2020 On-farm Trials Report

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

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IN A BEAN POD:

- In the 2020 crop season, the improved management treatment netted soybean producers an average of 3.2 bu/ac yield increase and $31/ac additional profit.
- Growers should consider improving their soybean management by fine tuning planting date, maturity group, seeding rate, and foliar fungicide and insecticide application.

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 which would have the greatest potential for increasing yield and profit for a given combination of climate and soil (a "technology extrapolation domain [TED]"). Those 'improved' prac-tices 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 man-agement practices.

EXECUTION

In 2020, 53 replicated on-farm trials in seven states were initiated to compare an "improved" treatment versus the "reference" producer practices, which added up to another 48 on-farm trials carried out in 2019. The "improved' management was specifi-cally designed for each 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).

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 provides the geographical reference of the trials and Table 2 indicates the specific treatments of the various trials in each of the states in 2020. A total of 53 trials were successfully conducted during 2020; each trial consisted of a side-by-side compari-son 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, always using treated seed, AND early and late (control) plantings should be apart by, at least, 3 weeks. ** Application around R3 stage (beginning of pod setting).

Table 2. Reference (R) and improved (I) treatments actually applied in each state.

	Experiment	Treatment	Planting date	Seed treatment	Maturity group	Seeding rate (x1000 seeds/ac)	Foliar Insecticide/ Fungicide
Iowa	IA 1	R	5/7/2020	yes	2.5	140	no/no
		I	4/24/2020	yes	3.0	140	no/no
	IA 2	R	5/8/2020	no	2.4	140	no/no
		I	4/21/2020	no	2.8	140	no/no
	IA 3	R	6/2/2020	no	3.1	140	no/no
		I	5/2/2020	no	3.7	140	no/yes
	IA 4	R	5/30/2020	no	2.8	140	no/no
		I	5/6/2020	no	3.2	140	no/no
	IA 5	R	5/13/2020	no	1.8	174	no/yes
		I	4/20/2020	no	2.5	174	no/yes
	IA 6	R	5/7/2020	no	2.0	140	no/no
		I	4/20/2020	no	2.6	140	no/no
	IA 7	R	5/22/2020	no	2.3	140	no/yes
		I	4/24/2020	no	2.8	140	no/yes
	IA 8	R	5/5/2020	no	1.9	140	no/no
		I	4/21/2020	no	2.0	140	no/yes
	IA 9	R	5/21/2020	no	2.4	140	no/no
		I	5/6/2020	no	3.0	140	no/yes
Wisconsin	WI 1	R	5/12/2020	no	2.0	120	no/no
		I	4/27/2020	no	2.0	120	no/no
	WI 2	R	5/13/2020	yes	2.1	140	no/no
		I	4/26/2020	yes	2.1	140	no/no
	WI 3	R	6/7/2020	yes	2.8	139	no/no
		I	5/9/2020	yes	2.8	139	no/no
	WI 4	R	5/20/2020	no	1.1	145	no/no
		I	5/1/2020	no	1.1	145	no/no
	WI 5	R	5/20/2020	yes	2.3	135	no/no
		I	4/27/2020	yes	2.3	135	no/no
	WI 6	R	5/25/2020	no	2.2	140	no/no
		I	5/4/2020	no	2.2	140	no/no
	WI 7	R	5/9/2020	yes	2.6	145	no/no
		I	4/27/2020	yes	2.6	145	no/no
Ohio	OH 1	R	6/3/2020	yes	3.1	160	no/no
		I	5/13/2020	yes	3.1	130	yes/yes
	OH 2	R	5/9/2020	yes	3.4	160	no/no
		I	4/22/2020	yes	3.4	130	yes/yes
	OH 3	R	5/26/2020	yes	3.6	165	no/no
		I	4/22/2020	yes	3.6	130	yes/yes
	OH 4	R	6/2/2020	yes	3.6	160	no/no
		I	5/7/2020	yes	3.6	130	yes/yes
	OH 5	R	5/27/2020	no	3.6	160	no/no
		I	5/6/2020	no	3.6	130	yes/yes
	OH 6	R	5/26/2020	yes	3.3	156	no/no
		I	5/5/2020	yes	3.3	130	yes/yes
	OH 7	R	5/14/2020	yes	2.8	150	no/no
		I	4/6/2020	yes	2.8	125	yes/yes
	OH 8	R	5/26/2020	yes	3.9	165	no/no
		I	5/7/2020	yes	3.9	130	yes/yes
	OH 9	R	6/2/2020	yes	2.7	160	no/no
		I	5/13/2020	yes	2.7	130	yes/yes
Minnesota	MN 1	R	5/26/2020	no	1.6	140	no/no
		I	4/26/2020	no	1.6	140	yes/yes

