KANSAS STATE UNIVERSITY | Department of Plant Pathology

TO: Kansas Soybean Commission

FROM: Dr. Christopher R. Little
Associate Professor of Plant Pathology

SUBJECT: Final Report: "Influence of planting date, ILeVO seed treatment, root structure, and soil compaction upon SDS in Kansas." (2016-2017)

DATE: 03/31/2017

Reporting Period: December 1 to March 1

Principle Investigators: Christopher R. Little (PI), Eric Adee (Co-PI), and DeAnn Presley (Co-PI)

Funding Amount: $36,568

Department Heads: Martin Draper (Plant Pathology)
Gary Pierzynski (Agronomy)

Objectives:

(1a) Determine the influence of planting date upon sudden death syndrome (SDS) in Kansas.

(1b) Examine the interaction between ILeVO seed treatment and planting date for SDS.

(2) Determine the relationship between root structure and SDS severity.

(3) Determine the relationship between soil compaction and SDS severity.

4024 Throckmorton Plant Sciences Center, Manhattan, KS 66506-5502 | (785) 532-6176 | fax: (785) 532-5692 | plantpath.ksu.edu

Major findings:

1. Traditionally, soybean planting dates in the Kansas River Valley have been delayed until after mid-May to help avoid the development of SDS. Planting date studies over the past two years have shown that SDS symptoms have been more severe in earlier plantings (first of May). As the planting dates progressed later the SDS severity decreased. However, the highest yields in these studies occurred with the earlier planting dates, in spite of increased SDS disease severity. Yields decreased by an average of almost 0.5 bu per day for more tolerant varieties when planting was delayed after the end of April or the first of May, and 0.3 bu per day for the more susceptible varieties. In both years, the SDS severity was not as high as previously observed at KRV.

2. As predicted, ILeVO reduces SDS disease severity. Moderately resistant soybeans show improved yield compared to susceptible regardless of ILeVO use.

3. Plants with longer root systems appear to have decreased SDS severity compared to those with shorter root systems. The SDS pathogen itself decreases root length for both moderately resistant and susceptible genotypes.

4. For both years of the compaction study (2015 and 2016), there was no impact of compaction on disease severity or yield. Thus, compacted soil may not influence sudden death syndrome in the Kansas River Valley. This may be due to the soil types that are common in the area. However, sub-surface compaction appears to be related to increased disease severity, although this finding is preliminary and non-significant.

Progress:

(Objective 1a) Determine the influence of planting date upon sudden death syndrome (SDS) in Kansas.
(Objective 1b) Examine the interaction between ILeVO seed treatment and planting date for SDS.

These two objectives are coupled together and therefore will be discussed under the same section.

The first, second, third, and fourth planting dates for the planting date study were planted on 05 May, 23 May, 10 June, and 23 June 2016, respectively, at the Rossville Unit of the Kansas River Valley Experiment Fields (Figure 1a). It was planted with # in 2015. Two varieties (Pioneer P35T58 and KS3406RR) were planted in a randomized complete block design where treatments consist of a combination of variety and planting date.

Figure 2a and 2b show the influence of planting date on yield and disease severity (AUDPC). In this year's study, there was a significant linear, negative relationship between planting date and yield. As expected, later planting results in lower yields. Along with that, later planting also results in lower SDS disease severity. For the susceptible variety (KS3406RR), the relationship appears to be curvilinear, whereas the relationship is linear for the resistant variety (P35T58).

The addition of ILeVO as as seed treatment reduced disease severity in resistant plants (Figure 3a). However, it did not significantly improve yield for either the resistant or susceptible variety in this year's study (Figure 3b).

(Objective 2) Determine the relationship between root mass/area and SDS disease severity.

Seedlings/plants will be harvested at V4, R1, and R3 to determine root mass/area. This data will be related to AUDPC measurements taken later in the season when the disease develops. As seen in Figure 4a, the SDS pathogen reduces root area in both moderately resistant and susceptible genotypes. The moderately resistant genotype in this experiment had overall greater root area than did the susceptible genotype. Further, there is a negative linear relationship between root length and disease severity (Figure 4b). In this case, varieties were measured for root length and cohorts of plants from those varieties were tested for disease severity. Therefore, it can be concluded that soybean varieties that produce lower root length (or area) are generally more susceptible to the disease. This could be because plants with lower root mass are not able to compensate for root disease to the same extent as those with greater root mass.

