

## **Assessing the Impacts of Row Spacing and Fungicide Timing on Disease Control and Profitability in Double Crop Soybean Production Systems**

### **PI's:**

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### **Objectives (Over two years and multiple sites)**

1. Evaluate the effects of row spacing on disease development in double crop soybean systems
2. Evaluate the efficacy and utility of foliar fungicides for disease control and / or profitability.

### **Justification**

Planting soybean in fields after winter barley or wheat, known as double cropping, is a popular means of producing soybeans in Delaware. In 2015 and 2016, approximately 45% and 50% of soybeans planted in Delaware were double cropped (NASS, 2016). Double cropping is valuable to Delaware producers as it increases total production of food, feed, and fiber without requiring additional acreage, helping growers meet the demands of increasing food demands on reduced land resources while providing significant environmental benefits. Many producers plant double cropped soybeans on 15" or 7-7.5" rows.

The majority of research on fungicides has been conducted on full season soybeans. Differences in length of growing season, spacing, and environment prevent the extrapolation of this work to a double cropped fungicide program. Due the shorter growing season for soybeans, there is less time for yield-limiting diseases to develop and impact plant development and growth. However, this effect could potentially be negated in some instances when spacing between rows is reduced. Planting on narrow rows allows the canopy to close sooner, shading out weeds and allowing the crop to capture more light for a longer period of time. However, the benefits of rapid canopy closure may result in increased canopy humidity, and potentially increase foliar disease and associated yield impacts.

A brief survey of consultants, agricultural agents, and growers indicated that approximately 20-30% of double cropped soybeans receive a fungicide application. We propose to conduct a set of replicated small plot studies in Delaware and Maryland to assess: 1) efficacy and profitability of fungicides in double cropped systems; 2) impacts of row spacing on fungicide efficacy and optimal timing. We are only seeking support for sites and research conducted in Delaware with this proposal.

## Results

### Study setup and methods

Research sites were established at five sites: 1) Carvel Research Center; 2) Harbenson Irrigation Farm; 3) Wye Research and Education Center; 4) Poplar Hill Research Center; 5) Beltsville Research Farm. The Poplar Hill site had an equipment issue at planting that resulted in severe stand variability, and this site was not included in the report.

The soybean variety Dynagro S39RY65 was used in this study. This variety yielded well in DE and MD state variety trials and is weak on foliar diseases such as frogeye leaf spot and brown spot. Thus, any yield benefits associated with fungal disease prevention or limitation were more likely to be realized. Seeds were planted at 200,000 seeds / A into fields that followed a typical corn/wheat/soybean rotation. Minimal tillage was used in each site and fertilizer applied based on soil tests. Main plots were 10' strips of soybeans, spaced at either 7.5 "or 15 ". The subplot was application of Priaxor fungicide at R1 or R3. The final individual plot size was 10 x 25'. Fungicide applications were made to the center 7' of each plot using a CO<sub>2</sub> backpack sprayer equipped with 80V02 Turbo TeeJet flat fan nozzles, and set to deliver 15 gal / A at 35 PSI. The design was a split plot with 3 reps of each spacing x fungicide timing treat each site. The Harbenson design was altered slightly to accommodate space, and plots were only 20 feet long. An example of the plot design can be viewed in **Table 1**.

**Table 1.** An example of the plot design used in this study. Green and yellow colors are used to indicate spacing treatment and pay homage to the Green Bay Packers, the greatest football team of all time.

