2019 on-farm trials report

Boots on the Ground: Validation of benchmarking process through an integrated on-farm partnership

Project team:
Dr. Shawn P. Conley (Principal Co-Investigator) University of Wisconsin-Madison, Madison, Wisconsin; Dr. Patricio Grassini (Principal Co-Investigator) University of Nebraska-Lincoln, Lincoln, Nebraska; Laura Lindsey (Ohio State University); Maninder Singh (Michigan State University); Scott Nelson (Iowa State University); Hans Kandel (North Dakota State University); Seth Naeve (University of Minnesota); Laura Thompson and Keith Glewen (University of Nebraska); John Gaska (University of Wisconsin)

IN A BEAN POD:

- The 'improved' management treatment netted soybean producers an average of 5 bu/ac yield increase and $51/ac additional profit (see figures 2 &3 on last page).
- Growers should consider improving their soybean management by fine tuning planting date, maturity group, seeding rate, and foliar fungicide and insecticide applications.

PROJECT BACKGROUND

Analysis of producer survey data performed during our previous 3-year NCSRP-funded benchmarking project revealed: (1) an average yield gap of 20-30% between current farmer yield and potential yield as determined by climate, soil, and genetics, and (2) a number of agronomic practices that, for a given soil-climate context, can be fine-tuned to close the gap and improve soybean producer profit.

GOALS

This project is focused on using the producer survey database to identify and strategically evaluate management changes in on-farm research settings across the US North Central region. In each state, a suite of specific agronomic practices was identified to have the greatest potential for increasing yield and profit for a given combination of climate and soil (a "technology extrapolation domain [TED]"). Those 'improved' practices were tested against the typical practices followed by producers (called 'reference' management). This evaluation demonstrated how individual producers can increase on-farm soybean yield, input-use efficiency, and net profit by fine tuning current management practices.

EXECUTION

In 2019, 49 replicated on-farm trials in seven states were initiated to compare an 'improved' treatment versus the 'reference' producer practices. The 'improved' management was specifically designed for each technology extrapolation domain (TED) in each state by fine tuning planting date, and usually involves earlier planting, lower seeding rate, insecticide and fungicide application, and in some cases, fine-tuning cultivar maturity group based on previous analysis of the survey data (Table 1).

The wet weather of 2019 hampered or prevented the establishment of many plots. Replicated trials were established through each university with the assistance of growers, extension personnel, retailers, and county-based agencies, in collaboration with the on-farm experimentation network in each state. Figure 1 (on last page) provides the geographical reference of the trials and Table 2 indicates the specific treatments of the various trials in each of the states in 2019. One trial in Iowa was excluded due to severe flooding that unevenly affected the field where the trial was conducted, not allowing a fair comparison between the 'improved' and the 'reference' treatments. Hence, a total of 48 trials were successfully conducted during 2019; each trial consisted of a side-by-side comparison of the 'improved (I)' versus 'reference (R)' management.

Table 1. The recommended "improved" management treatment in each state.

State	Recommended "Improved" treatment
IA	Early planting* + longer MG (> 3.6) + foliar fungicide AND insecticide** + 130K/ac seeding rate
MI	Early planting* + foliar fungicide AND insecticide** + 130K/ac seeding rate
MN	Early planting* + foliar fungicide AND insecticide** + 130K/ac seeding rate
ND	Early planting* + longer MG (>0.2)** + 150K/ac seeding rate
NE	Early planting* + foliar fungicide AND insecticide** + 130K/ac seeding rate
OH	Early planting* + foliar fungicide AND insecticide** + intermediate seeding rate (around 130K/ac)
WI	Early planting* + intermediate seeding rate (around 130K/ac)

* Early planting refers to end of April or early May using treated seed; early and late (control) plantings should be apart by at least 3 weeks. ** Application around R3 stage (beginning of pod setting).

Table 2. Actual 'reference (R) and' improved' (I) treatments applied in each state.

