Effect of Seed Treatment in a No-tillage Soybean Production System in Iowa

Joseph Osenga and Palle Pedersen. Department of Agronomy, Iowa State University

josenga@iastate.edu

Introduction

Early planting is important to increase soybean yield potential, mainly due to a longer vegetative period and increased biomass accumulation prior to flowering (Pedersen and Lauer, 2003). However, planting earlier represents a challenge in no-tillage systems because crop residue causes cooler, wetter soils than in conventional tillage systems (Burgess et al., 1996). These conditions slow early soybean growth (Yusuf et al., 1999) and favor damping-off pathogens, such as *Phytophthora sojae* and *Pythium* spp. Since *Pythium* spp. is more prevalent than *Phytophthora sojae* in cooler soils, no-tillage systems, especially when planted early, could experience increased problems with *Pythium* spp. (Bockus and Shroyer, 1998). Recent work has confirmed greater incidence of *Pythium* spp. than *Phytophthora sojae* in earlier planted fields (Murillo-Williams, 2007). *Pythium* spp. can not be managed by host resistance, leaving cultural practices and fungicide seed treatments as the only options for management. The use of seed treatments is a popular practice to manage seedling diseases as well as arthropod pests. However, no recommendations exist for their use by Iowa soybean producers under no-tillage production practices. Many studies from other states have found improved plant stands with little to no yield response. Since soybean has shown the ability to compensate for sparse plant populations to produce similar yields to increased populations (De Bruin and Pedersen, 2007), the potential economic response from using a seed treatment is reduced. Research is needed to evaluate seed treatments in a no-tillage production system in Iowa.

Objective

Our objective was to evaluate the use of seed treatments on soybean stand and yield in a no-tillage production system in Iowa. Our hypothesis is that the use of seed treatments may preserve soybean stand and yield in a no-tillage system to a greater degree than in a conventional system.

Materials and Methods

- Field experiments were conducted in 2007 at four locations in Iowa: Humboldt, Hudson, Nevada, and Oskaloosa

- Treatments included a control, two fungicide seed treatments (metalaxyl + trifloxystrobin and mefanoxam + fludioxonil), and two combination fungicide/insecticide seed treatments (mefanoxam + fludioxonil + thiamethoxam and metalaxyl + trifloxystrobin + imidacloprid)

- Three cultivars were chosen: AG2802, P92M54, and S-2932-4. P92M54 is susceptible to *Phytophthora* root rot

- The experimental design was a randomized complete block in a split-plot arrangement with four replications. Whole plots were 2 tillage systems while subplots consisted of the combination of the 5 treatments and 3 varieties

- Seed was planted at a rate of 370 700 seeds ha^{-1} in 38-cm rows during the first and second week of May

- Agronomic data taken included seed yield, early and harvest plant stands, plant height, and lodging

Table 1. Significance of F-values from analysis of variance of grain yield, early stands, harvest stands, plant height, and lodging.

Source of Variation	Seed Yield	Early Stand	Harvest Stand	Plant Height	Lodging
Tillage System (S)	NS	NS	NS	**	NS
Treatment (T)	NS	NS	NS	NS	NS
S x T	NS	NS	NS	NS	NS
Cultivar (C)	**	NS	NS	***	***
C x S	*	NS	NS	NS	NS
C x T	NS	NS	NS	**	NS
C x S x T	NS	NS	NS	NS	NS

*Significant at P=0.1; ** Significant at P=0.05; *** Significant at P=0.01; NS, no significance at $P \leq 0.1$

Table 2. Influence of fixed main effects on grain yield, early stand, harvest stand, plant height, and lodging.

Main Effect	Seed Yield	Early Stand	Harvest Stand	Plant Height	Lodging
Tillage System	Kg ha^{-1}	-------- Plants ha^{-1} --------		cm	1-5†
NT	4615	336000	319400	95	1.1
CT	4661	331200	315800	98	1.1
LSD (0.1)	NS	NS	NS	2	NS
Cultivar					
AG2802	4689	332200	313700	102	1.2
S-2932-4	4543	337300	321000	98	1.0
P92M54	4682	331300	318100	90	1.0
LSD (0.1)	75	NS	NS	1	0.1
Treatment‡					
Control	4612	334200	317900	96	1.1
Mef. + Flud.	4581	332700	314700	96	1.0
Mef. + Flud. + Thia.	4684	331400	317600	97	1.1
Meta. + Tri.	4610	327500	310200	97	1.0
Meta. + Tri. + Imid.	4702	342200	327500	96	1.1
LSD (0.1)	NS	NS	NS	NS	NS

