Title: "Mitigating soybean root and seedling diseases in Kansas." (FY2021-2022)
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Objective 1. Discover resistance to fungal pathogens.

Efforts during FY2021-2022 have focused on testing Kansas variety trial selections and K-State breeding varieties using the SDS toxin assay, rolled-towel assay, layer-cake assay, and seed-plate assay.

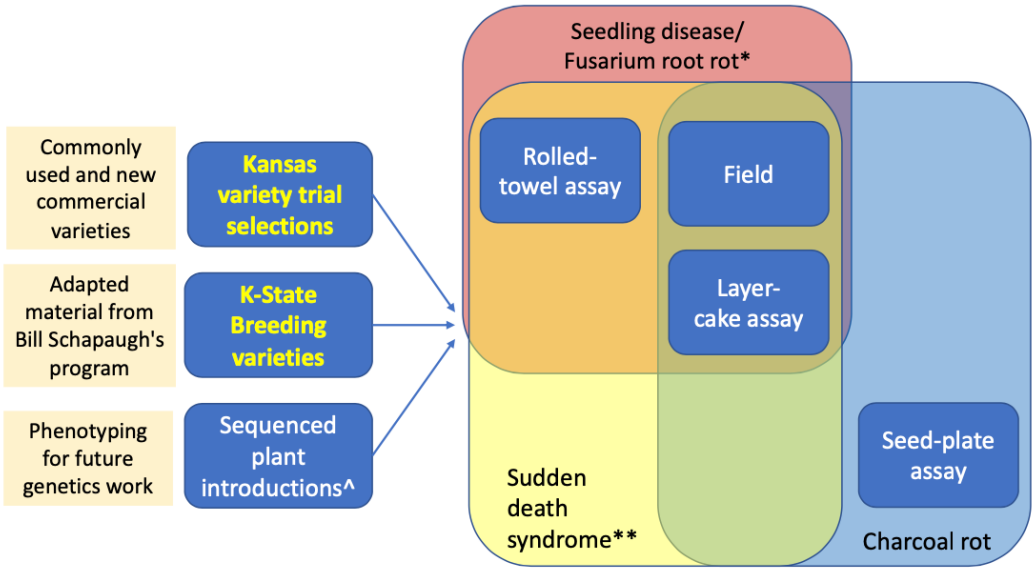
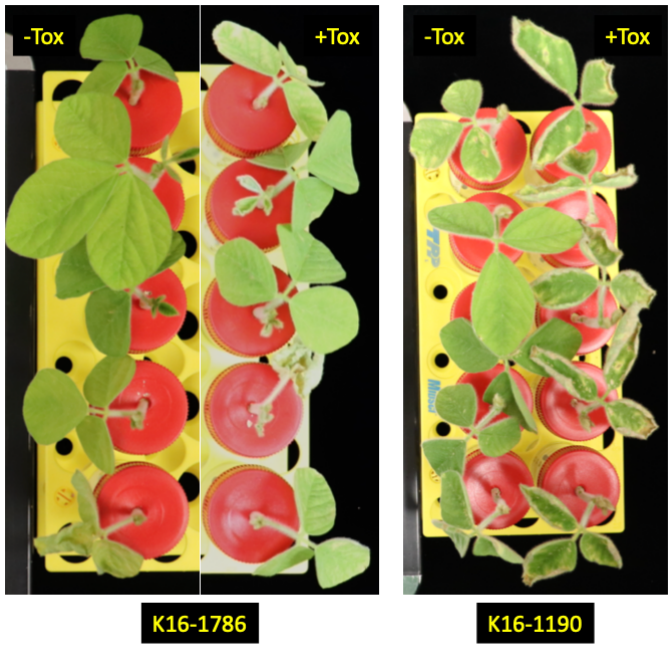


Figure 1. General outline of soybean screening experiments for SDS, seedling disease, and charcoal rot.



The SDS toxin assay is used to assess toxin sensitivity and resistance. It has also been useful in determining entries that are senescent vs. non-senescent. Senescent entries wilt, become chlorotic and necrotic, and roll at the leaf edges after stem cutting. However, non-senescent entries remain green.