(Objecctive 3) Determine the relationship between soil compaction and SDS disease severity.

The compaction study was planted on 05 May 2016 at the Paramore/Silver Lake Unit of the Kansas River Valley Experiment Fields. It was planted with # in 2015. Plots were planted with the same varieties as in Objective 1. Two varieties (Pioneer P35T58 and KS3406RR) were planted in a completely randomized design where treatments consisted of a combination of compaction and variety for a total of 4 treatments in 4 reps.

Compaction measurements for the plots were obtained on 03 Jun 2016. See Figure 5a for data. As observed in Figure 5b, increased surface and sub-surface compaction led to decreased stand. Although not significant (and when signficant outliers were removed from the data), the compaction treatment resulted in higher disease severity values than did the non-compacted treatment.

The relationship between soil compaction (PSI) and disease severity (AUDPC) (*r*) at surface and sub-surface soil depths showed a trend towards a positive relationship at increased depths (Figure 5d). In other words, as depth increases, subsurface soil compaction increases and this may increase SDS disease severity.

Plans for the next funding cycle (see 2017-2018 funded project):

1. Screen adapted Kansas germplasm and KSVT entries for SDS resistance using three high-throughput methods.

2. Examine the interaction between ILeVO seed treatment and planting date for SDS. A third year of this objective is needed to improve the overall data set.

3. Determine modes of residue and soilborne survival of the SDS pathogen in Kansas pro-duction fields.

4. Determine pathogenic variability of *Fusarium virguiliforme* isolates from multiple Kansas fields.

SDS x Planting Date, Little, Adee, Presely, KRV-Rossville, T6, 2016															^North			
	border		40'						border		40'							
10'																		
	15	2	6	1	10	9	11	13	5	3	14	7	12	16	8		4	
border	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415		416	
			30'								30'							
	16	3	14	13	8	10	15	7	12	6	9	1	4	2	5		11	
	301	302	303	304	305	306	307	308	309	310	311	312	313	314	315		316	
		30																
	9	11	4	8	14	2	7	16	6	1	13	15	5	10	3		12	
	201	202	203	204	205	206	207	208	209	210	211	212	213	214	215		216	
	alley	30'							alley	30'								
10'																		10'
	1	2	3	4	7	8	5	6	9	10	11	12	13	14	15		16	
border	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115		116	
30' border											10 x 45' plots							

Figure 1a. Plot layout for the SDS planting date/ILeVO study in Rossville, Kansas for the 2015 experimental season. Two varieties (Pioneer P35T58 and KS3406RR) were planted in a randomized complete block design where treatment consists of a combination of variety and planting date (4 dates) for a total of 8 treatments in 4 reps.

KANSAS STATE UNIVERSITY | Department of Plant Pathology

SDS * Compaction STudy, Little, Adee, Presely, KRV , T6, 2016									^North
	normal	Comp	Comp	normal	Comp	Comp	normal	normal	
	Var 1	Var 1	Var 2	Var 2	Var 2	Var 1	Var 1	Var 2	
	301	302	303	304	401	402	403	404	
	Y	O	O	Y	O	Y	Y	O	
	30' alley								
105' length	Comp	Comp	normal	normal	normal	normal	Comp	Comp	
10'	Var 2	Var 1	Var 2	Var 1	Var 1	Var 2	Var 1	Var 2	
	101	102	103	104	201	202	203	204	
30' border	O	Y	Y	O	Y	Y	O	O	

Figure 1b. Plot layout for the SDS compaction study in Rossville, Kansas for the 2016 experimental season. Two varieties (Pioneer P35T58 and KS3406RR) were planted in a completely randomized design where treatments consisted of a combination of compaction and variety for a total of 4 treatments in 4 reps.