Experiment	Treatment	Planting date	Seed treatment	Maturity group	Seeding rate (x1000 seeds/ac)	Foliar Insecticide/ Fungicide
IA1	R	5/6/2019	yes	2.6	143	no/yes
	I	4/22/2019	yes	3.5	143	no/yes
IA2	R	5/6/2019	no	2.5	140	no/yes
	I	4/26/2019	no	3.1	140	no/yes
IA3	R	6/1/2019	no	n.r.	n.r.	n.r./n.r.
	I	4/25/2019	no	n.r.	n.r.	n.r./n.r.
IA4	R	6/5/2019	yes	2	140	no/no
	I	5/16/2019	yes	2.9	140	no/yes
IA5	R	6/3/2019	no	3.1	140	no/yes
	I	4/22/2019	no	3.7	140	no/yes
IA6	R	5/6/2019	yes	2.6	143	no/yes
	I	4/22/2019	yes	3.5	143	no/yes
IA7	R	5/31/2019	no	1.9	140	no/yes
	I	5/7/2019	no	2.5	140	no/yes
IA8	R	6/3/2019	no	2	140	no/yes
	I	5/6/2019	no	2.5	140	no/yes
IA9	R	6/3/2019	no	2.3	140	no/yes
	I	5/7/2019	no	2.8	140	no/yes
IA10	R	5/17/2019	no	1.8	140	no/yes
	I	5/3/2019	no	3.3	140	no/yes
MI1	R	5/15/2019	yes	2.1	124.3	no/no
	I	4/27/2019	yes	2.1	123.5	yes/yes
MI2	R	4/25/2019	yes	3.0	145	yes/yes
	I	4/6/2019	yes	3.0	145	yes/yes
MI3	R	6/4/2019	yes	1.9	133	no/no
	I	5/16/2019	yes	1.9	130	yes/yes
MI4	R	5/17/2019	yes	2.4	130	no/no
	I	4/25/2019	yes	2.4	130	yes/yes
MI5	R	5/17/2019	yes	2.4	130	no/no
	I	4/26/2019	yes	2.4	130	no/no
MI6	R	5/17/2019	yes	2.4	130	no/no
	I	4/26/2019	yes	2.4	130	no/no
MI7	R	6/22/2019	no	2.7	160	no/no
	I	6/9/2019	no	2.7	160	yes/yes
MI8	R	6/8/2019	no	2.8	170	no/no
	I	5/18/2019	no	2.8	130	yes/yes
MI9	R	5/27/2019	yes	3.0	142	no/no
	I	5/14/2019	yes	3.0	130	yes/yes
MI10	R	6/8/2019	yes	2.6	165	no/no
	I	5/19/2019	yes	2.6	130	yes/yes
MN1	R	6/19/2019	no	1.7	160	no/no
	I	6/2/2019	yes	1.7	130	yes/yes
MN2	R	6/3/2019	no	2.1	160	no/no
	I	5/16/2019	yes	2.1	130	yes/yes
MN3	R	6/19/2019	no	1.7	160	no/no
	I	6/4/2019	yes	1.7	130	yes/yes
MN4	R	6/6/2019	yes	1.7	160	no/no
	I	5/7/2019	yes	1.7	130	yes/yes
MN5	R	5/29/2019	no	2	140	no/n.r.
	I	5/15/2019	no	2	140	no/n.r.

n.r.: not reported; information is still being collected.