	Priaxor	Treatment	5'	25'	5'	25'	5'	25'	5'	25'	5'	25'	5'
7 inch	none	a	d	a	e	b	f	c					
	R1	b	f	b	c	a	e	d					
	R3	c	a	d	b	c	f	e					
15 inch	None	d	f	e	a	d	c	b					
	R1	e	b	d	f	c	a	e					
	R3	f	f	c	d	e	b	a					

Plots were assessed for disease weekly. The relative amount of healthy canopy cover was assessed on 9/15, 9/25, 10/10, and 10/25 by measuring the NDVI of the center of each plot with the aid of a hand held greenseeker. Plots were rated for percent greenstem approximately 2 weeks before harvest, after foliage had senesced. The center 6.25' (Harbenson, Georgetown), or 5' (Wye, Beltsville) were harvested using a Massey 8x10 Small Plot research combine, and test weights and yields determined based on 13.5% moisture. Data were assessed across all sites using a mixed model ANOVA with block and site as random effects.

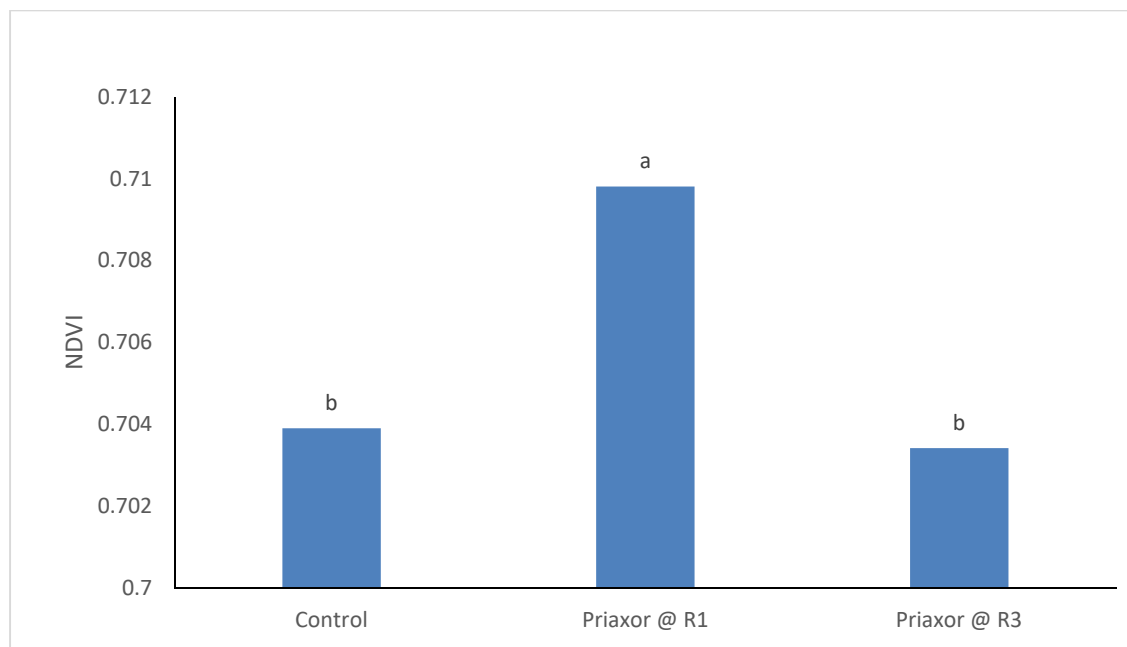
## Results

Across all sites, the only rateable disease was Soybean Vein Necrosis Virus (Wye). Thus, no disease data are presented. After assessing the greenseeker data, it was evident that utilizing an early and late rating provided the same amount of information as all four ratings. Thus, we present ratings from 9/15 (Greenseeker 1) and 10/25 (Greenseeker 2) here. Data showed that fungicide timing significantly impacted greenseeker ratings at 9/25, and percent green stem (**Table 2**).

**Table 2.** Mixed model ANOVA results for measured variables for four double cropped soybean sites replicated in Delaware and Maryland in 2017. Yellow boxes indicate significant effects at  $\alpha = 0.05$ .

