

2017 Soybean Management Yield Potential

Part 1: Yields

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RESEARCH APPROACH:

Understanding soybean yield responses to foliar protection and increased fertility may help producers better position soybean varieties to their anticipated crop management situation. 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 [foliar protection (insecticide and fungicide) versus no-foliar protection], (ii) fertility [187 lbs acre⁻¹ of MicroEssentials S10 (N, P, & S) versus no added fertility], and/or (iii) the combination of both treatments (additional fertility and foliar protection). Conversely, varieties with high yield performance under no additional fertilizer or foliar protection (i.e., the control treatment) and low yield increases from foliar protection were considered ‘Defensive’ varieties.

The 2017 trial evaluated 66 soybean varieties from six different brands comprising maturity groups ranging from 2.5 to 4.8 (Table 1). Thirty-six varieties were evaluated at each of the three locations. The trial was planted using a precision plot planter (SeedPro 360, ALMACO, Nevada, IA) at Harrisburg, IL (10 May 2017), Yorkville, IL (15 May 2017), and Champaign, IL (29 May 2017). 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 by tractor 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 18 July 2017 (Harrisburg), 27 July 2017 (Yorkville), and 31 July 2017 (Champaign). 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 blocks. 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 66 soybean varieties at Yorkville, Champaign, and Harrisburg, IL in 2017. Varieties are arranged by brand name and maturity group.

Variety	Brand	Maturity Group	Yorkville	Champaign	Harrisburg
AG2636	Asgrow	2.6	X		
AG26X8	Asgrow	2.6	X		
AG27X7	Asgrow	2.7	X		
AG29X8	Asgrow	2.9	X		
AG30X8	Asgrow	3.0	X		
AG32X8	Asgrow	3.2	X	X	
AG33X8	Asgrow	3.3	X	X	
AG34X6	Asgrow	3.4	X	X	
AG36X6	Asgrow	3.6	X	X	X
AG37X8	Asgrow	3.7		X	
AG38X6	Asgrow	3.8		X	
AG38X8	Asgrow	3.8		X	
AG39X7	Asgrow	3.9		X	X
AG4135	Asgrow	4.1		X	X
AG42X6	Asgrow	4.2			X
AG43X7	Asgrow	4.3			X
AG43X8	Asgrow	4.3			X
AG44X6	Asgrow	4.4			X
AG46X8	Asgrow	4.6			X
AG46X6	Asgrow	4.6			X
AG48X7	Asgrow	4.8			X
R2C2674	Croplan	2.6	X		
R2C3113	Croplan	3.1	X	X	
RX3556	Croplan	3.5	X	X	X
RX3896	Croplan	3.8	X	X	X
R2C4000	Croplan	4.1		X	X
RX4316s	Croplan	4.3		X	X
S26XT88	Dyna-Gro	2.6	X		
S28XT58	Dyna-Gro	2.8	X		
SX17829XT	Dyna-Gro	2.9	X		
S30XT68	Dyna-Gro	3.0	X	X	
S30XT96	Dyna-Gro	3.0	X	X	
S31XT48	Dyna-Gro	3.1	X	X	
S33XT07	Dyna-Gro	3.3	X	X	
S34XT78	Dyna-Gro	3.4	X	X	
S35XT97	Dyna-Gro	3.5	X	X	
S37XT28	Dyna-Gro	3.7	X	X	X
S39XT08	Dyna-Gro	3.9		X	X
S39XT68	Dyna-Gro	3.9		X	X
S41XS98	Dyna-Gro	4.1			X
S43XS27	Dyna-Gro	4.3			X
S44XS57	Dyna-Gro	4.4			X
SX17844XS	Dyna-Gro	4.4			X
S45XS37	Dyna-Gro	4.5			X
S46XS87	Dyna-Gro	4.6			X
S48XS78	Dyna-Gro	4.8			X
GH2537X	Golden Harvest	2.5	X		
GH2788X	Golden Harvest	2.7	X		
GH2981X	Golden Harvest	2.9	X		
GH3195X	Golden Harvest	3.1	X	X	
GH3324X	Golden Harvest	3.3	X		
GH3546X	Golden Harvest	3.5	X	X	X
GH3761X	Golden Harvest	3.7	X	X	X
GH3982X	Golden Harvest	3.9	X	X	X
GH3985X	Golden Harvest	3.9		X	X
GH4142X	Golden Harvest	4.1		X	X
GH4307X	Golden Harvest	4.3			X
GH4542X	Golden Harvest	4.5			X
NK S30-V6	NK	3	X	X	
NK S37-Z8	NK	3.7	X	X	X
NK S39-C4	NK	3.9	X	X	X
NK S42-P6	NK	4.2		X	X
P33T19X	Pioneer	3.3	X	X	
P36T36X	Pioneer	3.6	X	X	
P40T26X	Pioneer	4.0		X	X
P46T30X	Pioneer	4.6			X

