2020 SOYBEAN MANAGEMENT FIELD DAYS

SOYBEAN MANAGEMENT FIELD DAYS addresses issues that are important to farmers, as well as challenges on the home front and internationally.
SOYBEAN MANAGEMENT FIELD DAYS highlights checkoff dollars at work in: Research, Marketing, Promotion, New Uses, and Education.

The 2020 field days moved online for the first time ever due to the COVID-19 pandemic. However, research is active at the Soybean Management Field Days locations. Our virtual presentations in conjunction with this booklet provide updates from the sites, as well as information to help growers stay current and competitive in the global marketplace and increase profits. 2020 sites include:

- ***JEROME FRITZ FARM AT HILDRETH, NE***
- ***KEVIN DINSLAGE FARM AT ELGIN, NE***
- ***BART & GEOFF SRUTH FARM AT SHELBY, NE***
- ***MIKE FUCHS FARM AT ARLINGTON, NE***

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University of Nebraska–Lincoln Institute of Agriculture and Natural Resources

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2020 SOYBEAN MANAGEMENT VIRTUAL FIELD DAYS

Scott Ritzman
Executive Director
Nebraska Soybean Board

Keith Glewen
Nebraska Extension Educator

Nebraska Soybean Grower,

On behalf of the Nebraska Soybean Board and Nebraska Extension welcome to the 22nd year of the Soybean Management Field Days program. As a result of the virus pandemic, all of us approach each day with a degree of uncertainty. However, our partnership to provide you the Nebraska soybean grower with unbiased, research-based information is still a priority we are committed too. This year's program represents a grass root approach to research and extension education.

Members of the Nebraska Soybean Board who are soybean growers like yourself have partnered with University research and extension professionals to identify questions and topics important to the profitability of your soybean enterprise. In an effort to discover answers to these questions, we have again implemented on-farm research studies with four soybean growers whose farms represents an important growing region of the state.

After you have viewed this virtual field day and if you have questions specific to certain presentations, we encourage you to share your question with the respective speaker. Their contact information is located on the back page. Following harvest, we will share the results through a statewide mailing and also online.

Again, thank you for investing your time in viewing this field day and providing the world with a sustainable source of protein and oil. Be safe and continue the good work that you do.

Keith
Keith Glewen
Nebraska Extension Educator

Scott
Scott Ritzman
Executive Director
Nebraska Soybean Board

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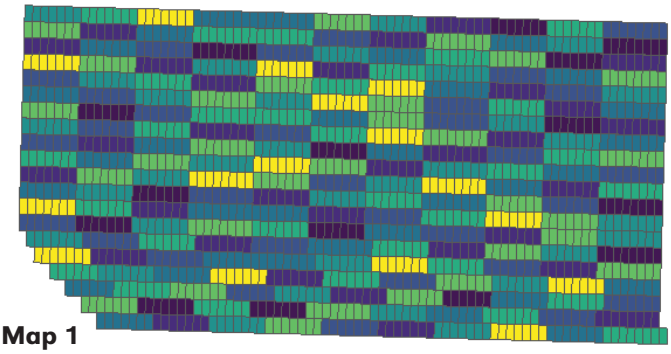
- The Ag Budget Calculator program is a new program to assist producers in creating enterprise budgets. Phase I of the program is ready to beta test with crop budgets. For more information and to participate, register at: farm.unl.edu/testabc

Taro Mieno
UNL Department of Ag Economics
Assistant Professor

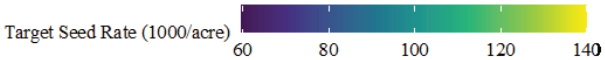
Glennis McClure
Nebraska Extension Educator /Farm and Ranch Management Analyst

On-Farm Trials to Find the Best Site-Specific Seed Rate: An Example

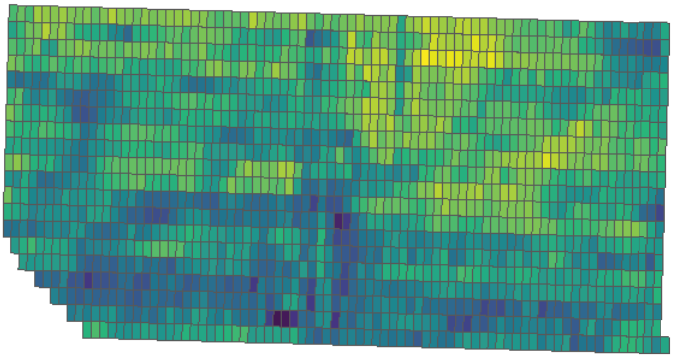
This section introduces an example of on-farm randomized field seed rate trial to find the economically optimal site-specific seed rates. Map 1 shows the trial design. The target seed rate ranges from 60,000 seeds per acre to 140,000 seeds per acre. As you can see, seed rates are randomized on the field.



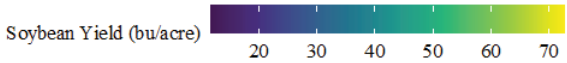
Map 1



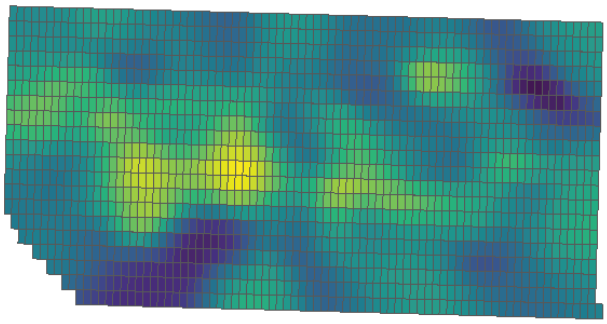
This experiment results in the following yield map (Map 2):



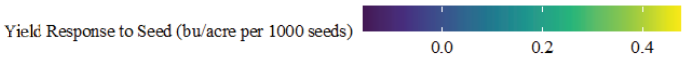
Map 2



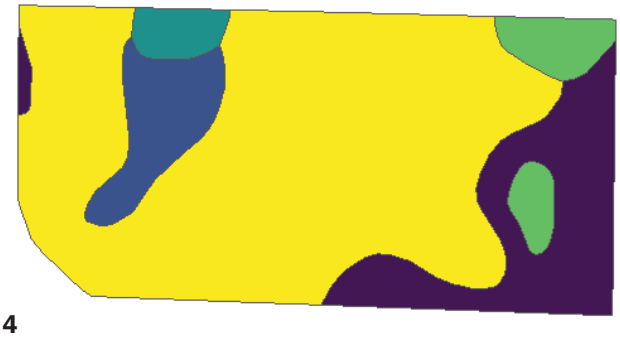
The upper parts of the field are more productive than the lower parts of the field. After statistical analysis of the data, we can find how responsive yield is to seed rate locally. Map 3 shows how yield responds to a change in seed rate.