4024 Throckmorton Plant Sciences Center, Manhattan, KS 66506-5502 | (785) 532-6176 | fax: (785) 532-5692 | plantpath.ksu.edu

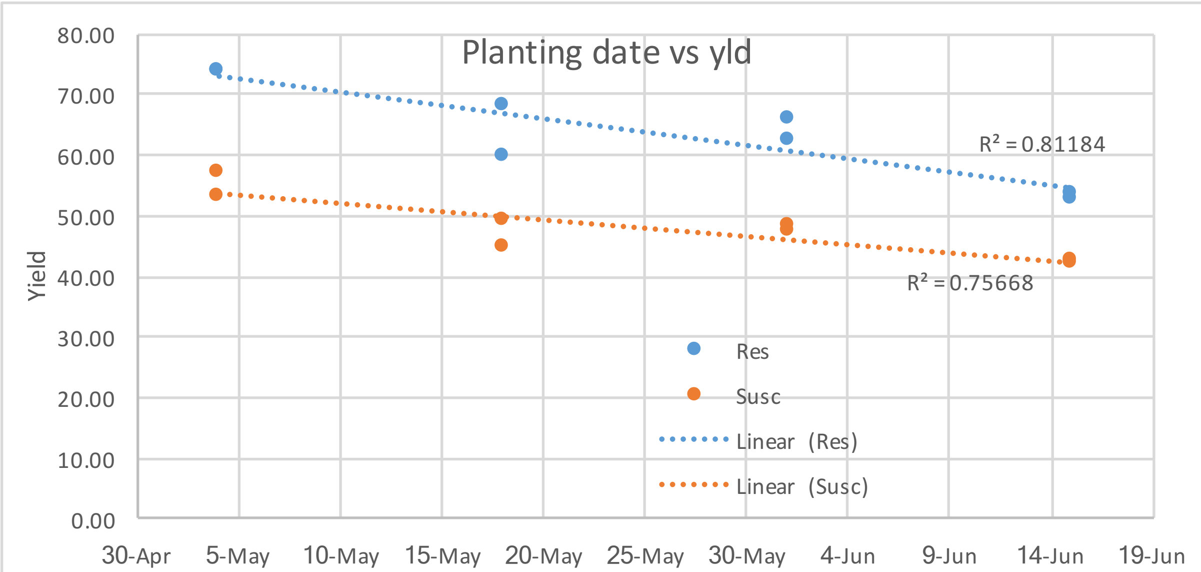

Figure 2a. Relationship between planting date and soybean yield at Silver Lake experimental site during the 2016 season.

