

# 2016 Soybean Management Yield Potential

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## Introduction

Although soybean yields have increased four-fold between 1924 and 2010, average yields have maintained relatively constant during the last 5 years. This yield improvement in the U.S. has been mostly due to genetic improvement (Specht et al., 1999) while the agricultural inputs in the soybean crop have remained unchanged. Modern high-yielding corn hybrids have the ability to extract a large amount of nutrients from the soil (especially phosphorus and potassium) (Bender et al., 2015). Nutrient removal by the previous corn crop may decrease yield of the following soybean crop if the remaining soil nutrient status doesn't meet the soybean requirement. Most of the potassium (K) accumulation in soybean occurs during vegetative and early reproductive growth, while most of the nitrogen (N), phosphorus (P), and sulfur (S) uptake occurs during seed-filling (Bender et al., 2015). In addition, approximately 60-80% of these nutrients are permanently removed from the soil in the harvested soybean grain. There has been little research investigating the soybean genetic differences regarding the yield response to increased soil fertility.

In addition, little information is available regarding soybean genotypic differences in response to foliar protection (fungicides and insecticides). Soybean varieties having different defensive mechanisms against pathogen and insect damage will likely exhibit yield differences in response to foliar protection. Most soybean farmers apply fungicides and/or insecticides only after assessment of the current pathogen and insect pest infestation levels (Bradley, 2009). However, fungicide applications in soybean may also provide improved plant physiological effects regardless of the presence of pathogens (Venancio et al., 2003). Understanding the soybean yield responses to foliar protection and increased fertility may help agronomists better position their soybean genotypes to provide more accurate agronomic recommendations for farmers.

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 SZ (N, P, S, & Zn)], 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.

## Materials and Methods

The 2016 trial evaluated 46 soybean varieties from four different brands, and maturity groups ranging from 2.3 to 4.8 (Table 1a and 1b). However, only 28 varieties were evaluated at Champaign and Harrisburg, and 29 varieties at Yorkville, IL. The trial was planted using a precision plot planter (SeedPro 360, ALMACO, Nevada, IA) at Harrisburg, IL (05 May 2016), Yorkville, IL (19 May 2016), and Champaign, IL (22 May 2016). Plots were 17.5 feet in length

with 30-inch row spacing and two rows in width to achieve a final population of approximately 160,000 plants acre<sup>-1</sup>. The foliar protection treatment was applied using a backpack sprayer and consisted of an insecticide (Endigo® ZC; Lambda-cyhalothrin + Thiamethoxam) and fungicide (Quadris Top® SB™; Azoxystrobin + Difenconazole) application at the R3 stage at a rate of 4 and 12 oz per acre, respectively. Application dates for foliar protection were 15 July 2016 (Harrisburg), 21 July 2016 (Yorkville), and 26 July 2016 (Champaign). The fertility treatment consisted of a premium MAP-based phosphorus fertilizer that also contained S and Zn, MicroEssentials SZ (MESZ, 12-40-0-10S-1Zn; The Mosaic Company, Plymouth, MN), applied at 187 lbs acre<sup>-1</sup> 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 P<sub>2</sub>O<sub>5</sub>, 18 lbs S and 1.8 lbs Zn per acre. Soil tests values (using Mehlich 3 extraction) at the 6 inch level taken immediately prior to planting for each site are given below.

| <b>Location</b>   | <b>OM</b> | <b>pH</b> | <b>CEC</b> | <b>P</b> | <b>K</b> | <b>Ca</b> | <b>Mg</b> | <b>S</b> | <b>Zn</b> |
|-------------------|-----------|-----------|------------|----------|----------|-----------|-----------|----------|-----------|
|                   | %         |           | Meg/100g   |          |          | ppm       |           |          |           |
| <b>Yorkville</b>  | 6.1       | 6.1       | 31.8       | 35       | 213      | 3888      | 840       | 14       | 3.5       |
| <b>Champaign</b>  | 3.5       | 6.4       | 19.5       | 21       | 145      | 2651      | 414       | 8        | 0.9       |
| <b>Harrisburg</b> | 3.1       | 6.1       | 20.6       | 62       | 219      | 2511      | 472       | 12       | 1.1       |

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=28 or 29) 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<sup>-1</sup>) was measured with a plot combine and adjusted to constant moisture (i.e., 13% grain moisture concentration).

Varieties were rated using the PROC RANK procedure of SAS to generate decile scores for yield response to foliar protection (PROT), fertility (FERT), fertility and foliar protection (PROT + FERT), yield under no additional fertilizer or foliar protection (Yield Control), and yield under the combination of both treatments (Yield BOTH). Response scores for each parameter and variety were calculated for each location. In the response scale, a 1 indicates the lowest yield and 10 the greatest yield. Our ultimate goal is to develop ‘Offensive’ and ‘Defensive’ indices for each soybean variety that describes their agronomic characteristics and responses to crop management. However, due to the limited number of varieties testing across all locations, and only having one year of data, we are currently unable to generate indices for all the parameters. Thus, we simply ranked the varieties for each of the measured parameters (Yield Control, Yield Both, and the yield responses to foliar protection (PROT), fertilization (FERT) and both foliar protection and fertilization (PROT + FERT), used these rankings to infer how an individual variety might respond to management.

**Table 1a.** Arrangement by maturity group and name of the 46 soybean varieties evaluated in the Soybean Management Yield Potential trial in 2016 grown at Champaign, Yorkville, and Harrisburg, IL.

| Variety   | Brand    | Maturity Group | Champaign | Yorkville | Harrisburg |
|-----------|----------|----------------|-----------|-----------|------------|
| AG23X6    | Asgrow   | 2.3            |           | x         |            |
| AG24X7    | Asgrow   | 2.4            |           | x         |            |
| AG25X6    | Asgrow   | 2.5            |           | x         |            |
| AG2636    | Asgrow   | 2.6            |           | x         |            |
| R2C2674   | Croplan  | 2.6            | x         | x         |            |
| AG27X7    | Asgrow   | 2.7            |           | x         |            |
| P27T47R   | Pioneer  | 2.7            |           | x         |            |
| AG2836    | Asgrow   | 2.8            |           | x         |            |
| AG28X7    | Asgrow   | 2.8            |           | x         |            |
| S28-N6    | Syngenta | 2.8            | x         | x         | x          |
| AG30X6    | Asgrow   | 3.0            | x         | x         |            |
| S30-V6    | Syngenta | 3.0            | x         | x         | x          |
| P31T77R   | Pioneer  | 3.1            |           | x         |            |
| R2C3113   | Croplan  | 3.1            | x         | x         | x          |
| AG32X6    | Asgrow   | 3.2            | x         | x         |            |
| RX3296    | Croplan  | 3.2            | x         | x         |            |
| R2C3323   | Croplan  | 3.3            | x         | x         | x          |
| AG34X6    | Asgrow   | 3.4            | x         | x         |            |
| P34T07R2  | Pioneer  | 3.4            | x         | x         |            |
| AG35X7    | Asgrow   | 3.5            | x         | x         |            |
| RX3556    | Croplan  | 3.5            | x         | x         | x          |
| S35-A5    | Syngenta | 3.5            | x         | x         | x          |
| AG36X6    | Asgrow   | 3.6            | x         |           |            |
| P36T86R   | Pioneer  | 3.6            | x         |           | x          |
| RX3746    | Croplan  | 3.7            | x         | x         | x          |
| S37-Z8    | Syngenta | 3.7            | x         | x         | x          |
| AG3832    | Asgrow   | 3.8            | x         |           |            |
| AG38X6    | Asgrow   | 3.8            | x         |           | x          |
| R2C3822   | Croplan  | 3.8            | x         | x         | x          |
| RX3896    | Croplan  | 3.8            | x         | x         | x          |
| AG39X7    | Asgrow   | 3.9            | x         |           | x          |
| S39-C4    | Syngenta | 3.9            | x         | x         | x          |
| AG40X6    | Asgrow   | 4.0            | x         |           | x          |
| R2C4000   | Croplan  | 4.0            | x         | x         | x          |
| AG4135    | Asgrow   | 4.1            | x         |           | x          |
| RX4106    | Croplan  | 4.1            |           |           | x          |
| 94Y23     | Pioneer  | 4.2            |           |           | x          |
| AG42X6    | Asgrow   | 4.2            |           |           | x          |
| S42-P6    | Syngenta | 4.2            | x         | x         | x          |
| AG43X7    | Asgrow   | 4.3            |           |           | x          |
| RX4316STS | Croplan  | 4.3            | x         |           | x          |
| AG44X6    | Asgrow   | 4.4            |           |           | x          |
| AG45X6    | Asgrow   | 4.5            |           |           | x          |
| AG46X6    | Asgrow   | 4.6            |           |           | x          |
| P47T36R   | Pioneer  | 4.7            |           |           | x          |
| AG48X7    | Asgrow   | 4.8            |           |           | x          |

**Table 1b.** Arrangement by brand name and maturity group of the 46 varieties evaluated in the Soybean Management Yield Potential trial in 2016 grown at Champaign, Yorkville, and Harrisburg IL.

| Variety   | Maturity Group | Champaign | Yorkville | Harrisburg |
|-----------|----------------|-----------|-----------|------------|
| AG23X6    | 2.3            |           | x         |            |
| AG24X7    | 2.4            |           | x         |            |
| AG25X6    | 2.5            |           | x         |            |
| AG2636    | 2.6            |           | x         |            |
| AG27X7    | 2.7            |           | x         |            |
| AG2836    | 2.8            |           | x         |            |
| AG28X7    | 2.8            |           | x         |            |
| AG30X6    | 3.0            | x         | x         |            |
| AG32X6    | 3.2            | x         | x         |            |
| AG34X6    | 3.4            | x         | x         |            |
| AG35X7    | 3.5            | x         | x         |            |
| AG36X6    | 3.6            | x         |           |            |
| AG3832    | 3.8            | x         |           |            |
| AG38X6    | 3.8            | x         |           | x          |
| AG39X7    | 3.9            | x         |           | x          |
| AG40X6    | 4.0            | x         |           | x          |
| AG4135    | 4.1            | x         |           | x          |
| AG42X6    | 4.2            |           |           | x          |
| AG43X7    | 4.3            |           |           | x          |
| AG44X6    | 4.4            |           |           | x          |
| AG45X6    | 4.5            |           |           | x          |
| AG46X6    | 4.6            |           |           | x          |
| AG48X7    | 4.8            |           |           | x          |
| R2C2674   | 2.6            | x         | x         |            |
| R2C3113   | 3.1            | x         | x         | x          |
| RX3296    | 3.2            | x         | x         |            |
| R2C3323   | 3.3            | x         | x         | x          |
| RX3556    | 3.5            | x         | x         | x          |
| RX3746    | 3.7            | x         | x         | x          |
| R2C3822   | 3.8            | x         | x         | x          |
| RX3896    | 3.8            | x         | x         | x          |
| R2C4000   | 4.0            | x         | x         | x          |
| RX4106    | 4.1            |           |           | x          |
| RX4316STS | 4.3            | x         |           | x          |
| P27T47R   | 2.7            |           | x         |            |
| P31T77R   | 3.1            |           | x         |            |
| P34T07R2  | 3.4            | x         | x         |            |
| P36T86R   | 3.6            | x         |           | x          |
| 94Y23     | 4.2            |           |           | x          |
| P47T36R   | 4.7            |           |           | x          |
| S28-N6    | 2.8            | x         | x         | x          |
| S30-V6    | 3.0            | x         | x         | x          |
| S35-A5    | 3.5            | x         | x         | x          |
| S37-Z8    | 3.7            | x         | x         | x          |
| S39-C4    | 3.9            | x         | x         | x          |
| S42-P6    | 4.2            | x         | x         | x          |

## Yield Results

### Treatment Effects

Significant genotypic and fertility effects were observed across all three locations (Table 2). Large F values indicate large treatment effect and yield variation due to treatment effect. Significant genotype by fertility interaction was observed at all locations indicating that soybean varieties differ in their yield production as a result of increased fertility. Foliar protection increased soybean yield at Champaign and Harrisburg, but did not increase yield at Yorkville due to low disease and insect pressure. There was no genotype by foliar protection interaction, indicating that the genotypes had similar yield changes due to the addition of foliar protection.