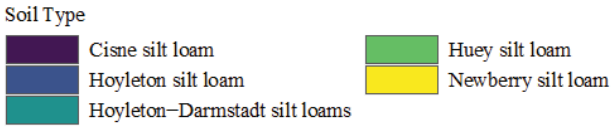
Map 3



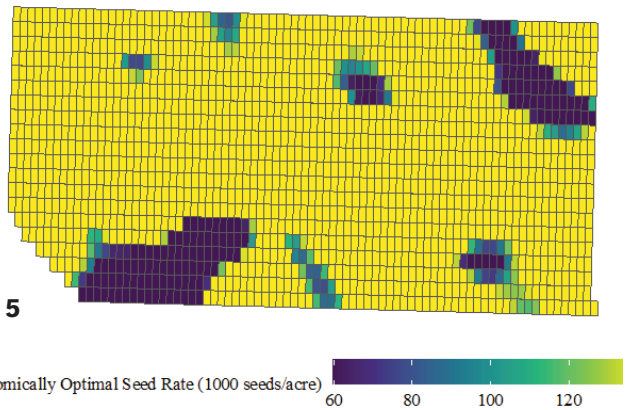
This shows that an increase in yield due to an increase in seed rate is particularly large in the middle parts of the field. For example, an increase of 10,000 seeds would increase yield by 4 bu/acre in the yellow parts of the field. The lower left and upper right corners of the field, however, are quite unresponsive to an increase in seed rate.



Map 4



The SSURGO soil map is presented on the previous page - Map 4. It does not seem like there is a clear connection between soil type and yield responsiveness to seed rate. It is a good idea to talk with specialists to further investigate the underlying reasons behind the differential yield responses across the field.



Map 5

Based on the estimation of how responsive yield is to seed rate, we can conduct economic analysis to find the economically optimal site-specific seed rates. Map 5 is generated assuming the soybean price of $9/bu and seed price of $0.35 per 1,000 seeds.

For most parts of the field, 140,000 seeds per acre is recommended except the lower left and upper right pockets where 60,000 seeds per acre is recommended. The grower would have chosen 120,000 seeds per acre if it were not for the experiment. The grower would make about $15/acre more if they would follow the site-specific optimal seed rates if they already have a variable rate application technology. If the grower to use commercial service to implement variable rate application, which could cost about $6 per acre, then the benefit of the variable rate application reduces to $9 per acre. The gain in profit is achieved through saving seed costs in the area where yield does not respond to an increase in seed rate (lower bottom and the upper right corner of the field) and planting more seeds in most parts of the field. Since the economically optimal rate was the highest rate of the experimental rates, the grower might want to run another year of experiment that tries higher rates.

In summary, this section illustrates how growers may be able to use on-farm field trials to know how different parts of a field responds to seed rate differently, and use the information to find economically optimal site-specific seed rates. Such an experiment may bring a sizable economic benefit.

Knowing Your Production Costs Using Enterprise Budgeting

Do you know which of your agricultural enterprises are most profitable? Can your crops be marketed above your breakeven cost? In the agricultural market environment, it is important to understand cost of production on a cash and economic basis. Preparing enterprise budgets can assist in making pricing decisions, tweaking production practices or inputs used, and to compare the profitability potential of various crop and livestock enterprises for a farm or ranch business operation. The focus of Nebraska Soybean Management Field Days is to consider various crop management practices leading to increased production and profit potential. We should ask ourselves, is a proposed change in production practices going to cost more than it is worth?

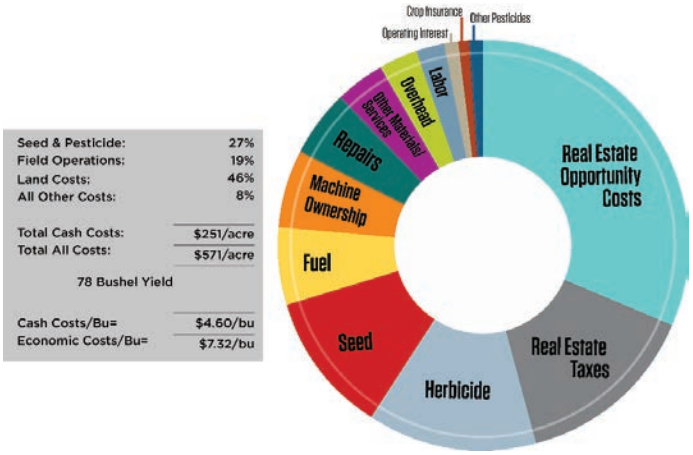
UNL Crop Budgets

Dating back to at least the 1970's, the University of Nebraska - Lincoln has been publishing annual crop budgets. The budgets are provided as guides with cost estimates included. For 2020, 82 crop budgets representing 15 crops in Nebraska are published online at cropwatch.unl.edu/budgets. The Nebraska crop budgets are created by a team of crop specialists and agricultural economists and are based on cropping practice norms throughout Nebraska. Revenue projections and profitability estimates are not included in the crop budgets.

For 2020, ten soybean budgets were prepared for Nebraska, including three dryland budgets at 45-bushel yield average, with cash costs estimated at $5.49 per bushel and economic costs per bushel at $8.04. The seven irrigated budgets include a 73-bushel yield average, with cash costs calculated to be $4.90 per bushel and total economic costs of $7.87 per bushel.

On page 4, the 2020 soybean budget #64 is provided. This cropping system most closely resembles the practices for this year's Soybean Management Day fields using center pivot irrigation, no-till, following corn production. Figure 1 shows the various cost categories of this 2020 soybean budget. Land costs total 46% of the total costs, with seed and pesticides totaling 27% and machinery costs at 19%. If the fields represented at this field-day closely represent your operation, this budget can be downloaded as an Excel file and modified to match your actual costs of production more closely. Or you can select other UNL crop budgets that more closely fit your production practices and modify those to determine your own cost of production.

Figure 1. 2020 Irrigated No Till Soybeans - UNL Budget #64 Cost of Production Estimate Per Acre



Modifications within a crop budget will change economic and cash costs per bushel. Table 1 provides an example of three budget changes to change the bottom-line cost of production per bushel. In column 1, soybean budget #64 is summarized. Column 2 shows a 10 bushel drop in yield. An increase in economic and cash costs per bushel are a result. In column 3, yield is adjusted back to 78 bushels with owned land costs replaced by $230 /acre cash rent. While total economic costs decrease in this scenario, cash costs per bushel increase since cash rent is a cash expense. In column 4, the change shown is an in increase in the fungicide application to 100% of the acres, including material cost and custom aerial spraying expense.

Table 1

2020 Soybean Budget #64	No Till, Pivot Irrigated, After Corn, 78 bu yield			
	1	2	3	4
Change Yield	78 bu yield	68 bu yield	78 bu yield	78 bu yield
Economic Cost Per Bushel	$ 7.32	$ 9.09		
Cash Cost Per Bushel	$ 4.60	$ 5.23		
Change Land Costs	$260/acre		$230/acre	
Economic Cost Per Bushel	$ 7.32		$ 7.02	
Cash Cost Per Bushel	$ 4.60		$ 6.59	
Change Fungicide Application %	20%			100%
Fungicide + Aerial Spraying	$5.63/ac			$28.13/ac
Economic Cost Per Bushel	$ 7.32			$ 7.62
Cash Cost Per Bushel	$ 4.60			$ 4.89

The Ag Budget Calculator Program

While the Excel files used to create the crop budgets are designed to allow farm managers to modify UNL budgets to resemble their own operations, it's long been a goal to develop a crop budget program that allows for more customization by its users. And we are doing just that with the development of the Ag Budget Calculator (ABC) program from UNL's Department of Agricultural Economics. Thanks again to the Nebraska Soybean Board for providing initial funding to develop this new program.