Table 2. Precipitation and temperature during the production season at Yorkville, Champaign, and Harrisburg, IL in 2017 compared to the 30-year average (Ave.). 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)	
	2017	Ave.	2017	Ave.	2017	Ave.	2017	Ave.	2017	Ave.	2017	Ave.
May	4.7	4.3	58	61	5.9	4.9	61	63	4.8	5.1	66	66
June	1.8	4.3	72	70	2.1	4.3	73	72	2.3	4.5	74	75
July	7.0	4.7	74	74	2.8	4.7	76	75	1.2	3.8	79	78
August	2.8	4.1	70	72	2.2	3.9	71	73	4.2	3.0	73	77
Sept.	0.1	3.1	68	65	0.8	3.1	69	66	1.5	3.1	70	69

Table 3. Pre-plant soil properties and Mehlich 3-extraction-based mineral test results obtained from 0 to 6 inches depth for the Soybean Management Yield Potential trial conducted at Yorkville, Champaign, and Harrisburg IL in 2017.

Location	OM†	pH	CEC	P	K	Ca	Mg	S
	%		Meg/100g			ppm		
Yorkville	5.2	5.8	22.3	43	201	2621	460	9.0
Champaign	2.8	6.3	16.7	33	120	2101	415	7.0
Harrisburg	2.1	6.6	13.2	20	140	2053	166	7.0

† OM, Organic Matter; CEC, Cation Exchange Capacity

YIELD RESULTS:

The 2017 crop growing season experienced excessive rainfall in May at Champaign and Yorkville (Table 2). During the remainder of the growing season (June through September) rainfall was below normal at all three locations, with the exceptions of July in Yorkville (2.3 inches more than the 30-year average) and August in Harrisburg (1.2 inches more than the 30-year average). Throughout the growing season temperatures at all sites were similar to the 30-year average, but August was cooler than normal while September was warmer than normal. Additionally, soil pH, organic matter, and fertility levels were relatively adequate, allowing for growing conditions generally conducive to favorable grain yields (Table 3).

Location significantly affected grain yields, with average yields of 81.8, 62.0, and 90.5 bu acre⁻¹ for Yorkville, Champaign, and Harrisburg, respectively (Tables 4 to 6). Foliar protection tended to increase soybean yields at Yorkville and Harrisburg, but did not increase yield at Champaign due to dry conditions and low disease and insect pressure. On average, foliar protection alone increased yield by +2.5, 0, and +3.5 bu acre⁻¹ at Yorkville, Champaign, and Harrisburg, respectively, while fertility additions alone altered yield by -1.2, +1.4, and +0.8 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 (+2.8 bu acre⁻¹) and Harrisburg (+3.8 bu acre⁻¹) compared to fertility or foliar protection alone.

Across all three locations, varieties exhibited significantly different grain yields. At standard management (no fertility additions or foliar protection), highest to lowest yielding varieties differed by 15, 13, and 19 bu acre⁻¹ in Yorkville, Champaign, and Harrisburg, respectively. The largest varietal yield range was from additional fertility in Harrisburg (23 bu acre⁻¹).