**Table 2.** Significance (*p*-value) and F-value for genotype, fertility, and foliar protection and their interaction effects at Champaign, Yorkville, and Harrisburg, IL in 2016.

| Source                        | Champaign |                 | Yorkville |                 | Harrisburg |                 |
|-------------------------------|-----------|-----------------|-----------|-----------------|------------|-----------------|
|                               | F Value   | <i>p</i> -value | F Value   | <i>p</i> -value | F Value    | <i>p</i> -value |
| <b>Genotype</b>               | 13.0      | <.001           | 8.9       | <.001           | 32.3       | <.001           |
| <b>Fertility</b>              | 46.7      | <.001           | 14.5      | 0.001           | 305.3      | <.001           |
| <b>Geno. x Fert</b>           | 1.9       | 0.003           | 1.6       | 0.029           | 1.8        | 0.090           |
| <b>Foliar Protection</b>      | 29.1      | <.001           | 0.3       | 0.584           | 122.6      | <.001           |
| <b>Geno. x Foliar</b>         | 0.8       | 0.800           | 0.5       | 0.975           | 1.3        | 0.145           |
| <b>Fert. x Foliar</b>         | 0.2       | 0.703           | 0.0       | 0.931           | 1.9        | 0.172           |
| <b>Geno. x Fert. x Foliar</b> | 0.8       | 0.704           | 0.4       | 0.999           | 0.7        | 0.890           |
| <b>Block</b>                  | 9.5       | <.001           | 9.9       | <.001           | 5.6        | 0.001           |

The following three sections correspond to the yield results for each treatment and variety, and the yield produced with different agronomic management factors at each location. Within each location section, the first five to six tables (e.g., Tables 3 to 7) describe the yield rank of each variety under different soil fertility and foliar protection conditions. Next are overall average yield values for all treatment combinations in a summary table (e.g., Table 8). Lastly, the yield responses (change in yield over respective controls) to the different agronomic managements (e.g., Figure 1) are presented for each location.

**Champaign, IL**
**Table 3.** Soybean grain yield when grown with no fertilizer or foliar protection application (Control) at Champaign, IL in 2016.

| Rank         | Variety   | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|-----------|--------------------------------------|-----------------------|---------|--------------------------------------|
| 1            | P34T07R2  | 93.6                                 | 16                    | S37-Z8  | 83.3                                 |
| 2            | S39-C4    | 90.3                                 | 17                    | P36T86R | 83.1                                 |
| 3            | RX3896    | 89.9                                 | 18                    | RX3746  | 82.9                                 |
| 4            | AG4135    | 87.3                                 | 19                    | AG30X6  | 82.4                                 |
| 5            | RX3556    | 87.0                                 | 20                    | AG38X6  | 82.3                                 |
| 6            | AG36X6    | 86.5                                 | 21                    | AG39X7  | 82.2                                 |
| 7            | R2C4000   | 84.8                                 | 22                    | RX3296  | 82.0                                 |
| 8            | S42-P6    | 84.6                                 | 23                    | AG40X6  | 81.2                                 |
| 9            | AG35X7    | 84.0                                 | 24                    | S35-A5  | 81.2                                 |
| 10           | R2C3113   | 83.8                                 | 25                    | AG32X6  | 81.0                                 |
| 11           | R2C3323   | 83.8                                 | 26                    | AG3832  | 80.4                                 |
| 12           | S30-V6    | 83.8                                 | 27                    | R2C3822 | 79.1                                 |
| 13           | AG34X6    | 83.7                                 | 28                    | S28-N6  | 76.0                                 |
| 14           | R2C2674   | 83.6                                 |                       |         |                                      |
| 15           | RX4316STS | 83.4                                 |                       |         |                                      |
| Overall Mean |           | 83.8                                 | LSD ( $P \leq 0.10$ ) |         | 4.3                                  |

**Table 4.** Soybean grain yield when grown with 187 lbs acre<sup>-1</sup> of MicroEssentials SZ and no foliar protection application at Champaign, IL in 2016.

| Rank         | Variety   | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|-----------|--------------------------------------|-----------------------|---------|--------------------------------------|
| 1            | RX4316STS | 92.5                                 | 16                    | S30-V6  | 86.8                                 |
| 2            | RX3746    | 91.9                                 | 17                    | R2C3113 | 86.1                                 |
| 3            | RX3896    | 91.9                                 | 18                    | RX3296  | 86.0                                 |
| 4            | AG3832    | 91.8                                 | 19                    | AG38X6  | 85.5                                 |
| 5            | P34T07R2  | 91.4                                 | 20                    | P36T86R | 84.7                                 |
| 6            | AG34X6    | 91.4                                 | 21                    | AG30X6  | 81.8                                 |
| 7            | S42-P6    | 91.2                                 | 22                    | R2C3822 | 81.4                                 |
| 8            | RX3556    | 90.5                                 | 23                    | S28-N6  | 80.5                                 |
| 9            | AG39X7    | 89.1                                 | 24                    | AG32X6  | 80.5                                 |
| 10           | AG36X6    | 89.1                                 | 25                    | AG40X6  | 80.2                                 |
| 11           | R2C4000   | 88.8                                 | 26                    | AG35X7  | 79.4                                 |
| 12           | R2C2674   | 88.2                                 | 27                    | R2C3323 | 78.8                                 |
| 13           | S39-C4    | 87.9                                 | 28                    | S35-A5  | 76.2                                 |
| 14           | AG4135    | 87.7                                 |                       |         |                                      |
| 15           | S37-Z8    | 87.6                                 |                       |         |                                      |
| Overall Mean |           | 86.4                                 | LSD ( $P \leq 0.10$ ) |         | 5.2                                  |

**Table 5.** Soybean grain yield when grown with no fertilizer and one foliar protection application (fungicide and insecticide) at the R3 growth stage at Champaign, IL in 2016.

| Rank         | Variety   | Grain yield           | Rank                  | Variety | Grain yield           |
|--------------|-----------|-----------------------|-----------------------|---------|-----------------------|
|              |           | bu acre <sup>-1</sup> |                       |         | bu acre <sup>-1</sup> |
| 1            | P34T07R2  | 94.7                  | 16                    | RX3296  | 84.0                  |
| 2            | RX3556    | 93.3                  | 17                    | R2C3323 | 83.5                  |
| 3            | S39-C4    | 91.5                  | 18                    | R2C3113 | 83.5                  |
| 4            | RX3896    | 91.5                  | 19                    | AG3832  | 83.2                  |
| 5            | AG4135    | 90.6                  | 20                    | AG38X6  | 83.0                  |
| 6            | S37-Z8    | 88.2                  | 21                    | S42-P6  | 83.0                  |
| 7            | S30-V6    | 88.0                  | 22                    | AG35X7  | 82.3                  |
| 8            | R2C4000   | 87.6                  | 23                    | AG30X6  | 82.1                  |
| 9            | P36T86R   | 87.1                  | 24                    | AG40X6  | 81.6                  |
| 10           | AG34X6    | 87.0                  | 25                    | S28-N6  | 81.3                  |
| 11           | RX4316STS | 86.9                  | 26                    | S35-A5  | 81.3                  |
| 12           | RX3746    | 86.9                  | 27                    | AG32X6  | 80.1                  |
| 13           | AG36X6    | 86.8                  | 28                    | R2C3822 | 79.2                  |
| 14           | R2C2674   | 86.1                  |                       |         |                       |
| 15           | AG39X7    | 85.8                  |                       |         |                       |
| Overall Mean |           | 85.7                  | LSD ( $P \leq 0.10$ ) |         | 5.4                   |

**Table 6.** Soybean grain yield when grown at 187 lbs acre<sup>-1</sup> of MicroEssentials SZ and one foliar protection application (fungicide and insecticide) at the R3 growth stage at Champaign, IL in 2016.

| Rank         | Variety   | Grain yield           | Rank                  | Variety | Grain yield           |
|--------------|-----------|-----------------------|-----------------------|---------|-----------------------|
|              |           | bu acre <sup>-1</sup> |                       |         | bu acre <sup>-1</sup> |
| 1            | RX3896    | 97.2                  | 16                    | AG40X6  | 87.6                  |
| 2            | S39-C4    | 95.6                  | 17                    | AG30X6  | 87.5                  |
| 3            | RX3556    | 95.6                  | 18                    | R2C4000 | 86.7                  |
| 4            | RX4316STS | 95.2                  | 19                    | R2C3822 | 86.6                  |
| 5            | AG4135    | 94.3                  | 20                    | AG38X6  | 85.9                  |
| 6            | P34T07R2  | 94.2                  | 21                    | AG35X7  | 85.5                  |
| 7            | AG39X7    | 93.8                  | 22                    | RX3296  | 84.9                  |
| 8            | S37-Z8    | 92.6                  | 23                    | AG3832  | 84.2                  |
| 9            | AG36X6    | 92.6                  | 24                    | P36T86R | 82.5                  |
| 10           | AG34X6    | 92.5                  | 25                    | S35-A5  | 81.4                  |
| 11           | R2C2674   | 91.6                  | 26                    | S28-N6  | 81.1                  |
| 12           | RX3746    | 91.4                  | 27                    | AG32X6  | 79.2                  |
| 13           | S42-P6    | 90.1                  | 28                    | R2C3323 | 78.2                  |
| 14           | S30-V6    | 88.4                  |                       |         |                       |
| 15           | R2C3113   | 87.9                  |                       |         |                       |
| Overall Mean |           | 88.7                  | LSD ( $P \leq 0.10$ ) |         | 6.2                   |