The ABC program is designed to lead producers through a series of data entry steps to reach an estimate of their various enterprises' cost of production both on a cash and economic basis. Both operating costs and ownership costs along with revenue projections, will be entered into the program. The key information segments built into the program include:

1) Crop identification and enterprise name, the corresponding year, anticipated yield, cropping system (irrigated or dryland), and land ownership or land lease information
2) Annual rates and prices, such as fuel costs anticipated for the year and interest rates
3) Field operations, including labor and specific cost information of machinery and implements used in those operations
4) Material and service costs associated with the field operation performed, for example, seed input cost information will be entered along with the planting operation
5) Irrigation system information and costs
6) Revenue projections per enterprise
7) General farm overhead expenses

The ABC program development has focused initially on cost of production information for crop enterprises. Plans are to include livestock enterprise entries. Later in the ABC program development we will include a whole farm cash flow feature where producers can identify when they anticipate paying for cash expenses and receiving revenue and enter additional financial information such as loan payments. In the end, users will be able to utilize the ABC program to enter all their enterprise expenses and revenue projections to create a whole farm cash flow and projected income statement.

As with any new program, there will be a learning curve. We are working diligently to make the users experience with the program a friendly one. Once producers have created an ABC program account used only by them, and after entering data for one or more enterprises for a given year, this information will be available and can be duplicated and modified to create additional enterprises for that same production year and subsequent years.

To create realistic enterprise budgets for a farm operation, keeping good records is critical. The new ABC program will require accurate information from current on farm records to be entered. There are key management decisions that can be derived from cash and economic cost of production information and field or farm data tracking, both in the short term, on an annual basis and over the long term.

Take Home Messages

Profitable soybean production depends on sound production practices, marketing, and risk management decisions.

- On-farm randomized experiments of seed rates can help growers better understand how yield responds to seed rate find site-specific economically optimal seed rates.
- Economic benefits of such experiments may be large.
- Focusing on production cost control and using budgets to accurately record and monitor costs is a critical part of effective management.
- The Ag Budget Calculator program will be a new resource available from the University of Nebraska – Lincoln soon, to help guide producers to a more customized set of enterprise budgets for their operation.

2020 Budget 64-Soybeans, LibertyLink® Treated, No Till Drilled 7.5-inch Rows, after Corn, 78 bushel Yield
Pivot Irrigated Diesel, 800 GPM 35 PSI, 6 acre/inches

	Field Operations	Times or Qty	Unit	Labor @ $25.00 /Hr	Fuel @ $2.27 and Lube	Repairs Power	Repairs Imp.	Ownership^ Power	Ownership^ Imp.	Total	Your Estimate
1	Spray Spring Burndown Herbicide	1		0.95	0.21	0.29	0.60	0.90	1.08	4.03	
2	No-Till Drill	1		2.29	1.32	0.79	1.57	2.47	3.21	11.65	
3	Spray Herbicide	1		0.95	0.21	0.29	0.60	0.90	1.08	4.03	
4	Aerial Spray	Custom									
5	Aerial Spray	Custom									
6	Pivot D 125' Lift	6	ai	5.21	29.06	2.06	10.38	3.91	5.70	56.32	
7	Combine Irr SB	1		4.58	4.57	10.09	1.85	10.78	3.67	35.54	
8	Truck	Custom									
	Total for Field Operations			13.98	35.37	13.52	15.00	18.96	14.74	111.57	

Materials & Services		Operation Index	Percent Acres Applied	Application Rate Unit	Applied Price	Total	Your Estimate
Glyphosate 5# w/Surfactant	Herbicide	1	100%	32 ounce	0.12	3.75	
2,4-D Ester LV4	Herbicide	1	100%	1 pint	2.00	2.00	
21-0-0-24S	Additive	1	100%	1.7 pound	0.35	0.60	
Zidua Pro	Herbicide	1	100%	5.25 ounce	3.91	20.51	
Soybeans - LiberyLink Treated	Seed	2	100%	1 k seed	62.00	62.00	
Liberty	Herbicide	3	100%	36 ounce	0.63	22.50	
AMS	Additive	3	100%	48 ounce	0.02	1.05	
Select Max	Herbicide	3	75%	6 ounce	0.90	4.04	
Outlook	Herbicide	3	100%	14 ounce	1.25	17.50	
* Approved adjuvant	Additive	3	100%	1 acre	3.00	3.00	
* Aerial Spray	Custom	4	20%	1 acre	10.00	2.00	
Warrior II/Zeon	Insecticide	4	20%	1.6 ounce	2.97	0.95	
Aerial Spray	Custom	5	20%	1 acre	10.00	2.00	
Stratego YLD	Fungicide	5	20%	4 ounce	4.53	3.63	
Haul Grain Bushels	Custom	8	100%	78 bushel	0.11	8.58	
Scouting Irrigated Soybeans	Scouting		100%	1 acre	12.00	12.00	
	Crop Insurance				7.00	7.00	
Total Materials & Services						173.11	

*Insecticide for Aphids and Caterpillars

Total listed costs for Field Operations and Materials and Services						284.68	
Interest on Operations Capital	$ 250.98	cash expense @		5.50%	for 6.0 mo.	6.90	
Total Operating and Use Related Ownership Costs						291.58	
Overhead (accounting, liability insurance, vehicle cost, office expense)						20.00	
Real Estate Opportunity^	Pivot (State)	$ 5,970	per acre @	3.00%		179.10	
Real Estate Taxes		$ 5,970	per acre @	1.35%		80.60	
Total Cost per Acre Including Overhead						571.28	
Cash Cost per bushel	*^Ownership and RE Opportunity not included in cash costs.*					4.60	
Cost of production per bushel						7.32	

~See benefits of soybeans in a corn/soybean rotation

Soybean Production & Cover Crops – Planting Rates, Row Spacing, Planting Dates, Maturity Groups, and Irrigation Management

- Current recommendations on soybean plant dates, seeding rates & depths, and row spacing.
- Update on soybean irrigation management practices
- Gain knowledge on how cover crops affect soil water and irrigation management.
- Learn differences in managing cover crops in irrigated versus rainfed systems

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Nebraska Extension Educator, Cropping Systems

Aaron Nygren
Nebraska Extension Educator, Cropping Systems

Jim Specht
UNL Emeritus Professor of Agronomy and Horticulture

Soybean Production With Cover Crops

The key agronomic soybean production practices used in NE are planting date (PD), variety maturity group (MG), the interaction of these two (i.e., PD x MG), plus optimal choices for seeding rate, seeding depth, and row spacing.

