

2018 Soybean Management Yield Potential

Alison Vogel and Fred E. Below

Crop Physiology Laboratory, Department of Crop Sciences, University of Illinois

RESEARCH APPROACH:

Understanding soybean yield responses to foliar protection and increased fertility may help producers better position soybean varieties. The objective of this study is to identify ‘Offensive’ soybean varieties, or varieties with adaptability to high yield environments (i.e., responsive to crop management), and ‘Defensive’ soybean varieties, or varieties with acceptable yields in low yield environments (i.e., resilience to pests and diseases, and tolerance to nutrient deficiency). In our approach, ‘Offensive’ varieties are the genotypes that combine above-average yield increases from: (i) foliar protection [PROT, foliar protection (insecticide and fungicide) versus no-foliar protection], (ii) fertility [FERT, yield change between 0 and 187 lbs/acre of MicroEssentials S10 (N, P, & S)], and (iii) yield performance under the combination of both treatments (BOTH, yield with additional fertility and foliar protection). Conversely, varieties with high yield performance under no additional fertilizer or foliar protection (Control) and low yield response to foliar protection (low PROT) were considered ‘Defensive’ varieties.

The 2018 trial evaluated 61 soybean varieties from six different brands, and maturity groups ranging from 2.1 to 4.8 (Table 1). Thirty-six varieties were evaluated at Yorkville, Champaign, and Harrisburg. The trial was planted using a precision plot planter (SeedPro 360, ALMACO, Nevada, IA) at Harrisburg, IL (2 May 2018), Champaign, IL (16 May 2018), and Yorkville, IL (19 May 2018). Plots were 16 feet in length with 30-inch row spacing and two rows in width to achieve a final population of approximately 160,000 plants acre⁻¹. The foliar protection treatment was applied using a tractor mounted sprayer and consisted of an insecticide (Endigo® ZC; Lambda-cyhalothrin + Thiamethoxam) and fungicide (Trivapro™; Benzovindiflupyr + Azoxystrobin + Propiconazole) application at the R3 stage at a rate of 3.8 and 13.7 oz per acre, respectively. Application dates for foliar protection were 7 July 2018 (Harrisburg), 17 July 2018 (Champaign), and 25 July 2018 (Yorkville). The fertility treatment consisted of a premium MAP-based phosphorus fertilizer that also contained S, MicroEssentials S10 (MES10, 12-40-0-10S; The Mosaic Company, Plymouth, MN), applied at 187 lbs acre⁻¹ in a subsurface band 4 to 6 inches deep immediately prior to planting using a research-scale fertilizer toolbar to provide 22 lbs N, 75 lbs P₂O₅, and 18 lbs S per acre.

Plots were arranged in a split-plot RCB design with four replications. The main plot was fertility (n=2) and the split-plot was foliar protection (n= 2) and variety (n=36) randomly assigned within each treatment block. Data were analyzed using analysis of variance with the PROC MIXED procedure of SAS (Version 8, SAS Institute, Cary, NC) and means were separated using Fisher’s protected LSD test at the 0.10 level of significance. Variety, fertility, and foliar protection were considered fixed effects, while block and interactions with blocks were considered random effects. At maturity, yield (bu acre⁻¹) was measured with a plot combine and adjusted to constant moisture (i.e., 13% grain moisture concentration).

Table 1. The evaluation distribution of 61 soybean varieties at Yorkville, Champaign, and Harrisburg, IL in 2018. Varieties are arranged by brand name and maturity group.