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	ND 1	R	6/1/2020	yes	0.5	185	yes/no
		I	5/21/2020	yes	0.8	165	yes/no
	ND 2	R	6/1/2020	yes	0.5	185	yes/no
		I	5/22/2020	yes	0.8	165	yes/no
	ND 3	R	6/1/2020	yes	0.5	185	yes/no
		I	5/15/2020	yes	0.8	165	yes/no
	ND 4	R	5/28/2020	yes	0.3	185	yes/no
		I	5/12/2020	yes	0.5	165	yes/no
	ND 5	R	5/28/2020	yes	0.5	185	yes/no
		I	5/12/2020	yes	0.8	165	yes/no
	ND 6	R	5/29/2020	yes	0.5	185	yes/no
		I	5/15/2020	yes	0.8	165	yes/no
Michigan	MI 1	R	5/30/2020	yes	2.4	140	no/no
		I	5/4/2020	yes	2.4	140	yes/yes
	MI 2	R	6/2/2020	no	2.7	140	no/no
		I	5/7/2020	no	2.7	140	yes/yes
	MI 3	R	5/22/2020	yes	2.3	140	no/no
		I	4/28/2020	yes	2.3	140	no/no
	MI 4	R	5/22/2020	yes	2.3	140	no/no
		I	4/28/2020	yes	2.3	140	no/no
	MI 5	R	5/6/2020	yes	3.2	160	no/no
		I	4/11/2020	yes	3.2	160	no/no
	MI 6	R	5/30/2020	yes	2.2	140	no/no
		I	5/7/2020	yes	2.2	140	yes/yes
	MI 7	R	5/12/2020	yes	1.9	130	no/no
		I	4/20/2020	yes	1.9	130	yes/yes
	MI 8	R	5/18/2020	no	2.4	130	no/no
		I	4/18/2020	no	2.4	130	yes/yes
	MI 9	R	5/23/2020	yes	2.5	140	no/no
		I	4/26/2020	yes	2.5	140	yes/yes
	MI 10	R	5/24/2020	yes	2.3	140	no/no
		I	5/4/2020	yes	2.3	130	yes/yes
	MI 11	R	5/16/2020	yes	3.1	125	no/no
		I	4/28/2020	yes	3.1	125	no/no
	MI 12	R	5/16/2020	yes	2.8	127	no/no
		I	4/28/2020	yes	2.8	127	no/no
	MI 13	R	6/5/2020	no	2.4	120	no/no
		I	5/3/2020	no	2.4	120	yes/yes
Nebraska	NE 1	R	5/1/2020	no	2.9	155	no/no
		I	4/23/2020	no	2.9	120	yes/yes
	NE 2	R	5/15/2020	yes	3.7	140	no/no
		I	4/22/2020	yes	3.7	130	yes/yes
	NE 3	R	5/12/2020	no	3.7	160	no/no
		I	4/23/2020	no	3.7	130	yes/yes
	NE 4	R	5/15/2020	n.r.	2.9	160	no/no
		I	5/4/2020	n.r.	2.9	135	yes/yes
	NE 5	R	n.r.	n.r.	n.r.	n.r.	n.r.
		I	n.r.	n.r.	n.r.	n.r.	n.r.
	NE 6	R	5/12/2020	yes	3.1	160	no/no
		I	4/27/2020	yes	3.1	130	yes/yes
	NE 7	R	5/13/2020	yes	4.2	160	no/no
		I	5/1/2020	yes	4.2	128	yes/yes

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

Figure 1. Locations of the 2020 NCSRP validation trials.