The optimum practices for a cover crop - cash crop production scenario do not differ much from optimum practices used for non-cover crop – cash crop production systems, with the exception of a planting date and choice of a variety maturity group. This difference arises because the optimization of cover crop (CC) biomass before it is terminated ordinarily requires delaying the planting of the soybean cash crop. In addition, to enhance the establishment of a fall-planted cover crop after soybean harvest producers may elect to use earlier soybean MG, so that the CC seed can be planted earlier in the fall and thus accumulate more biomass before it goes into dormancy as temperatures plunge prior to winter.

Soybean research to date has shown that as soybean planting date is delayed in NE and other north central states, soybean yields will predictably decline from the high yields attainable with late April & early May plant dates at a rate of 0.25 bu/ac per day in non-ideal soybean production years (or in fields of low productivity), but that yield penalty greatly increases in ideal soybean production years (or in highly productive fields – especially irrigated ones) to yield penalties of 0.6 to 0.7 bu/ac per day. In addition, there is an interaction of planting date choice and MG choice. The so-called full-season (later MG) varieties are typically greater yielding than short-season (earlier MG varieties) in early planting date scenarios, though that advantage lessens (but does not go to zero) when the planting date is delayed. Peer-reviewed recent research data on this point will be provided to the SMFD audience.

With regard to optimizing the other production practices listed above, these are typically applicable to both CC and non-CC systems, though CC can offer some advantages that pertain to weed control, but also disadvantages with respect to insects moving from the CC to the cash crop.

The main experiment in the 2020 SMFD is an evaluation of three soybean row widths (30-, 15-, & 7.5-inch) and three soybean seeding rates (60, 120, & 180 viable seeds per acre) that, in combination with each other, constitute nine different RS x SR treatments. These nine treatments were planted in the spring of 2020 in no-till (2019) corn fields into a block of nine plots that had a fall planted cereal rye cover crop (CC) block and into a block of nine plots that did not have a CC. The cereal rye CC was herbicide-killed immediately after the soybean crop was planted. The 9 x 2 = 18 plots were replicated four times at each SMFD site. The planting dates were May 11, 12, 18, & 19 at the four SMFD sites of Arlington, Hildreth, Shelby, & Elgin, NE, respectively. Soil water sensors were installed at 6-, 18-, & 30-inch soil depths in early April to monitor daily soil water status in the non-CC and in the CC blocks, but removed just before planting, then re-installed thereafter to monitor daily soil water status in the same blocks during subsequent soybean crop development on up to maturity. Rainfall has been collected after planting at each of four sites. All four sites have center pivot irrigation systems. Yield and its components of plants/acre, pods/plant, seeds/pod, and 100-seed weight will be collected from each plot at each SMFD site in October.

Indicate a soybean yield goal for the best field you have on your farm: _____Your Yield GOAL (bushels/acre). Below are the key yield components. Indicate on each underscore a number for each yield component. Use your own cropping practices or experience to select a number for each component. After all numbers are entered, use a calculator app on your cell phone to make the computation (X means multiply, ÷ means divide). Record your calculated yield.

_____average number of plants/acre
X _____average number final stem nodes/plant
X _____average number of pods/node
X _____average number of seeds/pod
÷_____average number of seeds/pound
÷__60___pounds per bushel
= _____Yield (bu/acre) (calculated for YOUR above numbers).

Now, if your calculated yield value seems crazy, ask Dr. Jim Specht for yield component numbers he has found in his research that does lead to calculated (& real) yield value of 84 bu/ac. Enter his numbers below.

_____average number of plants/acre
X _____average number final stem nodes/plant
X _____average number of pods/node
X _____average number of seeds/pod
÷_____average number of seeds/pound
÷__60___pounds per bushel
= _____Yield (bu/acre)
(calculated for the Specht numbers).

Soil Water Use Considerations with Cover Crops

The stored soil water used by cover crops has often been considered just one of the costs associated with growing them. However, in most years on irrigated land in the eastern half of Nebraska, the CC water use cost may be very small, if any.

One reason for this is that most farmers leave irrigated fields close to field capacity at the end of the season. This leaves very little room to store off-season precipitation and can result in a great deal of runoff and deep percolation. The University of Nebraska recommends that soil water levels at crop maturity will leave room to store 2.4 inches of precipitation in sandy soils and up to about 5.5 inches on silt loams. However, it is challenging to leave the soils this dry. Therefore, even on heavy soils, most farmers will leave no more than 2-3 inches of room to store off-season precipitation.

The average off-season and early season precipitation (October-May) for the Hildreth area is around 13 inches, 14.25 inches for the Elgin area, 14.75 inches for the Shelby area, and 15 inches in the Waverly area. Not all off-season and early season precipitation will make it into the soil due to runoff loss. However, even if only half of the water (6.5 to 7.5 inches) gets stored in the soil, the remainder could potentially deep percolate below the root zone after the soil profile is refilled. Any water that is deep percolated will move nitrates deeper into the soil, so it may be advantageous to have a CC using that water from the profile instead. In addition, water used by the CC is likely to be replenished by rainfall during the months of May and early June since precipitation is typically greater than crop water use during this period. June rainfall is not included in the above totals and could easily add 1-2 inches of additional water.

If you do decide to use CC with irrigated acres, it is important to have a management plan if weather conditions are dry to either terminate the CC earlier than initially planned to preserve moisture, or at least be prepared to irrigate the cash crop to ensure its establishment.

On the other hand, the water use of CC on dryland or rainfed acres may lead to different management decisions compared to irrigated acres. Rainfed acres usually have less soil water at the end of the season, making off-season precipitation more important in refilling the soil profile for the next cropping season. In addition, termination timing will be more critical in a dry year to ensure sufficient water in profile for crop establishment.

