Soybean Disease Loss Estimates for the Southern United States, 1994 to 1996

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Since 1974, soybean disease loss estimates for the southern United States have been published in the Southern Soybean Disease Workers (SSDW) Proceedings, summaries of which were published in 1978 (6), 1988 (2,3), 1993 (4), and 1995 (8). A summary of the results from 1974 to 1994 has also been published (7), and the 1994 results were published as part of the disease loss estimate for the top 10 soybean producing countries (9).

The loss estimates for 1994 to 1996 presented here were solicited from: Bill Gazaway, Alabama; Clifford Coker, Arkansas; Robert Mulrooney, Delaware; Tom Kucharek, Florida; Boyd Padgett, Georgia; Don Hershman, Kentucky; Ken Whitam, Louisiana; Arvydas Grybauskas, Maryland; Joe Fox, Mississippi; Allen Wrather, Missouri; Steve Koenning, North Carolina; Phil Pratt, Oklahoma; Charles Drye, South Carolina; Melvin Newman, Tennessee; Joseph Krausz, Texas; and Patrick Phipps, Virginia.

Various methods were used to identify the diseases of soybeans and to obtain disease loss estimates, with most estimates derived by more than one method. The methods used to assist in disease identification were field surveys, plant disease diagnostic clinic samples, questionnaires to Cooperative Extension staff, and private crop consultant reports. Methods used to obtain disease loss estimates were grower demonstrations conducted by the Cooperative Extension Service, private crop consultant reports, variety trials, foliar fungicide trials, and research plots. Yield losses were based on estimates of yield in the absence of disease.

The actual production figures for each state were supplied by the state crop reporting service. Dollars lost to disease were calculated by multiplying the estimated loss in metric tons by the average annual price of \$222.67/t in 1994 (\$6.68/bu), \$208.33/t in 1995 (\$6.25/bu), and \$263.33/t in 1996 (\$7.90/bu).

Percentage of loss estimates from each state is specific for the causal organism or the common name of the disease. In 1995, the list of diseases was modified in order to obtain more specific information on the occurrence of diseases that in previous years had been placed together in general categories. For example, the category "root and lower stem rots" was separated into brown stem rot, Fusarium root rot, Sclerotinia stem rot, and southern blight. The category "foliar diseases (other)" was separated into aerial blight and frogeye leaf spot. The Diaporthe/Phomopsis complex was added to the list of diseases. Additional information on each disease can be found in the *Compendium of Soybean Diseases* (5).

During 1994, 16.18 million metric tons (594.45 million bushels) were harvested from 7.11 million hectares (17.57 million acres) in the southern states. Disease losses were estimated at 9.29%, resulting in a production loss of 1.24 million metric tons (45.47 million bushels) valued at \$303.74 million (\$6.68/bu; Table 1). The greatest percentage of loss occurred in Florida (24.30%) and the least in Delaware (4.10%). The greatest financial loss occurred in Missouri (\$67.33 million), followed by Arkansas (\$57.31 million) and Louisiana (\$32.00 million).

During 1995, 12.43 million metric tons (456.70 million bushels) were harvested from 6.77 million hectares (16.73 million acres) in the southern states. Disease losses were estimated at 9.14%, resulting in a production loss of 1.18 million metric tons (39.52 million bushels), valued at \$247.03 million (\$6.25/bu; Table 2). The greatest percentage of loss occurred in Alabama (18.20%) and the least in Delaware (2.50%). The greatest financial loss occurred in Missouri (\$76.29 million), followed by Arkansas (\$50.26 million) and Mississippi (\$27.87 million).

During 1996, 15.67 million metric tons (575.8 million bushels) were harvested from 7.05 million hectares (17.42 million acres) in the southern states. Disease losses were estimated at 8.67%, resulting in a production loss of 1.58 million metric tons (58.22 million bushels) valued at \$459.92 million (\$7.90/bu; Table 3). The greatest percentage of loss occurred in Texas (14.70%) and the least in Virginia (1.30%). The greatest financial loss occurred in

Missouri (\$115.92 million), followed by Arkansas (\$99.89 million) and Mississippi (\$62.28 million).

The greatest economic loss over the 3-year period was caused by soybean cyst nematode (\$275.38 million), followed by charcoal rot (\$159.22 million), Phytophthora root rot and stem rot (\$84.43 million), and root-knot and ectoparasitic nematodes (\$79.50 million). Prior to 1995, Phytophthora root and stem rot was not identified as an individual disease in the SSDW disease loss estimates. It was included in the broad category of "root and stem rots."

