrate CAN 27 (27-0-0)  $\text{CaNH}_4\text{NO}_3$  in late May to end of June 2015. First nitrogen applications in the micro-plots were applied in 2011. Planting and harvesting dates for the Ccontinuous Poplar Trees: – Rotation 1 – planted 1988, harvested 1999 and 2008; Rotation 2 – planted May 2009

Individual measurement trees (see below diagram) will be marked with numbered aluminum identification tags. Prior to fertilizer application, individual measurement trees within each microplot (12) will be measured for basal diameter at 15 cm above the soil surface. Basal diameter measurements will be repeated at the end of each subsequent growing season in December. Leaf litter will be collected in 0.8 x 1.2 wooden litter trap frames. Two traps will be placed in the alleyway between the two rows of measurement tree in each microplot in late August. Leaves within the traps will be collected weekly throughout the season, dried, weighed, ground and archived for tissue analysis. Foliage will also be sampled during the peak of the growing season (~ mid-July) each year to measure nutrient concentrations. Three recently mature leaves will be collected from branches in the current height-growth increment of three randomly selected measurement trees in each microplot. The composite sample of nine leaves per microplot will be analyzed for nutrient concentrations. Control (0 lb N/acre) microplots will be available for baseline measurements.



- Buffer tree
- Measurement tree

**Microplot treatment assignments:**

	West					East
<b>Rep 1</b>	N5	N2	N1	N4	N6	N3
<b>Rep 2</b>	N2	N3	N4	N1	N5	N6
<b>Rep 3</b>	N6	N1	N2	N5	N4	N3
<b>Rep 4</b>	N6	N4	N2	N1	N5	N3
<b>Rep 5</b>	N4	N1	N6	N3	N5	N2
<b>Rep 6</b>	N1	N5	N4	N6	N3	N2

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

# 2015 LTER Agronomic Protocol Kellogg Biological Station

## Main Site Treatment 6: Management Summary Sheet

### Growing Season: 2015

Rotation: Alfalfa Tillage: No-Till

Tillable Acres: 13.5 Current Crop: Alfalfa Previous Crop: Alfalfa (2011) Yield Goal: 5 tons/A

Planting Date: June 2009 Planting Population: 2,000,000 seeds/A Variety: WL 347 LH

Row Spacing: 7.5 inches Planting Depth: 0.5 inch Insecticide Used: \_\_\_\_\_

Harvest Date: Three cuttings

#### Tillage Operations Applied Last Year: None

Plots were harvested three times in 2014.

Fertilizer: Applied 220 lbs/A of (0-46-0) in August 2014 which provided 101.2 lbs/A of P<sub>2</sub>O<sub>5</sub>/A.

Applied 500 lbs/A of 0-0-60 in split applications in April 2014 which provided 300 lbs K<sub>2</sub>O/A to the plots.

Applied 512 lbs/A of 0-0-60 in split application in August 2014 which provided 307.2 lbs K<sub>2</sub>O/A to the plots.

Applied 15 lbs/A Boron Sulfate in August 2014 which provided 2.1 lbs/A B to the plots.

#### Tillage Operations and Fertilizer Applied This Year:

Cut alfalfa three times in 2015.

Tillage: None, No-Till. T6 plots have not been tilled since the establishment of the LTER. When reseeding alfalfa or cover crops **do not** till treatment 6.

Fertilizer: **Do not add any nitrogen to treatment 6.** Phosphorus must be applied without nitrogen, e.g. superphosphate, which may need to be specially ordered from the fertilizer dealer. Most fertilizer dealers will only have 11-52-0 or 18-46-0.

#### Apply phosphorus and potassium based on MSU soil test recommendations:

Broadcast P<sub>2</sub>O<sub>5</sub> in the form of superphosphate (0-46-0) at 200 lbs/A (92 lbs P<sub>2</sub>O<sub>5</sub>/A).

Broadcast K<sub>2</sub>O in the form of potash (0-0-60) at 500 lbs/A (300 lbs of K<sub>2</sub>O/A).

Boron 3 lbs/A

#### Weed/Insect Control:

Postemergence: Spring/Summer 2015 scout for weeds and make a herbicide applications if necessary.