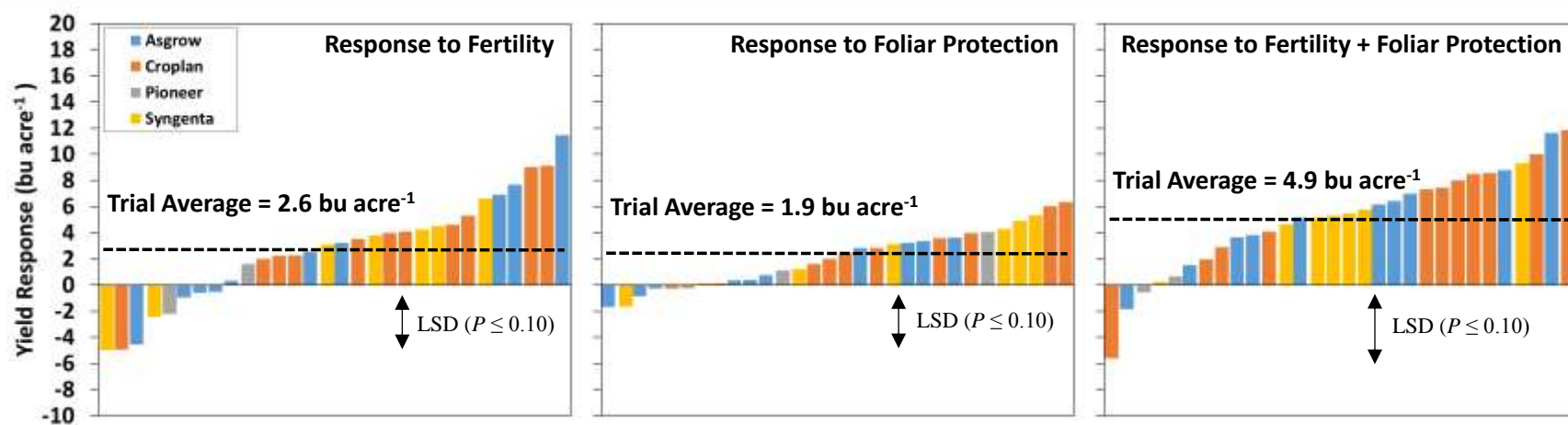


**Table 7.** Impact of fertilizer and foliar protection on soybean grain yield at Champaign, IL in 2016.

| Variety               | Foliar Protection                    |       |       |       |
|-----------------------|--------------------------------------|-------|-------|-------|
|                       | Without                              |       | With  |       |
|                       | Fertilizer (lbs acre <sup>-1</sup> ) |       |       |       |
|                       | 0                                    | 187   | 0     | 187   |
| <b>Asgrow</b>         | bu acre <sup>-1</sup>                |       |       |       |
| AG30X6                | 82.4                                 | 81.8  | 82.1  | 87.5  |
| AG32X6                | 81.0                                 | 80.5  | 80.1  | 79.2  |
| AG34X6                | 83.7                                 | 91.4  | 87.0  | 92.5  |
| AG35X7                | 84.0                                 | 79.4  | 82.3  | 85.5  |
| AG36X6                | 86.5                                 | 89.1  | 86.8  | 92.6  |
| AG3832                | 80.4                                 | 91.8  | 83.2  | 84.2  |
| AG38X6                | 82.3                                 | 85.5  | 83.0  | 85.9  |
| AG39X7                | 82.2                                 | 89.1  | 85.8  | 93.8  |
| AG40X6                | 81.2                                 | 80.2  | 81.6  | 87.6  |
| AG4135                | 87.3                                 | 87.7  | 90.6  | 94.3  |
| <b>Croplan</b>        |                                      |       |       |       |
| R2C2674               | 83.6                                 | 88.2  | 86.1  | 91.6  |
| R2C3113               | 83.8                                 | 86.1  | 83.5  | 87.9  |
| R2C3323               | 83.8                                 | 78.8  | 83.5  | 78.2  |
| R2C3822               | 79.1                                 | 81.4  | 79.2  | 86.6  |
| R2C4000               | 84.8                                 | 88.8  | 87.6  | 86.7  |
| RX3296                | 82.0                                 | 86.0  | 84.0  | 84.9  |
| RX3556                | 87.0                                 | 90.5  | 93.3  | 95.6  |
| RX3746                | 82.9                                 | 91.9  | 86.9  | 91.4  |
| RX3896                | 89.9                                 | 91.9  | 91.5  | 97.2  |
| RX4316STS             | 83.4                                 | 92.5  | 86.9  | 95.2  |
| <b>Pioneer</b>        |                                      |       |       |       |
| P34T07R2              | 93.6                                 | 91.4  | 94.7  | 94.2  |
| P36T86R               | 83.1                                 | 84.7  | 87.1  | 82.5  |
| <b>Syngenta</b>       |                                      |       |       |       |
| S28-N6                | 76.0                                 | 80.5  | 81.3  | 81.1  |
| S30-V6                | 83.8                                 | 86.8  | 88.0  | 88.4  |
| S35-A5                | 81.2                                 | 76.2  | 81.3  | 81.4  |
| S37-Z8                | 83.3                                 | 87.6  | 88.2  | 92.6  |
| S39-C4                | 90.3                                 | 87.9  | 91.5  | 95.6  |
| S42-P6                | 84.6                                 | 91.2  | 83.0  | 90.1  |
| LSD ( $P \leq 0.10$ ) | 4.3                                  | 5.2   | 5.4   | 6.2   |
| Mean                  | 83.8                                 | 86.4  | 85.7  | 88.7  |
| Range                 | 76-94                                | 76-92 | 79-95 | 78-97 |

**Table 8.** Influence of seed brand, foliar protection, and fertilizer on average soybean yield at Champaign, IL in 2016.

| Brand    | Foliar Protection                    |      |      |      |
|----------|--------------------------------------|------|------|------|
|          | Without                              |      | With |      |
|          | Fertilizer (lbs acre <sup>-1</sup> ) |      |      |      |
|          | 0                                    | 187  | 0    | 187  |
|          | bu acre <sup>-1</sup>                |      |      |      |
| Asgrow   | 83.1                                 | 85.6 | 84.3 | 88.3 |
| Croplan  | 84.0                                 | 87.6 | 86.3 | 89.5 |
| Pioneer  | 88.3                                 | 88.0 | 90.9 | 88.4 |
| Syngenta | 83.2                                 | 85.0 | 85.6 | 88.2 |



**Figure 1.** Yield response to fertility (yield difference between 0 and 187 lbs/acre of MESZ), 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 of MESZ with foliar protection) for soybean grown at Champaign, IL in 2016.

## Yorkville

**Table 9.** Soybean grain yield when grown with no fertilizer or foliar protection application (Control) at Yorkville, IL in 2016.

| Rank         | Variety | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety  | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|---------|--------------------------------------|-----------------------|----------|--------------------------------------|
| 1            | AG35X7  | 101.8                                | 16                    | S39-C4   | 90.2                                 |
| 2            | P31T77R | 100.2                                | 17                    | P34T07R2 | 89.9                                 |
| 3            | RX3556  | 99.0                                 | 18                    | S37-Z8   | 89.7                                 |
| 4            | S42-P6  | 97.3                                 | 19                    | AG27X7   | 89.2                                 |
| 5            | AG32X6  | 96.1                                 | 20                    | P27T47R  | 88.9                                 |
| 6            | RX3296  | 94.2                                 | 21                    | AG30X6   | 88.6                                 |
| 7            | AG2636  | 94.0                                 | 22                    | R2C3323  | 88.2                                 |
| 8            | R2C4000 | 94.0                                 | 23                    | AG34X6   | 86.7                                 |
| 9            | S28-N6  | 93.9                                 | 24                    | AG24X7   | 85.8                                 |
| 10           | AG2836  | 93.2                                 | 25                    | S35-A5   | 85.4                                 |
| 11           | RX3746  | 92.8                                 | 26                    | R2C3822  | 84.6                                 |
| 12           | R2C2674 | 91.8                                 | 27                    | S30-V6   | 84.5                                 |
| 13           | AG28X7  | 91.3                                 | 28                    | AG23X6   | 73.8                                 |
| 14           | R2C3113 | 90.7                                 | 29                    | AG25X6   | 70.9                                 |
| 15           | RX3896  | 90.6                                 |                       |          |                                      |
| Overall Mean |         | 90.3                                 | LSD ( $P \leq 0.10$ ) |          | 6.6                                  |

**Table 10.** Soybean grain yield when grown with 187 lbs acre<sup>-1</sup> of MicroEssentials SZ and no foliar protection application at Yorkville, IL in 2016.

| Rank         | Variety | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety  | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|---------|--------------------------------------|-----------------------|----------|--------------------------------------|
| 1            | P31T77R | 102.8                                | 16                    | RX3746   | 92.6                                 |
| 2            | AG2636  | 102.5                                | 17                    | AG32X6   | 91.8                                 |
| 3            | S42-P6  | 101.5                                | 18                    | AG2836   | 91.3                                 |
| 4            | RX3296  | 100.5                                | 19                    | R2C4000  | 91.2                                 |
| 5            | RX3556  | 99.9                                 | 20                    | S39-C4   | 90.0                                 |
| 6            | S28-N6  | 99.0                                 | 21                    | S35-A5   | 89.6                                 |
| 7            | R2C3323 | 98.4                                 | 22                    | RX3896   | 89.5                                 |
| 8            | R2C3822 | 98.1                                 | 23                    | AG24X7   | 89.0                                 |
| 9            | R2C3113 | 97.0                                 | 24                    | AG23X6   | 88.0                                 |
| 10           | P27T47R | 95.2                                 | 25                    | AG27X7   | 85.5                                 |
| 11           | AG34X6  | 93.7                                 | 26                    | AG30X6   | 84.9                                 |
| 12           | AG28X7  | 93.7                                 | 27                    | S30-V6   | 84.2                                 |
| 13           | R2C2674 | 93.3                                 | 28                    | P34T07R2 | 83.7                                 |
| 14           | AG35X7  | 93.1                                 | 29                    | AG25X6   | 76.6                                 |
| 15           | S37-Z8  | 93.0                                 |                       |          |                                      |
| Overall Mean |         | 92.8                                 | LSD ( $P \leq 0.10$ ) |          | 8.3                                  |

**Table 11.** Soybean grain yield when grown with no fertilizer and one foliar protection application (fungicide and insecticide) at the R3 growth stage at Yorkville, IL in 2016.

| Rank         | Variety | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety  | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|---------|--------------------------------------|-----------------------|----------|--------------------------------------|
| 1            | RX3556  | 99.6                                 | 16                    | AG30X6   | 89.3                                 |
| 2            | P31T77R | 98.6                                 | 17                    | S37-Z8   | 88.9                                 |
| 3            | AG35X7  | 98.5                                 | 18                    | AG34X6   | 88.9                                 |
| 4            | R2C2674 | 95.7                                 | 19                    | R2C4000  | 88.7                                 |
| 5            | S42-P6  | 95.6                                 | 20                    | P34T07R2 | 88.5                                 |
| 6            | S28-N6  | 94.6                                 | 21                    | R2C3113  | 88.5                                 |
| 7            | AG27X7  | 94.0                                 | 22                    | AG24X7   | 87.8                                 |
| 8            | P27T47R | 94.0                                 | 23                    | S35-A5   | 87.6                                 |
| 9            | S39-C4  | 93.8                                 | 24                    | AG2836   | 85.5                                 |
| 10           | AG32X6  | 93.5                                 | 25                    | RX3896   | 85.0                                 |
| 11           | RX3746  | 92.7                                 | 26                    | R2C3822  | 84.9                                 |
| 12           | R2C3323 | 92.3                                 | 27                    | S30-V6   | 81.7                                 |
| 13           | RX3296  | 91.8                                 | 28                    | AG23X6   | 74.5                                 |
| 14           | AG2636  | 91.8                                 | 29                    | AG25X6   | 71.9                                 |
| 15           | AG28X7  | 90.6                                 |                       |          |                                      |
| Overall Mean |         | 90.0                                 | LSD ( $P \leq 0.10$ ) |          | 8.2                                  |

**Table 12.** Soybean grain yield when grown at 187 lbs acre<sup>-1</sup> of MicroEssentials SZ and one foliar protection application (fungicide and insecticide) at the R3 growth stage at Yorkville, IL in 2016.

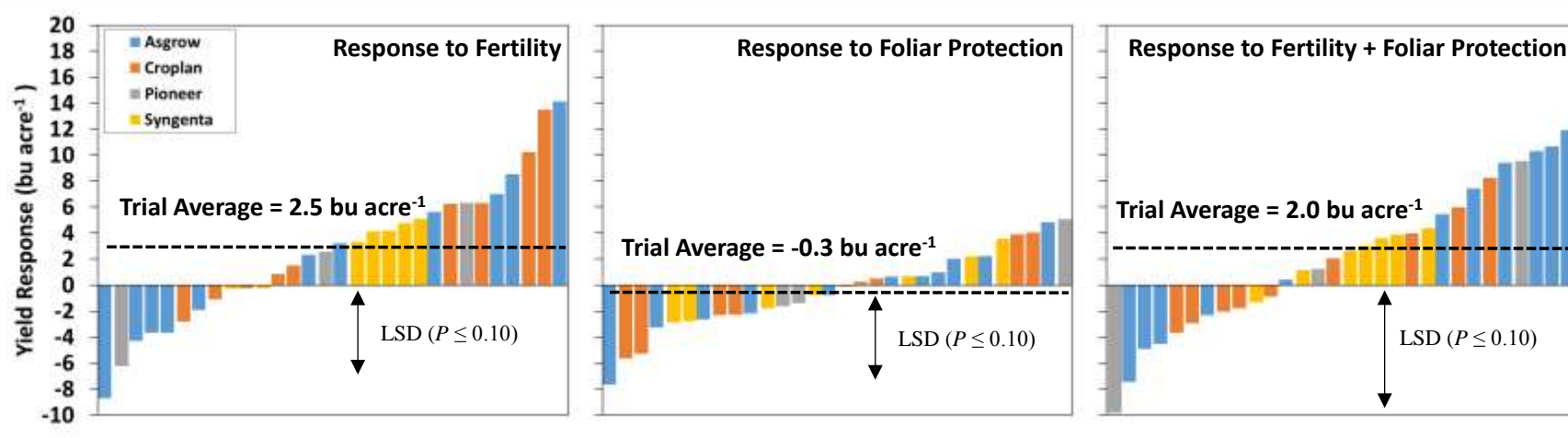
| Rank         | Variety | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety  | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|---------|--------------------------------------|-----------------------|----------|--------------------------------------|
| 1            | AG2636  | 105.9                                | 16                    | AG28X7   | 91.7                                 |
| 2            | P31T77R | 101.4                                | 17                    | AG24X7   | 91.2                                 |
| 3            | S42-P6  | 98.5                                 | 18                    | AG2836   | 90.9                                 |
| 4            | P27T47R | 98.5                                 | 19                    | RX3296   | 90.5                                 |
| 5            | RX3556  | 98.1                                 | 20                    | R2C2674  | 89.8                                 |
| 6            | AG34X6  | 97.0                                 | 21                    | S39-C4   | 88.9                                 |
| 7            | AG35X7  | 96.9                                 | 22                    | AG32X6   | 88.7                                 |
| 8            | RX3746  | 96.8                                 | 23                    | S35-A5   | 88.4                                 |
| 9            | AG27X7  | 96.6                                 | 24                    | S30-V6   | 88.4                                 |
| 10           | S28-N6  | 96.6                                 | 25                    | RX3896   | 87.7                                 |
| 11           | R2C3323 | 94.2                                 | 26                    | AG23X6   | 84.5                                 |
| 12           | S37-Z8  | 93.3                                 | 27                    | AG30X6   | 84.1                                 |
| 13           | R2C3822 | 92.9                                 | 28                    | AG25X6   | 80.3                                 |
| 14           | R2C3113 | 92.8                                 | 29                    | P34T07R2 | 80.1                                 |
| 15           | R2C4000 | 92.2                                 |                       |          |                                      |
| Overall Mean |         | 92.3                                 | LSD ( $P \leq 0.10$ ) |          | 9.2                                  |