Variety	Brand	Maturity Group	Yorkville	Champaign	Harrisburg
AG24X7	Asgrow	2.4	X		
AG24X9	Asgrow	2.4	X		
AG25X9	Asgrow	2.5	X		
AG27X7	Asgrow	2.7	X		
AG27X9	Asgrow	2.7	X		
AG28X9	Asgrow	2.8	X		
AG30X9	Asgrow	3.0	X	X	
AG32X8	Asgrow	3.2	X	X	
AG33X8	Asgrow	3.3	X	X	
AG34X6	Asgrow	3.4	X	X	
AG34X9	Asgrow	3.4	X	X	
AG36X6	Asgrow	3.6	X	X	X
AG37X9	Asgrow	3.7	X	X	X
AG39X7	Asgrow	3.9		X	X
AG41X8	Asgrow	4.1		X	X
AG42X6	Asgrow	4.2			X
AG42X9	Asgrow	4.2			X
AG44X6	Asgrow	4.4			X
AG46X6	Asgrow	4.6			X
AG48X9	Asgrow	4.8			X
R2C2674	Croplan	2.6	X		
RX3337	Croplan	3.3	X	X	
RX3556	Croplan	3.5	X	X	X
RX3896	Croplan	3.8	X	X	X
R2C4000	Croplan	4.0		X	X
RX4217s	Croplan	4.2		X	X
RX4316s	Croplan	4.3			X
S34XT69	Dyna-Gro	3.4	X	X	
S35XT97	Dyna-Gro	3.5	X	X	X
S36XT09	Dyna-Gro	3.6	X	X	X
S37XT28	Dyna-Gro	3.7	X	X	X
S37XS89	Dyna-Gro	3.7	X	X	X
S39XT68	Dyna-Gro	3.9		X	X
S41XS98	Dyna-Gro	4.1		X	X
S43XS27	Dyna-Gro	4.3			X
S44XS68	Dyna-Gro	4.4			X
S46XS87	Dyna-Gro	4.6			X
GH2537X	Golden Harvest	2.5	X		
GH2788X	Golden Harvest	2.7	X	X	
GH2981X	Golden Harvest	2.9	X		
GH3088X	Golden Harvest	3.0	X	X	
GH3195X	Golden Harvest	3.1	X	X	
GH3546X	Golden Harvest	3.5	X	X	X
GH3761X	Golden Harvest	3.7	X	X	X
GH3982X	Golden Harvest	3.9		X	X
GH4142X	Golden Harvest	4.1		X	X
GH4240XS	Golden Harvest	4.2		X	X
GH4307X	Golden Harvest	4.3			X
GH4524XS	Golden Harvest	4.5			X
NK21-W8X	NK	2.1	X		
NK33D7X	NK	3.3	X	X	
NK34T2X	NK	3.4	X	X	
NK45J3X	NK	4.5			X
P24A80X	Pioneer	2.4	X		
P28T71X	Pioneer	2.8	X		
P31A22X	Pioneer	3.1	X	X	
P36A18X	Pioneer	3.6	X	X	X
P38A98X	Pioneer	3.8		X	X
P40A47X	Pioneer	4.0		X	X
P42A52X	Pioneer	4.2		X	X
P46A93X	Pioneer	4.6			X

Table 2. Pre-plant soil properties and Mehlich 3-extraction-based mineral test results from the 6 inch level for the Soybean Management Yield Potential trail conducted at Yorkville, Champaign, and Harrisburg IL in 2018.

Location	OM†	pH	CEC	P	K	Ca	Mg	S
	%		Meg/100g			ppm		
Yorkville	5.3	6	25.7	47	235	3144	550	10
Champaign	3	6	20	44	157	2448	453	10
Harrisburg	2.7	6.5	21.6	46	232	3021	426	6

† OM, Organic Matter; CEC, Cation Exchange Capacity

Table 3. Precipitation and temperature during the production season at Yorkville, Champaign, and Harrisburg, IL in 2018 compared to the 30-year average. Values were obtained from Illinois State Water Survey.

Month	Yorkville, IL				Champaign, IL				Harrisburg, IL			
	Precip. (in)		Temp. (°F)		Precip. (in)		Temp. (°F)		Precip. (in)		Temp. (°F)	
	2018	30 Year Average	2018	30 Year Average	2018	30 Year Average	2018	30 Year Average	2018	30 Year Average	2018	30 Year Average
May	6.5	4.3	67	61	4.2	4.9	72	63	5.0	5.1	73	66
June	7.1	4.3	71	70	7.3	4.3	75	72	6.1	4.5	78	75
July	1.9	4.7	72	74	3.2	4.7	75	75	3.1	3.8	78	78
August	2.8	4.1	71	72	4.0	3.9	75	73	5.0	3.0	76	77
September	2.4	3.1	66	65	4.7	3.1	83	66	7.8	3.1	72	69

YIELD RESULTS:

Soil pH, organic matter, and fertility levels were relatively adequate, allowing for growing conditions generally conducive to favorable grain yields (Table 2). The 2018 crop growing season experienced excessive rainfall in June across the state (Table 3). During the remainder of the growing season rainfall was similar to the 30-year average. Throughout the growing season temperatures were consistent with the 30-year average, with the exception of excess heat in September at Champaign.