#### Soil Sample Analysis: Results from samples taken in the autumn of 2013.

pH:	<u>R1 6.2, R2 6.4, R3 6.3, R4 6.5, R5 6.3, R6 6.5</u>	Magnesium (Mg): ppm	<u>R1 215, R2 242, R3 242, R4 232, R5 211, R6 197</u>
Lime Index:	<u>R1 69, R2 70, R3 68, R4 70, R5 69, R6 71</u>	Calcium (Ca): ppm	<u>R1 937, R2 883, R3 986, R4 852, R5 788, R6 692</u>
Nitrogen (N):	<u>Do not add any nitrogen to treatment 6.</u>	C.E.C.: (meq/100 g)	<u>R1 7.9, R2 6.7, R3 9.6, R4 6.4, R5 7.1, R6 5.3</u>
Phosphorus (P): ppm	<u>R1 29, R2 20, R3 39, R4 22, R5 22, R6 33</u>	% O.M.:	_____
Potassium (K): ppm	<u>R1 91, R2 95, R3 112, R4 95, R5 76, R6 74</u>	Others:	_____

#### Fertility -- Fertilizer Recommendation:

Lime ton/A:	<u>Avg. = 1.3: R1 2.2, R2 1.1, R3 1.1, R4 1.1, R5 1.1, R6 1.1</u>	K <sub>2</sub> O lb/A:	<u>Avg. = 241.7: R1 255, R2 235, R3 185, R4 230, R5 275, R6 270</u>
Nitrogen lb/A:	<u>Avg. = 0: R1 0, R2 0, R3 0, R4 0, R5 0, R6 0</u>	Other:	<u>Boron at 2 lbs/A for all replications</u>
P <sub>2</sub> O <sub>5</sub> lb/A:	<u>Avg. = 75: R1 65, R2 90, R3 65, R4 85, R5 80, R6 65</u>		

Differences from Prior Rotations: These plots are normally planted to alfalfa however we decided to plant winter wheat in 2008 before replanting to alfalfa in late summer of 2009.

#### Comments:

Normal management when plots are planted to alfalfa:

Cuttings per year: 3

Tillage: None, No-Till. T6 plots have not been tilled since the establishment of the LTER. When reseeding alfalfa or cover crops **do not** till treatment 6.

Fertilizer: **Do not add any nitrogen to treatment 6.** Phosphorus must be applied without nitrogen, e.g. superphosphate, which may need to be specially ordered from the fertilizer dealer. Most fertilizer dealers will only have 11-52-0 or 18-46-0.

Apply phosphorus and potassium based on MSU soil test recommendations:

\*When pH is over 6.8 no lime index is given.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

Main Site Treatment 7: Native Succession

**Growing Season: 2015**

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- A. Burn all plots in the early spring.
- B. Chisel plow and soil finish the micro-plot area each spring. Try to time the tillage in the micro-plot area with the tillage of treatment 1 tillage. Try to have the micro-plot area of treatment 7 tilled within the same week that tillage in treatment 1 is completed.  
In a winter wheat years till the plots in late April or early May.  
The micro-plot area in treatment 7 is an annually disturbed (20 meters X 20 meters) area on the north end of each replication.  
Notify Carol Baker when tillage operations have been completed.
- C. No mowing or tillage within any treatment 7 plot at any time, except for the micro-plot area.

## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Main Site Treatment 8: Mid-succession Never Tilled (T8)

#### Growing Season: 2015

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- A. Annually mow entire plots in the fall.
  
- B. Make sure sample stations are removed prior to mowing. Re-flag the sampling stations after mowing is completed.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

**2015 LTER Agronomic Protocol Kellogg Biological Station**

**Main Site Treatment 8nt: No-till Agriculture on Historically Never Tilled Land (T8nt)**

**Growing Season: 2015**

Rotation: Soybeans – Winter Wheat — Corn Tillage: Conventional  
Tillable Acres: 0.77 Current Crop: Soybean Previous Crop: Corn Yield Goal: 40 bu/A  
Planting Date: May 2015 Planting Population: 180,000 seeds/A Variety: Pioneer P22T69R  
Row Spacing: 15 inches Planting Depth: 1 inches Insecticide Used: None  
Cover Crop: None  
Harvest Date: September – October 2015

**Tillage Operations Applied Last Year:**

No-till. Corn was harvested in November 2014. Corn stubble was fall mowed.

