2021 Illinois Soybean Management Yield Potential Report

Vitor R. Favoretto and Fred E. Below
Crop Physiology Laboratory, Department of Crop Sciences
University of Illinois at Urbana-Champaign

Research approach

The goal of this research is to provide farmers and agronomists with information on a soybean variety's yield response to critical agronomic management practices, a.k.a. its management yield potential. Practices included reduced row spacing, foliar protection, and different fertilizer nutrient combinations provided in an additive fashion to reveal the cumulative effects of combining management practices into a systems approach. Using this approach, varieties can be identified that are best suited to an individual farmer's level of agronomic management.

Trial implementation

The experimental plots were planted using a precision plot planter (SeedPro 360, ALMACO). They were sown on May 5 at Yorkville, IL (41°35'25.64"N, 88°23'43.53 "W), on April 15 at Champaign, IL (40° 3'24.24"N, 88°13'59.20"W), and on April 22 at Nashville, IL (38° 18'34.39 "N, 89°20'11.00"W). Plots were 16 feet in length and two rows in width. For weed control, pre-plant applications of Boundary (Syngenta) (24 oz acre^{-1}) and Authority First (FMC Corporation) (5 oz acre^{-1}) were made at Champaign and Nashville, while Fierce MTZ (Valent USA) (16 oz acre^{-1}) was used at Yorkville. In-season weed control at Champaign was provided at two growth stages; at growth stage V1, Dual 2 Magnum (Syngenta) (16 oz acre^{-1}) and RoundUp (Bayer) (32 oz acre^{-1}) were used, while ammonium sulfate (72 oz acre^{-1}), Warrant Ultra (Bayer) (50 oz acre^{-1}), Fusilade (Syngenta) (8 oz acre^{-1}), and RoundUp (32 oz acre^{-1}) were used at stage V4. For the other locations, ammonium sulfate (72 oz acre^{-1}), Warrant Ultra (50 oz acre^{-1}), and RoundUp (32 oz acre^{-1}) were used at Nashville to control the weeds at the V2 growth stage, while Yorkville did not need in-season weed control. No adjuvant was used because applications were done with a direct inject sprayer equipment, which mixed the product with the water moments before the application without the need for the premix of the water-herbicide solution.

How varieties were tested

The 33 commercial varieties (26 at each location) listed in Table 1 were assessed for their responses to the successive levels of agronomic management. Varieties were grown in two row spacing arrangements: 30 inches between rows (Standard control), or 20 inches (all other treatments), as shown in Table 2. Foliar protection (fungicide and insecticide) consisted of applying Miravis Top (13.7 oz acre^{-1}) and Endigo ZC (3.8 oz acre^{-1}) (Syngenta) with MasterLock (6.4 oz acre^{-1}) (WinField) as the adjuvant at the R3 growth stage (beginning pod development). Phosphorus (P) and sulfur (S) fertility entailed broadcasting 100 pounds acre^{-1} of MicroEssentials S10 (Mosaic) at planting. Potassium (K) and boron (B) fertility was achieved by applying 103 pounds acre^{-1} of Aspire (Mosaic) broadcasted at planting. Neither fertility treatment was incorporated after broadcasting. Rates of the nutrients provided with the fertility treatments are shown in Table 3. Foliar sprays were applied July 23 (Yorkville), July 20 (Champaign), and July 19 (Nashville). Each variety was planted at 160,000 seeds acre^{-1}. Lastly, because environmental and geographical factors influence agronomic performance, 20 varieties were planted across all three Illinois sites representing a wide range in inherent soil fertility levels (Table 4) and different weather characteristics (Table 5).

Growing conditions

April and May were drier than normal at Yorkville and Champaign, while Nashville had less precipitation in May (Table 5), which, paired with the soil characteristics, resulted in some surface "crusting" at that site. However, the ability of the crop to compensate for lower stands did not limit the yield potential of soybean, especially with higher temperatures in June (Table 5).