**Table 13.** Impact of fertilizer and foliar protection on soybean grain yield at Yorkville, IL in 2016.

| Variety               | Foliar Protection                    |        |        |        |
|-----------------------|--------------------------------------|--------|--------|--------|
|                       | Without                              |        | With   |        |
|                       | Fertilizer (lbs acre <sup>-1</sup> ) |        |        |        |
|                       | 0                                    | 187    | 0      | 187    |
| <b>Asgrow</b>         | bu acre <sup>-1</sup>                |        |        |        |
| AG23X6                | 73.8                                 | 88.0   | 74.5   | 84.5   |
| AG24X7                | 85.8                                 | 89.0   | 87.8   | 91.2   |
| AG25X6                | 70.9                                 | 76.6   | 71.9   | 80.3   |
| AG2636                | 94.0                                 | 102.5  | 91.8   | 105.9  |
| AG27X7                | 89.2                                 | 85.5   | 94.0   | 96.6   |
| AG2836                | 93.2                                 | 91.3   | 85.5   | 90.9   |
| AG28X7                | 91.3                                 | 93.7   | 90.6   | 91.7   |
| AG30X6                | 88.6                                 | 84.9   | 89.3   | 84.1   |
| AG32X6                | 96.1                                 | 91.8   | 93.5   | 88.7   |
| AG34X6                | 86.7                                 | 93.7   | 88.9   | 97.0   |
| AG35X7                | 101.8                                | 93.1   | 98.5   | 96.9   |
| <b>Croplan</b>        |                                      |        |        |        |
| R2C2674               | 91.8                                 | 93.3   | 95.7   | 89.8   |
| R2C3113               | 90.7                                 | 97.0   | 88.5   | 92.8   |
| R2C3323               | 88.2                                 | 98.4   | 92.3   | 94.2   |
| R2C3822               | 84.6                                 | 98.1   | 84.9   | 92.9   |
| R2C4000               | 94.0                                 | 91.2   | 88.7   | 92.2   |
| RX3296                | 94.2                                 | 100.5  | 91.8   | 90.5   |
| RX3556                | 99.0                                 | 99.9   | 99.6   | 98.1   |
| RX3746                | 92.8                                 | 92.6   | 92.7   | 96.8   |
| RX3896                | 90.6                                 | 89.5   | 85.0   | 87.7   |
| <b>Pioneer</b>        |                                      |        |        |        |
| P27T47R               | 88.9                                 | 95.2   | 94.0   | 98.5   |
| P31T77R               | 100.2                                | 102.8  | 98.6   | 101.4  |
| P34T07R2              | 89.9                                 | 83.7   | 88.5   | 80.1   |
| <b>Syngenta</b>       |                                      |        |        |        |
| S28-N6                | 93.9                                 | 99.0   | 94.6   | 96.6   |
| S30-V6                | 84.5                                 | 84.2   | 81.7   | 88.4   |
| S35-A5                | 85.4                                 | 89.6   | 87.6   | 88.4   |
| S37-Z8                | 89.7                                 | 93.0   | 88.9   | 93.3   |
| S39-C4                | 90.2                                 | 90.0   | 93.8   | 88.9   |
| S42-P6                | 97.3                                 | 101.5  | 95.6   | 98.5   |
| LSD ( $P \leq 0.10$ ) | 6.6                                  | 8.3    | 8.2    | 9.2    |
| Mean                  | 90.3                                 | 92.8   | 90.0   | 92.3   |
| Range                 | 71-102                               | 77-103 | 72-100 | 80-106 |

**Table 14.** Influence of seed brand, foliar protection, and fertilizer on average soybean yield at Yorkville, IL in 2016.

| Brand           | Foliar Protection                    |      |      |      |
|-----------------|--------------------------------------|------|------|------|
|                 | Without                              |      | With |      |
|                 | Fertilizer (lbs acre <sup>-1</sup> ) |      |      |      |
|                 | 0                                    | 187  | 0    | 187  |
|                 | bu acre <sup>-1</sup>                |      |      |      |
| <b>Asgrow</b>   | 88.3                                 | 90.0 | 87.8 | 91.6 |
| <b>Croplan</b>  | 91.8                                 | 95.6 | 91.0 | 92.8 |
| <b>Pioneer</b>  | 93.0                                 | 93.9 | 93.7 | 93.3 |
| <b>Syngenta</b> | 90.2                                 | 92.9 | 90.4 | 92.3 |



**Figure 2.** Yield response to fertility (yield difference between 0 and 187 lbs/acre of MESZ), foliar protection [yield difference between foliar protection (insecticide and fungicide) and no-foliar protection], and fertility and foliar protection (yield difference between control and 187 lbs/acre of MESZ with foliar protection) at Yorkville, IL in 2016.

## Harrisburg

**Table 15.** Soybean grain yield when grown with no fertilizer or foliar protection application (Control) at Harrisburg, IL in 2016.

| Rank         | Variety | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety   | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|---------|--------------------------------------|-----------------------|-----------|--------------------------------------|
| 1            | S42-P6  | 76.0                                 | 16                    | RX4316STS | 65.0                                 |
| 2            | S39-C4  | 75.6                                 | 17                    | R2C4000   | 64.8                                 |
| 3            | AG44X6  | 75.4                                 | 18                    | AG40X6    | 64.3                                 |
| 4            | AG46X6  | 72.2                                 | 19                    | AG38X6    | 63.3                                 |
| 5            | P36T86R | 71.6                                 | 20                    | R2C3113   | 62.3                                 |
| 6            | R2C3323 | 70.7                                 | 21                    | AG43X7    | 62.1                                 |
| 7            | P47T36R | 70.6                                 | 22                    | AG42X6    | 60.7                                 |
| 8            | R2C3822 | 69.9                                 | 23                    | RX4106    | 60.5                                 |
| 9            | S37-Z8  | 68.9                                 | 24                    | AG39X7    | 60.4                                 |
| 10           | S30-V6  | 68.3                                 | 25                    | AG45X6    | 59.6                                 |
| 11           | RX3556  | 68.3                                 | 26                    | S35-A5    | 58.0                                 |
| 12           | RX3746  | 67.3                                 | 27                    | RX3896    | 55.9                                 |
| 13           | AG4135  | 66.7                                 | 28                    | AG48X7    | 46.4                                 |
| 14           | S28-N6  | 66.4                                 |                       |           |                                      |
| 15           | 94Y23   | 65.1                                 |                       |           |                                      |
| Overall Mean |         | 65.6                                 | LSD ( $P \leq 0.10$ ) |           | 4.6                                  |

**Table 16.** Soybean grain yield when grown with 187 lbs acre<sup>-1</sup> of MicroEssentials SZ and no foliar protection application at Harrisburg, IL in 2016.

| Rank         | Variety   | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|-----------|--------------------------------------|-----------------------|---------|--------------------------------------|
| 1            | S42-P6    | 88.9                                 | 16                    | R2C4000 | 72.2                                 |
| 2            | AG44X6    | 85.0                                 | 17                    | 94Y23   | 71.3                                 |
| 3            | P47T36R   | 83.5                                 | 18                    | AG43X7  | 70.8                                 |
| 4            | R2C3323   | 81.9                                 | 19                    | AG40X6  | 70.0                                 |
| 5            | R2C3822   | 81.5                                 | 20                    | AG39X7  | 69.9                                 |
| 6            | S39-C4    | 81.0                                 | 21                    | S30-V6  | 69.9                                 |
| 7            | P36T86R   | 81.0                                 | 22                    | S28-N6  | 69.5                                 |
| 8            | AG46X6    | 78.7                                 | 23                    | RX4106  | 68.1                                 |
| 9            | RX4316STS | 78.1                                 | 24                    | S35-A5  | 64.7                                 |
| 10           | S37-Z8    | 77.0                                 | 25                    | AG45X6  | 63.8                                 |
| 11           | RX3746    | 75.5                                 | 26                    | RX3896  | 60.5                                 |
| 12           | RX3556    | 74.0                                 | 27                    | AG42X6  | 59.8                                 |
| 13           | R2C3113   | 73.4                                 | 28                    | AG48X7  | 44.5                                 |
| 14           | AG4135    | 73.0                                 |                       |         |                                      |
| 15           | AG38X6    | 72.5                                 |                       |         |                                      |
| Overall Mean |           | 72.9                                 | LSD ( $P \leq 0.10$ ) |         | 6.3                                  |

**Table 17.** Soybean grain yield when grown with no fertilizer and one foliar protection application (fungicide and insecticide) at the R3 growth stage at Harrisburg, IL in 2016.

| Rank         | Variety | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety   | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|---------|--------------------------------------|-----------------------|-----------|--------------------------------------|
| 1            | S39-C4  | 80.5                                 | 16                    | P47T36R   | 69.7                                 |
| 2            | R2C3822 | 79.4                                 | 17                    | R2C3113   | 69.5                                 |
| 3            | S42-P6  | 78.1                                 | 18                    | RX4316STS | 69.1                                 |
| 4            | RX3556  | 75.7                                 | 19                    | 94Y23     | 69.1                                 |
| 5            | AG44X6  | 75.1                                 | 20                    | AG38X6    | 68.9                                 |
| 6            | AG46X6  | 74.5                                 | 21                    | S35-A5    | 68.9                                 |
| 7            | R2C3323 | 74.5                                 | 22                    | AG39X7    | 67.7                                 |
| 8            | S37-Z8  | 73.2                                 | 23                    | RX4106    | 66.0                                 |
| 9            | AG4135  | 72.7                                 | 24                    | AG43X7    | 65.2                                 |
| 10           | P36T86R | 70.9                                 | 25                    | AG45X6    | 63.5                                 |
| 11           | AG40X6  | 70.8                                 | 26                    | AG42X6    | 60.3                                 |
| 12           | S28-N6  | 70.7                                 | 27                    | RX3896    | 58.7                                 |
| 13           | S30-V6  | 70.6                                 | 28                    | AG48X7    | 57.8                                 |
| 14           | R2C4000 | 70.5                                 |                       |           |                                      |
| 15           | RX3746  | 70.2                                 |                       |           |                                      |
| Overall Mean |         | 70.1                                 | LSD ( $P \leq 0.10$ ) |           | 4.9                                  |

**Table 18.** Soybean grain yield when grown at 187 lbs acre<sup>-1</sup> of MicroEssentials SZ and one foliar protection application (fungicide and insecticide) at Harrisburg, IL in 2016.

| Rank         | Variety   | Grain yield<br>bu acre <sup>-1</sup> | Rank                  | Variety | Grain yield<br>bu acre <sup>-1</sup> |
|--------------|-----------|--------------------------------------|-----------------------|---------|--------------------------------------|
| 1            | S42-P6    | 93.5                                 | 16                    | 94Y23   | 77.8                                 |
| 2            | S39-C4    | 88.8                                 | 17                    | S35-A5  | 77.1                                 |
| 3            | R2C3822   | 88.3                                 | 18                    | AG38X6  | 76.9                                 |
| 4            | R2C3323   | 87.1                                 | 19                    | AG43X7  | 76.9                                 |
| 5            | S37-Z8    | 85.0                                 | 20                    | AG39X7  | 76.2                                 |
| 6            | AG44X6    | 84.2                                 | 21                    | AG4135  | 75.9                                 |
| 7            | P36T86R   | 84.0                                 | 22                    | R2C4000 | 74.1                                 |
| 8            | S30-V6    | 82.5                                 | 23                    | AG40X6  | 73.9                                 |
| 9            | AG46X6    | 82.2                                 | 24                    | RX4106  | 72.5                                 |
| 10           | RX4316STS | 81.4                                 | 25                    | AG42X6  | 71.2                                 |
| 11           | S28-N6    | 81.0                                 | 26                    | AG45X6  | 71.1                                 |
| 12           | R2C3113   | 80.1                                 | 27                    | RX3896  | 61.9                                 |
| 13           | P47T36R   | 79.7                                 | 28                    | AG48X7  | 55.4                                 |
| 14           | RX3746    | 78.5                                 |                       |         |                                      |
| 15           | RX3556    | 77.9                                 |                       |         |                                      |
| Overall Mean |           | 78.4                                 | LSD ( $P \leq 0.10$ ) |         | 7.1                                  |