**Tillage Operations and Fertilizer Applied This Year:**

Tillage: No-till. DO NOT TILL.

Cover Crop: 2014 None

Fertilizer: Fertilizer the same as T2.

**Weed/Insect Control:**

**Soil Sample Analysis: Results from samples taken in the autumn of 2008.**

pH:	<u>R1 5.8, R2 5.7, R3 5.9, R4 5.9, R5 5.7, R6 6.0</u>	Magnesium (Mg): ppm	<u>R1 131, R2 139, R3 167, R4 157, R5 161, R6 142</u>
Lime Index:	<u>R1 68, R2 67, R3 67, R4 68, R5 67, R6 69</u>	Calcium (Ca): ppm	<u>R1 914, R2 770, R3 870, R4 863, R5 783, R6 725</u>
Nitrogen (N):	<u></u>	C.E.C.: (meq/100 g)	<u>R1 8.3, R2 8.8, R3 9.6, R4 8.3, R5 9.1, R6 6.1</u>
Phosphorus (P): ppm	<u>R1 25, R2 34, R3 28, R4 35, R5 18, R6 43</u>	% O.M.:	<u></u>
Potassium (K): ppm	<u>R1 100, R2 86, R3 95, R4 105, R5 89, R6 45</u>	Others:	<u></u>

**Fertility -- Fertilizer Recommendation:**

Lime ton/A:	<u>Avg. = : R1 , R2 , R3 , R4 , R5 , R6</u>	K <sub>2</sub> O lb/A:	<u>Avg. = : R1 , R2 , R3 , R4 , R5 , R6</u>
Nitrogen lb/A:	<u>Avg. = : R1 , R2 , R3 , R4 , R5 , R6</u>	Other:	<u></u>
P <sub>2</sub> O <sub>5</sub> lb/A:	<u>Avg. = : R1 , R2 , R3 , R4 , R5 , R6</u>		

**Differences from Prior Rotations:**

In both 2010 and 2011, the main crop was corn. The rotation did not follow the main site in 2010 and 2011 but was adjusted to follow the crop that was in the interaction plots.

**Comments:**

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

2015 Protocol for Biodiversity Study  
 LTER at Kellogg Biological Station, Michigan State University

System	Treatment	----- Plot Numbers -----				----- Crop Rotation -----
		Rep 1	Rep 2	Rep 3	Rep 4	
A	B1	106	201	303	401	Fall Fallow
A	B2	102	206	316	402	Spring Fallow
B	B3	111	203	306	403	Corn <small>covers A &amp; C</small> – Soybeans <small>cover B</small> – Wheat <small>covers A &amp; C</small>
B	B4	104	220	307	404	Soybeans <small>cover B</small> – Wheat <small>covers A &amp; C</small> – Corn <small>covers* A &amp; C</small>
B	B5	114	217	312	405	Wheat <small>covers A &amp; C</small> – Corn <small>covers A &amp; C</small> – Soybeans <small>cover B</small>
C	B6	107	207	317	406	Corn <small>cover A</small> – Soybeans – Wheat <small>cover A</small>
C	B7	105	219	305	407	Soybeans – Wheat <small>cover A</small> – Corn <small>cover A</small>
C	B8	118	214	310	408	Wheat <small>cover A</small> – Corn <small>cover A</small> – Soybeans
D	B9	119	205	314	409	Corn – Soybeans – Wheat
D	B10	117	209	320	410	Soybeans – Wheat – Corn
D	B11	110	216	309	411	Wheat – Corn – Soybeans
E	B12	109	202	313	412	Soybeans – Corn
E	B13	113	212	319	413	Corn – Soybeans
E	B14	115	204	304	414	Soybeans – Wheat
F	B15	112	213	301	415	Corn <small>cover A</small> – Corn <small>cover A</small> – Corn <small>cover A</small>
F	B16	101	210	308	416	Soybeans <small>cover C</small> – Soybeans <small>cover C</small> – Soybeans <small>cover C</small>
F	B17	116	211	302	417	Wheat <small>cover A</small> – Wheat <small>cover A</small> – Wheat <small>cover A</small>
G	B18	108	208	311	418	Corn – Corn – Corn
G	B19	103	218	315	419	Soybeans – Soybeans – Soybeans
G	B20	120	215	318	420	Wheat – Wheat – Wheat
H	B21	100	200	300	421	Continuous Fallow