Location significantly affected grain yields, with average yields of 90.6, 86.8, and 79.0 bu acre⁻¹ for Yorkville, Champaign, and Harrisburg, respectively (Tables 4 to 6). Foliar protection increased soybean yield at Champaign and Harrisburg, but did not increase yield at Yorkville due to dry conditions during July and August, and low disease and insect pressure. Unlike foliar protection, additional fertility increased grain yield in Yorkville. On average, foliar protection increased yield by +0.7, +6.9 and +3.5 bu acre⁻¹ at Yorkville, Champaign, and Harrisburg, respectively, while fertility additions altered yield by +1.6, -0.8, and +0.2 bu acre⁻¹ at these same sites (Figures 1 to 3). Additional fertility in combination with foliar protection had the largest yield responses in Yorkville (+2.3 bu acre⁻¹) and Harrisburg (+3.7 bu acre⁻¹) compared to fertility or foliar protection alone. At Champaign, foliar protection alone resulted in the largest response at +6.9 bu acre⁻¹.

Across all three locations, varieties had significantly different grain yields. At standard management (no fertility additions or foliar protection) there was a yield range of 25, 28, and 20 bu acre⁻¹ from highest to lowest yielding varieties in Yorkville, Champaign, and Harrisburg, respectively. The largest range in yield from variety was with foliar protection in Harrisburg (36 bu acre⁻¹).

The highest yields recorded were 107.8, 103.4, and 91.7 bu acre⁻¹ at Yorkville, Champaign, and Harrisburg, respectively (varieties AG36X6, S41XS98, and AG42X6 and P46A93X, respectively). In Yorkville, the top five yields were from the following varieties (without repeating a variety): AG36X6 (107.8 bu acre⁻¹), RX3896 (104.9 bu acre⁻¹), AG32X8 (101.9 bu acre⁻¹), S34XT69 (101.9 bu acre⁻¹), AG37X9 (101.3 bu acre⁻¹), RX3337 (101.3 bu acre⁻¹), and S37XT28 (100.2 bu acre⁻¹). Moving down the state of Illinois, the top five yields in Champaign were achieved with the following varieties: S41XS98 (103.4 bu acre⁻¹), S39XT68 (100.5 bu acre⁻¹), AG37X9 (100.4 bu acre⁻¹), AG36X6 (100.4 bu acre⁻¹), GH3546X (99.7 bu acre⁻¹), AG32X8 (98.6 bu acre⁻¹), AG36X6 (98.6 bu acre⁻¹), and S36XT09 (97.7 bu acre⁻¹). Harrisburg achieved the highest overall yields with: AG42X6 (91.7 bu acre⁻¹), P46A93X (91.7 bu acre⁻¹), AG42X6 (91.4 bu acre⁻¹), AG41X8 (90.7 bu acre⁻¹), S39XT68 (88.4 bu acre⁻¹), S44XS68 (88.4 bu acre⁻¹), and S37XS89 (88.0 bu acre⁻¹).

Fertility responses from individual varieties compared to the untreated control at all locations ranged from -11.8 to +11.7 bu acre⁻¹ indicating different genetic sensitivity to soil nutrient availability. Foliar protection responses went from -12.5 to +19.7 bu acre⁻¹ and when applied in combination with fertility the responses ranged from -13.9 to +14.3 bu acre⁻¹.

The differences observed in yield performance among varieties and their interaction with agronomic management across environments highlights the importance of soybean genetic characterization in response to different agronomic factors. These characterizations will be summarized in a more in depth report to follow.

Yorkville, IL

Table 4. Grain yield of 36 commercial soybean varieties in response to fertilizer and foliar protection at **Yorkville, IL** in 2018. Within a seed brand, varieties are sorted by maturity group.

