SOYBEAN YIELD LOSS TO DISEASES IN THE MIDSOUTHERN US, 2011-2017

Members of the Southern Soybean Disease Workers Group conduct an annual survey to estimate yield losses to soybean diseases in the southern US. These estimates are solicited from research and extension pathologists throughout the region, and are based on field surveys, plant disease samples, variety trials, questionnaires to Extension Specialists, research plots, grower demonstrations, private crop consultant reports, foliar fungicide trials, and sentinel plot data. Production losses are based on estimates of yield in the absence of diseases.

Below are summary results from this survey for the 2011-2017 period in the midsouthern US.

Table 1. Soybean yield loss (in millions of bushels) to diseases and nematodes, Midsouthern US states*, 2011-2017.

Disease/pest	2011[a]	2012[b]	2013[c]	2014[d]	2015[e]	2016[f]	2017[g]
Charcoal rot (CR)	12.06	11.67	7.26	5.25	7.34	6.78	3.34
Soybean cyst nematode (SCN)	8.51	5.89	17.12	14.88	7.72	13.55	15.02
Root knot nematode (RKN)	3.36	4.73	5.39	10.82	9.62	9.68	10.20
Frogeye leaf spot (FLS)	1.96	2.53	10.07	12.06	9.55	7.74	7.52
Sudden death syndrome (SDS)	0.29	0.06	5.65	15.87	2.64	2.92	3.07
Reniform nematode (RN)	---	---	---	4.65	3.42	3.22	1.79
Cercospora leaf blight (CLB)	---	---	---	3.57	3.89	6.73	7.27
Seedling diseases	1.56	1.04	1.49	3.02	7.81	2.59	4.91
Rhizoctonia aerial blight (RAB)	1.13	0.72	0.30	2.41	0.65	2.08	1.71
Anthracnose	0.92	1.18	1.68	1.13	0.75	0.85	0.34
Pod and stem blight (PSB)	0.13	0.30	2.61	1.54	1.38	0.43	1.84
Phytophthora root rot (PRR)	3.05	0.80	2.37	0.76	3.65	1.42	3.18
Stem canker	0.08	0.58	0.89	0.68	0.74	0.82	1.67
Bacterial diseases	0	0	0.02	0.46	0.10	0.12	0.18
Viruses	0	0.24	4.34	1.68	0.15	0.07	0.05

*Arkansas, Louisiana, Mississippi, Missouri, and Tennessee. From summaries provided by Dr. S. R. Koenning, North Carolina State Univ., and Dr. Tom Allen et al (click here for reference sources).

Majority of losses to major diseases were:

[a]2011: CR–all states; SCN–Ark., Mo.; RKN–Ark.; PRR–Mo.; FLS–Tenn.

[b]2012: CR–negligible in La.; SCN–Ark., Mo., Tenn.; RKN–Ark.; FLS–Miss., Tenn.

[c]2013: SCN–Miss., Mo., Tenn.; FLS–all states; CR–none in Mo.; SDS–Mo., Tenn.; RKN–negligible in Tenn.;

[d]2014: SDS–negligible in La., Miss.; SCN–none in La.; FLS–all states; RKN–none in Tenn.; CR–none in Mo.; RN–La., Miss.; CLB–La., Miss.

[e]2015: CR–none in Mo.; SCN–none in La.; RKN–negligible in Mo., Tenn.; FLS–all states; SDS–Mo., Tenn.; RN–La., Miss.; CLB–La., Miss.; seedling diseases–Mo., Tenn.; PRR–Mo.

[f]2016: CR–none in Mo., negligible in La.; SCN–negligible in La., 2/3 of yield loss in Mo.; RKN–Ark., La., Miss., negligible in Mo., Tenn.; FLS–all states; SDS–Mo., Tenn., negligible in Ark., La., Miss.; RN–La., Miss. only; CLB–mostly Ark., La., Miss.; Seedling diseases–mostly Tenn.; RAB–mostly La., Miss.; PRR–mostly Mo.

[g]2017: CR–none in La. & Mo., negligible in Ark.; SCN–none or negligible in La. & Miss., ~half of yield loss in Mo.; RKN–none or negligible in Mo. & Tenn., half of yield loss in Ark.; FLS–all states, heavy in La. & Tenn.; SDS–significant only in Mo.; RN–none in Ark., Mo., and Tenn.; CLB–neglibible in Mo. & Tenn., heavy in La. & Miss.; Seedling diseases–only significant in Mo. & Tenn.; RAB–significant only in La.; PRR–mostly Mo.

Table 2. Estimated yield lost to diseases (% and millions of bushels) in indicated Midsouth states in the 2011-2017 period. Data in last row are total value of lost yield each year in millions of dollars (lost yield x $10/bu) for the five shown Midsouth states (using production data by state from NASS).

