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Research update on seedling diseases of corn and soybean caused by oomycete pathogens

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Uniform emergence and development of corn and soybean seedlings is key to maximize farmer profitability. In corn, poor stand and plant-to-plant variability lower yield potential as smaller plants compete with their larger neighbors for resources. With the dramatic increase in soybean seed costs within the past decade, farmers now plant fewer seeds per acre and thus depend on improved emergence and better stand establishment to achieve an even stand and maximize yield potential.

Uneven plant emergence and poor stands can occur as a result of many factors, including seedling disease. In 2005, an estimated 829 thousand tonnes of soybean were lost in the U.S. due to seedling disease, excluding losses due to *P. sojae* (Wrather and Koenning, 2006). In a recent survey (March 2012) of certified crop advisors (CCA) in the Midwest and southeastern U.S., 77 percent of CCAs indicated they had encountered soybean stand establishment problems on 15% of the acreage they had scouted over the past five years and 20 percent of the problems were attributed to seedling diseases and/or seed rot.

Seedling disease of corn and soybean can be caused by fungal pathogens, e.g., *Fusarium* spp. and *Rhizoctonia solani*, and oomycete pathogens, e.g., *Pythium* spp. and *Phytophthora sojae* (soybean only). These pathogens each require different environmental conditions to infect and cause disease. Flooded conditions favor seedling diseases caused by oomycetes since this group of organisms produces swimming spores, known as zoospores that swim in free water and infect germinating seedlings. Moreover, infection by one species can predispose seedlings to infection by other species.

Even though seedling diseases are among the most widely distributed diseases of corn and soybean, our knowledge of the complex of pathogens that infect these crops, and the environmental conditions that favor disease development is very limited. Almost 20 years ago, Rizvi and Yang (1996) reported six *Pythium* spp., *Phytophthora sojae* and *Rhizoctonia solani*, as the major casual organisms associated with soybean seedling disease in Iowa. More recently, similar seedling disease surveys in Ohio recovered 22 species of *Pythium* from diseased corn and soybean seedlings (Broders et al., 2007, Broders et al., 2008). Some species are highly pathogenic on both crops, while other species may be more aggressive on soybean than corn and vice versa.

Sensitivity to seed treatment fungicides can also vary across and within *Pythium* spp. Broders et al (2007) evaluated the sensitivity of 13 *Pythium* spp. to four seed treatment fungicides and found no fungicide provided control for all 13 species.

Regional assessment of seedling disease of soybean

Currently we are collaborating with other soybean pathologists in the north central region on two projects on soybean seedling disease that are being funded by USDA-NIFA (2011-2014) and the United Soybean Board (USB) (2012-2014). An extensive survey of pathogens associated with soybean seedling disease in the region is being completed.

Data collected from the first two years of the seedling disease survey has provided baseline information on oomycete pathogens affecting soybean in the north central region. In 2011, 19 species of *Pythium* were recovered from diseased soybean seedlings in Iowa (Robertson, 2012), and a similar number of species is expected in 2012. This included five of the six species that had previously been reported by Rizvi and Yang (2006) but also several species that have not previously been reported as pathogens of soybean In Iowa, and at least two species not reported in Ohio by Broders et al. (2007). Across the north central region, 54 species of *Pythium* were associated with diseased soybean seedlings in 2011 (Rojas et al., 2012).

The portfolio of *Pythium* spp. recovered in each year of the survey varied, which is perhaps not surprising since the

2011 planting season was characterized by cool, wet conditions across much of the region, while 2012 was warm and dry. Across the north central region it was found that soil temperature, precipitation and soil texture influenced the species composition between states and regions (Rojas et al., 2012).

Statewide evaluation of commercial seed treatments for soybean in 2011

The use of seed treatments on soybeans has increased considerably over the past few years. Seed treatments protect seed from seedling diseases, caused by *Pythium*, *Phytophthora*, *Fusarium* and *Rhizoctonia*, and insect pests such as the bean leaf beetle. Although a seed treatment may help ensure uniform emergence and optimum stands, such benefits do not always result in greater yields.

In Iowa, the benefits of a seed treatment on soybean have not been well studied. Over the past two growing seasons we have evaluated the effect of commercially available fungicide and insecticide seed treatments on seedling disease, insect pests, and yield of soybean. In both 2011 and 2012, the study was done at three locations in Iowa: ISU Northeast Research and Demonstration Farm (NERF), Nashua, Ames (central), ISU Southeast Research and Demonstration Farm (SERF) near Crawfordsville and a farmer's field in Nevada (two planting dates). In 2012, an additional location at the ISU Field Extension and Education Laboratory (FEEL) near Boone was also planted. The following data were collected: Stand counts at 14 and 21 days after planting (dap), seedling vigor at 28 dap, seedling disease incidence, foliar and stem disease severity, Bean leaf beetle and aphid population counts, and yield.