Variety	Foliar Protection			
	Without		With	
	Fertilizer (lbs acre ⁻¹)			
	0	187	0	187
Asgrow	bushels/acre			
AG24X7	77.0	75.8	76.7	81.6
AG24X9	75.6	84.7	79.8	87.2
AG25X9	76.5	86.2	75.5	86.4
AG27X7	78.5	75.6	80.6	81.5
AG27X9	85.3	81.5	86.2	88.3
AG28X9	85.9	92.9	83.7	89.1
AG30X9	93.1	95.9	96.5	95.6
AG32X8	98.3	99.3	98.4	101.9
AG33X8	97.0	96.7	94.1	93.6
AG34X6	97.8	93.4	98.2	99.8
AG34X9	92.0	96.8	92.0	98.7
AG36X6	100.2	107.8	102.6	101.2
AG37X9	93.6	94.0	100.9	101.3
Croplan				
R2C2674	88.1	89.1	87.4	88.0
RX3337	101.3	94.8	97.1	96.6
RX3556	94.3	95.7	95.1	94.1
RX3896	94.4	95.4	102.5	104.9
Dyna-Gro				
S34XT69	97.1	101.9	93.0	101.7
S35XT97	93.7	97.4	91.9	94.5
S36XT09	96.0	97.3	90.2	92.0
S37XS89	99.8	98.4	94.1	94.6
S37XT28	97.9	97.6	100.2	99.4
Golden Harvest				
GH2537X	79.2	76.9	83.7	87.3
GH2788X	78.2	84.5	81.2	81.1
GH2981X	91.8	90.0	91.7	93.6
GH3088X	86.1	86.7	88.4	90.2
GH3195X	88.9	93.6	83.8	93.3
GH3546X	92.4	84.5	89.8	82.7
GH3761X	81.0	82.1	91.8	86.4
NK				
NK21-W8X	78.1	80.2	79.7	80.9
NK33D7X	85.6	90.3	93.3	92.6
NK34T2X	89.0	92.3	88.3	90.8
Pioneer				
P24A80X	86.5	86.4	86.6	91.5
P28T71X	90.5	90.8	89.7	90.5
P31A22X	96.9	93.7	84.4	83.0
P36A18X	89.1	90.6	92.4	94.2
Overall Mean	89.6	90.9	90.0	91.8
Range	76-101	76-108	76-103	81-105
LSD ($P \leq 0.10$)	10.2	9.0	10.6	9.7

