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Soybean Rust Incidence and the Response of Soybeans to Fungicides in 2007

Dr. Patrick M. Phipps, Professor of Plant Pathology
Virginia Tech, Tidewater AREC, 6321 Holland Rd., Suffolk, VA 23437
(Email: pmphipps@vt.edu; Telephone: 757-657-6450, Ext. 413)

Dr. Erik L. Stromberg, Professor of Plant Pathology
Virginia Tech, Dept. Plant Pathology, Physiology & Weed Science, Blacksburg, VA 24061
(Email: elstrom@vt.edu; Phone: 540-231-6361)

Dr. Steve Rideout, Assistant Professor of Plant Pathology
Virginia Tech, Eastern Shore AREC, 33446 Research Drive, Painter, VA 23420
(Email: srideout@vt.edu; Phone: 757-414-0724)

Dr. David Holshouser, Associate Professor of Crop, Soil and Environmental Sciences
Virginia Tech, Tidewater AREC, 6321 Holland Rd., Suffolk, VA 23437
(Email: dholshou@vt.edu; Telephone: 757-657-6450, Ext. 412)

Mr. Robert Pitman, Superintendent
Virginia Tech, Eastern Virginia AREC, 2229 Menokin Rd., Warsaw, VA 22572
(Email: rpitman@vt.edu; Telephone: 804-435-1965)

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2007 Growing Season

Rainfall in May, June, July, August and September was 1.66, 1.33, 4.16, 0.71 and 4.09 in. below normal, respectively, and October was 1.74 in. above normal at the Tidewater AREC in Suffolk. Rainfall during the period totaled 17.56 in. which was 10.21 in. below normal. Minimum air temperatures averaged near normal (±1° F) in June, July and September, 2° F above normal in August, 3° F above normal in May, and 9° F above normal in October. Maximum air temperatures were near normal (±1° F) in May and July, 3° F above normal in June and September, 5° F above normal in August, and 10° F above normal in October. Most fields planted to full-season soybeans showed good emergence after planting, whereas drought stress in some areas planted to double-cropped soybeans after wheat harvest showed delayed emergence.

Soybean Rust in 2007

The initial findings of the fungus on soybeans were generally within 100 miles of kudzu vines which provided green leaves for growth and sporulation of the fungus during winter months and after soybeans were planted. The spread of soybean rust northward through states

along the Atlantic Coast began on soybeans in Alabama, Georgia, Florida and Texas. By July 15, the disease had been reported on soybeans in eastern Texas, Louisiana, Mississippi, Alabama, Florida, and Georgia (Fig. 1A). Rainfall in eastern Texas and parts of Oklahoma, Louisiana, Arkansas, Mississippi and Alabama favored disease spread into the Mississippi Valley whereas widespread drought throughout the Mid-Atlantic Region suppressed spread of soybean rust in September, October, and November in 2007 (Fig. 1B, 1C). The disease was first detected in South Carolina on 21 August, North Carolina on 14 September, and Virginia on 19 October.

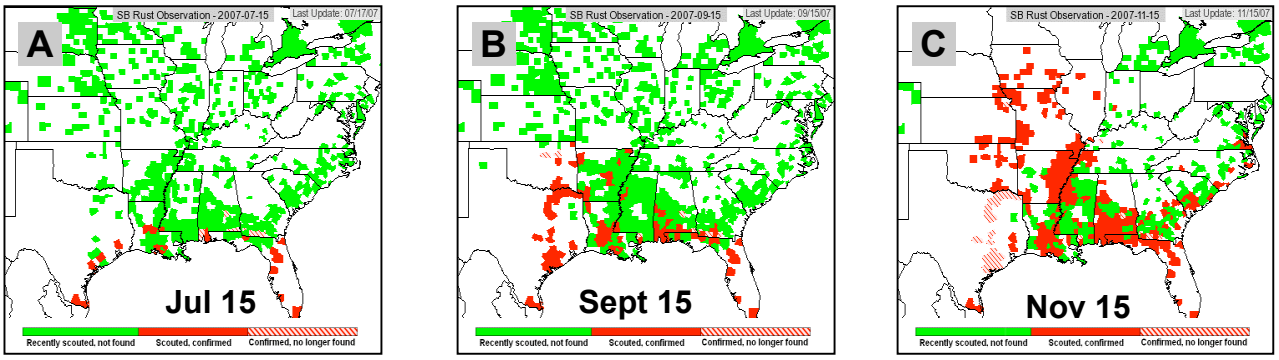

Fig. 1. Counties with soybean rust on 15 July, 15 September, and 15 November 2007

The distribution of counties with soybean rust through 15 November 2007 matched well with the expected pattern of disease spread from south to north and the distribution map for planted acres of soybean in the United States (Fig. 2). It seems likely that the delayed spread of disease until after September was likely a result of the low concentration of soybean acreage in coastal areas bordering the Gulf of Mexico and disease suppression by drought stress in the southeast and states in the Mid-Atlantic Region.