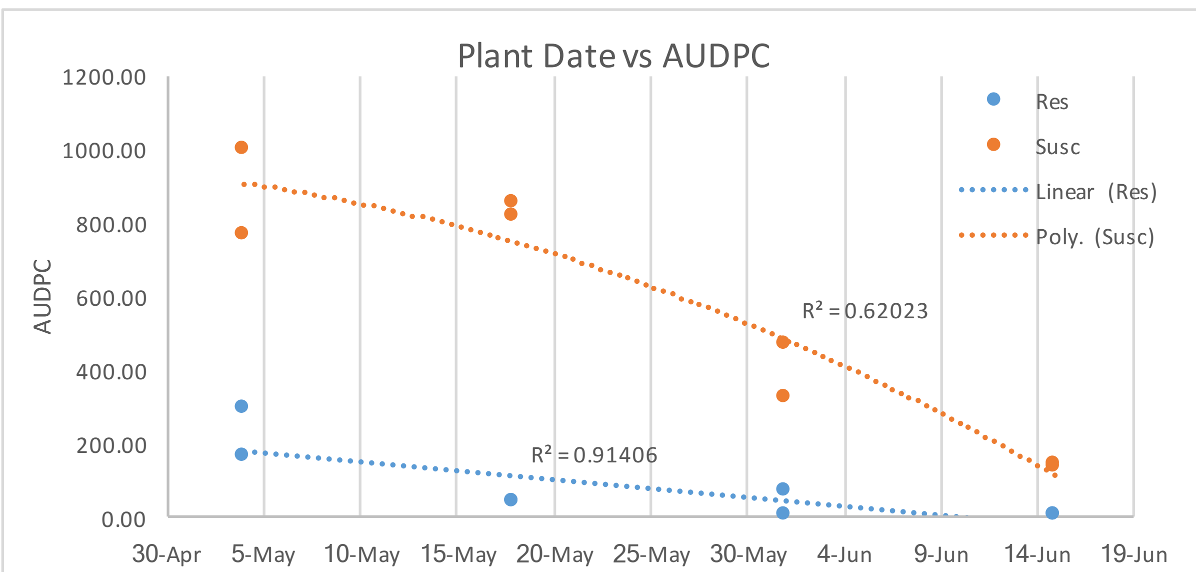

Figure 2b. Relationship between planting date and disease severity (AUDPC) at the Silver Lake experimental site during the 2016 season.

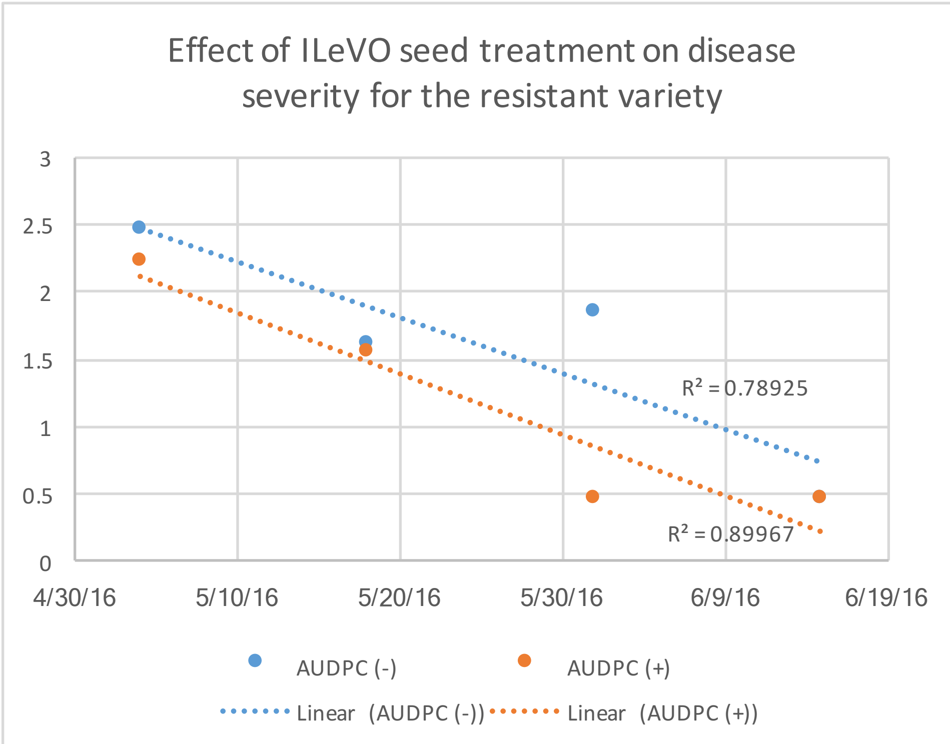

Figure 3a. ILeVO reduces SDS severity as seen in the resistant variety planted at the Silver Lake experimental site during the 2016 season. AUDPC = area under the disease progress curve; (-) no ILeVO seed treatment; (+) ILeVO seed treatment