Total precipitation over the summer months (June-September) was less than normal at the Yorkville site and greater than normal at Champaign and Nashville (Table 5), differing from the drier conditions observed in other Corn Belt states. However, season totals do not reflect the differing rainfall distribution experienced in 2021. For instance, Champaign and Yorkville had almost two times more precipitation in June, with tropical storms recorded in the second half of June at both sites, bringing high-speed wind gusts. In July, Nashville

recorded 5.3 inches of rain due to two storms that occurred six days apart in the first half of the month, followed by dry weather until the end of the month. Lack of rain at Yorkville in August and September (Table 5) resulted in abnormally dry conditions, and Champaign totals were close to normal but limited to few rain events with extreme precipitations observed in the middle of August, which resulted in lodged stands. Nashville's last two months of summer had good rain distribution, ideal for soybean grain fill. Lastly, frequent rain events at the beginning of the fall delayed harvest at Yorkville and Champaign.

Table 1. Variety Entries and Distribution.

Brand	MG	Variety	Yorkville	Champaign	Nashville
Asgrow	2.7	AG27XF1	X	X	
Asgrow	2.8	AG28XF2	X		
Asgrow	2.9	AG29XF2	X	X	X
Asgrow	3.0	AG30XF2	X	X	X
Asgrow	3.1	AG31XF2	X	X	X
Asgrow	3.3	AG33XF2	X	X	X
Asgrow	3.5	AG35XF1	X	X	X
Asgrow	3.7	AG37XF2	X	X	X
Asgrow	3.8	AG38XF1	X	X	X
Asgrow	4.0	AG40XF1	X	X	X
Asgrow	4.2	AG42XF0		X	X
Golden Harvest	1.9	GH1932XF	X		
Golden Harvest	2.1	GH2102XF	X		
Golden Harvest	2.2	GH2292E3	X		
Golden Harvest	2.4	GH2442E3	X		
Golden Harvest	2.5	GH2562XF	X	X	
Golden Harvest	2.7	GH2722XF	X	X	X
Golden Harvest	2.8	GH2872XF	X	X	X
Golden Harvest	2.9	GH2922E3	X	X	X
Golden Harvest	3.1	GH3132E3	X	X	X
Golden Harvest	3.1	GH3192XF	X	X	X
Golden Harvest	3.4	GH3442XF	X	X	X
Golden Harvest	3.5	GH3512E3S	X	X	X
Golden Harvest	3.7	GH3732XF	X	X	X
Golden Harvest	3.7	GH3762E3S	X	X	X
Golden Harvest	3.9	GH3902E3S	X	X	X
Golden Harvest	3.9	GH3952XF	X	X	X
Golden Harvest	4.0	GH4072E3		X	X
Golden Harvest	4.2	GH4222XF		X	X
Golden Harvest	4.3	GH4392XF		X	X
Golden Harvest	4.4	GH4452XFS		X	X
Golden Harvest	4.5	GH4512XF			X
Golden Harvest	4.5	GH4582E3			X

Data collection and analysis

Plots were harvested on November 5 (Yorkville), October 19 (Champaign), and October 9 (Nashville). Grain yield is reported as bushels per acre at 13% moisture in the individual location reports (Tables 6-8). Treatments were arranged in a split-split-plot experimental design, with row spacing (n=2) as the main plots and foliar protection and fertility in the 20 inch row blocks (n=3) as the subplots, with variety (n=26) randomly assigned within each treatment block. Statistical analysis was performed using a linear mixed model approach with PROC MIXED in SAS (version 9.4; SAS Institute, Cary, NC), and means were separated using Fisher's protected LSD test at the 0.10 level of significance. The normalities of residuals were assessed using PROC UNIVARIATE, and the assumption of homoscedasticity was tested using the Brown-Forsythe modification of the Levene Test in PROC GLM.

Table 2. Agronomic Treatments.

Treatment Description	Row Spacing	R3 Foliar Protection[1]	P and S Fertility[2]	K and B Fertility[3]
Standard	30	None	No	No
+ Narrow Rows	20	None	No	No
+ R3 Foliar Protection	20	Yes	No	No
+ P and S Fertility	20	Yes	Yes	No
+ K and B Fertility	20	Yes	Yes	Yes

[1]Miravis Top and Endigo ZC (Syngenta) applied at 13.7 oz/acre and 3.8 oz/acre, respectively.
[2]Applied as MicroEssentials S-10 broadcast at planting.
[3]Applied as Aspire broadcast at planting.