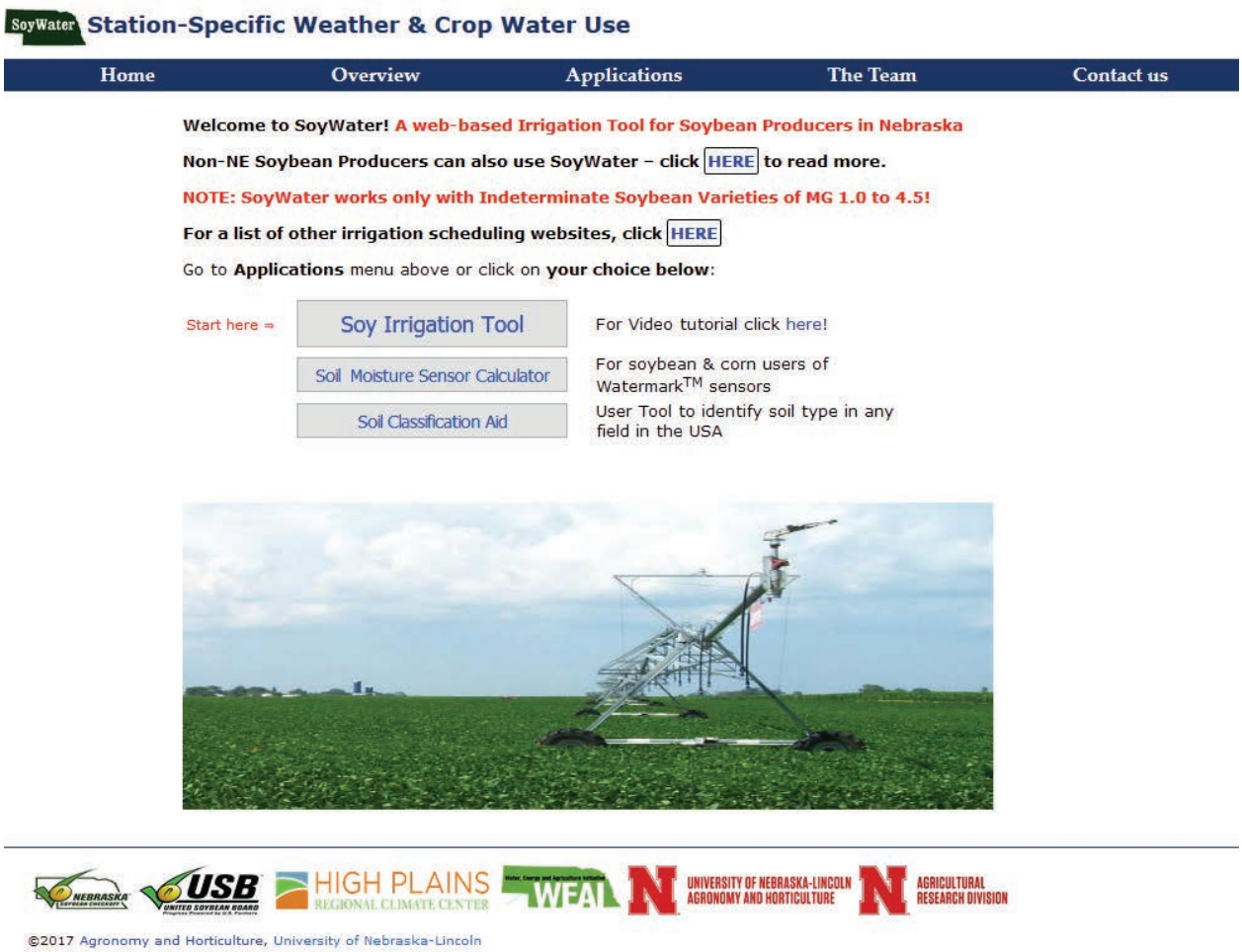
Irrigation Scheduling

Irrigation scheduling applies to irrigated fields with and without a CC. However, in CC soybean fields, applications may be needed at different times of the year. For instance, a fall irrigation to ensure a sound fall establishment of the CC may be helpful. In the spring, an irrigation event after the CC is terminated may be needed to enable the planting of the soybean crop. Such an irrigation event is likely not needed in wet spring scenarios, but in some years and some producer locations, the CC may have depleted soil water in dry springs to the point that (1) the surface soil at 3-4 inches is so dry that soybean seed will not germinate – thus delaying the start of soybean vegetative development, or (2) limited rainfall to date has moistened the soybean seed depth zone to allow soybean seed germination, but below that zone there is a dry soil layer that seedling roots cannot penetrate, leading to the death of emerged seedlings. In either case, it is always important to have the pivot ready to apply water before the crop is planted as a backup plan.

Other than the above scenarios, the scheduling of soybean irrigation events in non-CC and CC fields is not different, and can be accomplished in several ways. One method is to install soil water sensors to track the depletion of soil water by the soybean crop. If you are using Watermark sensors, one option is to go to the NE Soy Board – funded SoyWater home page (Figure 1) and click on the "Soil Moisture Sensor Calculator" to convert the sensor centi-bar readings into inches of water extracted per foot of soil depth. This can also be accomplished by using the Crop Water app. Another method is to use the SoyWater program itself to provide you with a day-by-day estimate of soybean crop water depletion based on a nearby weather station data for the calculation of daily soybean crop

ET. The minimal inputs you need are just four: field location & soil texture (SoyWater provides the user with help for both), planting date, and planted variety MG number. Thereafter, you have to log-in to input rainfall amounts on the day of occurrence, and irrigation amounts on the application day.

Figure 1. Login screen for SoyWater



Results from 2018 & 2019 Studies

Data from 2018 and 2019 focused on soil water content at three main points during the growing season: planting time, wettest day (highest soil water content) of the summer after planting, and driest day (lowest soil water content) of the year after planting.

Planting Time: There were significant differences in Watermark sensor readings at five of the seven sites at planting time as shown in Table 1. At five of the seven sites, the no CC plots had wetter soils and the differences at the other sites were very small. Additionally, only one of the sites had soil water content below field capacity.

Table 1. Soil water content at planting time above or below field capacity and differences between plots. Treatments sharing a common letter are not statistically different at P<.05. The "+" numbers for soil water content show soils that are above field capacity and a high level of deep percolation of soil water is occurring.

Site		Albion (2018)	Cedar Bluffs (2018)	Kenesaw (2018)	Pilger (2019)	Plymouth (2019)	Sargent (2019)	Waverly (2019)
Soil Water Content Above (+) or Below (-) Field Capacity in Inches	*No Cover*	+1.57 a	+3.08 a	+0.67 a	+0.33 a	+2.14 a	+0.63 a	+2.97 a
	Rye	+0.06 b	+0.64 b	-1.68 b	+0.63 a	+1.67 b	+0.01 b	+3.07 a
Difference in Soil Water Content of Rye versus No Cover in Inches		-1.15	-2.44	-2.35	+0.30	-0.47	-0.62	+0.10

Wettest Day of the Summer after Planting: Soil water content in matric potential (kPa) for all seven sites is shown in Figure 1. Only one site had a significant difference in soil water content with .35 inches less water in the profile for the cover crop plot. At this site, both the rye and no CC plots were above field capacity.

Driest Day of the Summer after Planting: Soil water content in matric potential (kPa) for all seven sites is shown in Figure 2. There were no significant differences in Watermark sensor readings at any of the seven sites.

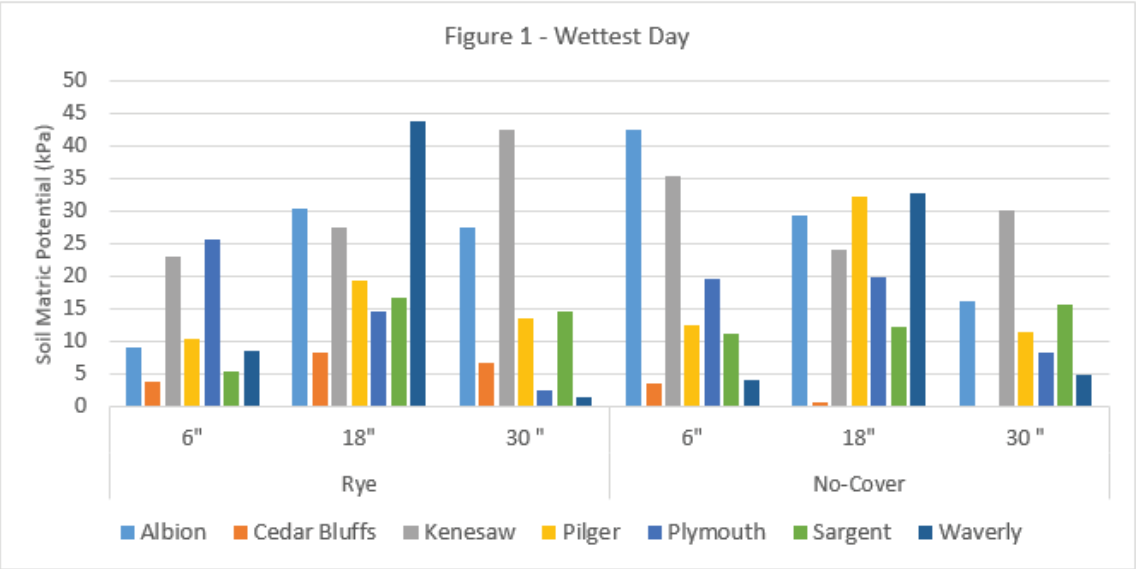


Figure 1 – Soil water content in matric potential (kPA) on the wettest day after planting for SMFD sites from 2018-2019.