Diseases have been reported to cause significant loss in soybean production in the United States and in other major soybean-producing countries (1-9). Since 1977, soybean diseases have been reported as causing significant yield reduction in the southern soybean producing states (2-8). It is essential that University Research and Cooperative Extension continue their efforts to discover methods to control these diseases and to educate soybean producers concerning the best methods to prevent yield loss due to soybean diseases.

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Table 1. Estimated percentage of loss to disease of soybean yields in 1994 in 16 southern states

Diseases	Percent loss per state															
	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA
Anthracnose	1.00	0.40	TR ^b	2.00	0.25	0.50	0.50	TR	0.78	... ^b	0.40	1.50	1.50	1.00	3.00	...
Bacterial diseases	0.10	0.10	...	...	...	TR	TR	...	TR	...	0.05	TR	0.05	TR	0.10	...
Brown spot	0.50	...	TR	...	...	0.50	TR	...	0.06	...	0.05	TR	0.15	1.00	0.10	TR
Charcoal rot	0.10	1.00	...	0.10	...	0.05	1.00	...	2.60	2.00	0.05	2.00	0.07	0.50	1.00	...
Diaporthe pod & stem blight	0.60	0.10	TR	2.00	0.75	1.20	2.00	0.50	0.90	...	0.04	1.00	1.00	...	0.50	0.10
Downy mildew	0.10	0.10	TR	0.10	...	TR	TR	...	TR	...	0.02	TR	0.10	0.01	TR	...
Foliar diseases (other)	0.40	0.50	...	...	2.00	...	1.00	...	0.33	...	0.30	0.50	0.50	0.01	0.40	...
Other diseases ^c	...	...	...	...	...	...	3.00	...	...	...	...	...	...	0.01	...	0.20
Purple stain	0.10	0.20	TR	0.10	0.75	0.02	2.00	TR	0.53	...	0.02	0.50	0.70	...	1.00	0.10
Root & stem rots	0.10	0.25	TR	10.00	0.25	0.05	1.00	...	1.60	1.00	0.40	0.20	1.10	0.50	0.70	0.10
Root-knot & other nematodes	1.00	0.20	1.00	7.00	3.50	...	2.00	0.50	0.02	...	2.50	TR	7.00	0.10	0.40	1.00
Seedling diseases	0.20	1.50	...	2.00	0.50	0.20	TR	...	0.45	...	0.05	0.20	0.10	1.50	0.50	0.20
Soybean cyst nematode	1.50	0.80	3.00	1.00	3.00	2.50	1.00	7.00	0.86	3.00	4.50	0.75	3.00	2.00	0.10	3.40
Stem canker	0.10	0.75	...	...	...	0.05	0.50	...	TR	...	...	...	0.01	0.02	0.50	...
Sudden death syndrome	0.40	0.75	...	...	...	0.05	TR	...	TR	...	...	...	...	0.50	0.10	...
Virus diseases	0.20	0.60	0.10	...	0.50	TR	1.00	...	TR	...	0.40	TR	1.00	TR	0.30	0.10
Total percent loss ^a	6.40	7.25	4.10	24.30	11.50	5.12	15.00	8.00	8.13	6.00	8.78	6.65	16.28	7.15	8.70	5.20
Yield (t/ha) ^{a,d}	1.95	2.49	2.42	1.61	2.02	2.49	1.95	2.62	1.95	2.49	2.08	1.61	1.68	2.29	2.08	2.22
Total hectares ($\times 10^6$) ^a	0.12	1.30	0.09	0.02	0.20	0.45	0.45	0.22	0.81	1.84	0.55	0.11	0.25	0.43	0.08	0.21
Yield loss ($t \times 10^5$) ^{a,d}	0.15	2.33	0.09	0.06	0.45	0.58	1.30	0.47	1.28	2.74	1.00	0.14	0.69	0.69	0.15	0.24
Dollar loss ($\times 10^6$) ^{a,e}	3.74	57.31	2.20	1.54	11.02	14.16	32.00	11.49	31.53	67.33	24.65	3.34	16.83	17.03	3.61	5.95

^a Rounding errors present.^b TR = trace.^c Other diseases not identified in LA, TN, and VA.^d The yield loss is based on the percentage of loss of what yield would have been had no diseases occurred.^e Dollar loss = estimated loss $\times$ \$245.49/t.**Table 2.** Estimated percentage of loss to disease of soybean yields in 1995 in 16 southern states