\*Cover A: Red Clover  
 Cover B: Crimson Clover  
 Cover C: Cereal Rye

System	----- Descriptions -----
A	Fallow system: No crop is planted. Plots are tilled once a year.
B	One annual crop with two cover crops. Three year crop rotation.
C	One annual crop with one cover crop. Three year crop rotation.
D	One annual crop with no cover crop. Three year crop rotation.
E	One annual crop with no cover crop. Two year crop rotation.
F	One annual crop with one cover crop. Monoculture cropping system (no crop rotation).
G	One annual crop with no cover crop. Monoculture cropping system (no crop rotation).
H	Continuous fallow system: No cover, no crop growth. Plots are tilled as needed (2 - 6 times) a year to prevent plant growth from becoming established.

Research Objective: Incorporating biological diversity into weed management. Determine the impact of crop rotation and cover crops on weed communities in row crops.

Notes: **All plots will be managed like the LTER main site treatment 4 plots.**

No herbicides and no synthetic nitrogen will be used on any treatment.

This study was established in 2000. In 2000 and 2001 some treatments received fertilizer and herbicides.

Beginning in 2002 all treatments and plots have been treated like the LTER main site treatment 4, no herbicides and no synthetic fertilizer.

Plot size = 30' x 90' (9 meters x 27meters).

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

**System A:** Treatments B1 and B2. Fallow system. No crop is planted. Plots are tilled once a year.

**Treatment B1** Fall Fallow: No crop is planted. Plots are chisel plowed and soil finished once a year.

**Treatment B2** Spring Fallow: No crop is planted. Plots are chisel plowed and soil finished once a year.

**System B:** Treatments B3, B4, and B5. These plots will have one annual crop with two cover crops, three year crop rotation.

**Treatment B3: Rotation Sequence** Wheat - Corn - Soybeans Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting corn in late April or early May, when corn is knee high plant red clover. After the corn is harvested no-till c. rye into the clover. Chisel plow c. rye and clover the following spring and plant soybeans, when soybeans are knee high plant crimson clover. Harvest soybeans in September or October. After soybean harvest chisel plow and soil finish before planting winter wheat. In February or March frost seed red clover. Harvest wheat in July; allow red clover to grow until September or October. In September or October mow the clover and plant c. rye. The following spring chisel plow and soil finish before planting corn.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

**Treatment B4: Rotation Sequence** Corn - Soybeans - Wheat Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** This follows the same description as listed in treatment B3. The idea of treatments B3, B4, and B5 is that each crop rotation is planted ever year. (i.e. If B3 is in corn B4 will have soybeans and B5 will have winter wheat. If B3 has soybeans B4 will have winter wheat and B5 will have corn. If B3 has winter wheat B4 will have corn and B5 will have soybeans.)

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

**Treatment B5: Rotation Sequence** Soybean - Wheat - Corn Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** This follows the same description as listed in treatment B3. The idea of treatments B3, B4, and B5 is that each crop rotation is planted ever year. (i.e. If B3 is in corn B4 will have soybeans and B5 will have winter wheat. If B3 has soybeans B4 will have winter wheat and B5 will have corn. If B3 has winter wheat B4 will have corn and B5 will have soybeans.)

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.



**System C:** Treatments B6, B7, and B8. These plots will have one annual crop with one cover crop, three year crop rotation.