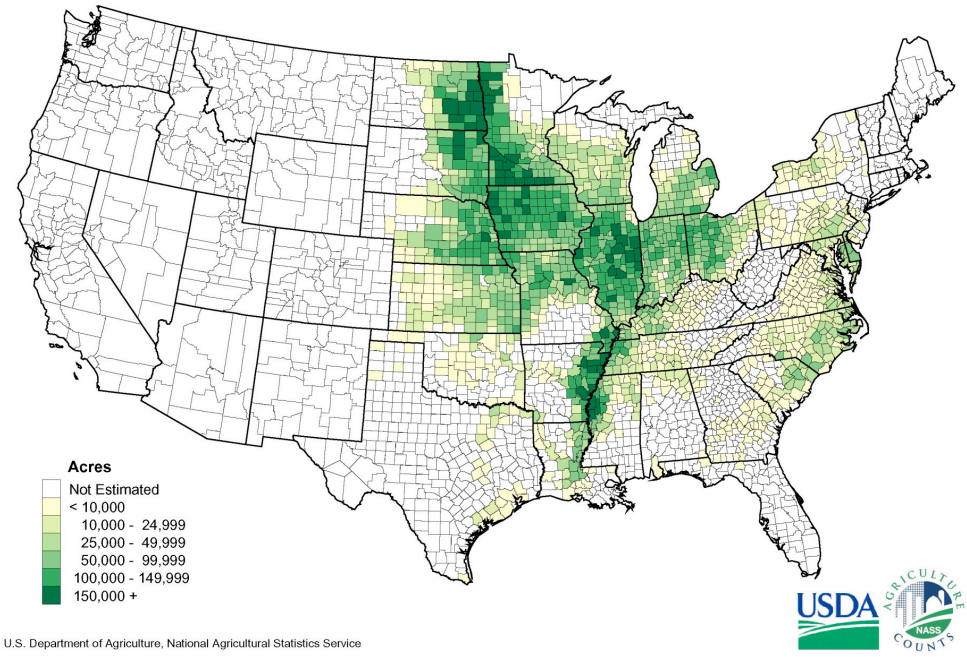

Fig. 2. Distribution of planted acres of soybean by counties across the U.S. in 2006.

DISEASE INCIDENCE AND YIELD LOSSES IN 2007

Soybean yields in 2007 were estimated to average 27 bu/A on an estimated 480,000 acres harvested in Virginia. Nematodes had the greatest impact on yield based on diagnostic tests performed in the plant disease clinic at the Tidewater AREC and field observations in Eastern Virginia (Table 1). Leaf diseases (frogeye leaf spot, anthracnose, Cercospora blight) in 2007 showed low incidence which is expected in years of excessive dry weather stress.

Low yields were likely a result of dry weather stress and root damage by nematodes (Table 1). Soybean cyst, southern and northern root-knot, sting, lance and stubby root nematodes probably accounted for the greatest losses of yield. Soybean rust was first detected on 19 October through weekly examinations of leaf samples from 10 sentinel plots and numerous commercial fields. Further sampling up to 10 November confirmed incidence of the disease in a total of nine counties; all located in southeastern Virginia.

Soybean rust was believed to cause no significant loss of yield in Virginia due to low incidence and late appearance. Essentially all soybean fields were beyond R6 (full seed stage) when the disease was detected.

Table 1. Estimated loss in yield as a result of soybean diseases in 2007.

Disease	Causal agent(s)	Percent loss
Seedling diseases	*Rhizoctonia spp., Pythium spp., etc.*	0.5
Cercospora blight	*Cercospora kikuchii*	0.2
Purple seed stain	*Cercospora kikuchii*	0.1
Downy mildew	*Peronospora manshurica*	Trace
Anthracnose	*Colletotrichum truncatum*	0.4
Brown spot	*Septoria glycines*	0.2
Pod & stem blight	*Diaporthe phaseolorum* var. *sojae*	0.1
Frogeye leaf spot	*Cercospora sojina*	0
Asian soybean rust	*Phakopsora pachyrhizi*	0
Southern blight	*Sclerotium rolfsii*	0.1
Brown stem rot	*Phialophora gregata*	0.1
Charcoal rot	*Macrophomina phaseolina*	0.1
Stem canker	*Diaporthe phaseolorum* var. *caulivora*	Trace
Sudden death syndrome	*Fusarium solani* f.sp. *glycines*	Trace
Root & lower stem rot	*Rhizoctonia* spp.	Trace
Red crown rot	*Cylindrocladium parasiticum*	Trace
Phytophthora root & stem rot	*Phytophthora megasperma* f.sp. *glycinea*	0
Sclerotinia stem rot	*Sclerotinia sclerotiorum* and *S. minor*	0
Viruses	SMV, PMV, BPMV, etc.	Trace
Bacterial pustule	*Xanthomonas phaseoli*	Trace
Bacterial blight	*Pseudomonas glycinea*	0.2
Soybean cyst nematode	*Heterodera glycines*	2.3
Southern root knot nematode	*Meloidogyne incognita*	1.5
Other nematodes	---various---	0.5
Total loss (%)		**6.3***

* The loss estimate equals 871,376 bushels based on production of 12.96 million bushels in 2007. At a value of $10.50/bu, the loss in revenues at the farm gate would be 9.15 million dollars.