Table 3. Supplied Nutrients.

Treatment Description	N	P_2O_5	K_2O	S	B
	pounds acre^{-1}				
Standard	-	-	-	-	-
+ Narrow Rows	-	-	-	-	-
+ R3 Foliar Protection	-	-	-	-	-
+ P and S Fertility	12	40	-	10	-
+ K and B Fertility	12	40	60	10	0.5

Dashes represent nutrients not supplied.

Table 4. Preplant Soil Test Levels for Locations in Illinois.

Location	OM	CEC	pH	P	K	Ca	Mg	S	Zn
	%	Meq/100g		---------- ppm ----------					
Yorkville	6.4	22.8	6.6	58	185	2914	677	8	5.7
Champaign	3.7	16.7	6.9	34	123	2390	422	8	1.5
Nashville	2.7	9.9	7.1	47	113	1713	123	12	2.1

Soil samples were taken from the 0-6 inch depth before planting and extracted using Mehlich III.

Table 5. Weather (Precipitation and Average Temperature) During the Production Season at Yorkville, Champaign, and Nashville, Illinois in 2021 Compared to the 30-Year Average. Values are from the Illinois State Water Survey.

Month	Yorkville				Champaign				Nashville			
	Precipitation		Temperature		Precipitation		Temperature		Precipitation		Temperature	
	2021	30-Year Average	2021	30-Year Average	2021	30-Year Average	2021	30-Year Average	2021	30-Year Average	2021	30-Year Average
	inches		Fahrenheit		inches		Fahrenheit		inches		Fahrenheit	
April	1.9	3.0	49	49	2.1	3.7	53	53	4.5	4.4	57	56
May	3.4	3.8	59	60	3.4	4.7	61	63	4.1	4.9	64	66
June	6.6	3.8	73	70	7.6	4.4	75	72	2.8	3.9	77	74
July	2.7	3.2	71	72	4.3	4.1	74	75	9.8	3.3	77	77
August	1.1	3.4	73	70	4.1	3.4	76	74	3.1	3.3	78	75
September	1.3	3.0	67	63	3.0	3.1	70	67	3.4	2.9	71	68

Table 6. Yield of 26 Soybean Varieties in Response to Sequential Increases in Agronomic Management at Yorkville, Illinois in 2021.

			Yield[1]					
				Treatments are cumulative from left to right				
Brand	MG	Variety	Average	Standard	+Narrow rows	+Foliar protection	+P and S fertilization	+K and B fertilization
			bushels acre^{-1}					
Asgrow	2.7	AG27XF1	79.2	88.0	73.9	79.1	74.8	80.0
Asgrow	2.8	AG28XF2	84.3	85.4	85.6	83.9	82.9	83.8
Asgrow	2.9	AG29XF2	78.5	84.1	75.9	75.5	77.1	79.8
Asgrow	3.0	AG30XF2	90.3	86.9	84.8	93.8	91.8	94.3
Asgrow	3.1	AG31XF2	88.0	84.9	87.9	90.2	86.5	90.7
Asgrow	3.3	AG33XF2	72.6	77.8	70.8	73.9	71.7	68.7
Asgrow	3.5	AG35XF1	94.7	92.9	93.4	97.0	95.8	94.2
Asgrow	3.7	AG37XF2	91.0	89.3	85.4	90.2	99.2	91.0
Asgrow	3.8	AG38XF1	87.3	95.4	81.6	87.7	84.5	87.1
Asgrow	4.0	AG40XF1	86.5	91.2	81.6	86.1	88.4	85.5
Golden Harvest	1.9	GH1932XF	80.4	76.1	77.7	82.8	87.1	78.2
Golden Harvest	2.1	GH2102XF	76.8	74.1	74.3	79.5	81.2	75.0
Golden Harvest	2.2	GH2292E3	73.7	73.3	71.9	72.3	75.7	75.0
Golden Harvest	2.4	GH2442E3	72.6	68.2	71.1	76.4	76.7	70.5
Golden Harvest	2.5	GH2562XF	71.1	76.7	70.4	73.9	69.1	65.6
Golden Harvest	2.7	GH2722XF	82.8	81.6	80.8	81.4	83.7	86.6
Golden Harvest	2.8	GH2872XF	94.1	87.9	90.8	96.4	96.7	98.8
Golden Harvest	2.9	GH2922E3	89.1	83.3	84.8	94.1	88.6	94.7
Golden Harvest	3.1	GH3132E3	77.3	83.2	74.7	75.7	76.6	76.1
Golden Harvest	3.1	GH3192XF	97.2	92.3	92.5	103.2	98.2	99.7
Golden Harvest	3.4	GH3442XF	88.5	90.7	86.4	85.8	88.9	90.8
Golden Harvest	3.5	GH3512E3S	72.3	78.4	69.5	73.3	74.1	66.5
Golden Harvest	3.7	GH3732XF	98.3	92.8	92.6	103.3	103.4	99.5
Golden Harvest	3.7	GH3762E3S	91.6	90.3	89.8	95.9	85.1	97.1
Golden Harvest	3.9	GH3902E3S	83.6	81.4	89.8	83.3	82.1	81.1
Golden Harvest	3.9	GH3952XF	92.2	85.3	93.8	98.6	90.6	92.5
LSD ($P \leq 0.10$)			5.5	6.8	14.1	13.2	13.2	13.7
		Mean	84.4	84.3	82	85.9	85.0	84.7
		Range	71.1-98.3	68.2-95.4	69.5-93.8	72.3-103.3	69.1-103.4	65.6-99.7