Figure 2. Example of the toxin assay. Note that the toxin resistant plants (left panel) remain green versus toxin sensitive (right panel). "-Tox" = no toxin added; "+Tox" = toxin added.

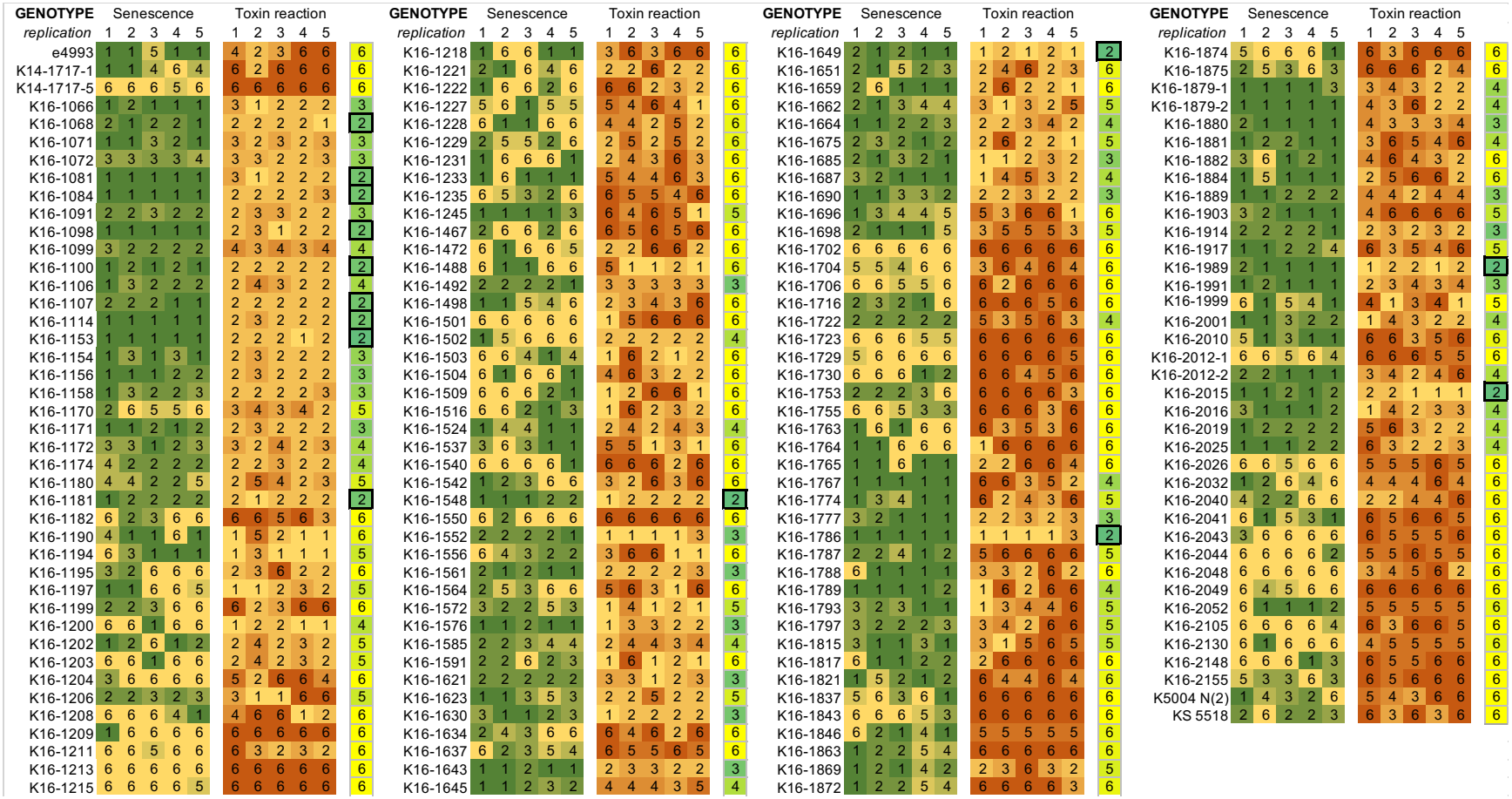


Figure 3. Screening of K-State breeding varieties using the toxin assay. See explanation below.