Table 2. (continued)

	Experiment	Treatment	Planting date	Seed treatment	Maturity group	Seeding rate (x1000 seeds/ac)	Foliar Insecticide/ Fungicide
North Dakota	ND1	R	6/3/2019	yes	0.5	185	yes/no
		I	5/17/2019	yes	0.8	165	yes/no
	ND2	R	5/29/2019	yes	0.8	185	yes/no
		I	5/16/2019	yes	0.8	165	yes/no
	ND3	R	5/30/2019	yes	0.5	185	no/no
		I	5/14/2019	yes	0.8	165	no/no
	ND4	R	6/3/2019	yes	0.5	185	yes/no
		I	5/17/2019	yes	0.8	165	yes/no
	ND5	R	5/30/2019	yes	0.5	185	no/no
		I	5/14/2019	yes	0.8	165	no/no
	ND6	R	5/29/2019	yes	0.3	185	yes/no
		I	5/13/2019	yes	0.5	165	yes/no
Nebraska	NE1	R	6/5/2019	yes	4.0	160	no/no
		I	4/26/2019	yes	4.0	130	yes/yes
	NE2	R	5/16/2019	yes	2.8	150	no/no
		I	5/6/2019	yes	2.8	150	yes/yes
	NE3	R	6/2/2019	yes	3.5	160	no/no
		I	5/3/2019	yes	3.5	130	yes/yes
	NE4	R	6/1/2019	yes	3.3	160	no/no
		I	4/20/2019	yes	3.3	130	yes/yes
Ohio	OH1	R	5/26/2019	yes	3.4	160	no/no
		I	5/8/2019	yes	3.4	130	yes/yes
	OH2	R	6/5/2019	yes	3.6	165	no/n.r.
		I	5/21/2019	yes	3.6	130	yes/yes
	OH3	R	5/23/2019	yes	2.4	160	no/no
		I	5/17/2019	yes	2.4	130	yes/yes
	OH4	R	5/20/2019	yes	3.6	160	no/no
		I	4/30/2019	yes	3.6	130	yes/yes
	OH5	R	5/26/2019	yes	3.1	160	yes/yes
		I	5/12/2019	yes	3.1	130	no/yes
	OH6	R	5/29/2019	yes	3.8	160	no/no
		I	5/8/2019	yes	3.8	130	yes/yes
	OH7	R	6/28/2019	yes	3.6	155	no/no
		I	5/25/2019	yes	3.6	135	yes/yes
Wisconsin	WI1	R	5/13/2019	no	2.6	140	no/no
		I	4/22/2019	no	2.6	140	no/no
	WI2	R	6/5/2019	yes	2.5	140	no/no
		I	5/13/2019	yes	2.5	140	no/no
	WI3	R	5/31/2019	yes	2.5	159	no/no
		I	4/24/2019	yes	2.5	159	no/no
	WI4	R	5/23/2019	yes	2.1	130	yes/yes
		I	5/5/2019	yes	2.1	130	yes/yes
	WI5	R	5/23/2019	no	2.4	138	no/no
		I	5/5/2019	no	2.4	138	no/no
	WI6	R	6/1/2019	no	2.2	140	no/no
		I	5/16/2019	no	2.2	140	no/no
	WI7	R	5/26/2019	no	2.2	140	no/no
		I	5/8/2019	no	2.2	140	no/no

n.r.: not reported; information is still being collected.

RESULTS

Soybean yield

Yield from the 2019 trials were analyzed as a large group by comparing the 'improved' versus 'reference' management. Across the 48 trials, an average of 5.5 bu/ac yield increase was realized from using the 'improved' management treatment (Figure 2). Note that in one North Dakota trial, rainfall caused severe soil crusting after the early planting of the 'improved' treatment (but not until after the late planting of the 'reference' treatment), which significantly reduced the yield in the 'improved' management treatment (10 b/ac compared with the 'reference' treatment).

Partial economic analysis

An economic analysis of the 'improved' versus the 'reference' treatments was conducted to calculate a profit or loss from applying the recommended 'improved' treatments. Our assumptions for the analysis were:

- Soybean price: $9/bu
- Treated seed cost: $60/140k seeds
- Non-treated seed cost: $54/140k seeds
- Foliar insecticide (product only) = $3/ac
- Foliar fungicide (product only) = $10/ac
- Foliar fungicide and/or insecticide application (excluding product cost)=$6.50/ac

We found that yield increase, together with lower costs due to lower seeding rate, resulted on average +$51/ac extra net profit in the 'improved' management treatment compared with the 'reference' treatment (Figure 3). The additional profit derived from the 'improved' management was higher than $10/ac profit in 85% of the cases. In other words, the economic impact derived from the 'improved' treatment was high and consistent across farms. These studies will be continued in 2020 at additional sites.