	Year													
	2011		2012		2013		2014		2015		2016		2017	
	Yield lost to diseases													
State	%	Bu. x 1 million	%	Bu. x 1 million	%	Bu. x 1 million	%	Bu. x 1 million	%	Bu. x 1 million	%	Bu. x 1 million	%	Bu. x 1 million
Arkansas	8.88	12.31	8.96	13.49	9.12	14.14	9.03	15.72	9.10	15.55	9.09	14.59	7.85	15.21
Louisiana	6.00	2.25	8.30	4.69	7.00	4.09	14.00	12.83	12.95	8.51	16.00	10.99	12.80	9.91
Mississippi	9.05	6.99	7.35	6.96	9.66	9.73	17.81	24.68	15.04	18.48	14.28	16.15	8.96	11.32
Missouri	5.35	10.75	3.10	5.06	14.00	32.88	8.50	24.15	8.90	17.72	7.60	22.33	8.50	26.90
Tennessee	14.33	6.74	13.74	7.44	14.24	11.97	12.62	10.70	11.17	9.95	14.21	12.15	9.10	8.31
Total value	$390,400,000		$376,400,000		$728,100,000		$880,743,800		$702,182,750		$761,915,430		$716,441,910	

A summary of the estimates of soybean yield lost to diseases and nematodes in the above five midsouthern states follows.

- In 2013-2017, soybean yield losses to disease pathogens and nematodes in the Midsouth approached or exceeded 10%.
- In the 2011-2017 growing seasons, the most damaging pests across the Midsouth states were charcoal rot (CR), soybean cyst nematode (SCN), root knot nematode (RKN), and frogeye leaf spot (FLS). Cercospora leaf blight became increasingly important in 2016-2017.
- From 2011 to 2016, CR was a significant damaging pest across all years in all states except Missouri. In 2017, it was significant only in Mississippi and Tennessee. CR may be an opportunistic disease; i.e., it likely is not a major pest in well-managed soybeans.
- FLS was a significant damaging pest in all states starting in 2013, and this may be associated with the increasing resistance of the FLS pathogen to fungicide control.
- Sudden death syndrome became a significant pest in 2013 and 2014, but declined in significance in 2015-2017. Its major yield-reducing effect in 2015 and 2016 was in Missouri and Tennessee, whereas in 2017, it was significant only in Missouri. It has not caused significant yield loss in the lower Midsouth as of the 2017 survey.
- Reniform nematode and Cercospora leaf blight became significant damaging pests in Louisiana and Mississippi in 2014; both were again significant in those states in 2015-2017.
- The high losses to RKN that occurred in Arkansas, Louisiana, and Mississippi emphasize the need to develop resistant varieties to combat this pest.
- Bacterial diseases were not a significant damaging pest in any state during the 2011-2017 period.
- Viruses contributed to significant yield loss only in 2013, and they were a factor only in Arkansas and Mississippi in that year. In the 2014-2017 period,

their effect on yield was negligible in all states.

- The relatively low yield loss to stem canker in all years is testimony to the effectiveness of varietal resistance as a control measure to avoid yield loss to a fungal pathogen. The virility of this pathogen is documented by the devastating effect it had in the late 1980's when planted varieties had little or no resistance. Since there is no efficacious fungicide for the stem canker pathogen, this is even stronger testimony that plant resistance to a fungal pathogen can be a most effective long-term tool to minimize loss to disease.

The above estimates and summary points result in the following important tenets for disease management in the Midsouth soybean crop.

- Diseases and nematodes pose a constant threat to soybean production in the midsouthern US. Economic losses using a commodity price of $10/bu were near or above 3/4 billion dollars in 2013-2017.

- Fungicide resistance management must be constantly practiced in order to protect the efficacy of current fungicides that are used against major foliar disease pathogens such as Frogeye Leaf Spot.

- A constant effort must be exerted to provide genetic resistance to major soybean disease pathogens and nematodes in order to provide the most effective long-term defense against these pests. The effectiveness of this strategy is evidenced by the continued low effect of stem canker on soybean yield in the region. This is a major point of consideration for protection against pathogens that cause/are related to mature soybean seed decay.

- The major effect of SCN on soybean yield reduction in Missouri and Tennessee across the survey period underlines the continued importance of using resistant varieties and crop rotation to manage this pest. Seed-applied nematicides will not replace these proven management practices. It is also important to rotate varieties that have different resistance sources since SCN will adapt to varieties that have the same source of genetic resistance. In fields known to be infested with SCN, it is imperative to have an HG Type test conducted on nematode samples. Click here and here for additional details.

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