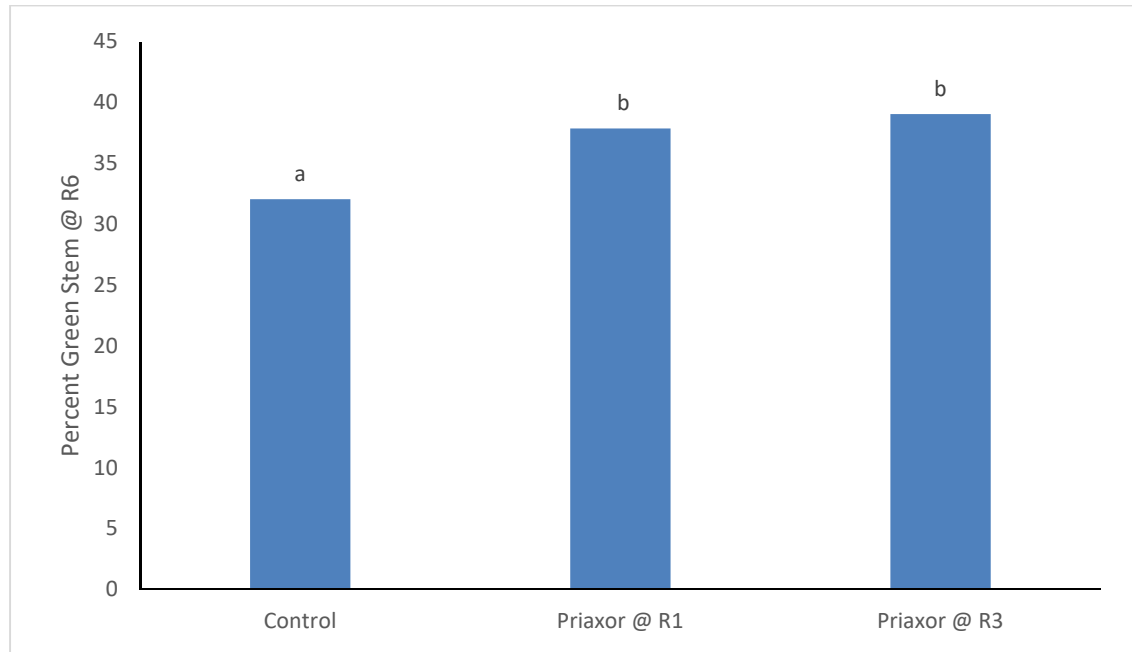
Source	greenseeker 9/15		greenseeker 10/25		green stem		twt		yield	
	F Ratio	Prob > F	F Ratio	Prob > F	F Ratio	Prob > F	F Ratio	Prob > F	F Ratio	Prob > F
spacing	0.0282	0.867	3.4588	0.0659	4.8311	0.03	0.0138	0.9068	43.0876	<.0001
fungicide	3.1453	0.047	2.1873	0.1171	3.8056	0.025	2.336	0.1019	0.7993	0.4524
spacing *fungicide	0.6625	0.517	0.1764	0.8385	0.2004	0.818	0.0627	0.9392	0.6456	0.5264

For the greenseeker rating, NDVI was significantly greater (thus more canopy closure or healthy tissue at 9/15) compared to untreated controls or treatments applied at R3 (**Figure 1**).