**Treatment B6: Rotation Sequence** Wheat - Corn - Soybean Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting corn in late April or early May, when corn is knee high plant red clover. Harvest corn in October or November. Chisel plow and soil finish the following spring and plant soybeans, when soybeans are knee high plant crimson clover. Harvest soybeans in September or October, after soybean harvest soil finish before planting winter wheat. In February or March frost seed red clover. Harvest wheat in July. Allow plots to remain idle until the following May when corn will be planted. Keep in eye on the weeds if the weeds grow taller than the red clover the weeds should be mowed to prevent the weeds from producing seeds.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

**Treatment B7: Rotation Sequence** Corn - Soybeans - Wheat Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** This follows the same description as listed in treatment B6. The idea of treatments B6, B7, and B8 is that each crop rotation is planted ever year. (i.e. If B6 is in corn B7 will have soybeans and B8 will have winter wheat. If B6 has soybeans B7 will have winter wheat and B8 will have corn. If B6 is winter wheat B7 will have corn and B8 will have soybeans.)

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

**Treatment B8: Rotation Sequence** Soybean - Wheat - Corn Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** This follows the same description as listed in treatment B6. The idea of treatments B6, B7, and B8 is that each crop rotation is planted ever year. (i.e. If B6 is in corn B7 will have soybeans and B8 will have winter wheat. If B6 has soybeans B7 will have winter wheat and B8 will have corn. If B6 is winter wheat B7 will have corn and B8 will have soybeans.)

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

**System D:** Treatments B9, B10, and B11. These plots will have one annual crop with no cover crop, three year crop rotation.

**Treatment B9: Rotation Sequence** Wheat - Corn - Soybean Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting corn in late April or early May. Harvest corn in October or November. The following May chisel plow, soil finish and plant soybeans. Harvest soybeans in September or October. After soybean harvest soil finish before planting winter wheat, harvest wheat in July. Allow plots to remain idle until the following May when corn will be planted. After wheat harvest plots can be mowed to prevent weeds from producing seeds.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

**Treatment B10: Rotation Sequence** Corn - Soybean - Wheat Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** This follows the same description as listed in treatment B9. The idea of treatments B9, B10, and B11 is that each crop rotation is planted ever year. (i.e. If B9 is in corn B10 will have soybeans and B11 will have winter wheat. If B9 has soybeans B10 will have winter wheat and B11 will have corn. If B9 has winter wheat B10 will have corn and B11 will have soybeans.)

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

**Treatment B11: Rotation Sequence** Soybean - Wheat - Corn Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** This follows the same description as listed in treatment B9. The idea of treatments B9, B10, and B11 is that each crop rotation is planted ever year. (i.e. If B9 is in corn B10 will have soybeans and B11 will have winter wheat. If B9 has soybeans B10 will have winter wheat and B11 will have corn. If B9 has winter wheat B10 will have corn and B11 will have soybeans.)

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

**System E:** Treatments B12, B13, and B14. One annual crop with no cover crop. Two year crop rotation.

**Treatment B12: Rotation Sequence** Soybean - Corn Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting corn in late April or early May, harvest corn in October or November. The following May chisel plow, soil finish and plant soybeans. Harvest soybeans in September or October. Till and plant corn the following May.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

**Treatment B13: Rotation Sequence** Corn - Soybean Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** This follows the same description as listed in treatment B12. If B12 is in corn B13 will have soybeans. If B12 has soybeans B13 will have corn.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

**Treatment B14: Rotation Sequence** Soybean - Wheat Rotation.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting soybeans in May, harvest soybeans in September or October. After soybean harvest soil finish and plant winter wheat. Harvest wheat the following July, allow plot to remain idle until the following May when soybeans will be planted. The weeds in the wheat stubble should be mowed to prevent the weeds from producing weed seeds.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

**System F:** Treatments B15, B16, and B17. One annual crop with one cover crop. Monoculture cropping system (no crop rotation).