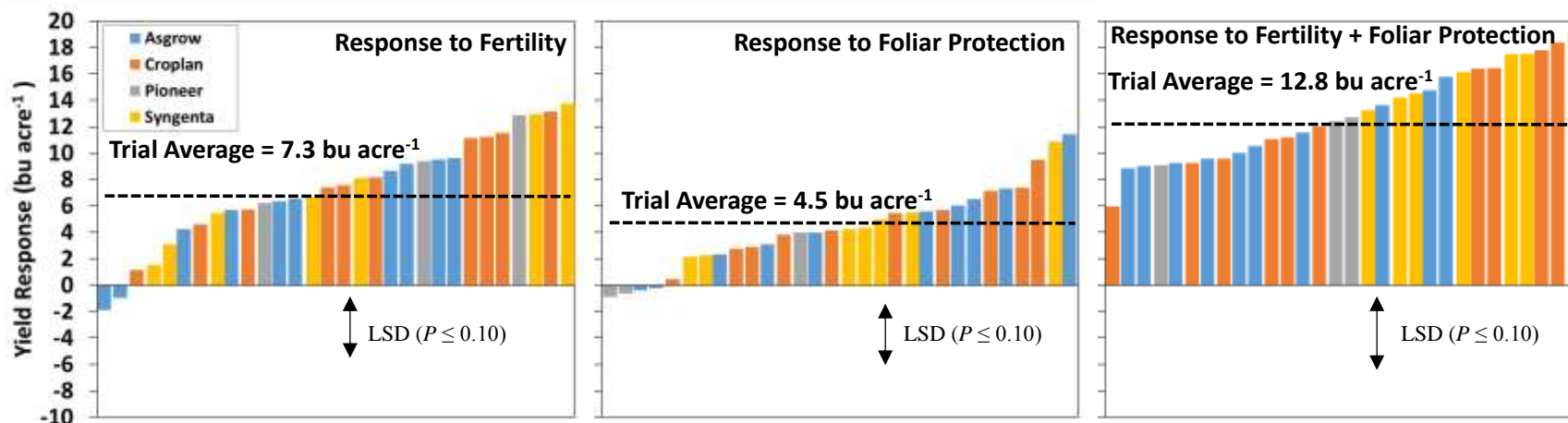


**Table 19.** Impact of fertilizer and foliar protection on soybean grain yield at Harrisburg, IL in 2016.

| Variety               | Foliar Protection                    |       |       |       |
|-----------------------|--------------------------------------|-------|-------|-------|
|                       | Without                              |       | With  |       |
|                       | Fertilizer (lbs acre <sup>-1</sup> ) |       |       |       |
|                       | 0                                    | 187   | 0     | 187   |
| <b>Asgrow</b>         | bu acre <sup>-1</sup>                |       |       |       |
| AG38X6                | 63.3                                 | 72.5  | 68.9  | 76.9  |
| AG39X7                | 60.4                                 | 69.9  | 67.7  | 76.2  |
| AG40X6                | 64.3                                 | 70.0  | 70.8  | 73.9  |
| AG4135                | 66.7                                 | 73.0  | 72.7  | 75.9  |
| AG42X6                | 60.7                                 | 59.8  | 60.3  | 71.2  |
| AG43X7                | 62.1                                 | 70.8  | 65.2  | 76.9  |
| AG44X6                | 75.4                                 | 85.0  | 75.1  | 84.2  |
| AG45X6                | 59.6                                 | 63.8  | 63.5  | 71.1  |
| AG46X6                | 72.2                                 | 78.7  | 74.5  | 82.2  |
| AG48X7                | 46.4                                 | 44.5  | 57.8  | 55.4  |
| <b>Croplan</b>        |                                      |       |       |       |
| R2C3113               | 62.3                                 | 73.4  | 69.5  | 80.1  |
| R2C3323               | 70.7                                 | 81.9  | 74.5  | 87.1  |
| R2C3822               | 69.9                                 | 81.5  | 79.4  | 88.3  |
| R2C4000               | 64.8                                 | 72.2  | 70.5  | 74.1  |
| RX3556                | 68.3                                 | 74.0  | 75.7  | 77.9  |
| RX3746                | 67.3                                 | 75.5  | 70.2  | 78.5  |
| RX3896                | 55.9                                 | 60.5  | 58.7  | 61.9  |
| RX4106                | 60.5                                 | 68.1  | 66.0  | 72.5  |
| RX4316STS             | 65.0                                 | 78.1  | 69.1  | 81.4  |
| <b>Pioneer</b>        |                                      |       |       |       |
| 94Y23                 | 65.1                                 | 71.3  | 69.1  | 77.8  |
| P36T86R               | 71.6                                 | 81.0  | 70.9  | 84.0  |
| P47T36R               | 70.6                                 | 83.5  | 69.7  | 79.7  |
| <b>Syngenta</b>       |                                      |       |       |       |
| S28-N6                | 66.4                                 | 69.5  | 70.7  | 81.0  |
| S30-V6                | 68.3                                 | 69.9  | 70.6  | 82.5  |
| S35-A5                | 58.0                                 | 64.7  | 68.9  | 77.1  |
| S37-Z8                | 68.9                                 | 77.0  | 73.2  | 85.0  |
| S39-C4                | 75.6                                 | 81.0  | 80.5  | 88.8  |
| S42-P6                | 76.0                                 | 88.9  | 78.1  | 93.5  |
| LSD ( $P \leq 0.10$ ) | 4.6                                  | 6.3   | 4.9   | 7.1   |
| Overall Mean          | 65.6                                 | 72.9  | 70.1  | 78.4  |
| Range                 | 46-76                                | 44-89 | 58-81 | 55-93 |

**Table 20.** Influence of seed brand, foliar protection, and fertilizer on average soybean yield at Harrisburg, IL in 2016.

| Brand           | Foliar Protection                    |      |      |      |
|-----------------|--------------------------------------|------|------|------|
|                 | Without                              |      | With |      |
|                 | Fertilizer (lbs acre <sup>-1</sup> ) |      |      |      |
|                 | 0                                    | 187  | 0    | 187  |
|                 | bu acre <sup>-1</sup>                |      |      |      |
| <b>Asgrow</b>   | 63.1                                 | 68.8 | 67.7 | 74.4 |
| <b>Croplan</b>  | 65.0                                 | 73.9 | 70.4 | 78.0 |
| <b>Pioneer</b>  | 69.1                                 | 78.6 | 69.9 | 80.5 |
| <b>Syngenta</b> | 68.9                                 | 75.2 | 73.7 | 84.6 |



**Figure 3.** Yield response to fertility (yield difference between 0 and 187 lbs/acre of MESZ), 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 of MESZ with foliar protection) at Harrisburg, IL in 2016.

## Characterization of Varieties for Response to Management

The differences observed in yield performance among varieties and their interaction with agronomic management across environments in 2016 highlights the importance of soybean genetic characterization in response to different agronomic factors. Soybean genetics and the yield response to increased fertility and foliar protection (insecticide and fungicides) are among the most important agronomic factors influencing soybean yield. Added fertility accounted for most of the yield variation (F-value) across locations followed by foliar protection and genotype at Champaign and Harrisburg, or genotype at Yorkville (Table 2). On average, fertility additions increased yield by +2.6, +2.5, and +7.3 bu acre<sup>-1</sup> at Champaign, Yorkville, and Harrisburg, IL, respectively, while foliar protection changed soybean yield by +1.9, -0.3, and +4.5 bu acre<sup>-1</sup> at these same sites. Interestingly the greater yield response to fertility at Harrisburg was not associated with lower soil P levels, as soil P tests at Harrisburg were 62 ppm compared to 21 ppm at Champaign and 35 ppm at Yorkville (see Materials and Methods page 3). Three varieties (AG35X7, R2C3323, and S35-A5) at Champaign and two varieties at Yorkville (AG35X7 and P34T07R2) significantly decreased in yield from added fertility ( $P \leq 0.10$ ), indicating different genetic sensitivity to soil nutrient availability.

Although no synergistic effect was observed between fertility and foliar protection across locations (i.e., there was no significant interaction between fertility and foliar protection, Table 2), the highest yields were observed when the plants were grown under increased fertility plus foliar protection conditions. The highest yields recorded were 97.2, 105.9, and 93.5 bu acre<sup>-1</sup> at Champaign, Yorkville, and Harrisburg, respectively (varieties RX3896, AG2636, and S42-P6, respectively).

The objective of the Soybean MYP trial is to characterize elite soybean cultivars for their response to different agronomic management conditions. Variety decile ranks for yield performance under low agronomic management input (Yield Control), yield response to increased fertility (FERT), yield response to foliar protection (PROT), yield response to foliar protection and increased fertility (PROT + FERT), and yield performance resulting from the combination of both treatments (Yield BOTH) across locations are presented in Table 21. While this is only one year of data, agronomists and farmers may use the score from each parameter to better position their soybean variety based on the agronomic performance and response to agronomic management at different locations. ‘Defensive’ varieties can be considered as ones having a high ranking for Yield Control and a low ranking for yield response to foliar protection (low PROT), while ‘Offensive’ varieties can be considered ones having a high ranking for Yield Both and high rankings for yield response to foliar protection (high PROT) and increased fertility (high FERT).

**Table 21.** Decile scores for yield with no additional fertilizer or foliar protection (Control), and the yield responses to increased fertility (FERT), foliar protection (PROT), and the combination of both treatments (BOTH). Varieties are sorted by brand name. Scores range from 1 indicating the lowest yield (or yield increase) and 10 indicating the greatest yield (or yield increase).

|               | Champaign     |      |      |            |            | Yorkville     |      |      |            |            | Harrisburg    |      |      |            |            |
|---------------|---------------|------|------|------------|------------|---------------|------|------|------------|------------|---------------|------|------|------------|------------|
|               | Yield Control | FERT | PROT | PROT +FERT | Yield BOTH | Yield Control | FERT | PROT | PROT +FERT | Yield BOTH | Yield Control | FERT | PROT | PROT +FERT | Yield BOTH |
| <b>Asgrow</b> |               |      |      |            |            |               |      |      |            |            |               |      |      |            |            |
| AG23X6        | -             | -    | -    | -          | -          | 1             | 10   | 7    | 10         | 2          | -             | -    | -    | -          | -          |
| AG24X7        | -             | -    | -    | -          | -          | 2             | 6    | 8    | 7          | 5          | -             | -    | -    | -          | -          |
| AG25X6        | -             | -    | -    | -          | -          | 1             | 8    | 8    | 9          | 1          | -             | -    | -    | -          | -          |
| AG2636        | -             | -    | -    | -          | -          | 8             | 9    | 4    | 10         | 10         | -             | -    | -    | -          | -          |
| AG27X7        | -             | -    | -    | -          | -          | 4             | 2    | 10   | 8          | 8          | -             | -    | -    | -          | -          |
| AG2836        | -             | -    | -    | -          | -          | 7             | 3    | 1    | 3          | 4          | -             | -    | -    | -          | -          |
| AG28X7        | -             | -    | -    | -          | -          | 6             | 5    | 5    | 4          | 5          | -             | -    | -    | -          | -          |
| AG30X6        | 4             | 3    | 2    | 5          | 4          | 4             | 2    | 7    | 2          | 1          | -             | -    | -    | -          | -          |
| AG32X6        | 2             | 3    | 1    | 1          | 1          | 9             | 1    | 3    | 1          | 3          | -             | -    | -    | -          | -          |
| AG34X6        | 6             | 9    | 7    | 9          | 7          | 3             | 9    | 9    | 10         | 9          | -             | -    | -    | -          | -          |
| AG35X7        | 7             | 1    | 1    | 2          | 3          | 10            | 1    | 2    | 1          | 8          | -             | -    | -    | -          | -          |
| AG36X6        | 8             | 5    | 3    | 6          | 7          | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          |
| AG3832        | 1             | 10   | 6    | 4          | 2          | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          |
| AG38X6        | 3             | 6    | 4    | 3          | 3          | -             | -    | -    | -          | -          | 4             | 7    | 7    | 6          | 4          |
| AG39X7        | 3             | 9    | 8    | 10         | 8          | -             | -    | -    | -          | -          | 2             | 8    | 9    | 7          | 4          |
| AG40X6        | 2             | 2    | 4    | 6          | 5          | -             | -    | -    | -          | -          | 4             | 3    | 8    | 3          | 3          |
| AG4135        | 9             | 3    | 7    | 7          | 8          | -             | -    | -    | -          | -          | 6             | 4    | 8    | 2          | 3          |
| AG42X6        | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 3             | 1    | 1    | 4          | 2          |
| AG43X7        | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 3             | 7    | 4    | 7          | 4          |
| AG44X6        | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 10            | 8    | 2    | 1          | 8          |
| AG45X6        | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 2             | 2    | 5    | 4          | 2          |
| AG46X6        | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 9             | 5    | 3    | 3          | 7          |
| AG48X7        | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 1             | 1    | 10   | 1          | 1          |