In 2011, we planted into excellent seedbed conditions. No seedling disease or insect damage occurred at any location. There were no differences in stand counts at either 14 dap or 28 dap in three of the four trials. At the first Nevada planted field, stand counts at 14 dap for the CruiserMaxx and CrusierMaxx Plus treatments were statistically greater than the control (untreated seed). At 28 dap, stand counts for the Trilex 6000 +Heads up treatment were statistically greater than the control.

At Crawfordsville, soybean seedlings from seed treated with CruiserMaxx were more vigorous (taller) ($P<0.1$) than untreated control. At the early planting date at Nevada, seedling vigor of the AgriGardian Micro Mix and Foliar blend treatment was lower than the untreated control ($P<0.1$). For all other treatments, seedling vigor did not differ. There was no evidence of an effect of seed treatment on seedling vigor at Nashua or the later planting date at Nevada.

Weather conditions during grain fill were not favorable for foliar disease development. At Nashua, there was some *Cercospora* leaf blight, and an application of Headline+Leverage at R3, reduced disease severity ($P<0.001$). Sudden death syndrome occurred in the trial at Crawfordsville but at very low incidence and no treatment effects were evident.

Soybean aphids were not present at any of the locations at R1, while at Nevada and Crawfordsville populations were extremely low (<10 aphids per plant) later in the growing season. At Nashua, the mean number of aphids per plant at growth stage R4.5 ranged from 41 to 63 in the treatments, well below threshold levels.

Yield varied across locations ranging from 51.1 to 63.3 bu/ac in the untreated control (Table 1). There was evidence of an effect of seed treatment on yield at all locations ($P<0.1$). At Crawfordsville, the yield of soybean treated with CruiserMaxx was greater than the untreated control (71.6 bu/A versus 63.3 bu/A). In the early planting date trial at Nevada, the CruiserMaxx (58.1 bu/A), CruiserMaxx Plus (58.1 bu/A), "Pioneer premium" (56.8 bu/A) and AgriGardian (56.5 bu/A) foliar blend treatments all yielded higher than the untreated control (51.3 bu/A). Yield of soybean treated with Trilex 6000 plus HeadsUp was greater than that of the untreated control in the later planting date trial at Nevada (54.5 bu/A versus 51.1 bu/A). Lastly, at Nashua, the Trilex 6000 plus HeadsUp (64.3 bu/A) and "Pioneer Premium" (64.3 bu/A) treatments yielded higher than the untreated control (57.9 bu/A).

At the ISU FEEL, we planted twelve demonstration plots on April 15, just as two weeks of very wet, cold weather conditions started. Six of the plots were inoculated with *Pythium* spp., and six with the SDS pathogen, *Fusarium virguliforme*. Untreated seed was planted in one plot inoculated with each pathogen; the remaining five plots inoculated with each pathogen were each planted with soybean seed treated with a commercial seed treatment. Stand count was assessed 21 dap and 28 dap. At 21 dap, three seedlings had emerged across the 12 plots; at 28 dap, 41 percent of the non-treated seeds had emerged in each plot compared to 78 to 84 percent of the treated seeds in the remaining 10 plots. The benefits of seed treatments on soybeans have been well documented when planting conditions are not optimal, specifically if conditions at planting or soon after planting are cold and wet, and the plots at FEEL clearly bore this out.

Table 1. Seed treatment products tested in soybean seed treatment trials at three locations in Iowa in 2011 and mean yield (bu/A) of each treatment

Treatment	Yield (bu/A)			
	Crawfordsville	Nevada early	Nevada late	Nashua
Untreated	63.3	51.3	51.1	57.9
Untreated [a]	72.7	52.5	47.1	64.7
Trilex 6000	61.0	56.1	53.6	60.8
Trilex 6000 [a]	64.3	59.3**	49.0	66.3
Inovate System	62.8	56.1	47.2	60.4
Inovate and Metastar	62.2	51.5	50.1	55.6
Inovate and Metastar [a]	61.9	58.7**	48.0	70.7**
AgriGardian foliar blend [b]	-	55.2	49.4	-
AgriGardian foliar blend [c]	-	56.5*	52.4	-
CruiserMaxx	62.3	58.1*	50.0	60.4
CruiserMaxx Plus	71.6*	58.1*	49.1	60.5
CruiserMaxx Plus [a]	63.6	50.4	51.2	67.1
"Pioneer Premium"	62.9	56.8*	50.7	63.9*
Trilex 6000 and Heads up	60.6	52.3	54.5*	64.3*
Trilex 6000 and L1940-A	64.2	52.7	49.8	62.3
Acceleron fungicide	62.5	55.4	48.8	62.1
Poncho / VOTiVO	63.6	55.8	52.1	60.1
Acceleron Fungicide and Insecticide	62.8	53.9	51.8	58.5
AgriGardian Micro Mix [d]	-	50.5	47.9	-
AgriGardian Micro Mix and Foliar blend [e]	-	51.0	47.5	-
LSD (0.1)	6.0	4.9	3.3	5.8