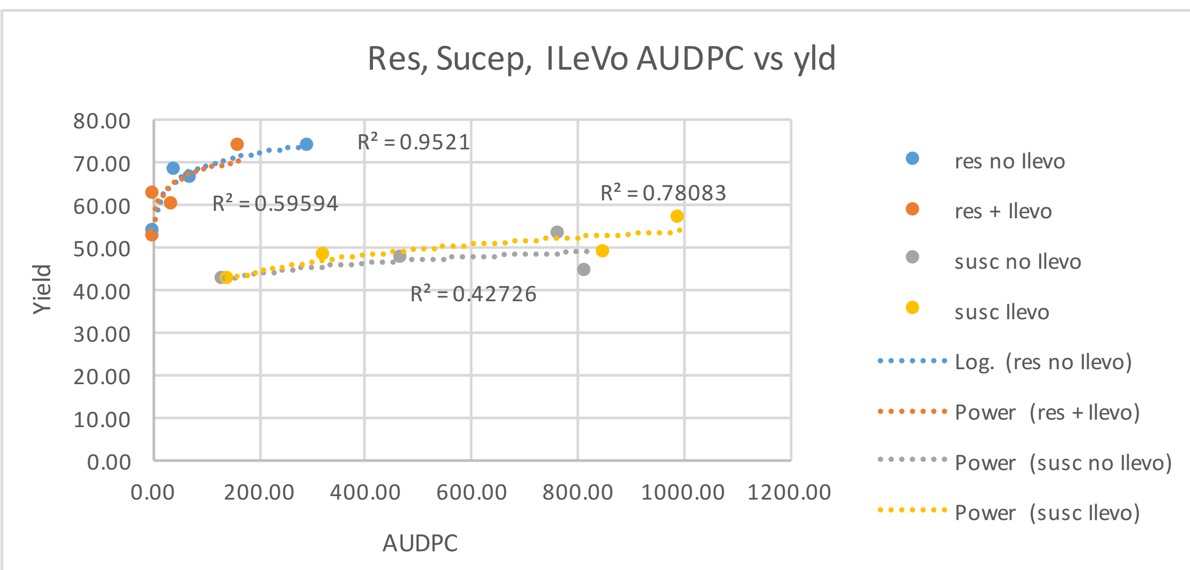

Figure 3b. Relationship between AUDPC (disease severity) and yield for both resistant and susceptible varieties after treatment or no treatment with ILeVO.

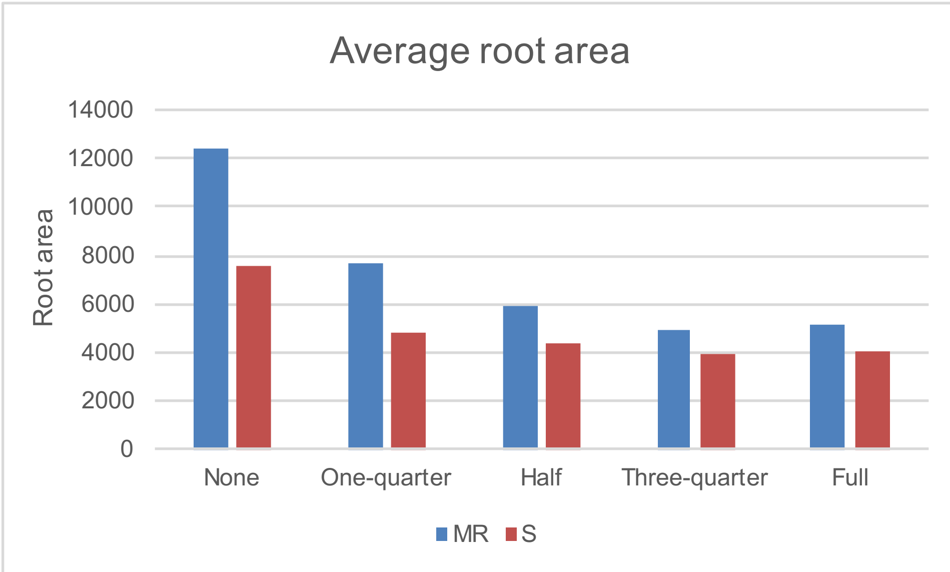

Figure 4a. Impact of SDS on root length in soybean depending upon levels of inoculation (none, 1/4, 1/2, 3/4, and full). MR = moderately resistant, S = susceptible.