Diseases	Percent loss per state															
	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA
Anthracnose	2.00	0.51	... ^b	2.00	0.01	0.50	0.50	0.20	0.30	...	0.80	0.30	2.00	0.50	3.00	TR ^b
Bacterial diseases	0.50	0.01	...	...	TR	TR	TR	...	TR	...	0.05	1.00	0.05	TR	0.10	...
Brown spot	0.20	0.05	TR	...	...	0.50	TR	0.10	0.10	0.10	0.10	0.30	0.15	0.50	0.20	...
Brown stem rot	...	...	...	...	...	TR	...	...	...	0.10	...	...	...	...	0.10	...
Charcoal rot	...	1.9	0.50	0.10	...	0.10	2.00	0.05	5.80	1.00	0.05	2.00	0.01	0.70	1.00	TR
Diaporthe/Phomopsis	2.00	0.01	TR	2.00	0.25	0.20	1.00	...	...	...	4.30	1.50	...	...	1.00	...
Downy mildew	1.00	0.01	TR	TR	...	TR	TR	...	TR	...	0.06	0.50	0.10	0.01	TR	...
Frogeye leaf spot	1.00	0.42	...	TR	TR	TR	0.25	...	0.30	...	0.30	0.20	0.05	0.02	1.00	...
Fusarium wilt & rot	...	0.02	...	...	0.25	TR	TR	...	...	1.00	...	...	0.01	...	...	...
Other diseases ^c	...	...	...	...	...	...	...	...	...	...	TR	...	...	0.01	0.30	TR
Phytophthora rot	...	0.03	...	...	...	0.05	0.50	...	0.20	2.00	0.30	0.10	0.01	0.01	...	...
Pod & stem blight	3.00	0.50	TR	...	0.50	0.20	1.00	0.10	0.50	...	TR	1.50	1.00	...	0.30	0.10
Purple stain	...	0.30	...	0.20	0.25	0.10	1.00	0.05	0.50	...	0.20	1.00	1.00	...	2.50	TR
Rhizoctonia aerial blight	0.30	0.06	...	0.10	...	...	0.50	...	TR	...	...	...	0.01	...	0.30	...
Root-knot & other nematodes	2.50	0.80	TR	3.00	3.50	...	2.00	1.00	0.10	0.50	2.00	TR	7.00	0.10	0.30	0.50
Sclerotinia stem rot	...	...	...	...	...	...	TR	...	...	...	...	...	...	...	0.10	...
Seedling diseases	0.50	1.11	...	1.00	0.50	0.30	TR	...	0.30	0.50	TR	0.30	0.10	1.00	0.50	0.10
Southern blight	0.20	...	...	0.10	0.01	TR	...	...	TR	...	TR	TR	1.00	...	...	TR
Soybean cyst nematode	3.00	3.10	2.00	1.00	3.00	3.50	0.50	5.00	0.10	2.50	5.00	0.70	3.00	1.50	0.10	2.50
Stem canker	1.00	0.27	...	...	...	0.02	TR	...	0.30	...	...	...	0.01	0.01	0.50	...
Sudden death syndrome	1.00	0.27	...	...	...	0.08	...	...	TR	0.50	...	...	...	0.60	0.10	...
Virus	...	0.03	TR	...	0.25	0.03	0.50	...	TR	...	0.40	0.10	1.00	TR	0.30	0.10
Total percent loss ^a	18.20	9.40	2.53	9.51	8.53	5.62	9.79	6.50	8.53	8.20	13.58	9.51	16.50	4.97	11.71	3.33
Yield (t/ha) ^{a,d}	1.55	1.68	1.34	2.15	1.61	2.55	1.68	1.68	1.61	2.02	1.55	1.68	1.61	2.08	1.68	1.81
Total hectares ($\times 10^6$) ^a	0.09	1.26	0.09	0.01	0.13	0.46	0.40	0.22	0.81	1.84	0.43	0.10	0.21	0.43	0.10	0.20
Yield loss ($t \times 10^5$) ^{a,d}	0.31	2.19	0.03	0.03	0.19	0.69	0.79	0.27	1.29	3.32	1.03	0.18	0.68	0.46	0.22	0.12
Dollar loss ($\times 10^6$) ^{a,e}	7.04	50.26	0.74	0.59	4.48	15.96	18.05	6.26	29.66	76.21	23.71	4.11	15.71	10.64	4.98	2.87

^a Rounding errors present.^b TR = trace.^c Other diseases include loss due to ozone damage and black root rot (NC). Other diseases not identified in TN, TX, and VA.^d The yield loss is based on the percentage of loss of what yield would have been had no diseases occurred.^e Dollar loss = estimated loss $\times$ \$229.69/t.