The highest yields recorded were 91.0, 70.3, and 103.8 bu acre⁻¹ at Yorkville, Champaign, and Harrisburg, respectively (varieties R2C2674, AG36X6, and NK S39-C4, respectively) observed when the plants were grown under increased fertility plus foliar protection conditions. In Yorkville, the top five yields were from the following varieties: R2C2674 (91.0 bu acre⁻¹), GH3195X (90.4 bu acre⁻¹), GH2981X (89.4 bu acre⁻¹), S28XT58 (89.3 bu acre⁻¹), and GH2788X (89.0 bu acre⁻¹), all achieved with foliar protection plus fertility. Moving down the state of Illinois, the top five yields in Champaign were achieved with the following varieties: AG36X6 (70.3 bu acre⁻¹), AG34X6 (68.6 bu acre⁻¹), AG4135 (68.5 bu acre⁻¹), P40T26X (68.2 bu acre⁻¹), and AG32X8 (67.3 bu acre⁻¹). Harrisburg achieved the highest overall yields with: NK S39-C4 (103.8 bu acre⁻¹), NK S42-P6 (103.2 bu acre⁻¹), S41XS98 (100.3 bu acre⁻¹), AG39X7 (98.2 bu acre⁻¹), RX3556 (97.9 bu acre⁻¹), and S37XT28 (97.9 bu acre⁻¹).

Yield responses of individual varieties to additional fertility compared to the untreated control at all locations ranged from -7.6 to +8.4 bu acre⁻¹, indicating different genetic sensitivity to soil nutrient availability. Foliar protection changed yield by -5.8 to +11.4 bu acre⁻¹, and when applied in combination with fertility, yields changed by -7.1 to +12.3 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.

Table 4. Grain yield of 36 commercial soybean varieties in response to fertilizer and foliar protection at **Yorkville, IL** in 2017. Within a seed brand, varieties are sorted by maturity group. Values are the average of four replications.

Variety	Foliar Protection			
	Without		With	
	Fertilizer (lbs acre ⁻¹)			
	0	187	0	187
Asgrow	bu acre ⁻¹			
AG2636	85.5	81.0	86.2	83.7
AG26X8	84.8	86.0	85.3	85.2
AG27X7	78.7	79.4	79.5	85.2
AG29X8	77.1	80.1	77.4	81.2
AG30X8	77.3	76.2	78.2	82.8
AG32X8	82.4	82.0	87.1	87.2
AG33X8	80.2	79.5	80.9	78.9
AG34X6	77.8	75.6	84.2	82.0
AG36X6	79.5	79.1	79.3	81.4
Croplan				
R2C2674	84.5	85.5	87.2	91.0
R2C3113	80.5	78.7	83.0	85.0
RX3556	80.8	80.6	82.2	85.0
RX3896	71.6	70.9	77.4	75.7
Dyna-Gro				
S26XT88	78.0	78.5	78.3	78.6
S28XT58	83.4	84.5	86.8	89.3
SX17829XT	81.0	81.1	85.4	84.2
S30XT68	85.5	78.5	87.6	86.5
S30XT96	81.5	83.1	87.0	85.3
S31XT48	75.0	81.3	83.7	82.8
S33XT07	81.7	77.0	81.4	78.2
S34XT78	84.5	82.3	84.6	85.6
S35XT97	81.1	78.0	82.5	80.8
S37XT28	79.6	83.4	83.8	83.2
Golden Harvest				
GH2537X	82.2	81.1	86.3	83.8
GH2788X	86.8	85.6	89.0	89.0
GH2981X	78.7	80.6	86.1	89.4
GH3195X	86.3	85.8	85.2	90.4
GH3324X	79.7	82.5	79.4	81.3
GH3546X	84.2	80.8	84.7	88.8
GH3761X	80.8	74.9	87.2	82.9
GH3982X	75.4	67.7	86.2	79.7
NK				
NK S30-V6	79.7	74.8	83.3	84.8
NK S37-Z8	80.7	76.4	84.0	84.7
NK S39-C4	81.4	76.0	75.6	74.2
Pioneer				
P33T19X	84.7	83.7	81.6	80.5
P36T36X	76.3	73.5	81.6	81.4
Overall Mean	80.8	79.6	83.3	83.6
Range	72-87	68-86	76-89	74-91
LSD ($P \leq 0.10$)	4.8	5.9	5.6	5.9