Both senescence and toxin reaction were evaluated using a 1-5 scale. Non-senescent seedlings were rated 1-2 vs. senescent seedlings that were rated 3-5. Toxin resistant plants were rated 1-2 vs. toxin sensitive plants that were rated 3-5. Overall ratings, in the third column of each set, represent the maximum value across both senescence and toxin reactions. The best performing varieties were rated 1-2, and the value is boxed in bold.

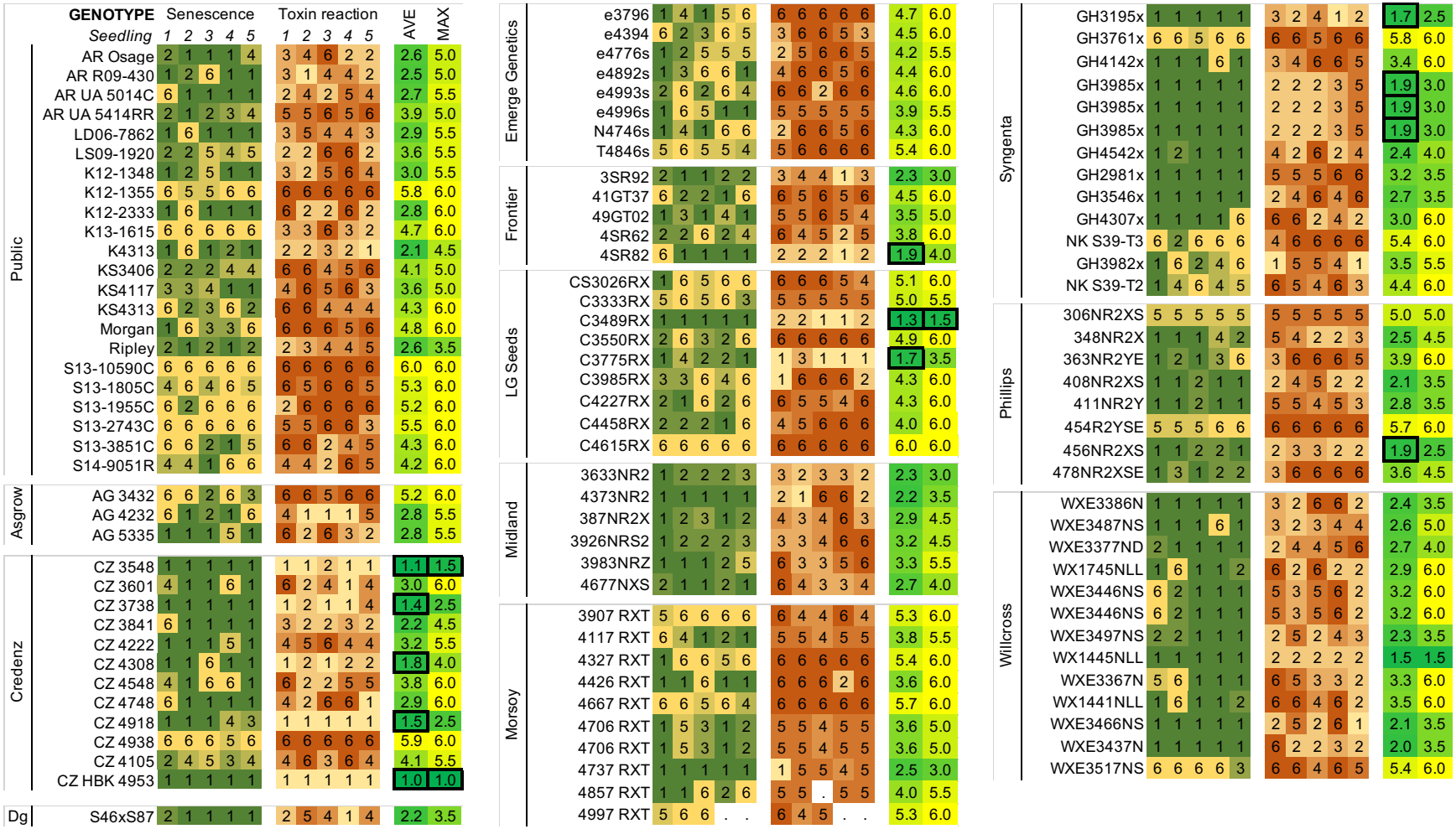


Figure 4. Screening of public and commercial varieties using the toxin assay. See explanation below.