[1]Values are presented with 13% moisture.

Table 7. Yield of 26 Soybean Varieties in Response to Sequential Increases in Agronomic Management at Champaign, Illinois in 2021.

			Yield[1]					
				Treatments are cumulative from left to right				
Brand	MG	Variety	Average	Standard	+Narrow rows	+Foliar protection	+P and S fertilization	+K and B fertilization
			bushels acre^{-1}					
Asgrow	2.7	AG27XF1	70.2	74.6	69.7	69.6	69.7	67.6
Asgrow	2.9	AG29XF2	71.3	73.0	72.7	73.2	66.6	70.9
Asgrow	3.0	AG30XF2	81.0	81.7	78.9	80.2	79.4	84.6
Asgrow	3.1	AG31XF2	75.9	75.8	77.0	75.2	78.1	74.1
Asgrow	3.3	AG33XF2	82.1	76.1	82.6	86.0	79.1	85.8
Asgrow	3.5	AG35XF1	86.7	87.7	82.3	89.6	81.7	92.4
Asgrow	3.7	AG37XF2	85.6	81.8	80.7	87.2	89.5	88.5
Asgrow	3.8	AG38XF1	94.3	91.9	93.2	95.9	91.9	98.4
Asgrow	4.0	AG40XF1	81.1	85.3	81.5	79.2	80.7	78.7
Asgrow	4.2	AG42XF0	92.1	85.8	91.3	95.6	93.5	94.5
Golden Harvest	2.5	GH2562XF	64.1	73.5	60.6	64.8	61.1	60.6
Golden Harvest	2.7	GH2722XF	74.0	79.7	76.8	72.6	69.6	71.0
Golden Harvest	2.8	GH2872XF	81.8	78.2	80.5	85.0	84.7	80.8
Golden Harvest	2.9	GH2922E3	73.6	79.2	70.1	73.0	72.7	73.0
Golden Harvest	3.1	GH3132E3	83.5	83.3	82.2	83.0	83.5	85.5
Golden Harvest	3.1	GH3192XF	93.6	93.8	97.5	91.1	92.2	93.4
Golden Harvest	3.4	GH3442XF	84.8	86.7	86.2	85.3	83.3	82.5
Golden Harvest	3.5	GH3512E3S	74.4	77.8	73.5	73.4	72.7	73.9
Golden Harvest	3.7	GH3732XF	100.7	100.6	97.1	103.7	101.6	100.3
Golden Harvest	3.7	GH3762E3S	88.0	86.6	87.9	91.6	87.2	86.9
Golden Harvest	3.9	GH3902E3S	89.0	91.3	88.9	90.9	88.2	85.6
Golden Harvest	3.9	GH3952XF	85.5	87.2	82.1	86.2	87.4	84.8
Golden Harvest	4.0	GH4072E3	77.9	86.1	71.5	78.3	78.0	75.6
Golden Harvest	4.2	GH4222XF	94.5	87.7	93.4	98.3	99.5	94.1
Golden Harvest	4.3	GH4392XF	93.7	96.0	89.1	90.8	93.7	99.1
Golden Harvest	4.4	GH4452XFS	86.8	88.9	83.6	85.9	86.6	88.8
LSD ($P \leq 0.10$)			4.0	6.7	9.2	10.6	8.1	9.9
		Mean	83.3	84.2	82.0	84.1	82.8	83.5
		Range	64.1-100.7	73.0-100.6	60.6-97.5	64.8-103.7	61.1-101.6	60.6-100.3