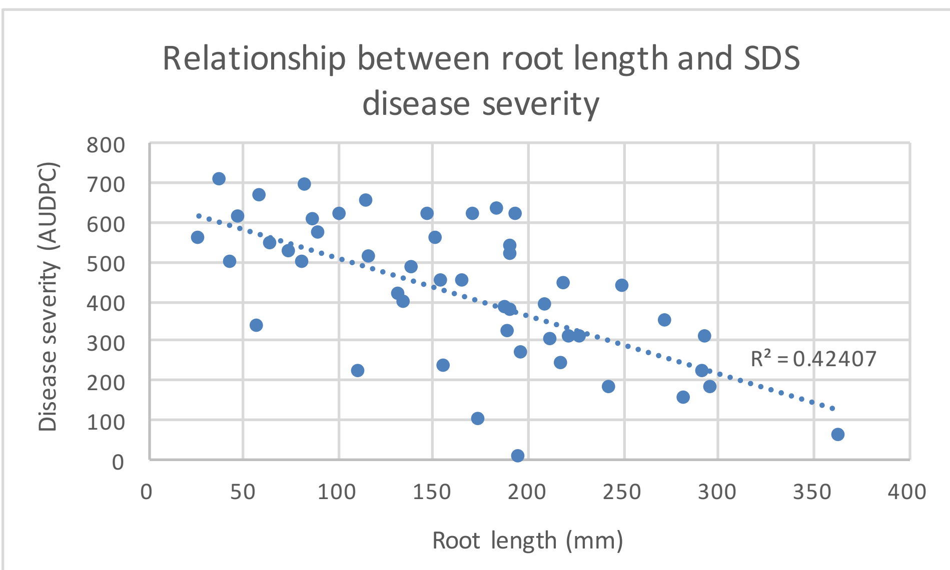

Figure 4b. Relationship between root length and SDS disease severity at V3 stage. Cohorts of different varieties of healthy (control) plants were measured for root length. Partner cohorts of the same varieties were measured for disease severity in side-by-side test.

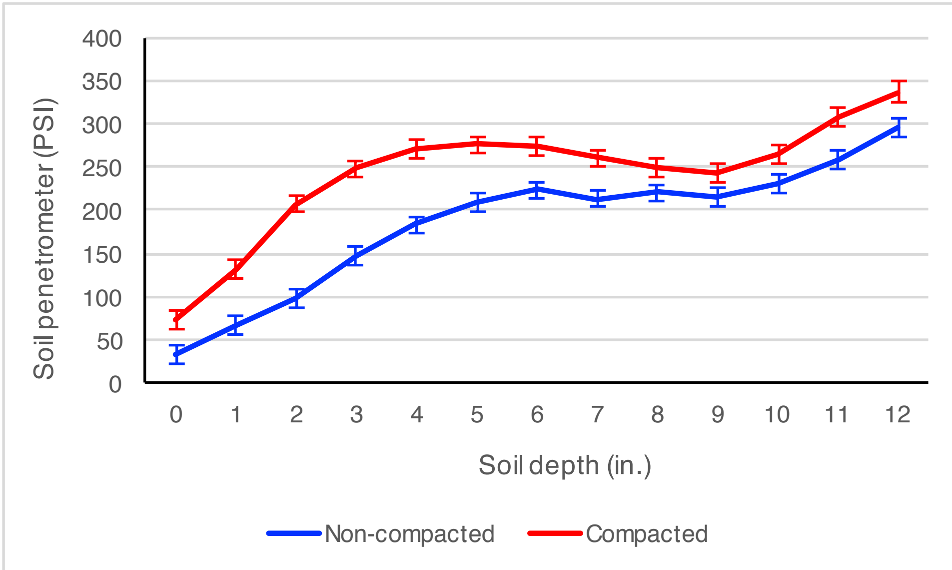

Figure 5a. Soil compaction (psi, penetrometer resistance) profiles for the top foot of soil at the compaction study site at Topeka (Silver Lake), Kansas.