Table 1. Layer cake disease severity ratings for selected Kansas breeding materials.

	Layer-cake -- Disease Severity Ratings					
	Exp #1			Exp #2		
ENTRY	CONT	INOC	t-test	CONT	INOC	t-test
e4394	1.75	3.25	0.18 ns	1.72	5.58	0.0014**
K16-1190	1.08	2.94	0.011*	1.41	3.68	0.036*
K16-1194	1.18	2.50	0.031*	1.17	3.73	0.0025**
K16-1197	1.25	3.22	0.11 ns	1.75	4.60	0.0071**
K16-1200	2.16	3.54	0.28 ns	1.12	2.55	0.0076**
K16-1204	1.45	3.02	0.047*	1.30	3.20	0.0058**
K16-1228	2.04	2.64	0.54 ns	1.60	2.33	0.40 ns
K16-1233	2.31	3.27	0.51 ns	1.05	2.92	0.013*
K16-1245	2.40	2.94	0.68 ns	1.25	4.53	0.0003**
K16-1502	1.68	3.49	0.082~	2.02	3.40	0.19 ns
K16-1503	2.41	2.44	0.98 ns	1.16	4.30	0.0021**
K16-1537	1.61	3.29	0.022*	1.13	4.40	0.018*
K16-1623	1.41	4.05	0.0084**	.	.	
K16-1630	2.68	3.43	0.57 ns	1.57	4.53	0.0003**
K16-1634	1.85	4.14	0.084~	1.50	5.63	0.0038**
K16-1649	1.36	3.18	0.0065**	1.19	4.51	< 0.0001***
K16-1664	1.55	2.49	0.064~	2.64	4.10	0.17 ns
K16-1685	1.15	3.39	0.0011**	1.23	5.67	< 0.0001***
K16-1690	2.16	.		1.20	5.80	0.0002**
KS4117NS	2.89	2.41	0.66 ns	1.64	4.73	0.0083**

Significantly different from control treatment at $P < 0.10$ (~), $P < 0.05$ (*), $P < 0.01$ (**), and $P < 0.001$ (***).

Table 2. Layer-cake disease severity ratings and emergence for selected commercial entries.

	Exp #1		
ENTRY	CONT	INOC	t-test
Credenz			
CZ 4105 LL	1.00	5.69	***
CZ 4308 LL	1.50	3.55	*
CZ 4918 LL	1.00	3.08	**
CZ 4938 LL	1.08	4.25	***
LG			
C3775RX	1.00	3.40	*
C3985RX	1.54	4.86	**
C4227RX	1.75	3.38	ns
C4458RX	1.50	2.50	ns
C4615RX	2.05	4.85	**
DynaGrow			
S43XS27	1.50	5.50	**
S46XS87	1.33	5.40	***
Emerge Genetics			
e4394	1.81	2.50	ns
e4766s	1.07	5.50	***
e4892s	1.00	2.77	*
e4993s	1.00	3.95	***
e4996	1.00	2.89	***
T4846s	1.00	4.74	***
Phillips			
454 R2YSE	1.09	2.00	*
456 R2XS	2.00	4.00	*
478 NR2XSE	1.58	4.10	**

Objective 2. Evaluate management strategies for fungal pathogens.