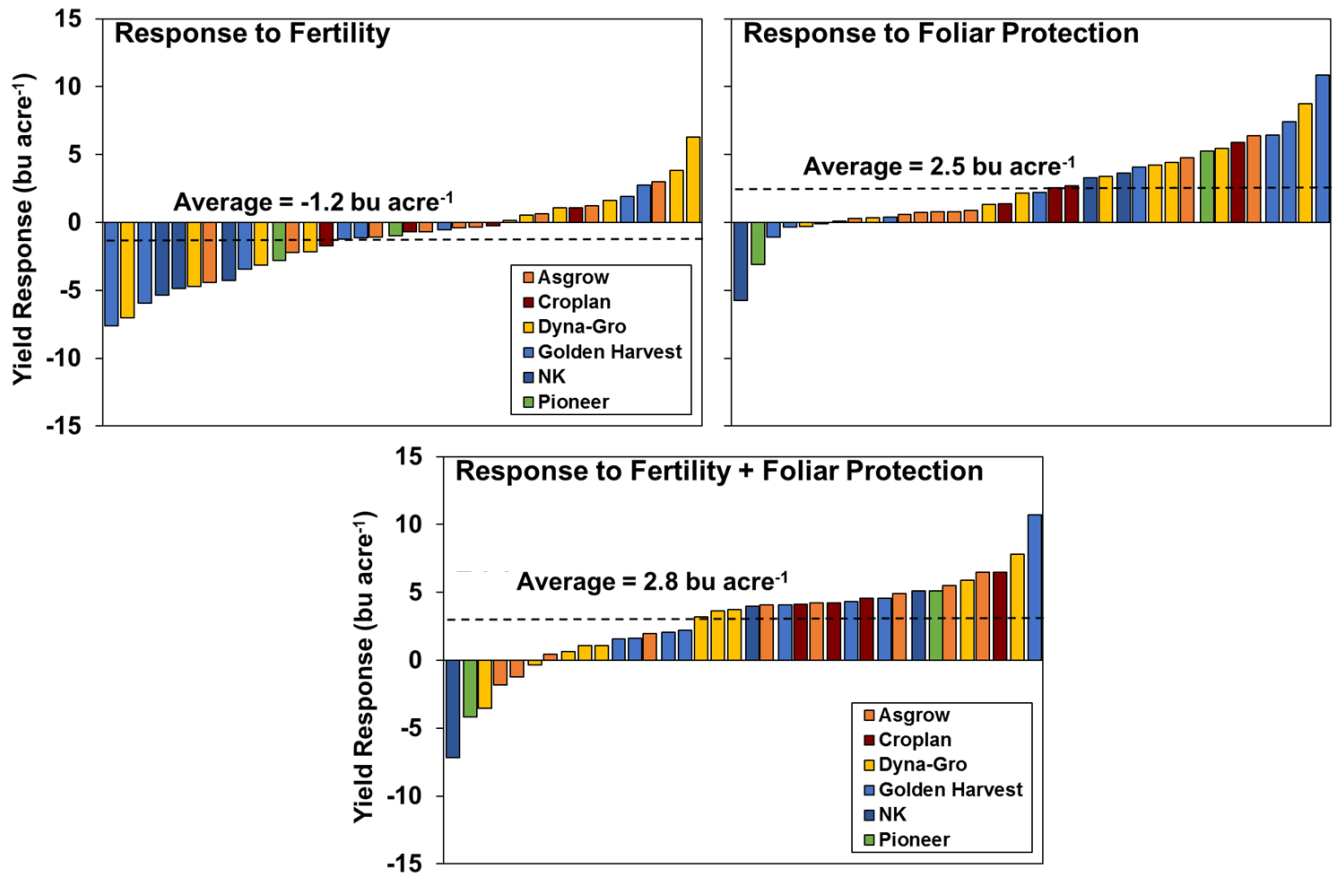


Figure 1. Yield response to fertility (yield difference between 0 and 187 lbs acre⁻¹ of MES10), foliar protection [yield difference between foliar protection (insecticide and fungicide) and no foliar protection], and the combination of fertility and foliar protection (yield difference between control and 187 lbs acre⁻¹ of MES10 with foliar protection) for 36 soybean varieties grown at **Yorkville**, IL in 2017.

Champaign, IL

Table 5. Grain yield of 36 commercial soybean varieties in response to fertilizer and foliar protection at **Champaign, IL** in 2017. Within a seed brand, varieties are sorted by maturity group.