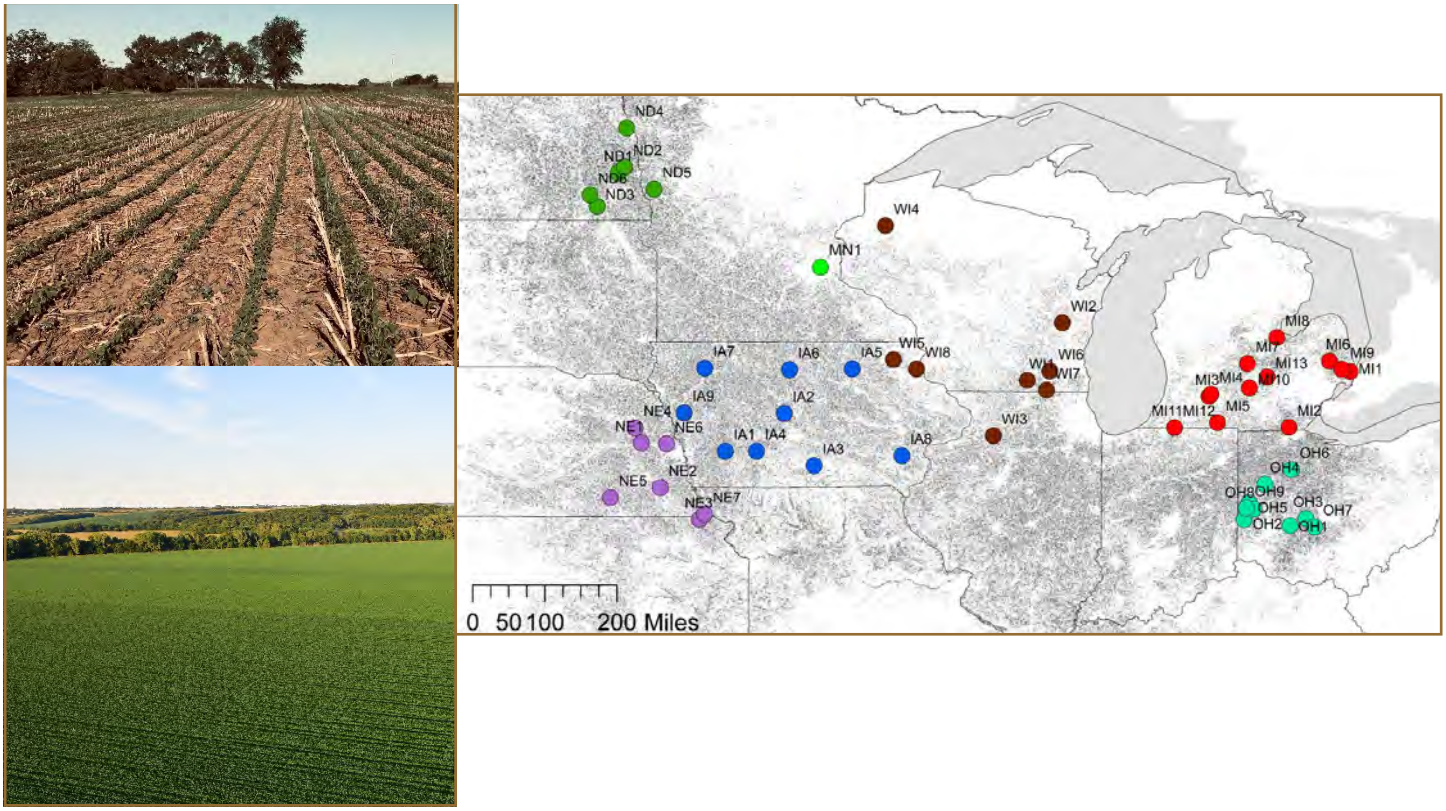


Figure 2. Yield comparison between reference and improved treatment across 48 farms in 2019 and 53 farms in 2020, distributed in seven states. The red dashed line is the 1:1 line of agreement. The dashed and dotted lines show the ±5 and ±10 bu/ac deviation from the 1:1 line of agreement.