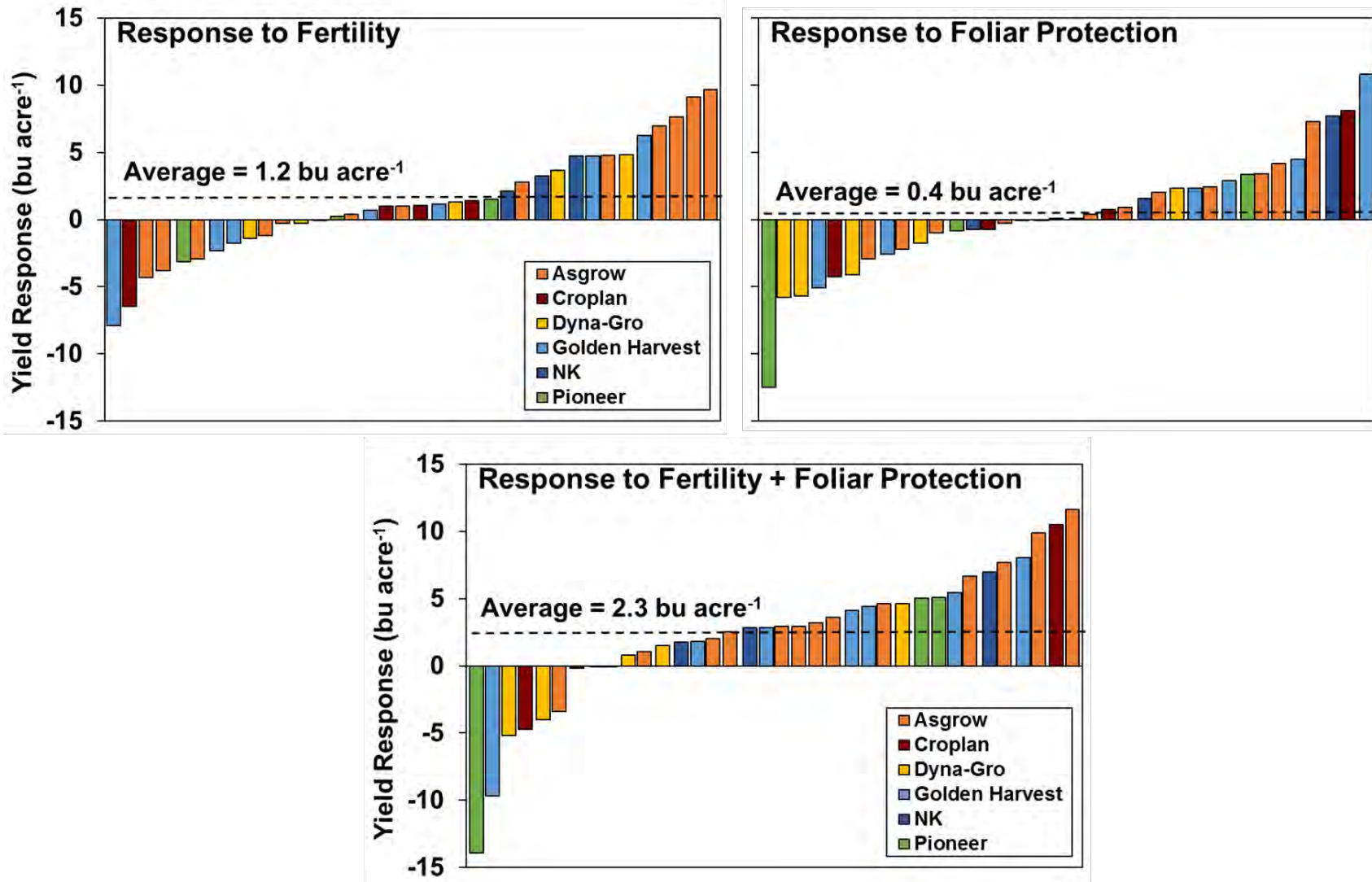


Figure 1. Yield response to fertility (yield difference between 0 and 187 lbs acre⁻¹ of MES10), foliar protection [yield difference between foliar protection (insecticide and fungicide) and no-foliar protection], and the combination of fertility and foliar protection (yield difference between control and 187 lbs acre⁻¹ of MES10 with foliar protection) for soybean grown at Yorkville, IL in 2018.

Champaign, IL

Table 5. Grain yield of 36 commercial soybean varieties in response to fertilizer and foliar protection at **Champaign, IL** in 2018. Within a seed brand, varieties are sorted by maturity group.

Variety	Foliar Protection			
	Without		With	
	Fertilizer (lbs acre ⁻¹)			
	0	187	0	187
Asgrow	bushels/acre			
AG30X9	80.8	76.0	84.0	82.7
AG32X8	90.8	82.4	98.6	96.0
AG33X8	81.8	82.5	91.3	96.0
AG34X6	88.5	91.2	87.8	90.9
AG34X9	83.3	84.2	87.8	84.9
AG36X6	93.8	96.9	98.6	100.4
AG37X9	89.9	86.3	96.7	100.4
AG39X7	84.4	82.8	92.0	90.7
AG41X8	85.2	81.9	95.6	90.9
Croplan				
RX3337	80.7	92.3	92.3	91.7
RX3556	89.6	92.4	95.8	97.6
RX3896	81.6	83.4	89.0	90.4
R2C4000	82.1	78.0	86.9	81.9
RX4217s	73.5	72.8	83.9	80.8
Dyna-Gro				
S34XT69	90.9	84.2	93.0	84.4
S35XT97	89.5	90.8	89.8	97.0
S36XT09	87.0	86.1	94.6	97.7
S37XT28	87.9	82.7	88.2	89.8
S37XS89	89.2	88.1	95.0	93.6
S39XT68	88.1	87.7	97.6	100.5
S41XS98	91.0	89.5	98.6	103.4
Golden Harvest				
GH2788X	74.7	70.2	81.8	81.2
GH3088X	80.4	84.0	88.9	86.0
GH3195X	72.5	72.7	83.2	74.8
GH3546X	86.5	84.0	98.9	99.7
GH3761X	84.2	81.9	82.3	85.6
GH3982X	81.1	79.0	91.0	91.7
GH4142X	77.0	80.2	84.0	81.0
GH4240XS	82.4	89.6	89.3	96.0
NK				
NK33D7X	88.5	76.7	87.2	85.7
NK34T2X	82.1	76.7	93.7	85.5
Pioneer				
P31A22X	66.0	65.4	85.7	72.2
P36A18X	79.4	75.1	91.9	87.2
P38A98X	86.1	92.2	92.3	94.1
P40A47X	86.7	84.7	92.3	94.8
P42A52X	77.1	78.4	83.9	81.9
Overall Mean	83.7	82.9	90.7	90.0
Range	66-94	65-97	82-99	72-103
LSD ($P \leq 0.10$)	9.3	9.1	8.1	10.6