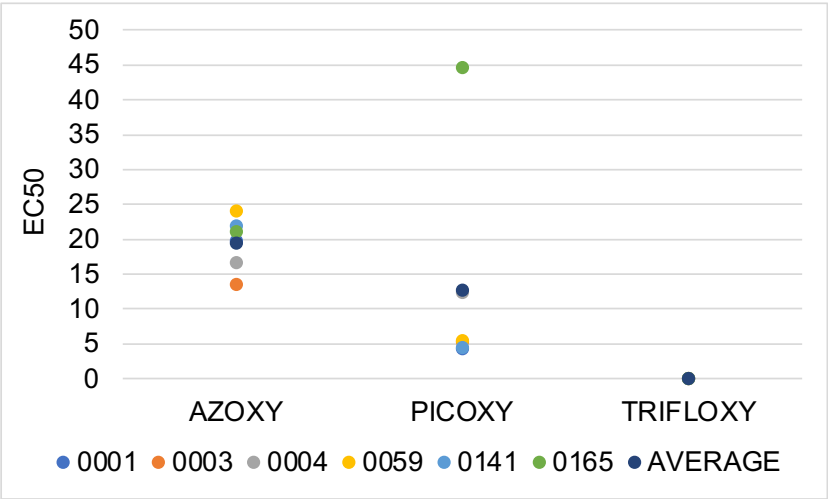


Figure 5. EC_{50} concentrations for three strobilurin fungicides (azoxystrobin, picoxy-strobin, and trifloxystrobin) against six isolates of *Fusarium proliferatum*.

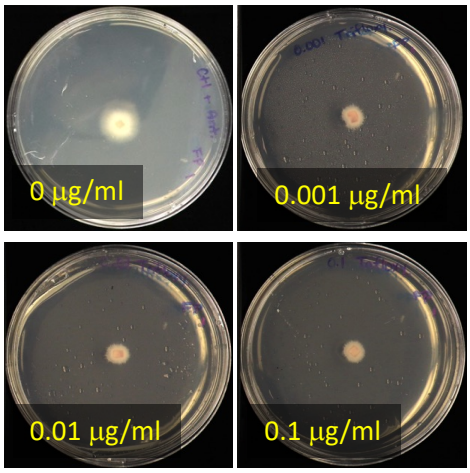


Figure 6. Example of trifloxystrobin test plates versus *F. proliferatum*.

According to the screening of three strobilurin fungicides that are commonly used for seed treatments, trifloxystrobin exhibited the greatest effect against *F. proliferatum*, compared to azoxystrobin and picoxystrobin. Trifloxystrobin can be found in such products as Trilex flowable or Trilex 2000 in combination with metalaxyl.

Other fungicide active ingredients are being tested as the pure, lab grade materials are available.

Brassica juncea as a cover crop option. What impact does this have on pathogen populations in the soil in combination with residue management?

Treatments included: (1) Fallow, (2) Control (no mustard cover crop), (3) Plant into standing mustard, (4) Roll mustard, (5) Mow mustard, (6) Disk mustard in.