[1]Values are presented with 13% moisture.

Table 8. Yield of 26 Soybean Varieties in Response to Sequential Increases in Agronomic Management at Nashville, Illinois in 2021.

			Yield[1]					
				Treatments are cumulative from left to right				
Brand	MG	Variety	Average	Standard	+Narrow rows	+Foliar protection	+P and S fertilization	+K and B fertilization
			bushels acre^{-1}					
Asgrow	2.9	AG29XF2	73.6	75.5	71.5	72.7	74.4	73.9
Asgrow	3.0	AG30XF2	66.2	71.1	65.1	66.1	66.7	61.8
Asgrow	3.1	AG31XF2	56.9	59.9	55.8	58.0	58.8	51.7
Asgrow	3.3	AG33XF2	82.4	79.4	79.1	82.8	86.9	83.7
Asgrow	3.5	AG35XF1	81.8	83.0	76.7	80.8	87.8	80.4
Asgrow	3.7	AG37XF2	79.6	79.3	85.0	79.9	71.9	81.8
Asgrow	3.8	AG38XF1	86.2	88.1	80.6	87.9	86.4	87.7
Asgrow	4.0	AG40XF1	87.1	84.1	88.6	85.0	89.3	88.7
Asgrow	4.2	AG42XF0	93.4	95.9	89.6	90.9	93.4	97.0
Golden Harvest	2.7	GH2722XF	74.0	72.9	73.5	70.9	77.6	75.1
Golden Harvest	2.8	GH2872XF	67.2	67.1	64.9	65.4	70.6	68.4
Golden Harvest	2.9	GH2922E3	82.2	79.7	79.5	86.2	85.7	79.6
Golden Harvest	3.1	GH3132E3	90.6	85.9	89.3	88.1	93.2	97.8
Golden Harvest	3.1	GH3192XF	81.4	80.9	78.0	83.6	81.5	82.8
Golden Harvest	3.4	GH3442XF	81.1	83.6	79.1	77.6	84.7	80.6
Golden Harvest	3.5	GH3512E3S	77.8	75.4	75.9	76.4	78.5	82.9
Golden Harvest	3.7	GH3732XF	95.4	87.4	91.6	101.2	111.2	98.2
Golden Harvest	3.7	GH3762E3S	88.6	83.4	86.4	91.4	90.6	91.0
Golden Harvest	3.9	GH3902E3S	86.6	82.8	84.4	83.4	89.5	90.6
Golden Harvest	3.9	GH3952XF	89.1	88.0	89.0	85.7	94.8	87.7
Golden Harvest	4.0	GH4072E3	78.9	77.5	77.9	76.2	81.4	81.2
Golden Harvest	4.2	GH4222XF	103.0	97.0	100.6	105.2	104.2	108.6
Golden Harvest	4.3	GH4392XF	97.4	94.0	95.3	97.0	97.5	103.2
Golden Harvest	4.4	GH4452XFS	98.9	87.8	99.3	100.0	103.3	103.9
Golden Harvest	4.5	GH4512XF	94.9	84.9	94.6	96.2	96.0	102.5
Golden Harvest	4.5	GH4582E3	94.4	87.9	92.8	97.7	94.8	98.9
LSD ($P \leq 0.10$)			4.8	7.4	10.7	11.1	11.1	12.5
		Mean	84.2	82.0	82.5	84.1	86.6	86.1
		Range	56.9-103.0	59.9-97.0	55.8-100.6	58.0-105.2	58.8-111.2	51.7-108.6

[1]Values are presented with 13% moisture.