**Treatment B15:** Continuous corn.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting corn in late April or early May, when corn is knee high plant red clover. Harvest corn in October or November. Let plot remain ideal until the following spring. Chisel plow, soil finish and plant corn the following spring.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

**Treatment B16:** Continuous soybeans.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Plant soybeans in May. Harvest soybeans in September or October. After harvesting soybeans plant c. rye. Let plots remain ideal until the following spring, chisel plow, soil finish and plant soybeans.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

**Treatment B17:** Continuous winter wheat.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Plant winter wheat in late September or early October. In February or March frost seed red clover. Harvest wheat in July, allow red clover to grow until September. Chisel plow and soil finish before planting wheat in September or October.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.

No herbicides will be used to control weeds.

No insecticides will be applied to control insects.

This is a working protocol used for planning purposes. Due to potential changes in chemicals, fertilizer, varieties planted, planting dates etc... please refer to the agronomic field log for actual field operations that take place during 2015.

**System G:** Treatments B18, B19, and B20. One annual crop with no cover crop. Monoculture cropping system (no crop rotation).

**Treatment B18:** Continuous corn.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting corn in late April or early May, harvest corn in October or November. Let plots remain ideal until the following spring, chisel plow and soil finish and plant corn again.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

**Treatment B19:** Continuous soybeans.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Chisel plow and soil finish before planting soybeans in May, harvest soybeans in September or October. Let plots remain ideal until the following spring, chisel plow and soil finish before planting soybeans again.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

**Treatment B20:** Continuous winter wheat.

**Tillage:** Conventional, chisel plow and soil finish.

**Planting Time:** Late September or early October. Harvest wheat in July. Let plots remain ideal until the following spring. Mow the wheat stubble to prevent the weeds from producing weed seeds.

**Fertilization:** None

**Weed/Insect Control:** Cultivate/Rotary hoe as needed to control weeds.  
No herbicides will be used to control weeds.  
No insecticides will be applied to control insects.

**System H:** Continuous fallow system: No crop growth, no cover growth and no weed growth.

**Treatment B21** Continuous fallow:

No crop is planted. Plots are tilled as needed (2-6 times a year) to prevent plant growth from becoming established.

Tillage can be soil finishing, rototilling or any tillage that keeps plant growth from becoming established.

Plots can be chisel plowed and soil finished if more aggressive tillage is needed.

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## Nitrogen Rate Study

### 2015 LTER Agronomic Protocol Kellogg Biological Station

**Growing Season: 2015 Treatments: 9 Replication: 4**

Rotation: Soybeans – Winter Wheat – Corn Tillage: No-Till

Tillable Acres: 3 Current Crop: Soybeans Previous Crop: Corn Yield Goal: 45-65 bu/A

Planting Date: May 2015 Planting Population: 180,000 seeds/A Variety: Pioneer P22T69R

Row Spacing: 15 inches Planting Depth: 1 inches Insecticide Used: None

Harvest Date: September – October 2015

**Tillage Operations Applied Last Year:**

Corn was harvested in November 2014. Corn stubble was fail mowed.

**Tillage Operations and Fertilizer Applied This Year:**

Tillage: None (No-Till).

Soybean Fertilizer: **Dry-land (rain fed):**

Spring 2015 Broadcast K<sub>2</sub>O/A in the form of Potash (0-0-60) at 200 lbs/A (120 lbs of K<sub>2</sub>O/A).

Spring 2015 Broadcast P<sub>2</sub>O<sub>5</sub> in the form of superphosphate (0-20-0) at 150 lbs/A (30 lbs P<sub>2</sub>O<sub>5</sub>/A).

Spring 2015 Nitrogen and Lime applications **To Be Determined.**

**Irrigated plots:**

Spring 2015 Broadcast K<sub>2</sub>O/A in the form of Potash (0-0-60) at 250 lbs/A (150 lbs of K<sub>2</sub>O/A).

Spring 2015 Broadcast P<sub>2</sub>O<sub>5</sub> in the form of superphosphate (0-20-0) at 250 lbs/A (50 lbs P<sub>2</sub>O<sub>5</sub>/A).

Winter Wheat Fertilizer: Fall 2015: Broadcast **To Be Determined.**

Cover Crop: None

**Weed/Insect Control:**

Burndown: Roundup PowerMax at 22 fl oz/Acre and 2,4-D ester at 1 pt/A. Application of 2,4-D must be 7 days before planting. If Roundup application is within 7 days of planting do not use 2,4-D in the tank mix.