Figure 1. Locations of the 2019 NCSRP validation trials.

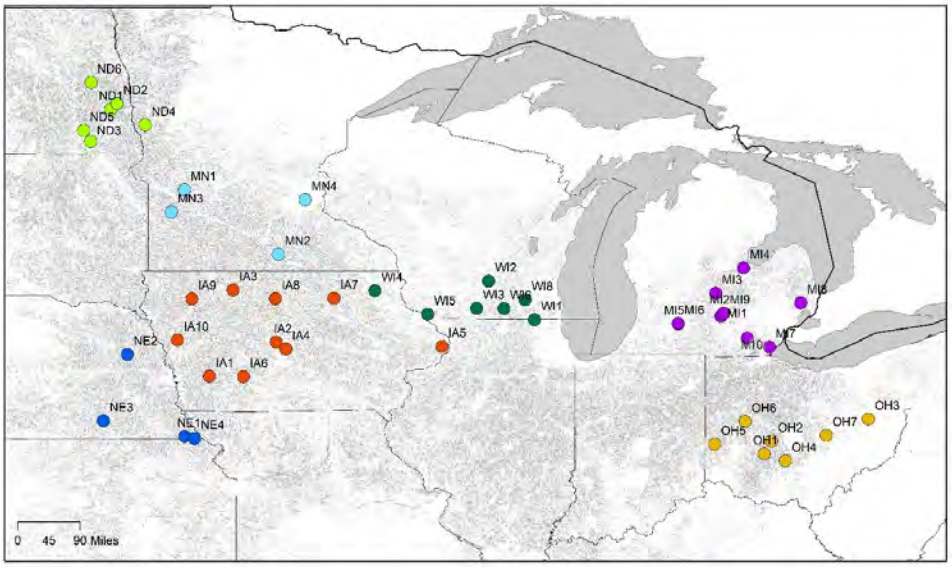

Figure 2. Yield comparison between reference and improved treatment across 48 farms distributed in 7 states. The red dashed line is the 1:1 line of agreement. The dashed and dotted lines show the ±5 and 10 bu/ac deviation from the 1:1 line of agreement.

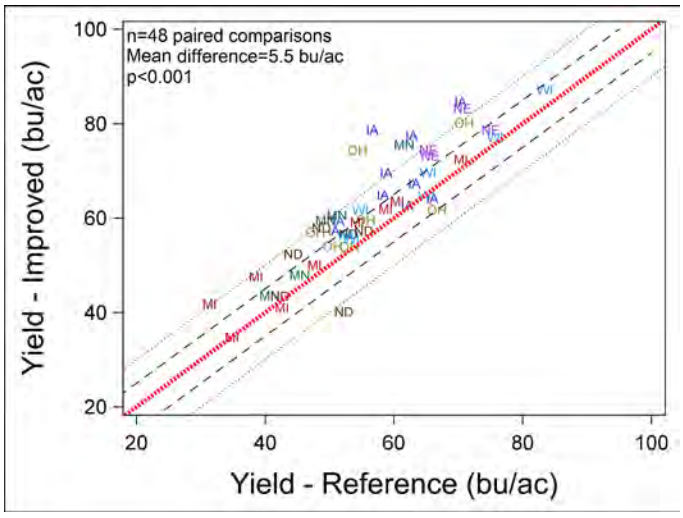

Figure 3. Distribution of partial profit ('reference' -' improved' treatment profits) across 42 farms. The red dashed line shows the zero-profit threshold, and the black dashed line shows the $10/ac profit threshold.