**Table 21 (cont.).** Decile scores for yield with no additional fertilizer or foliar protection (Control), and the yield responses to increased fertility (FERT), foliar protection (PROT), and the combination of both treatments (BOTH). Scores range from 1 indicating the lowest yield (or yield increase) and 10 indicating the greatest yield (or yield increase).

|                 | Champaign     |      |      |            |            | Yorkville     |      |      |            |            | Harrisburg    |      |      |            |            |
|-----------------|---------------|------|------|------------|------------|---------------|------|------|------------|------------|---------------|------|------|------------|------------|
|                 | Yield Control | FERT | PROT | PROT +FERT | Yield BOTH | Yield Control | FERT | PROT | PROT +FERT | Yield BOTH | Yield Control | FERT | PROT | PROT +FERT | Yield BOTH |
| <b>Croplan</b>  |               |      |      |            |            |               |      |      |            |            |               |      |      |            |            |
| R2C2674         | 5             | 8    | 6    | 8          | 6          | 7             | 5    | 9    | 3          | 4          | -             | -    | -    | -          | -          |
| R2C3113         | 7             | 5    | 2    | 4          | 5          | 6             | 8    | 3    | 5          | 6          | 4             | 8    | 9    | 9          | 6          |
| R2C3323         | 6             | 1    | 2    | 1          | 1          | 3             | 10   | 10   | 8          | 7          | 9             | 9    | 4    | 8          | 9          |
| R2C3822         | 1             | 4    | 3    | 7          | 4          | 2             | 10   | 6    | 8          | 6          | 8             | 9    | 10   | 10         | 10         |
| R2C4000         | 8             | 7    | 6    | 3          | 4          | 8             | 2    | 1    | 3          | 6          | 5             | 5    | 8    | 2          | 3          |
| RX3296          | 3             | 7    | 5    | 3          | 3          | 9             | 9    | 3    | 2          | 4          | -             | -    | -    | -          | -          |
| RX3556          | 8             | 6    | 10   | 8          | 9          | 10            | 4    | 6    | 4          | 9          | 7             | 4    | 9    | 3          | 5          |
| RX3746          | 4             | 10   | 8    | 8          | 6          | 7             | 4    | 6    | 7          | 8          | 6             | 6    | 4    | 4          | 6          |
| RX3896          | 9             | 4    | 5    | 7          | 10         | 6             | 3    | 1    | 2          | 2          | 1             | 3    | 3    | 1          | 1          |
| RX4106          | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 3             | 6    | 7    | 5          | 2          |
| RX4316STS       | 5             | 10   | 8    | 10         | 9          | -             | -    | -    | -          | -          | 5             | 10   | 5    | 8          | 7          |
| <b>Pioneer</b>  |               |      |      |            |            |               |      |      |            |            |               |      |      |            |            |
| 94Y23           | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 5             | 4    | 5    | 5          | 5          |
| P27T47R         | -             | -    | -    | -          | -          | 4             | 8    | 10   | 9          | 9          | -             | -    | -    | -          | -          |
| P31T77R         | -             | -    | -    | -          | -          | 10            | 5    | 4    | 5          | 10         | -             | -    | -    | -          | -          |
| P34T07R2        | 10            | 2    | 4    | 2          | 8          | 5             | 1    | 5    | 1          | 1          | -             | -    | -    | -          | -          |
| P36T86R         | 4             | 4    | 9    | 1          | 2          | -             | -    | -    | -          | -          | 9             | 7    | 1    | 5          | 8          |
| P47T36R         | -             | -    | -    | -          | -          | -             | -    | -    | -          | -          | 8             | 9    | 1    | 2          | 6          |
| <b>Syngenta</b> |               |      |      |            |            |               |      |      |            |            |               |      |      |            |            |
| S28-N6          | 1             | 8    | 10   | 5          | 1          | 8             | 7    | 7    | 6          | 7          | 6             | 2    | 6    | 7          | 7          |
| S30-V6          | 6             | 5    | 9    | 4          | 5          | 1             | 3    | 2    | 7          | 2          | 7             | 2    | 3    | 6          | 8          |
| S35-A5          | 2             | 1    | 3    | 2          | 2          | 2             | 7    | 8    | 6          | 3          | 2             | 5    | 10   | 10         | 5          |
| S37-Z8          | 5             | 7    | 9    | 9          | 7          | 5             | 6    | 5    | 6          | 7          | 7             | 6    | 6    | 8          | 9          |
| S39-C4          | 10            | 2    | 5    | 5          | 9          | 5             | 4    | 9    | 4          | 3          | 10            | 3    | 6    | 6          | 10         |
| S42-P6          | 7             | 9    | 1    | 6          | 6          | 9             | 6    | 4    | 5          | 10         | 10            | 10   | 2    | 9          | 10         |

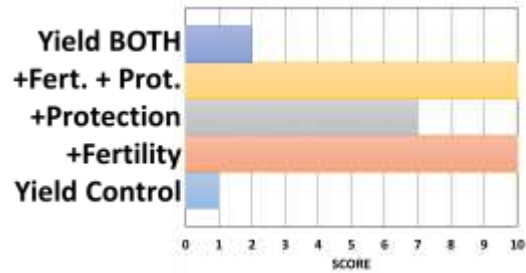
**Summary of Variety Agronomic Characteristics**

This section presents a brief summary for each variety performance in response to foliar protection and/ or added fertility. Decile yield response scores for each variety (bar-graph figures) were averaged across locations when applicable.

**Asgrow**

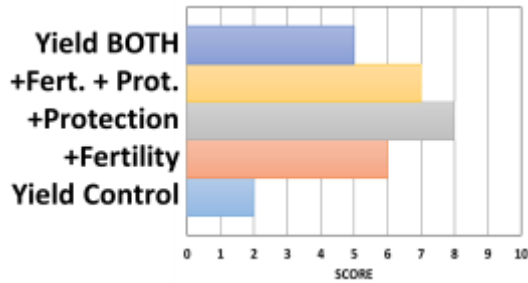
**AG23X6**

High yield response to fertility and foliar protection. Low yield performance with Control or BOTH conditions.



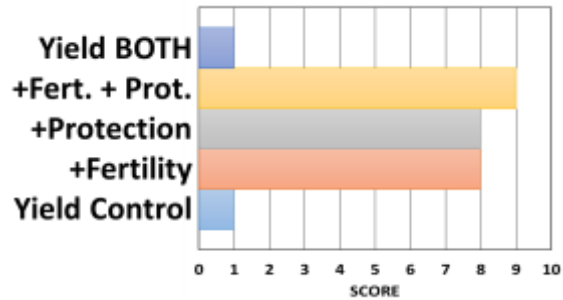
**AG24X7**

High yield response to foliar protection. Low yield under control and average yield under BOTH conditions.



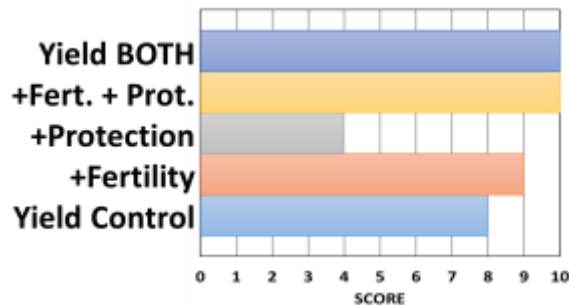
**AG25X6**

High yield response to additional fertility and/or foliar protection. Low yield performance under control and under the BOTH treatments.



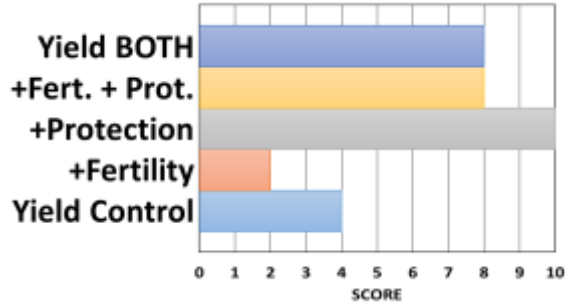
**AG2636**

High yield under Control and BOTH conditions. High response to additional fertility, with or without foliar protection.



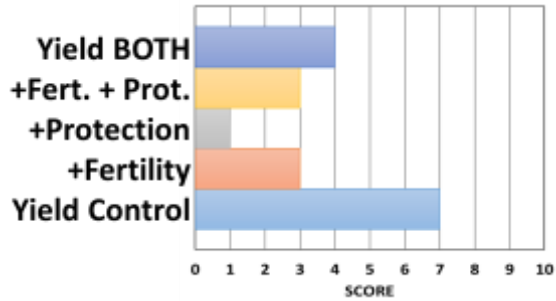
**AG27X7**

High yield response to foliar protection with or without added fertility. Above average yield under BOTH, and below average yield under Control conditions.



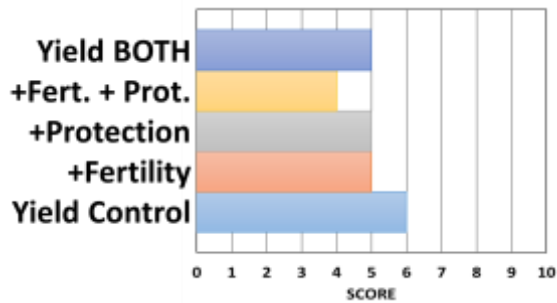
**AG2836**

High yield performance under control conditions, but below-average score for the other treatments. Would be considered a good 'Defensive' variety.



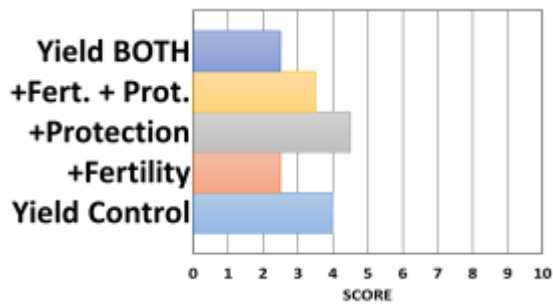
**AG28X7**

Average yield performance under Control and BOTH conditions. Average yield response to foliar protection and additional fertility.



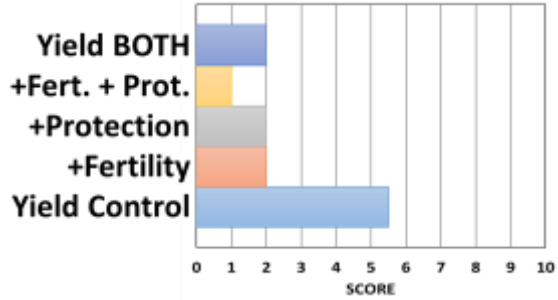
**AG30X6**

Below average score for all treatments.