Preemergence: 1.33 pts/A of Dual II Magnum (**crop rotation** is 4.5 months after application of Dual II Magnum before planting wheat)

Postemergence: Scout for weeds and make herbicide application of Roundup PowerMax at 22 fl oz/Acre and ammonium sulfate at 17 lbs/100 gals of water when weeds are 2-6 inches.

Insect control: Scout for aphids. If needed an insecticide application can be used to control aphids.

**Soil Sample Analysis (lb./acre): No resent soil analysis is available.**

pH: _____	Magnesium (Mg): _____
Lime Index: _____	Calcium (Ca): _____
Nitrogen (N): _____	C.E.C.: _____
Phosphorus (P): _____	% O.M.: _____
Potassium (K): _____	Others: _____

**Fertility -- Fertilizer Recommendation:**

Lime ton/A: _____	K <sub>2</sub> O lb/A: _____
Nitrogen lb/A: _____	Other: _____
P <sub>2</sub> O <sub>5</sub> lb/A: _____	

**Fertility -- Fertilizer Used:**

Analysis	lb/Acre Used

**Comments:** Normally nitrogen is not applied to soybeans we may apply some N to these plots. Lime will most likely be applied based on per individual plot recommendations.

**Treatments:** Nine nitrogen (28-0-0) rates (lbs. nitrogen/A as 28% UAN). (Wheat years): where: F1=Control, F2=20, F3=40, F4=60, F5=80, F6=100, F7=120, F8=140 and, F9=160.

**Randomization:** From West to East are: F1-F9. Replicate 1 F1-2-3-4-5-6-7-8-9 Replicate 2 F7-2-1-5-3-9-8-4-6  
Replicate 3 F9-3-8-2-4-5-7-6-1 Replicate 4 F5-6-4-1-8-2-3-7-9

In 2003 we established a second study that is the same size and same randomization. One study is rain fed (non-irrigated) and the second study is irrigated weekly during the growing season to exceed normal precipitation. The non-irrigated study has plot numbers that range from 101-409. The irrigated study has plot numbers that range from 501-809.

In 2006 it was decided to change the crop rotation from continuous corn to a corn-soybean-wheat rotation. The n-rate study will follow the same crop rotation as the main site LTER. Most of the management and field operation will follow the LTER main site treatment 2 i.e. we will use the same herbicide on the n-rate study as we use on the main site treatment 2.

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## 2015 LTER Agronomic Protocol Kellogg Biological Station

### Irrigation Scheduling for the Resource Gradient Experiment (N-rate Study)

Irrigation events in the Resource Gradient Experiment will be scheduled by employing a soil water budget that balances the amount of plant available water. In this budget, rainfall and irrigation amounts represent a credit to the soil, whereas evapotranspiration (ET) is recorded as a debit to the soil. Daily values of  $ET_{max}$  were generated by running a 100 year simulation with the SALUS model that incorporated site-specific historical weather data (1984-2010) and crop-specific data from T1 (Basso, unpublished data).

Starting on May 1, LTER staff will record rainfall and irrigation events and these values will be entered daily into the soybean-specific soil water budget spreadsheet. This spreadsheet is located in the shared folder "LTER Irrigation", which is located in the "data entry" folder on the lter ([\lterfiles](#)) server. Based on these inputs and modeled values of daily  $ET_{max}$ , the spreadsheet calculates a daily estimate of plant available water (mm). Negative values indicate that soil water is not available for plant uptake. When a negative value is observed for two consecutive days, an irrigation event will be scheduled for the next day unless there is a rainfall event that results in net plant available water. The amount of water to be applied during irrigation events will be determined by the value of the plant available water deficit on the day prior to the scheduled irrigation event. Communication of scheduled irrigation events to key investigators and LTER staff will occur via e-mail and will be coordinated by Joe Simmons. During the 2015 growing season, the following individuals will be included on these e-mails: Stacey Vanderwulp, Kevin Kahmark, Neville Millar, Iurii Shcherbak, Justin Kunkle, Bruno Basso and Phil Robertson.

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