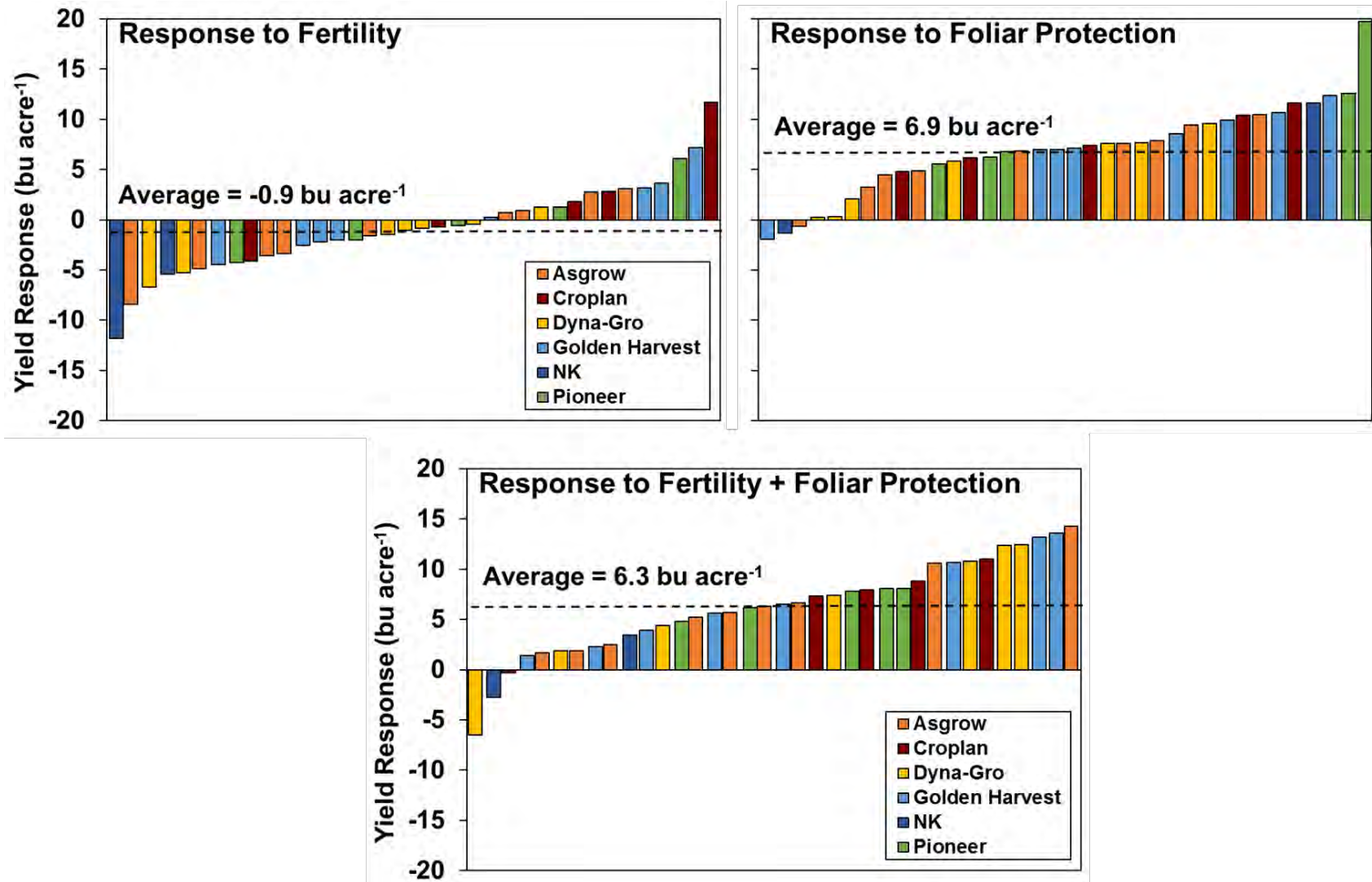


Figure 2. Yield response to fertility (yield difference between 0 and 187 lbs acre⁻¹ of MES10), foliar protection [yield difference between foliar protection (insecticide and fungicide) and no-foliar protection], and the combination of fertility and foliar protection (yield difference between control and 187 lbs acre⁻¹ of MES10 with foliar protection) for soybean grown at Champaign, IL in 2018.

Harrisburg, IL

Table 6. Grain yield of 36 commercial soybean varieties in response to fertilizer and foliar protection at **Harrisburg, IL** in 2018. Within a seed brand, varieties are sorted by maturity group.

Variety	Foliar Protection			
	Without		With	
	Fertilizer (lbs acre ⁻¹)			
	0	187	0	187
Asgrow	bushels/acre			
AG36X6	77.0	74.1	79.5	78.9
AG37X9	76.1	76.1	77.0	74.3
AG39X7	81.8	83.3	80.2	80.4
AG41X8	83.4	85.2	85.9	90.7
AG42X6	84.7	82.1	91.4	91.7
AG42X9	84.7	78.1	80.7	81.7
AG44X6	81.2	77.1	79.1	78.3