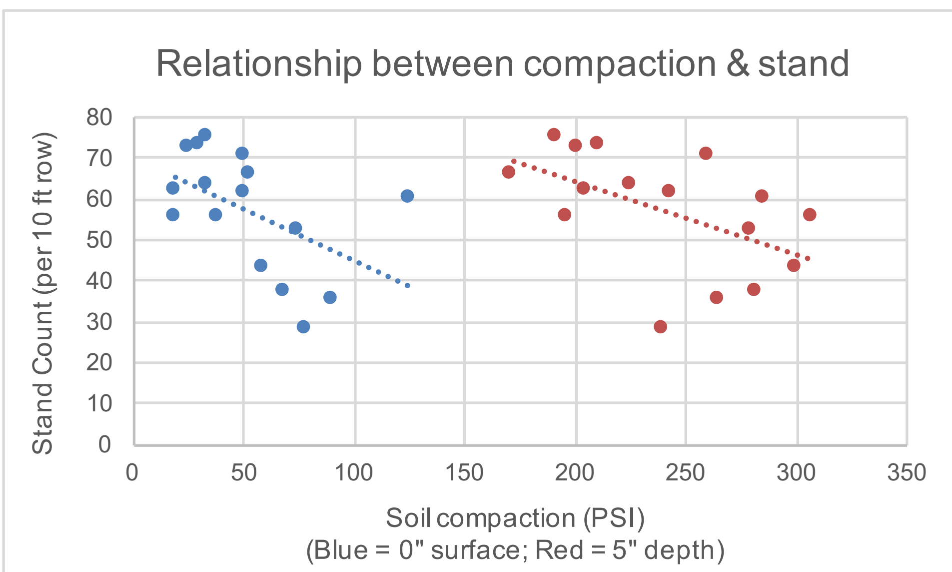

Figure 5b. The relationship between soil compaction (psi) and stand count at the compaction study site at Topeka (Silver Lake), Kansas.

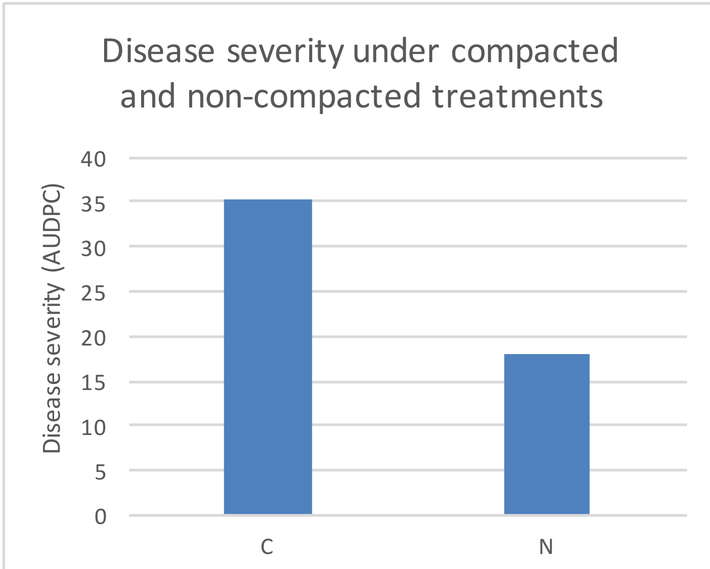

Figure 5c. Disease severity under compacted (C) and non-compacted (N) treatment for the 2016 study site at Topeka (Silver Lake), Kansas.

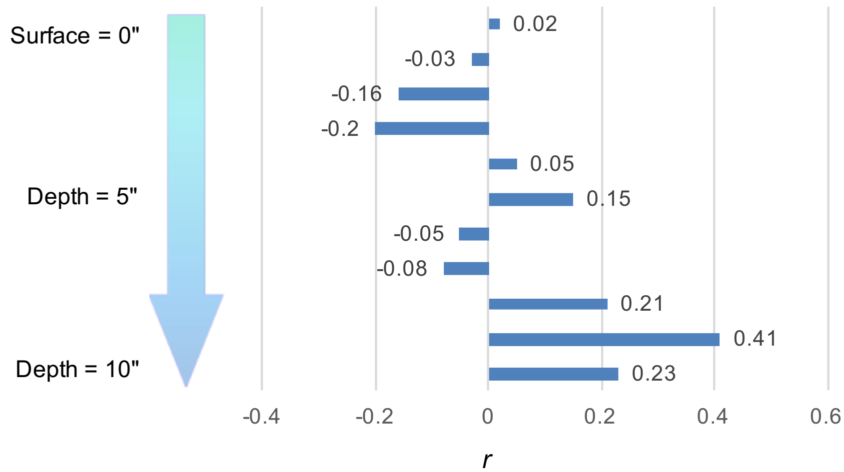

Figure 5d. Relationship between soil compaction (PSI) and disease severity (AUDPC) (*r*) at surface and sub-surface soil depths. Values greater than zero indicate a positive relationship between compaction and disease severity.