Variety	Foliar Protection			
	Without		With	
	Fertilizer (lbs acre ⁻¹)			
	0	187	0	187
Asgrow	bu acre ⁻¹			
AG32X8	66.1	63.2	67.3	61.9
AG33X8	60.7	61.9	61.1	60.7
AG34X6	68.6	66.9	66.4	65.3
AG36X6	62.6	64.3	68.7	70.3
AG37X8	66.6	66.0	62.4	63.4
AG38X6	59.2	62.7	58.5	62.1
AG38X8	57.5	55.9	57.3	54.5
AG39X7	63.8	65.4	59.8	63.2
AG4135	68.5	68.5	68.5	67.6
Croplan				
R2C3113	64.3	64.1	61.0	63.1
R2C4000	61.7	65.0	64.1	63.6
RX3556	65.5	62.9	63.1	62.7
RX3896	59.3	63.9	60.5	65.0
RX4316s	65.0	66.1	64.0	62.8
Dyna-Gro				
S30XT68	62.1	64.7	61.9	65.8
S30XT96	59.6	63.3	56.9	57.9
S31XT48	62.9	65.4	61.0	64.0
S33XT07	61.3	67.0	61.2	61.4
S34XT78	65.1	62.4	62.9	64.3
S35XT97	60.5	64.5	59.6	66.1
S37XT28	61.1	62.6	59.4	61.0
S39XT08	54.4	53.7	53.9	54.5
S39XT68	64.7	65.3	63.1	62.3
Golden Harvest				
GH3195X	61.9	64.5	62.6	65.6
GH3546X	63.2	59.6	62.4	61.7
GH3761X	61.8	59.1	62.6	59.3
GH3982X	64.9	65.2	65.3	66.1
GH3985X	54.4	55.6	56.2	57.7
GH4142X	57.7	62.7	57.7	60.0
NK				
NK S30-V6	58.1	59.7	59.4	60.2
NK S37-Z8	61.0	66.0	60.9	59.6
NK S39-C4	54.9	57.4	57.5	60.2
NK S42-P6	57.8	59.2	59.2	58.7
Pioneer				
P33T19X	61.2	64.5	59.1	60.5
P36T36X	55.9	60.6	57.6	58.7
P40T26X	59.7	64.9	61.2	68.2
Overall Mean	61.5	62.9	61.2	62.2
Range	54-67	54-69	54-69	55-70
LSD ($P \leq 0.10$)	6.0	7.5	6.9	7.4