AG46X6	76.3	76.1	79.4	80.2
AG48X9	74.5	85.5	78.9	87.8
Croplan				
RX3556	66.1	64.8	56.4	69.2
RX3896	76.6	75.4	78.4	78.7
R2C4000	70.9	69.7	72.6	79.8
RX4217s	69.3	72.9	74.4	78.2
RX4316s	74.1	74.7	83.2	82.3
Dyna-Gro				
S35XT97	70.4	68.2	76.8	72.5
S36XT09	81.7	79.8	84.5	84.4
S37XS89	86.0	82.9	84.3	88.0
S37XT28	77.9	78.0	80.8	83.6
S39XT68	82.4	79.1	85.0	88.4
S41XS98	84.9	83.9	84.4	83.0
S43XS27	84.3	76.3	81.2	82.0
S44XS68	82.2	80.2	86.1	88.4
S46XS87	76.3	70.8	80.4	78.9
Golden Harvest				
GH3546X	75.5	76.4	79.9	79.8
GH3761X	73.4	71.6	78.6	77.2
GH3982X	74.0	72.9	78.2	80.2
GH4142X	70.9	67.4	74.3	77.0
GH4240XS	78.0	77.1	83.3	87.1
GH4307X	75.9	77.0	78.9	77.5
GH4524XS	83.8	77.4	83.0	84.5
NK				
NK S45-J3X	71.3	74.9	78.7	78.3
Pioneer				
P36A18X	74.0	74.0	76.5	71.9
P38A98X	72.7	77.5	77.4	75.9
P40A47X	76.5	82.5	84.8	86.6
P42A52X	82.0	82.2	80.8	84.1
P46A93X	86.3	82.6	91.7	89.5
Overall Mean	77.7	76.9	80.2	81.4
Range	66-86	65-85	56-92	69-92
LSD ($P \leq 0.10$)	8.3	7.9	8.6	7.6