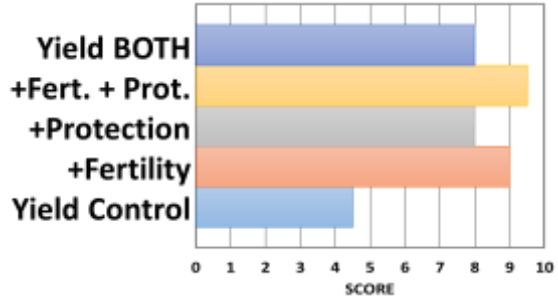
**AG32X6**

Average yield performance under Control conditions, and below average score for all other treatments. Would be considered a moderate ‘Defensive’ variety.



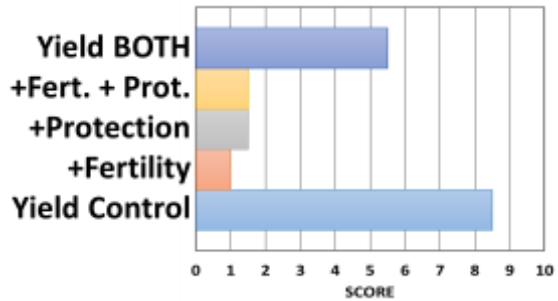
**AG34X6**

High yield performance under BOTH and average under Control conditions. High yield response to additional fertility and foliar protection. Would be considered a good ‘Offensive’ variety.



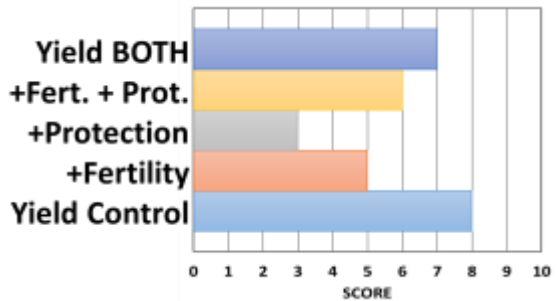
**AG35X7**

High yield performance under Control and average yield under BOTH conditions. Poor yield response to foliar protection or additional fertility. Would be considered a good ‘Defensive’ variety.



**AG36X6**

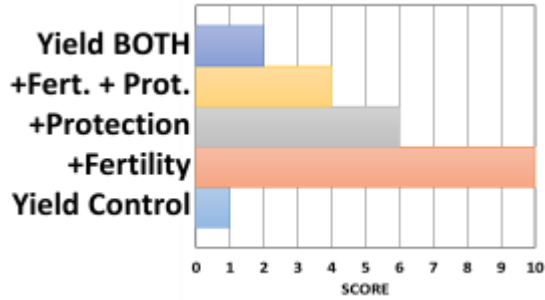
High yield performance under Control or BOTH conditions, but average to low yield response to foliar protection or additional fertility alone.





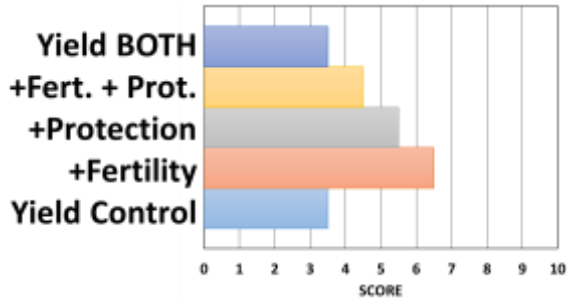
**AG3832**

High yield response to additional fertility, but low yield performance under Control and BOTH conditions. Foliar Protection boosted the yield response from the control to an average level.



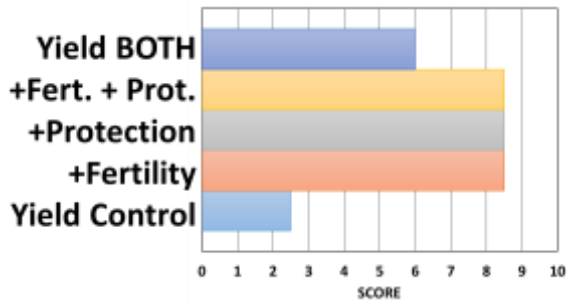
**AG38X6**

Average yield response to foliar protection or additional fertility. Below average yield performance with Control and BOTH treatments.



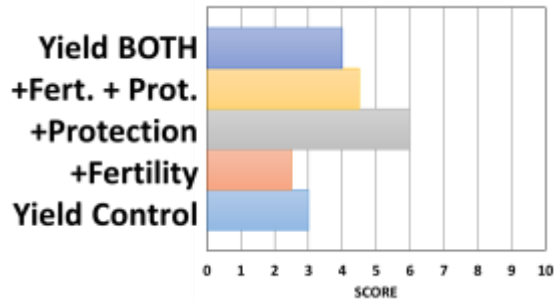
**AG39X7**

High yield response to foliar protection, additional fertility, and the combination treatments. Below average yield performance with Control conditions. Would be considered a moderated 'Offensive' variety.



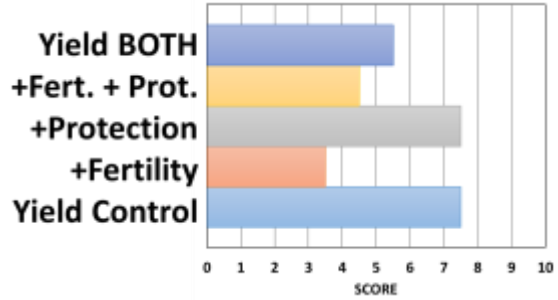
**AG40X6**

Average yield response to foliar protection, but below average score for the other treatments.



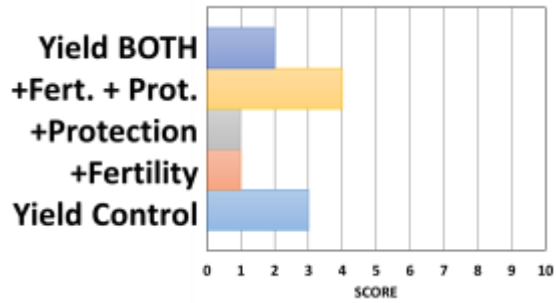
**AG4135**

Above average yield response to foliar protection and above average yield performance under Control conditions.



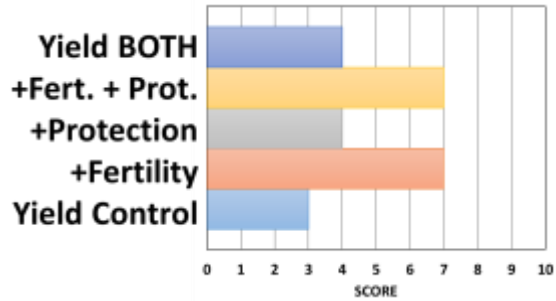
**AG42X6**

Below average score for all treatments.



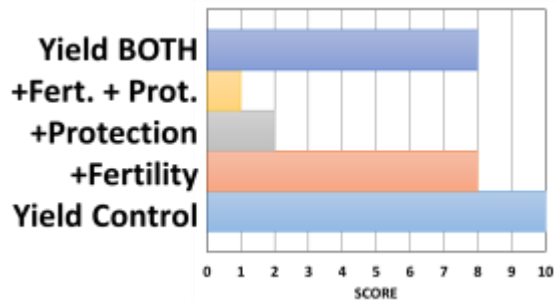
**AG43X7**

Above average score for yield response to additional fertility, but below average score for the other treatments.



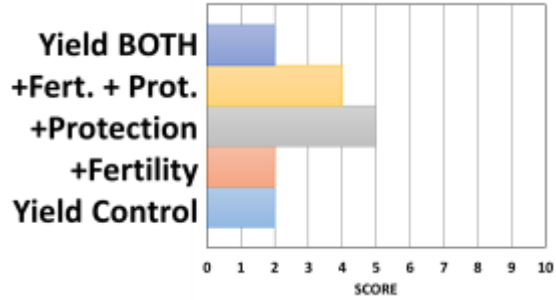
**AG44X6**

High yield performance under Control and BOTH conditions. High yield response to additional fertility. Low yield response to foliar protection alone. Would be considered a good 'Defensive' variety.



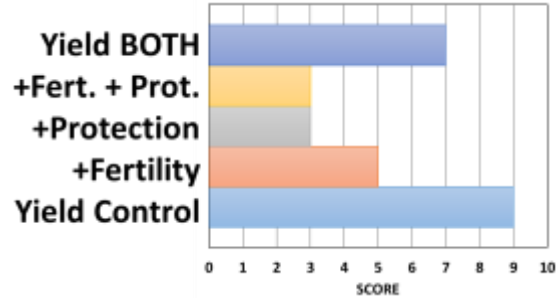
**AG45X6**

Average score for yield response to foliar protection, but below average score for the other treatments.



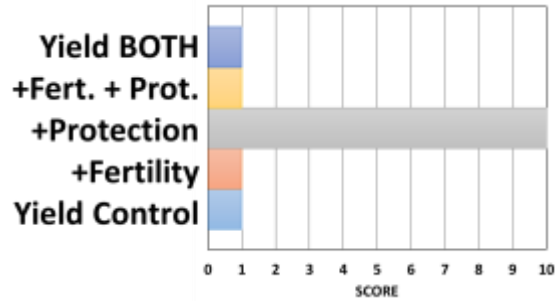
**AG46X6**

High yield performance under Control and above average yield performance under BOTH treatments. Below average yield response to foliar protection. Would be considered a good 'Defensive' variety.



**AG48X7**

High yield response to foliar protection, but below average score for the other treatments.

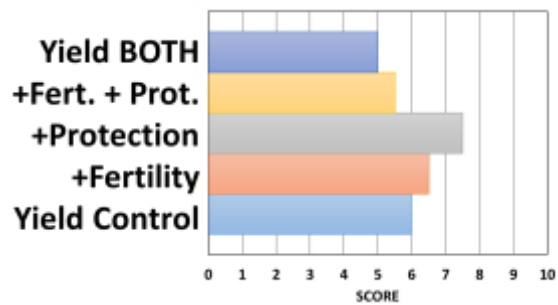


**Croplan**

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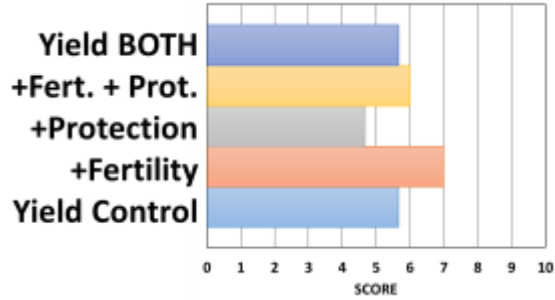
**R2C2674**

Above average yield response to foliar protection and additional fertility. Average yield performance under Control and BOTH conditions.



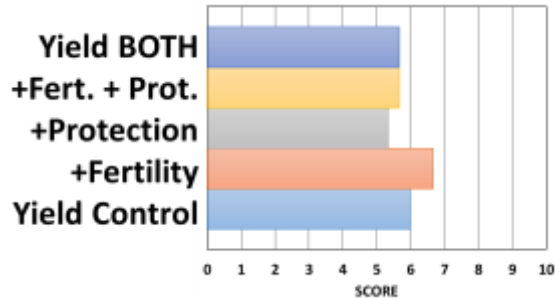
**R2C3113**

High yield response to additional fertility. Average yield performance with the other treatments.



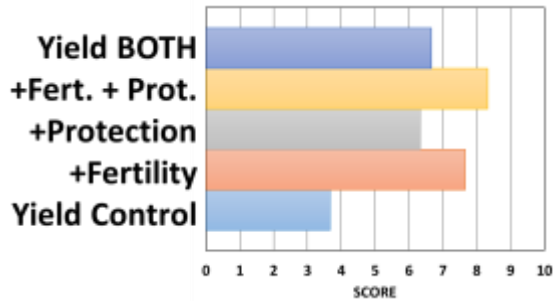
**R2C3323**

Above average yield response to additional fertility. Average score for the other treatments.



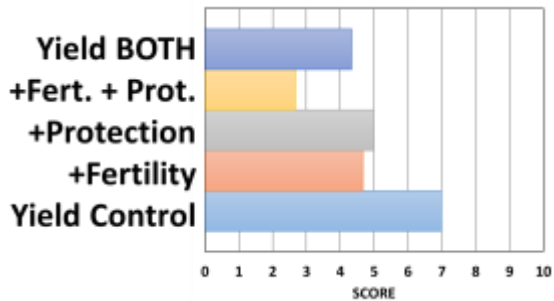
**R2C3822**

Above average yield response to foliar protection, additional fertility, or the combination. Below average yield performance under Control conditions. Would be considered a moderate 'Offensive' variety.