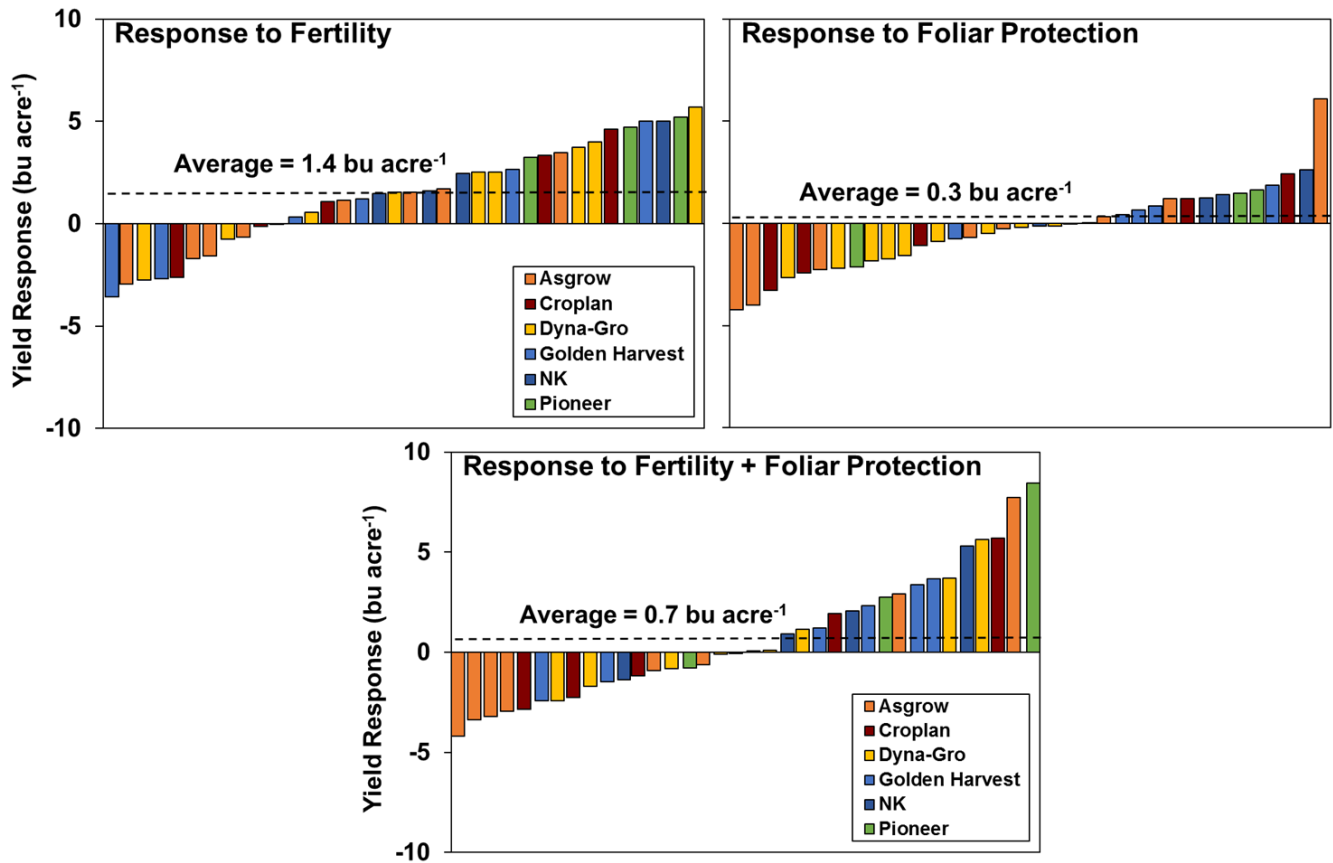


Figure 2. Yield response to fertility (yield difference between 0 and 187 lbs acre⁻¹ of MES10), foliar protection [yield difference between foliar protection (insecticide and fungicide) and no foliar protection], and the combination of fertility and foliar protection (yield difference between control and 187 lbs acre⁻¹ of MES10 with foliar protection) for 36 varieties of soybean grown at **Champaign, IL** in 2017.

Table 6. Grain yield of 36 commercial soybean varieties in response to fertilizer and foliar protection on soybean grain yield at **Harrisburg, IL** in 2017. Within a seed brand, varieties are sorted by maturity group.

Variety	Foliar Protection			
	Without		With	
	Fertilizer (lbs acre ⁻¹)			
	0	187	0	187
Asgrow	bu acre ⁻¹			
AG36X6	86.7	87.5	93.8	96.7
AG39X7	88.8	92.4	98.2	95.6
AG4135	90.2	90.1	97.0	95.3
AG42X6	87.6	90.3	92.6	95.9
AG43X7	86.8	88.3	86.8	91.6
AG43X8	87.8	83.6	93.1	91.7
AG44X6	81.0	89.5	89.0	93.2
AG46X8	88.5	88.7	92.9	92.5
AG46X6	86.0	84.6	80.7	85.2
AG48X7	79.8	79.9	78.9	92.1
Croplan				
RX3556	94.6	94.4	97.0	97.9
RX3896	85.4	85.6	91.3	90.0
R2C4000	90.7	88.1	93.1	92.6
RX4316s	86.8	88.1	89.6	88.9
Dyna-Gro				
S37XT28	96.4	96.9	97.9	96.9
S39XT08	87.3	82.1	90.5	91.6
S39XT68	84.3	89.9	95.7	95.6
S41XS98	90.7	94.6	97.4	100.3
S43XS27	88.4	87.6	92.2	87.7
S44XS57	88.5	89.4	92.9	90.1
SX17844XS	88.3	86.0	91.0	90.2
S45XS37	93.2	90.9	94.2	92.2
S46XS87	82.9	86.5	84.0	85.9
S48XS78	87.7	83.9	88.4	85.7
Golden Harvest				
GH3546X	90.6	92.1	96.5	93.1
GH3761X	89.9	95.0	95.1	92.8
GH3982X	89.8	91.9	93.7	91.0
GH3985X	82.6	86.3	87.3	89.6
GH4142X	78.6	81.9	84.2	83.8
GH4307X	92.9	93.1	94.0	94.8
GH4542X	88.3	87.9	89.1	90.1
NK				
NK S37-Z8	94.5	90.7	91.8	95.5
NK S39-C4	95.3	95.6	98.3	103.8
NK S42-P6	98.1	103.2	98.6	94.6
Pioneer				
P40T26X	85.7	86.1	87.7	90.7
P46T30X	90.7	92.9	95.2	88.4
Overall Mean	88.5	89.3	91.9	92.3
Range	79-98	80-103	79-99	88-104
LSD ($P \leq 0.10$)	5.9	6.2	5.1	5.7