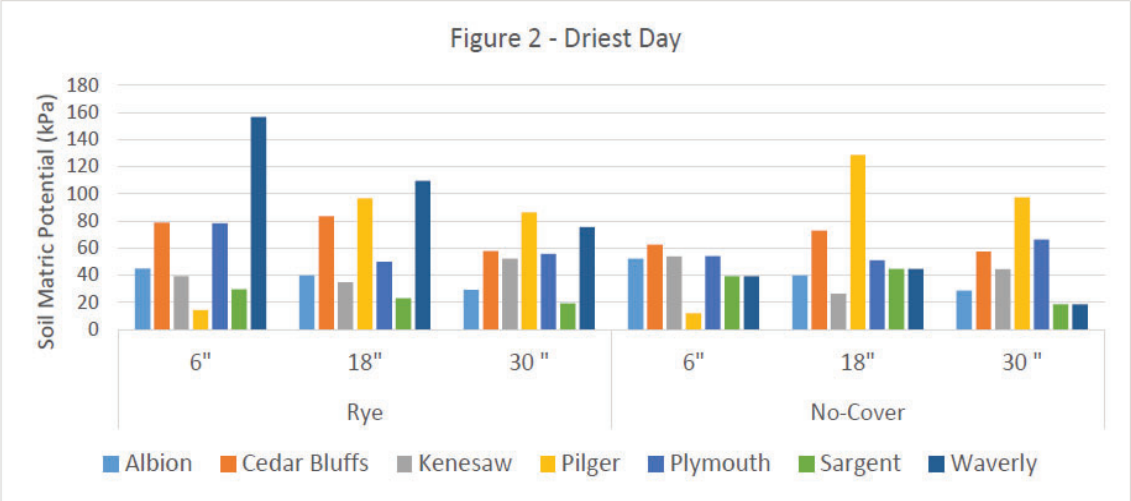


Figure 2 – Soil water content in matric potential (kPA) on the wettest day after planting for SMFD sites from 2018-2019.

Take Home Messages

- SMFD studies have shown significant differences in soil water content between a rye cover crop and no cover crop at planting time.
- However, after planting, rainfall has exceeded crop water use for a few weeks while the plants were small and refilled the soil profile, resulting in little to no differences in soil water content between a rye cover crop and no cover crop. The no cover crop area likely deep percolated more water than the cover crop area, likely resulting in the loss of nitrogen that the crop could have used.
- When growing cover crops that will be terminated just before planting soybeans, it is always important to make sure the pivot is ready to apply water before the crop is planted in case the soils are dry, even though most years it will not be needed.
- Cover crop termination timing may be more critical on rainfed acres to ensure sufficient soil water for crop establishment.
- Other than the possibility of irrigation to ensure the establishment of the cover crop in the fall or the soybean crop in the spring, proper irrigation scheduling for soybeans does not differ between cover crop or non-cover crop fields.

Strategies for Soybean Gall Midge and Insect/Disease Management in Cover Crops

:

- An update on the biology, ecology, distribution, and the latest on potential management strategies for soybean gall midge, a new pest of soybean
- Insect activity and management in cover crop to soybean transition systems

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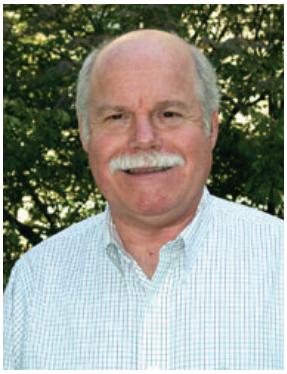

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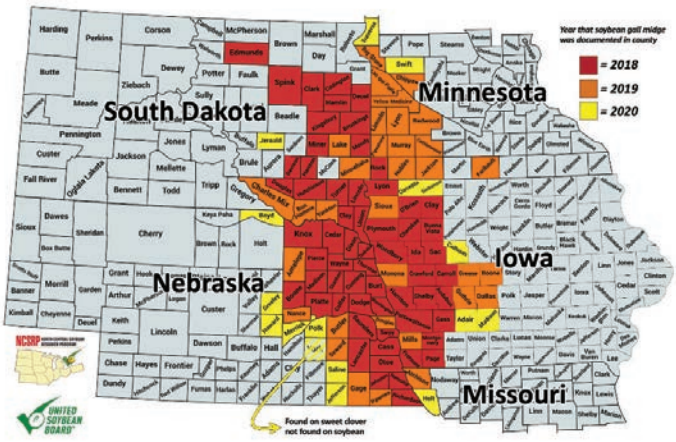
Soybean Gall Midge: A New and Emerging Pest of Soybean

Distribution and Adult Activity

Soybean gall midge (SGM) was identified as a new species in 2018 in the Midwestern United States causing extensive injury to soybean in parts of eastern Nebraska (Fig. 1) as well as western Iowa, southwestern Minnesota and eastern South Dakota.

Figure 1. Counties where the presence of soybean gall midge has been documented in 2018 and 2019.



Adult Emergence

In 2020, soybean gall midge adult emergence was monitored from last year's soybean fields at 33 locations across four states with support from the Nebraska Soybean Board and North Central Soybean Research Program. Adults were first captured on June 10th in Cass County near Louisville, NE. With emergence occurring at a number of sites in east-central on June 12th. First emergence in northeast Nebraska was on June 14th.

One of the primary challenges with managing soybean gall midge is the duration of adult emergence. In 2019, the average duration of emergence in Nebraska was 16 days . In 2020, emergence sites average of 25.6 days from last year's soybean fields with the longest duration occurring near Eagle, NE at 24 days (Figure 2). Adult emergence from this year's soybean was first documented in east-central Nebraska on July 1st near Memphis, NE. An overlap in adult emergence from last year and this year's soybean was observed for 6 days. The extended and overlapping adult emergence poses a significant challenge for managing soybean gall midge.

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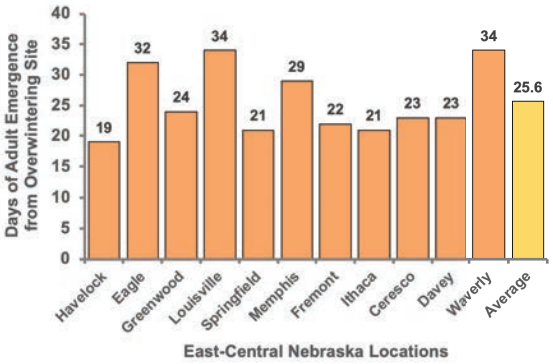


Figure 2. Soybean gall midge overwintering adult emergence duration by location.