†Lodging is based on a 1 (erect) to 5 (flat) scale.
‡Mef.=Mefanoxam; Flud.=Fludioxonil; Thia.=Thiamethoxam; Meta.=Metalaxyl; Tri.=Trifloxystrobin; Imid.=Imidacloprid

Figure 3. Soybeans in a no-tillage system

Figure 4. Stand density is recorded in a 1 m by 4 row area (1.52 m^2)

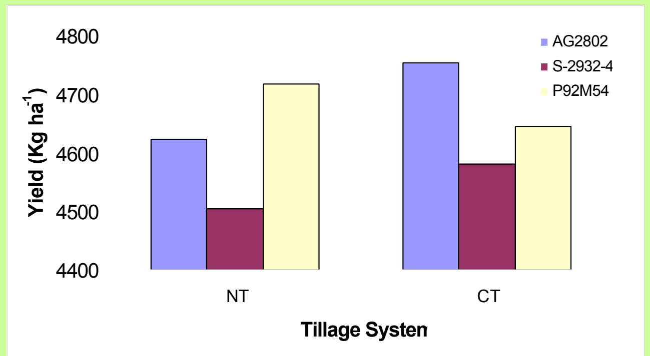

Figure 1. Interaction of cultivar and tillage system for seed yield.
Within tillage system: LSD (0.1) = 106 Kg ha^{-1}
Between tillage systems: LSD (0.1) = NS

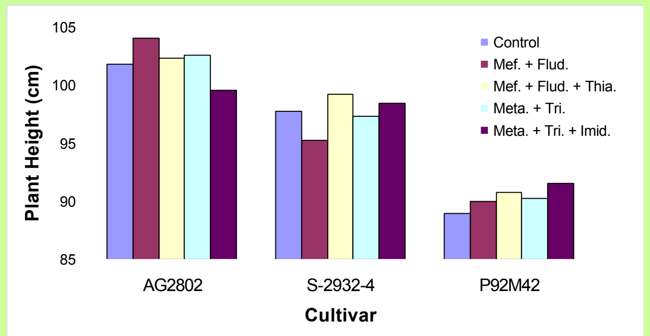

Figure 2. Interaction of cultivar and treatment for plant height.
LSD (0.1) = 2 cm

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Summary

Interactions

A cultivar by tillage system interaction was found for seed yield (figure 1). AG2802 had the highest yield and was different from the other two cultivars in the conventional system. In the no-tillage system, AG2802 and P92M54 yielded higher than S-2932-4. This supports the idea that cultivars can differ in their seed yield response when grown under different tillage systems.

A cultivar by seed treatment interaction was found for plant height (figure 2). S-2932-4 treated with mefanoxam + fludioxonil and AG2802 treated with metalaxyl + trifloxystrobin + imidacloprid produced shorter plants than the other seed treatments for their respective cultivars. This result cannot be explained, and the interaction's significance may disappear with subsequent years of study.

Tillage system

Small differences were found between the two tillage systems. Soybeans grown in the conventional tillage system grew on average 3 cm taller than in the no-tillage system. Tillage systems did not influence any other measured variable in this study.

Cultivar

Seed yield, plant height, and lodging were influenced by cultivars. The highest yielding cultivars were AG2802 and P92M54, yielding 146 and 139 kg ha^{-1} greater than S-2932-4, respectively. AG2802 was the tallest cultivar followed by S-2932-4 and P92M54. AG2802 had a higher lodging score, however, no differences in lodging was found between S-2932-4 and P92M54. No differences were found among cultivars for either stand counts.

Seed Treatment

No differences between seed treatments were observed for any of the five response variables.

Conclusion

The 2007 growing season in Iowa was characterized by a very wet spring and fall. Heavy rainfall in April led to a delay in planting for all four locations of two to three weeks. The relatively late planting date may have contributed to the lack of response from seed treatments. Higher soil temperatures allow faster seed germination and emergence, decreasing the general susceptibility to damping-off pathogens. While higher temperatures can favor *Phytophthora sojae* over *Pythium* spp., the susceptible cultivar P92M54 was not adversely affected, indicating that inoculum levels may not have been high enough to be problematic. Therefore, protection that could have been provided by fungicide seed treatments was not needed. In addition, the delayed planting also avoided most of the early-season damage from overwintering bean leaf beetles (*Coleoptera trifurcate*), reducing the potential response from the insecticide component of two of the seed treatments. This research project will be continued in 2008 and 2009 to obtain more conclusive results.

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IOWA STATE UNIVERSITY
Department of Agronomy
Crop, Soil, and Environmental Sciences

IOWA SOYBEAN ASSOCIATION