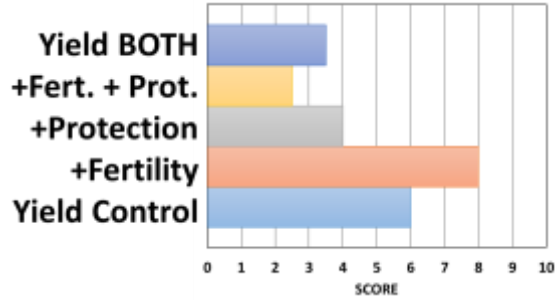
**R2C4000**

Above average yield performance under Control conditions. Below average yield response score for the other treatments.



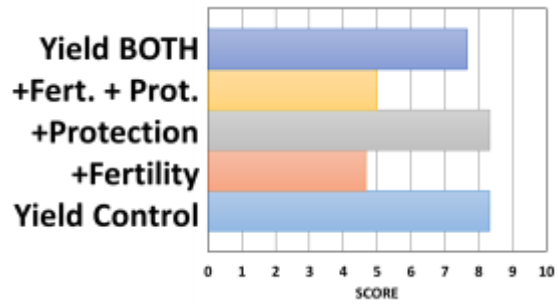
**RX3296**

Above average yield performance with additional fertility. Average to below average score for the other treatments.



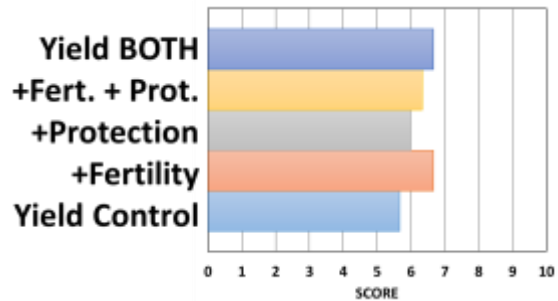
**RX3556**

High yield performance under Control and BOTH conditions as well yield response score to foliar protection.



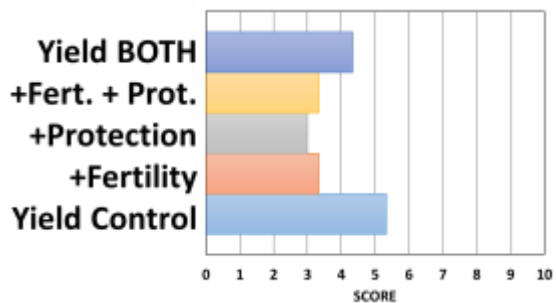
**RX3746**

Average to above-average yield performance under all conditions.



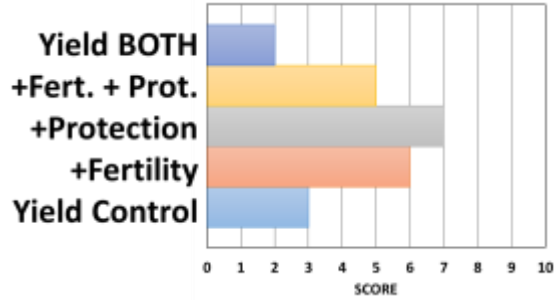
**RX3896**

Average yield performance under Control conditions. Below average score to the other treatments.



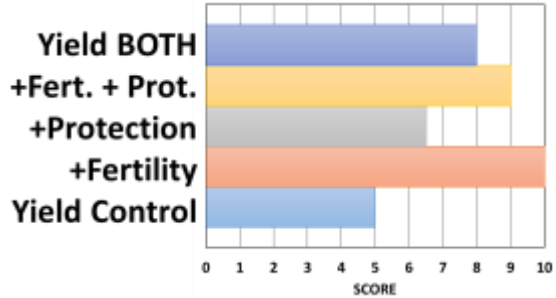
**RX4106**

Low yield performance under Control and BOTH conditions. Above average yield response to additional fertility or foliar protection individually.



**RX4316STS**

High yield performance with additional fertility, foliar protection, or BOTH conditions. Would be considered a good 'Offensive' variety.

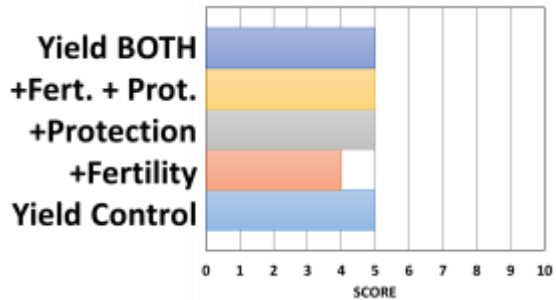


**Pioneer**

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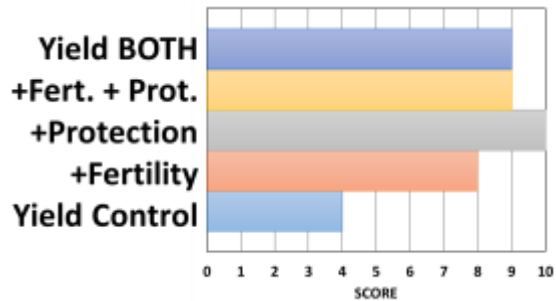
**94Y23**

Average to- below average yield response under all growing conditions.



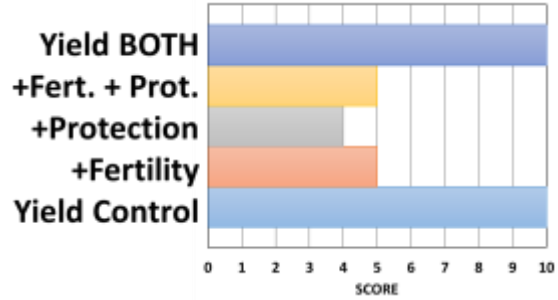
**P27T47R**

High yield response to additional fertility, foliar protection, and the combination of treatments. Would be considered a very good 'Offensive' variety.



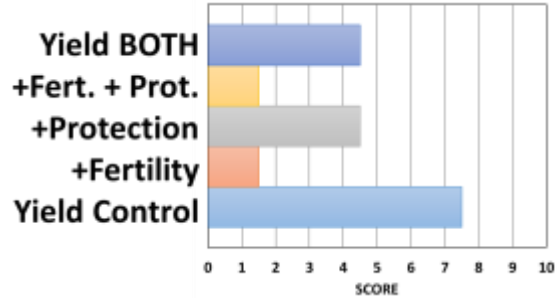
**P31T77R**

High yield performance under Control and BOTH conditions. Below to-average yield response to additional fertility or foliar protection. Would be considered a good ‘Defensive’ variety.



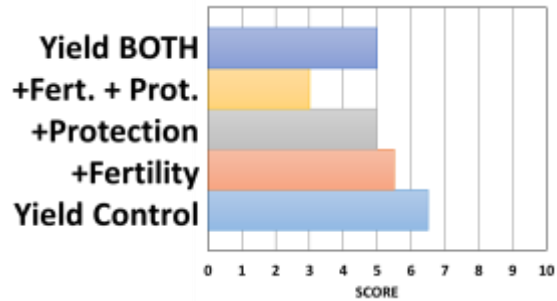
**P34T07R2**

High yield performance under Control conditions. Below average response score to the other treatments. Would be considered a good ‘Defensive’ variety.



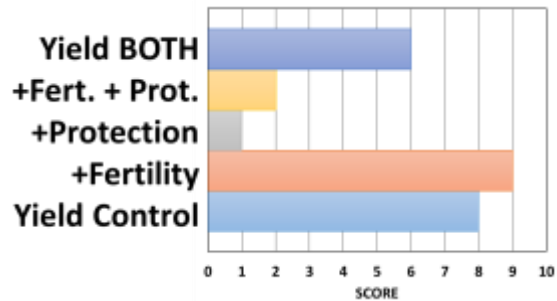
**P36T86R**

Above average yield performance under Control conditions. Average to-below score for the other treatments.



**P47T36R**

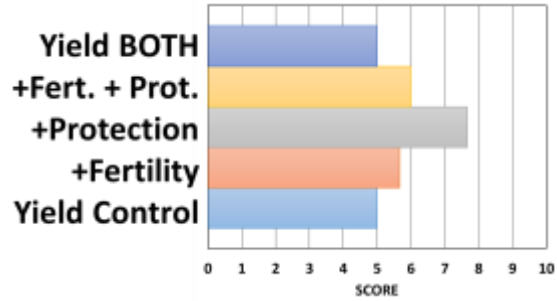
High yield performance under Control conditions and high yield response to additional fertility. Average yield under BOTH conditions, but low yield response to foliar protection. Would be considered a good ‘Defensive’ variety.



**Syngenta**

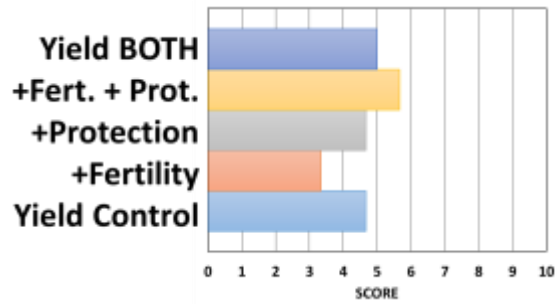
**S28-N6**

High yield response to foliar protection. Average yields with the other treatments.



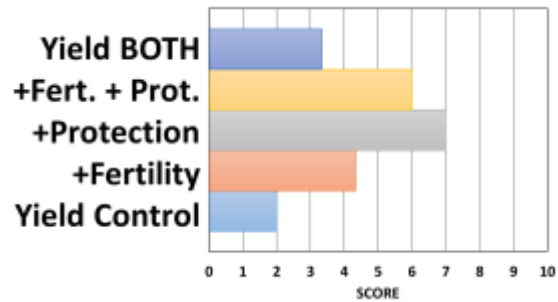
**S30-V6**

Average yield performance with most treatments, but below average yield response to added fertility.



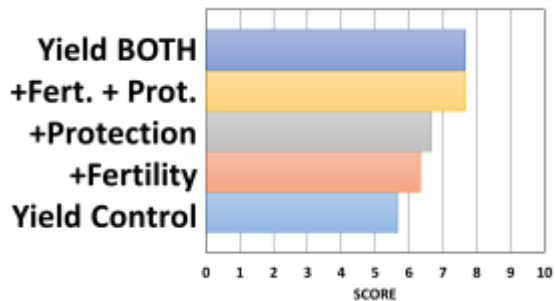
**S35-A5**

Above average yield response to foliar protection and in combination with additional fertility. Below average yield performance under Control and BOTH conditions.



**S37-Z8**

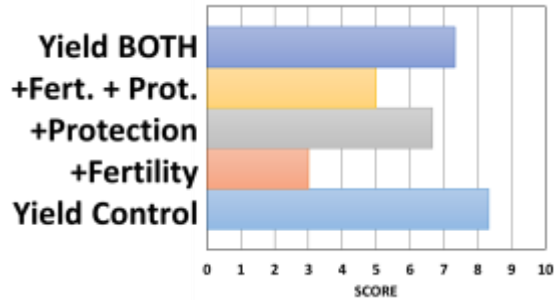
High yield performance with the combination of additional fertility and foliar protection conditions. Above average score with the individual additive treatments. Would be considered a moderate 'Offensive' variety.





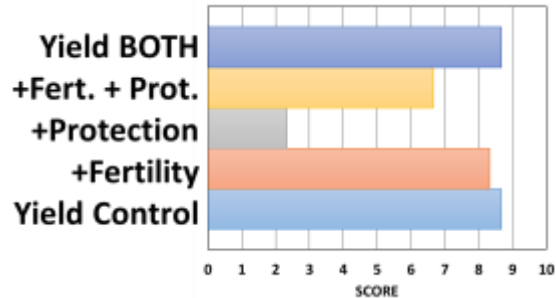
**S39-C4**

High yield performance under Control and BOTH conditions. Above average yield response to foliar protection, but low yield response to additional fertility.



**S42-P6**

High yield performance under Control and BOTH conditions. Above average yield response to additional fertility with or without foliar protection. Could be considered as either a 'Defensive' or an 'Offensive' variety.



**References**

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