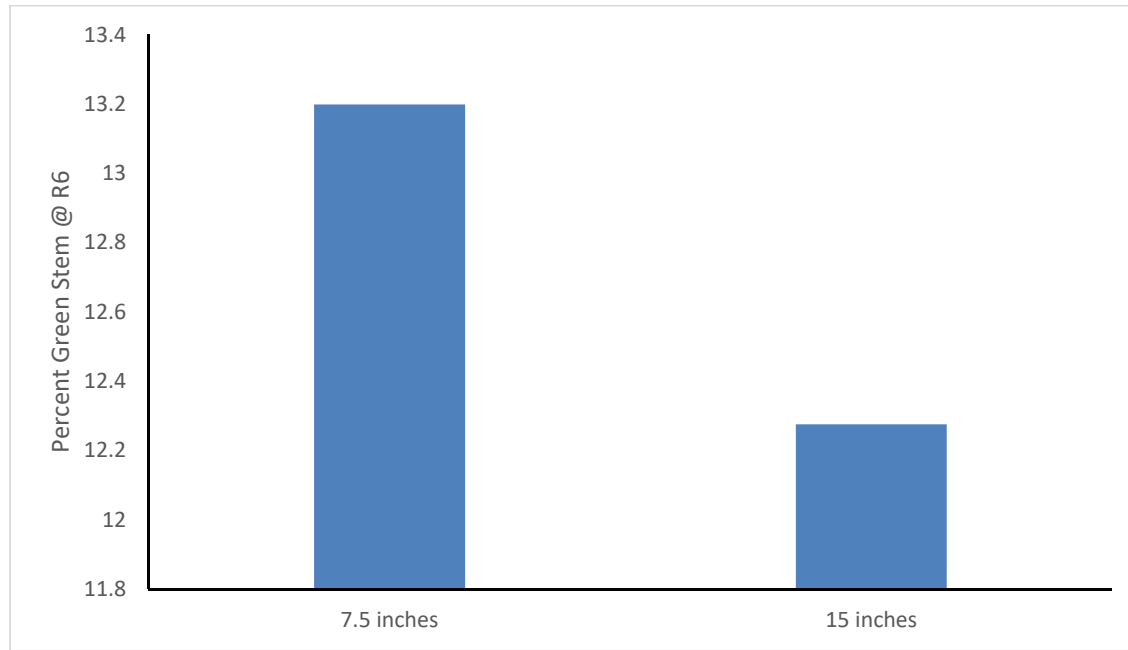
**Figure 1.** Main effects of fungicide timing on NDVI ratings acquired using a handheld greenseeker on 9/15/2017 at Georgetown, Harbenson, Wye, and Beltsville sites. Priaxor was applied to plots as described in the methods section. Data are averaged across sites and spacing treatments.

The percent green stem of plots treated with Priaxor at R1 or R3 were approximately 7% greater than untreated control plots (**Figure 2**).



**Figure 2.** Main effects of fungicide timing on green stem from double cropped soybeans planted across 4 sites in Delaware and Maryland in 2017. Data are averaged across sites and spacing treatments.

Spacing affected percent green stem and yield (**Table 1**). Double cropped soybeans planted on 7.5" rows averaged approximately 10% more green stem than plots planted on 15" spacing (**Figure 3**).



**Figure 3.** Main effects of spacing on the percent greenstem of double cropped soybeans planted across 4 sites in Delaware and Maryland in 2017.

Yield was significantly greater in the 7.5” spacing, when compared to the 15-inch spacing (**Figure 4**).