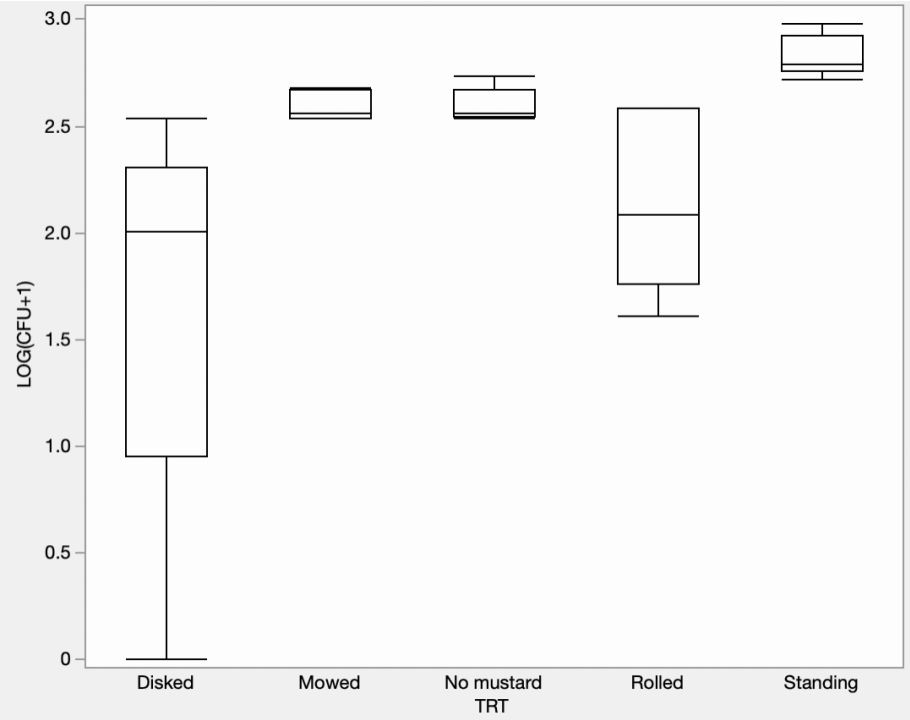


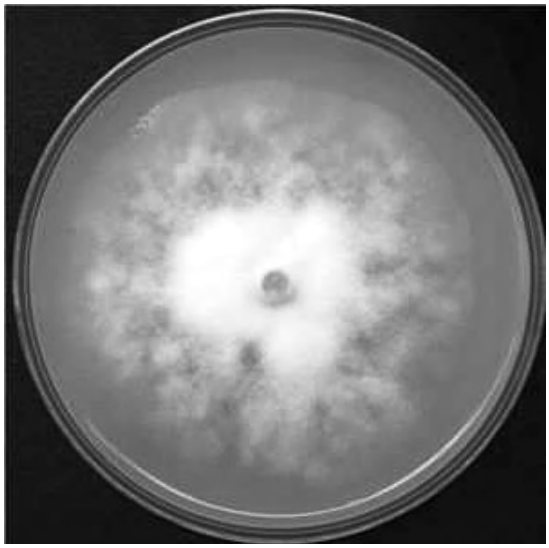
Figure 7. Soil populations of *F. proliferatum* after mustard treatments.

Disking or rolling B. juncea prior to soybean planting appeared to decrease soil populations of *F. proliferatum* seedling pathogens.

Objective 3. Assess the impact of re-emerging root pathogens: *Phytophthora sojae* in south-eastern Kansas.

Figure 8. Example of seedlings affected by *Phytophthora sojae*. Note demarcated, black lesions on seedling stems. These plants were collected in Riley County, Kansas.

Figure 9. Culture of *P. sojae* isolated from diseased soybean seedlings.



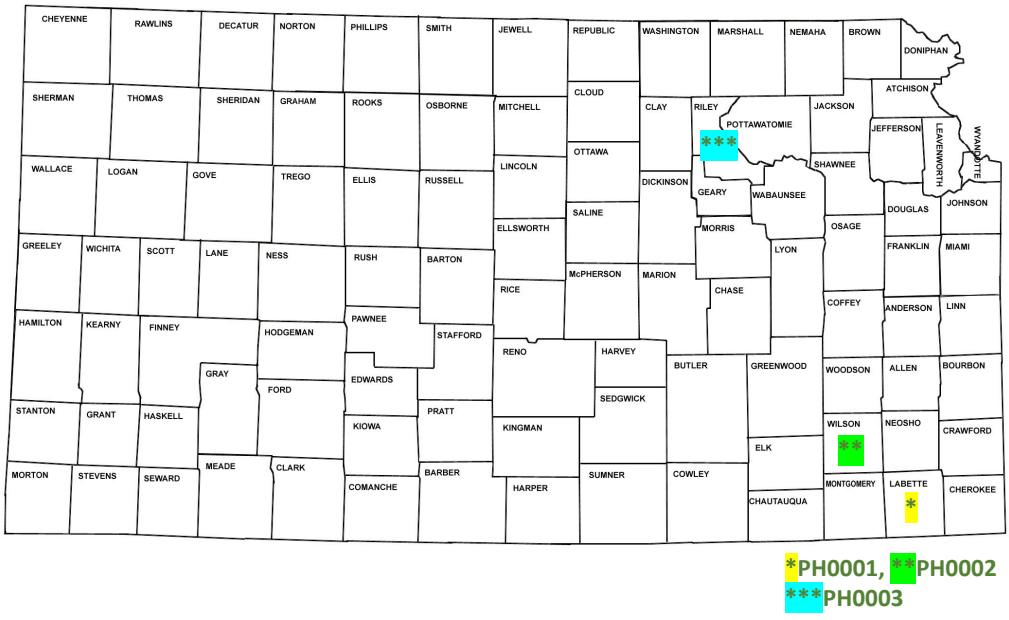


Figure 10. Collection locations of *P. sojae* isolates in Kansas during 2021 & 2022.

Isolates have been located and are still in the collection phase prior to testing differentials and pathogenicity tests.