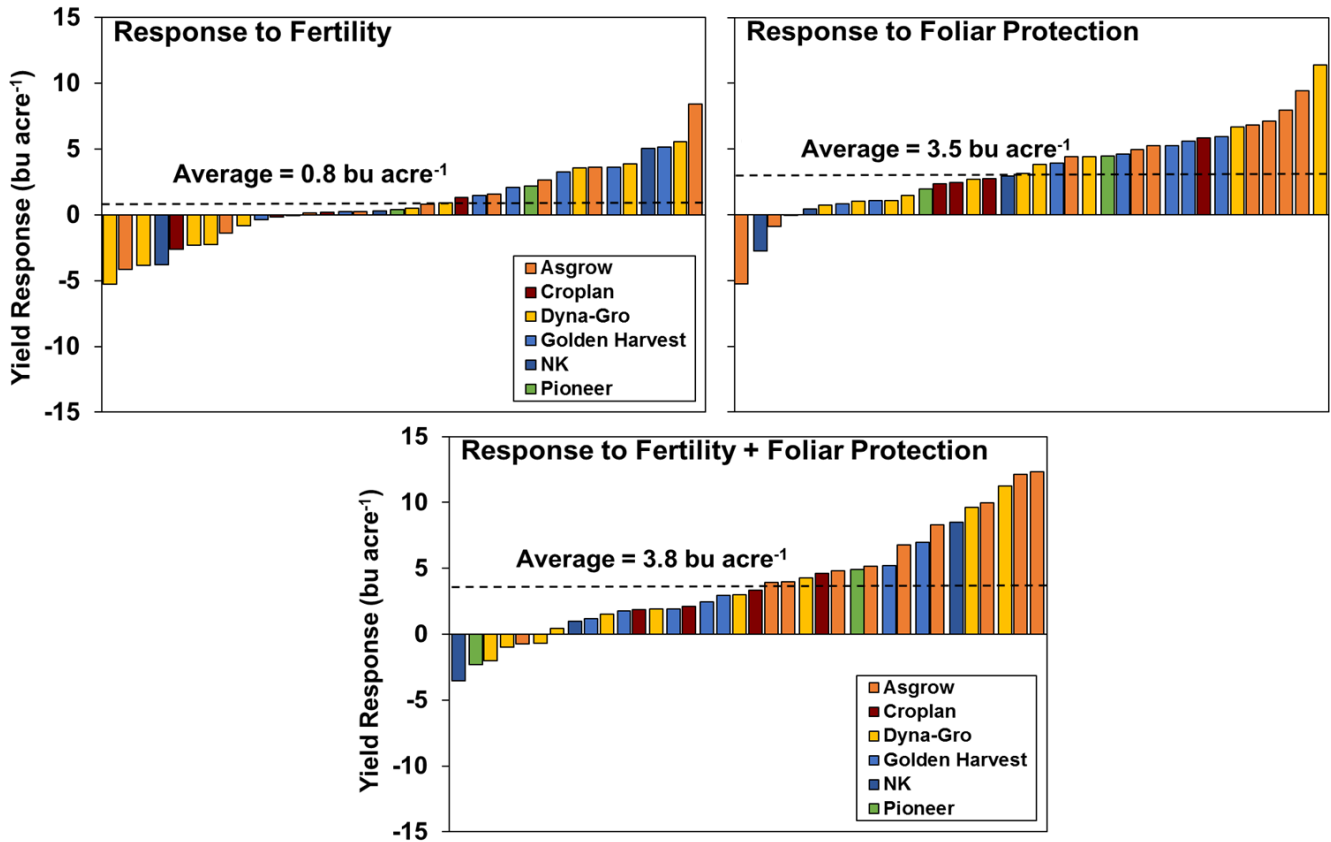


Figure 3. Yield response to fertility (yield difference between 0 and 187 lbs acre⁻¹ of MES10), foliar protection [yield difference between foliar protection (insecticide and fungicide) and no-foliar protection], and the combination of fertility and foliar protection (yield difference between control and 187 lbs acre⁻¹ of MES10 with foliar protection) for 36 varieties of soybean grown at **Harrisburg, IL** in 2017.