[a] Sprayed with Leverage and Headline at R3
[b] AgriGardian foliar blend infurrow 16 oz/ac followed by two 16 oz/ac foliar sprays with Roundup
[c] AgriGardian foliar blend infurrow 8 oz/ac followed by two 8 oz/ac foliar sprays with Roundup
[d] AgriGardian Micro Mix infurrow 6.4 oz/ac followed by 6.4 oz/ac foliar spray with Roundup
[e] AgriGardian Micro Mix infurrow 6.4 oz/ac followed by two 6.4 oz/ac Micro Mix and 16 oz/ac Foliar blend tank mix with Roundup
* Indicates significantly different from untreated control with no application of Leverage and Headline at R3
** Indicates significantly different from untreated control with an application of Leverage and Headline at R3

Seedling blight of corn in southeastern Iowa

In 2012, several thousand acres of corn in southern Iowa were replanted in late May because of poor stands caused by seedling disease. Emergence issues due to seedling disease have been prevalent in the southern part of the state for the past few years. In 2011, farmers in Lee County replanted twice because of stand loss due to disease.

The seedling disease issues that have occurred in southern Iowa are often associated with a period of several days of cold (<55F), wet soils that occur soon after planting. These types of conditions favor *Pythium* spp. In 2012, between April 28 and May 8, two to six inches of rain fell across southern Iowa and soil temperatures dropped below 55F for four to five days. Seedling disease issues were most prevalent in fields planted just prior to the cool, wet weather.

Seedling disease risk can be reduced with fungicide seed treatments. Mefenoxam/metalaxyl (e.g., Apron®, Allegiance®) have traditionally been used to manage seedling disease caused by *Pythium* spp. More recently strobilurins, e.g., Trilex®, Dynasty®, also have been used, although they are not as effective. Reduced sensitivity of *Pythium* spp. to mefenoxam and some strobilurin fungicides was reported from Ohio (Broders et al.,2008). Although all corn seed is treated with fungicides, growers in southeastern Iowa have been applying additional metalaxyl/mefenoxam to corn seed before planting in an effort to reduce *Pythium* seedling blight. This practice has had limited success.

In May 2012, we visited 28 cornfields in which emergence was affected due to seedling disease in southern and southeastern Iowa and collected diseased corn seedlings. We identified the P*ythium* spp. associated with symptomatic seedlings and assessed the isolates we collected for sensitivity to several fungicides used in commercial seed treatments and two additional fungicides.

Nine *Pythium* spp. were recovered from seedlings collected from 19 of the 30 fields sampled. Over 80 percent of the isolates collected were identified as *P. torulosum,* a species that is favored by cold, wet conditions. Data from fungicide sensitivity assays in vitro will be presented at the conference.

References

Broders, K.D. et al. 2007. Characterization of *Pythium* spp. Associated with corn and soybean seed and seedling disease in Ohio. Plant Dis. 91:727-735.

Elmore, R. 2012. Progress of corn planting and corn emergence. Integrated Crop Management News, www.extension.iastate.edu/CropNews, 5/1/12

Robertson, A. and Munkvold, G. 2012. Seedling diseases reported in corn and soybean. Integrated Crop Management News, www.extension.iastate.edu/CropNews, 5/16/12

Robertson, A. and Saalau-Rojas, E. 2011. Post emergent damping off or corn prevalent in some fields. Integrated Crop Management News, www.extension.iastate.edu/CropNews, 6/7/11

Robertson, A. 2010. Assess seedling health when doing stand counts. Integrated Crop Management News, www.extension.iastate.edu/CropNews, 5/4/10

Rojas, A., Jacobs, J., Bradley, C.A., Esker, P.D., Giesler, L., Jardine, D., Nelson, B.D., Malvick, D. K., Markell, S., Robertson, A.E., Rupe, J.C., Sweets, L. Wise, K.A., Chilvers, M.I. 2012. Survey of oomycete species associated with soybean seedling diseases in the United States. Phytopathology 102 (Suppl): S5.8

Wrather, J.A. and Koenning, S.R. 2006 Estimates of disease effects on soybean yields in the United States 2003 to 2005. Journal of Nematology. 38(2):173–180.