Scouting

It's important to determine if you have soybean gall midge in your field even if you don't see signs of dead or dying plants. To scout for soybean gall midge, focus on the edge of the field especially in soybean field that are adjacent to a field that was soybean the previous year. Look for signs of wilting or dying soybean plants. Approximately two weeks after adult activity, dark discolorations become visible at or near the soil surface. Peel back the outer layer of tissue on these areas and look for the presence of orange or white larvae.

Management

Several studies are underway this season to evaluate the efficacy of seed treatments, in-furrow, and foliar insecticides on soybean gall midge. None of the treatment evaluated this season completely eliminated the soybean gall midge, however, some chemistries, especially in combination with cultural control strategies (planting date) showed early season potential to mitigate soybean gall midge injury to soybean plants.

In east-central Nebraska, soybean were planted on five different dates in 10 day intervals beginning on April 22nd with each planting consisting of untreated and gaucho treated seed. On June 13th, adult activity was documented in an adjacent field that was soybean the previous year. Infestation assessments on June 25th found that there was a reduction in the number of infested plants (Figure 3) as well as the number of larvae per plant occurred when soybean was planted on and after May 12th. Within each planting date, a reduction in infestation and larval number occurred when Gaucho was present with plantings on and after May 12th. Yield results will be needed to determine if these differences have the potential for an economic return.

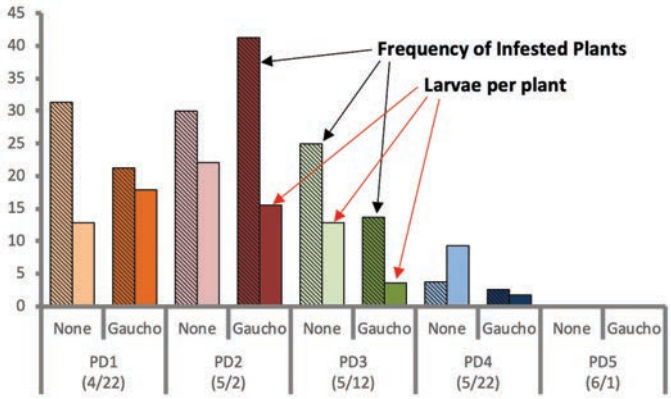
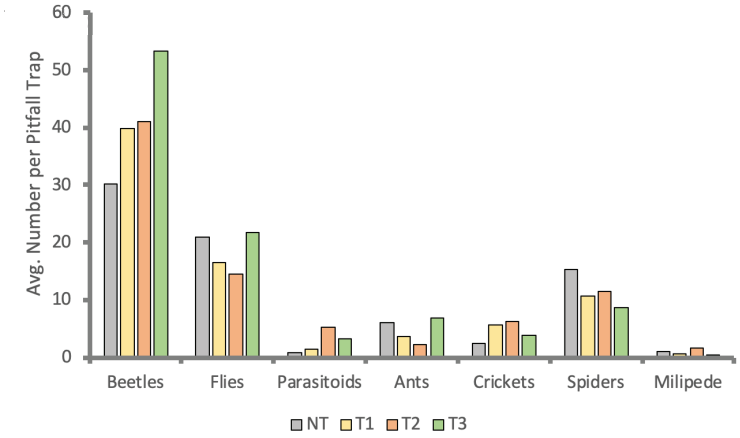


Figure 3. Infestation and the average number of larvae per plant across five planting dates with and without Gaucho seed treatment.

Cover Crops

Cover crops can attract both pest and beneficial arthropods. Damage from insect pests is based on a number of different factors such as, timing of cover crop establishment or termination method, number of years with a cover crop, weather conditions, and the interval between termination and planting as well as the subsequent cash crop species. Studies and field observations have shown significant risks from pests such as black cutworm, wireworm, Japanese beetle, green cloverworm, southern corn rootworm, seed corn maggot, stinkbugs, and bean leaf beetle and slugs with rye cover crops (Smith et al. 1988). In contrast, Koch et al. 2012 reported reduced aphid and bean leaf beetle population with a rye cover crop. Methods of termination varied considerably between studies (plowing, paraquat, or mowing). In addition, termination dates were not utilized in a way to evaluate their impact on insect populations. Such studies have demonstrated the risk with each of these pests, but no studies have been conducted to determine how management practices such as the timing of termination might influence this relationship.

In 2020, pitfall traps (small holes in the ground that capture insects moving on the soil surface) found a wide diversity of insects (Figure 4) many of which are beneficial to growers. In addition, none of the sites showed any injury from defoliators that exceeded the threshold needed for treatment.



Take Home Messages

- Soybean gall midge is a new species causing significant injury to soybean in east-central Nebraska
- The long duration of adult emergence from last year's soybean fields will make management difficult
- Termination date had a significant impact on arthropod activity with many representing beneficial arthropods such as predators or fungal feeders
- Defoliation thresholds were not reached at any of the cover crop termination dates or sites
- No differences in soybean yield were observed between termination treatments at any of the field study sites in 2019

Figure 4. 2020 data showing the average number of arthropods recovered from pitfall traps for no cover crop (NT) , early (T1), at-plant (T2) and post-plant (T3) terminations averaged across Arlington, Shelby and ENREC.

Soybean Weed Control & Cover Crops

- Cover crops and weed control study (research findings and plot walk)
- Discussion about integrating multiple strategies to improve weed management
- What we know about cover crops and weed suppression
- How to get the most out of your herbicide program
- Examine testing soil microbial abundance and diversity at SMFD plots with/without rye cover crops
- Learn why soil nitrate levels at the 0-4" depth were lower in plots with rye compared to plots without rye
- Learn why we expect higher fungi and bacteria numbers in plots with rye
- What could this mean for corn residue breakdown and soybean nutrition?

Cereal Rye Influence on Soil Nutrients and Microbial Abundance

Katja Koehler-Cole
UNL Agronomy Research Assistant Professor

Background and justification
The formation of soil organic matter, the breaking down of plant residue and the release of plant available nutrients are all carried out by soil organisms. Planting a cover crop between main crops can improve the conditions in the soil for these microbes. Cover crop roots leak simple sugars and amino acids, preferred food sources for a multitude of soil organisms. The space adjacent to living plant roots, called the rhizosphere, is where most soil microbes live, illustrating the importance of plants roots as habitat.

Bacteria are the most prevalent microbes in agricultural soils. They break down simple organic compounds such as the ones found in fresh cover crop residue, are hardy and can quickly reproduce. **Fungi** are more delicate than bacteria and are disturbed by tillage. *Saprophytic fungi* can break down more complex organic compounds, such as the ones found in corn stalks. *Arbuscular mycorrhizal fungi (AMF)* colonize plant roots, and transfer nutrients to the plant in exchange for sugars from the plant. Fungi are essential in forming soil aggregates by excreting glomalin, a glue-like substance that binds soil particles. **Protozoa** are single-celled animals that feed on bacteria and release plant available ammonium.