Table 3. Estimated percentage of loss to disease of soybean yields in 1996 in 16 southern states

Diseases	Percent loss per state																Avg ^a
	AL	AR	DE	FL	GA	KY	LA	MD	MS	MO	NC	OK	SC	TN	TX	VA	
Anthraxnose	1.60	0.58	... ^b	2.00	0.20	1.20	0.05	...	0.60	...	0.40	0.40	1.00	0.50	2.50	...	0.69
Bacterial diseases	...	0.03	...	...	TR ^b	0.02	TR	...	TR	...	0.05	0.20	0.05	TR	0.10	...	0.03
Brown spot	0.60	0.04	0.5	...	...	0.20	0.20	0.10	0.20	...	0.05	TR	0.10	0.50	0.30	...	0.17
Brown stem rot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.10	...	0.01
Charcoal rot	...	1.95	...	0.50	...	0.10	1.00	...	4.80	1.00	0.05	0.80	0.10	1.00	2.00	...	0.83
Diaporthe/Phomopsis	0.30	0.01	...	3.00	0.25	0.70	1.00	0.05	...	...	0.08	1.50	TR	...	1.00	...	0.49
Downy mildew	0.20	0.01	...	TR	...	0.02	TR	0.05	TR	...	0.08	0.20	0.05	0.01	...	...	0.03
Frogeye	0.30	0.21	...	0.50	TR	0.05	0.50	...	0.20	...	0.10	TR	0.10	0.03	1.00	...	0.19
leaf spot																	
Fusarium wilt & rot	0.10	0.03	...	...	0.25	0.01	...	...	...	...	...	...	0.01	...	0.50	...	0.06
Other diseases ^c	...	...	...	...	TR	...	...	...	...	...	5.00	...	0.60	0.20	1.30	...	0.44
Phytophthora rot	...	0.10	...	...	...	0.02	0.50	...	1.10	2.00	0.40	0.01	0.01	0.01	0.10	...	0.27
Pod & stem blight	0.40	1.00	...	3.00	0.75	0.70	2.00	0.10	0.50	...	0.01	1.50	0.95	...	0.30	TR	0.70
Purple stain	0.30	0.50	...	0.20	0.25	0.03	1.00	0.10	1.00	...	0.20	0.40	0.25	...	3.00	TR	0.45
Rhizoctonia aerial blight	...	0.06	...	0.10	...	...	4.00	...	0.10	...	...	...	0.01	...	0.30	...	0.29
Root-knot & other nematodes	1.00	0.45	...	2.50	3.50	...	1.50	0.05	0.20	...	1.50	TR	5.00	0.11	0.30	0.20	1.02
Sclerotinia stem rot	...	...	...	...	...	...	...	...	...	...	...	...	...	...	0.10	...	0.01
Southern blight	...	0.005	...	0.10	0.01	...	...	...	TR	...	0.03	0.01	1.00	...	0.30	...	0.09
Seedling diseases	0.10	1.85	...	1.00	0.50	0.20	TR	...	0.50	1.00	0.03	0.20	0.10	1.20	0.50	...	0.44
Soybean cyst nematode	1.50	2.55	2.00	0.10	3.00	4.30	1.00	2.00	0.20	4.50	4.00	0.70	3.00	1.50	0.10	1.00	1.97
Stem canker	0.10	0.10	...	...	...	0.10	TR	...	0.30	...	...	...	...	0.05	0.50	...	0.07
Sudden death syndrome	0.40	0.22	...	...	...	0.10	...	...	0.10	...	...	...	...	0.60	0.10	...	0.10
Virus	...	0.20	0.10	...	0.25	0.05	0.50	TR	1.50	...	0.60	0.05	1.50	TR	0.30	0.10	0.32
Total	6.90	9.90	2.60	13.00	8.96	7.80	13.25	2.45	11.30	8.50	12.58	5.97	13.83	5.71	14.70	1.30	8.67
percent loss ^a																	
Yield (t/ha) ^{a,d}	2.08	2.15	2.15	2.02	1.81	2.55	2.22	2.29	2.08	2.62	1.95	1.61	1.75	2.15	1.68	2.35	2.09
Total hectares ($\times 10^6$) ^a	0.13	1.54	0.09	0.01	0.16	0.48	0.41	0.19	0.81	1.64	0.49	0.12	0.22	0.47	0.11	0.19	7.05
Yield loss ($t \times 10^5$) ^{a,d}	0.20	3.44	0.05	0.04	0.29	1.03	1.41	0.11	2.15	3.99	1.36	0.11	0.61	0.61	0.38	0.06	15.84
Dollar loss ($\times 10^6$) ^{a,e}	5.72	99.89	1.45	1.17	8.40	29.96	40.83	3.24	62.28	115.92	39.56	3.31	17.81	17.61	11.03	1.75	459.92

^a Rounding errors present.^b TR = trace.^c Other diseases include loss due to ozone damage and black root rot (NC), and *Cylindrocladium* black root rot (SC). Other diseases not identified in GA, TN, and TX.^d The yield loss is based on the percentage of loss of what yield would have been had no diseases occurred.^e Dollar loss = estimated loss $\times$ \$290.33/t.