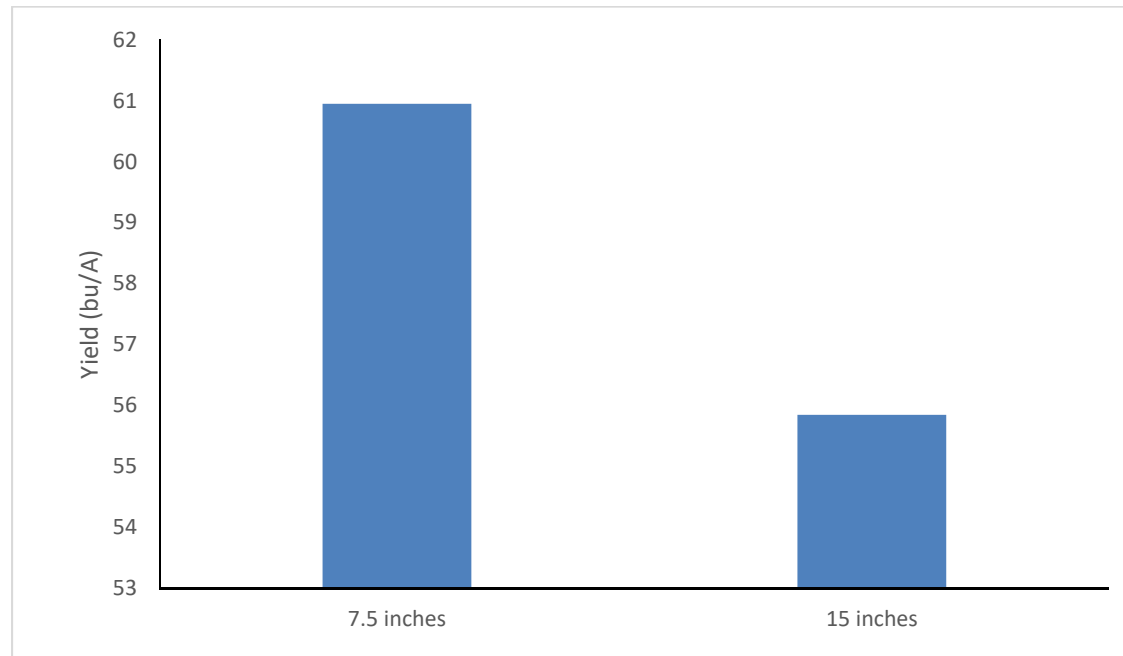


Figure 4. Main effects of spacing on yield of double cropped soybeans planted across 4 sites in Delaware and Maryland in 2017.

## Summary

The first year of this study provided insight into the impacts of fungicide use and spacing on disease and productivity in double cropped soybean systems commonly used in Delaware and Maryland. Despite ample residue, the use of a variety with susceptibility to common foliar diseases, and significant rain during several periods of the growing season, there was not enough foliar disease to rate. Profitable fungicide use is best attained when using a susceptible variety and the environment is conducive for disease. Although this was only a single season, our results indicate that other aspects of double crop production may limit foliar fungal disease and subsequent yield impacts associated with fungicide use. In double crop systems, soybean residues have more time to decompose due to the presence of corn and small grains, as well as additional residue sizing resulting from light tillage. Consequently, this can reduce the amount of residue borne foliar diseases such as Septoria brown spot, frogeye leaf spot, and pod diseases such as phomopsis pod and stem blight. Other aspects of the double cropped system are at a disadvantage for foliar fungal disease development. For example, later planting dates result in canopy closure during hotter, drier periods of the year, which may not favor disease development. Additional years and sites would give us more confidence as to the likelihood of fungicide need in double cropped soybean systems, as we expect variability in disease between growing seasons. Regardless, the lack of any disease across four sites despite a susceptible variety and weather is telling.

We did not see any additional yield benefit from the use of Priaxor in these conditions. Although this product, and several others with a strobilurin active ingredient are touted as having plant health benefits that can improve yield in the absence of the disease, we did not observe this to be true. However, we did notice that the Priaxor treatments did result in greater amounts green stem near harvest, compared to untreated controls. This may be a direct consequence of the strobilurin active ingredient, which may promote tissue longevity and thus carbohydrate production. When carbohydrate production exceeds demands by carbon sinks such as pods, tissues remain lush for a longer period. This can result in delayed harvest or harvest issues.

Narrow rows, as expected, resulted in greater yields when compared to 15" rows. This is likely due to less weed pressure and increased light interception of the canopy. As mentioned previously, at least one year of additional field research would be needed to improve our dataset and generate more robust management recommendations for growers. At present, we have no evidence that spacing influences foliar disease in double cropped soybeans produced around the Chesapeake Bay. Our data indicate that fungicide use may have a potential harmful effect if used in double cropped soybeans. Again, we utilized a susceptible variety, and this was what we would consider a disease favorable year. Based on the current dataset I would not recommend using a fungicide in double crop production in this region.