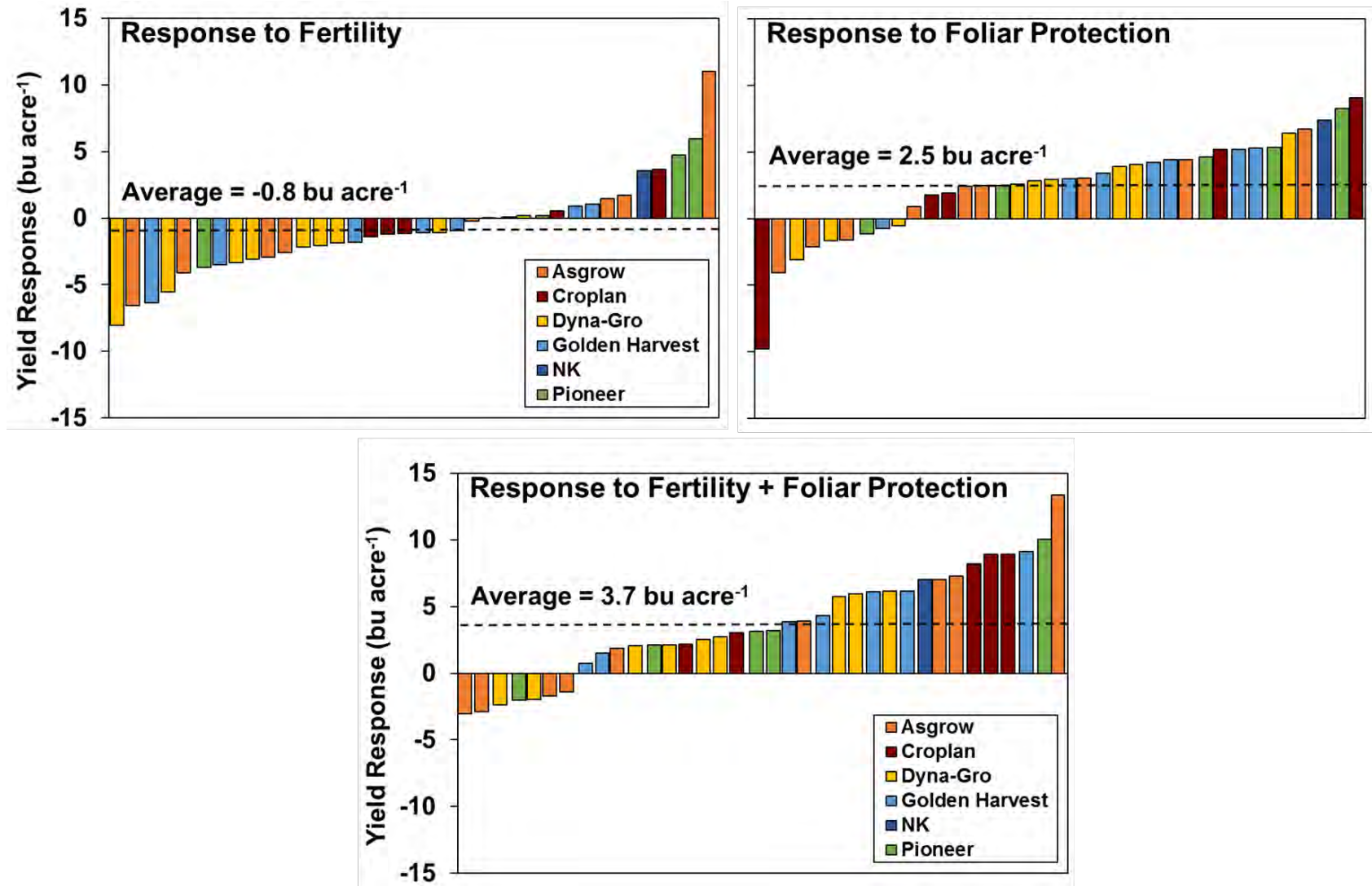


Figure 3. Yield response to fertility (yield difference between 0 and 187 lbs acre⁻¹ of MES10), foliar protection [yield difference between foliar protection (insecticide and fungicide) and no-foliar protection], and the combination of fertility and foliar protection (yield difference between control and 187 lbs acre⁻¹ of MES10 with foliar protection) for soybean grown at Harrisburg, IL in 2018.