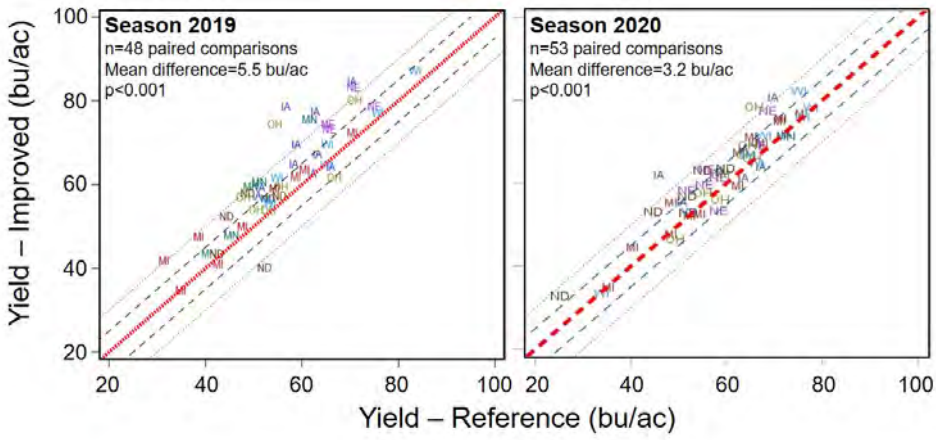
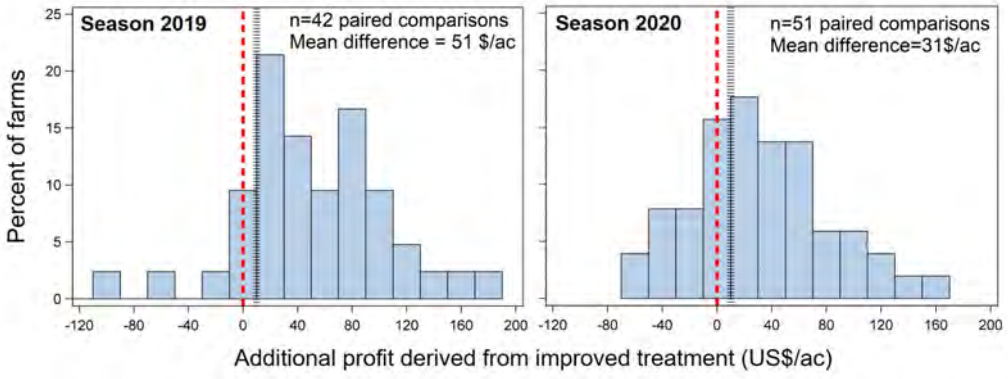


Figure 3. Distribution of partial profit (improved minus reference treatment profits) across 42 farms in 2019 (left panel) and 51 farms in 2020 (right panel). The red dashed line shows the zero-extra profit threshold and the black dashed line shows the 10 $/ac extra profit threshold.



RESULTS

SOYBEAN YIELD

Yield from the 2020 trials were analyzed as a large group by comparing the "improved" versus "reference" management. Across the 53 trials, an average 3.2 bu/ac yield increase was realized from using the improved management treatment (Figure 2). The yield benefit derived from the improved treatment in 2020 was comparably smaller than the yield increase observed in 2019 (+3.2 versus +5.5 bu/ac, respectively). We believe this is related with planting date in both reference and improved managements in the 2020 season, which was, on average, a week earlier than in 2019 due to favorable weather that allowed early planting. The shift in the planting window towards an earlier time of the year in 2020 may have reduced the yield benefit derived from difference in planting dates between the two management systems.

PARTIAL ECONOMIC ANALYSIS

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

- Soybean price: $11/bu in 2020 ($9/bu in 2019)
- 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 the yield increase, together with lower costs due to lower seeding rate, resulted on average +$31/ac extra net profit in the "improved" management treatment compared with the "reference" treatment in the 2020 season (Figure 3). The additional profit was smaller than in 2019 (+ $51/a) due to the smaller yield response in 2020. The additional profit derived from the "improved" management in 2020 was higher than 10 $/ac profit in 65% of the cases (compared with 85% of the cases in 2019). In general, one can conclude that the economic impact derived from the improved treatment was high and consistent across farms and years. These studies will be continued in 2021 at additional sites.

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