Increasing the amount of living plant roots in the soil may lead to greater microbial activity and thus improved soil structure and nutrient cycling. Further, nutrient uptake by the plant itself may reduce contamination of groundwater and surface water, a reason why cover crops are now subsidized in several states.

Our research questions were:
1. Can rye cover crops growing before soybean reduce soil nitrate?
2. Can rye cover crops growing before soybean increase microbial abundance as a whole?
3. How do rye cover crops influence different groups of soil microbes?

Katja Koehler-Cole
UNL Agronomy Research Assistant Professor

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Nebraska Weed Management Extension Educator

Research methods
At the Soybean Management Field Day sites near Shelby and Arlington, cereal rye was planted at 60 lb/a in November of 2019. We compared plots with cereal rye to plots without cereal rye (control plots), a total of 8 plots per site. Soybean were planted in mid-May and cereal rye terminated with glyphosate within 5 days after soybean planting.
We took soil tests (4" depth) in May and July from the plots without cover crops (NONE treatment) and from the plots with cereal rye cover crop (RYE treatment). The soil was analyzed for NPK and organic matter content. Soil biology was assessed using phospholipid fatty acid analysis (PLFA) which shows different microbial groups (bacteria, AMF, saprophytic fungi, protozoa) present in the soil and their abundance. All soil tests were carried out by Ward Laboratories in Kearney, NE.

Soil chemical analysis results
Rye produced moderate levels of biomass, 1,100 lb/ac at Arlington and 1,300 lb/ac at Shelby (biomass is dry weight). Soil nitrate was slightly, but not significantly, lower following a cover crop than without cover crop (Figure 1).
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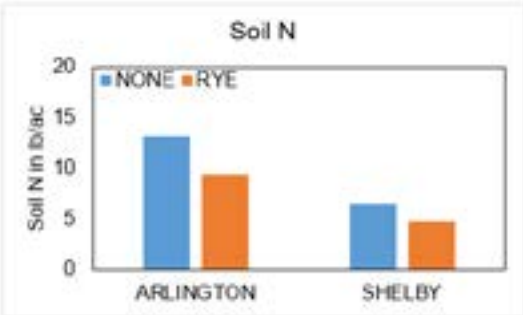

Fig. 1. Soil nitrate in lb/ac under cereal rye cover crop (RYE) and no cover crop (NONE) at Arlington and Shelby.

Soil phosphorus (P) was not different between the cereal rye cover crop and the no cover crop treatment (Figure 2).

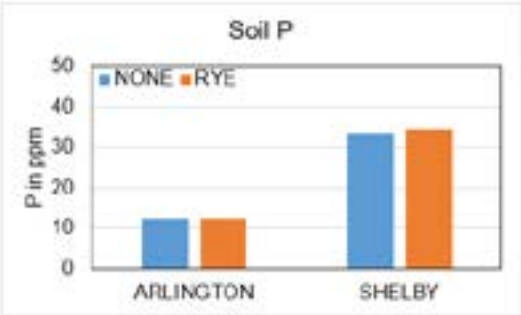

Fig. 2. Soil P in ppm under cereal rye cover crop (RYE) and no cover crop (NONE) at Arlington and Shelby.

Soil potassium (K) levels were also not influenced by a cereal rye cover crop (Figure 3).

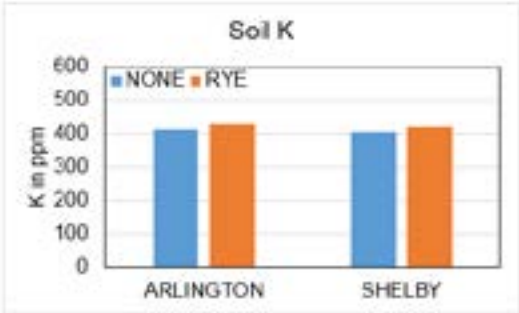

Fig. 3. Soil K in ppm under cereal rye cover crop (RYE) and no cover crop (NONE) at Arlington and Shelby.

Soil Biological analysis

Data from the soil biological analysis is not yet available, but will be presented during the field days and will be included in the research update later this year. In similar trials at Soybean Management Field Days last year, we found that cereal rye cover crops increased overall microbial biomass compared to the no cover crop treatment. Most of that increase was due to greater numbers of bacteria, and small increases in saprophytic fungi, AMF fungi and protozoa.
Bacteria are the most numerous soil microbes, and often quickly respond to changes in management, such as when cover crops are introduced.

Greater soil microbial abundance, especially of fungi, could improve soil structure, making it less vulnerable to erosion by wind and water. This could be particularly important in soils with low organic matter or sandy soils that are prone to erosion. We will continue to investigate how cover crops can be used to increase the populations of beneficial soil microbes such as fungi across a range of soil types in Nebraska.

Take Home Messages

- Cereal rye can reduce soil nitrate levels in the period before soybean planting, possibly reducing nitrate leaching to the groundwater
- Cereal rye did not impact P and K
- Soil microbial populations may be increased by cereal rye cover crops
- Greater numbers of soil microbes may improve soil aggregation and residue breakdown

Interseeding Cover Crops in Soybean: Key Considerations for Success

Chris Proctor, Weed Management Extension Educator

2020 Cover Crop Interseeding Study

Cover crops have the potential to be a useful tool, but there are challenges to establishment in a soybean and corn cropping system. One of these challenges include limited time for successful establishment after harvest. To overcome the limited time for cover crop growth following harvest drill interseeding has been used with some success planting at V3 of corn. To better understand if this would work for soybean an drill interseeding study is being conducted at each of the 2020 Soybean Management Field Day Sites.

Research Questions:

- What effect to soybean variety stature have on a drill interseeded cover crop?
- How do herbicide Preemergence herbicides effect establishment if a drill interseeded cover crop?
- How do drill interseeded cover crops affect soybean yield?

Methods:

The study was established at all locations of the 2020 Soybean Management Field Days (Arlington, Shelby, Elgin, Hildreth). Cover crop mix of annual rygrass (2lb/a) and winter wheat (10 lb/a) were drill interseeded using a Hiniker cover crop drill interseeder. A standard and short stature soybean varieties (100,000 seeds/a) and two herbicide programs (PRE + POST and POST only) were tested. The PRE herbicide application was Valor at 3 oz/A applied at planting and the POST application was Roundup at 32 fl oz./A plus applied prior to cover crop interseeding. Soybean planting and cover crop interseeding dates are listed in Table 1. Data collected includes cover crop biomass, weed suppression following POST application, and soybean grain yield.

Statistical analysis. The experimental data will be analyzed to evaluate cover crop effects on yield. Significant differences will be determined based on a probability of $\alpha = 0.05$.

Location	Arlington	Shelby	Elgin	Hildreth
Soybean Planting	May 11	May 18	May 19	May 12
Cover Crop Interseeding	June 24	June 24	June 25	June 25

Table 1. Soybean planting and cover crop interseeding dates.

Results from 2020 will be summarized in the 2020 Soybean Management Field Days Research Update.

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