SENTINEL PLOTS

Ten regional sentinel plots were sampled from flowering up to beginning senescence for early detection of soybean rust in 2007 (Table 2). A total of 264 samples of 100 leaflets were processed from sentinel plots by microscopic examination; 127 at the Tidewater AREC, 54 at the Eastern Shore AREC, and 83 at the PPWS Department in Blacksburg. Sentinel plots were located at the Tidewater AREC in Suffolk, Charles City County, Mecklenburg County, Greensville County at Skippers, Eastern Shore AREC at Painter, Northampton County, Shenandoah County, Northern Piedmont AREC at Orange, Eastern Virginia AREC at Warsaw, and Virginia Tech – Kentland Farm at Blacksburg. Leaf samples were collected and either shipped overnight by site cooperators or hand carried to the Tidewater AREC, Eastern Shore AREC, or the Virginia Tech - PPWS Department for processing.

A total of 166 samples from 84 commercial fields in 26 counties were processed in 2007 (Table 3). The Tidewater AREC processed 87 samples and the Eastern Shore AREC processed 79 samples. Upon receipt, the samples were placed in moist chambers at room temperature (70º - 77° F), incubated for 3 to 5 days, and examined under a dissecting microscope for pustules of soybean rust.

Microscopic examinations of samples from sentinel plots and commercial fields resulted in detection of soybean rust on leaflets from a commercial field in Isle of Wight County on 19 October. Continued sampling up to 15 November confirmed incidence of the disease in a total of 9 counties (Chesapeake, Gloucester, Isle of Wight, Matthews, Middlesex, Suffolk, Surry, Sussex, and Virginia Beach). Photographs of leaflets were taken to illustrate the small size of lesions and the need for microscopes to find and identify rust pustules (uredinia) and spores for disease detection (Fig 2). Confirmation of positive samples with pustules on leaflets was obtained by ELISA tests on 13 of 32 samples in the laboratory.

Table 2. Sentinel plot samples processed for soybean rust in 2007.

	June		July		August		September		October		November		Total	Total
County	-*	+	-	+	-	+	-	+	-	+	-	+	+	samples
Accomack.....	1	0	5	0	12	0	8	0	1	0	0	0	0	27
Charles City.....	0	0	6	0	15	0	7	0	1	0	0	0	0	29
Greensville.....	1	0	8	0	15	0	6	0	2	0	0	0	0	32
Mecklenburg....	1	0	7	0	14	0	3	0	3	0	0	0	0	28
Montgomery	0	0	0	0	4	0	9	0	2	0	0	0	0	15
Northampton....	1	0	8	0	9	0	8	0	1	0	0	0	0	27
Orange	0	0	5	0	11	0	9	0	1	0	0	0	0	26
Richmond	0	0	2	0	8	0	9	0	2	0	0	0	0	21
Shenandoah	0	0	2	0	13	0	6	0	0	0	0	0	0	21
Suffolk	3	0	12	0	12	0	7	0	3	1	0	0	1	38
Total.....	**7**	**0**	**55**	**0**	**113**	**0**	**72**	**0**	**16**	**1**	**0**	**0**	**1**	**264**

* - equals number of samples negative for soybean rust; + equals number positive.

Table 3. Commercial field samples processed for soybean rust in 2007.

County	June		July		August		September		October		November		Total	Total
	-*	+	-	+	-	+	-	+	-	+	-	+	+	Samples
Accomack	3	0	5	0	8	0	8	0	11	0	5	0	0	40
Brunswick	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Chesapeake	0	0	1	0	2	0	2	0	1	2	0	0	2	8
Dinwiddie	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Essex	0	0	0	0	1	0	1	0	2	0	0	0	0	4
Gloucester	0	0	0	0	0	0	1	0	0	1	0	0	1	2
Greensville	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Isle Of Wight	0	0	0	0	0	0	1	0	2	1	0	0	1	4
James City	0	0	0	0	0	0	0	0	3	0	0	0	0	3
King & Queen	0	0	0	0	0	0	2	0	1	0	0	0	0	3
King William	0	0	0	0	1	0	2	0	1	0	0	0	0	4
Lancaster	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Matthews	0	0	0	0	0	0	1	0	0	1	0	0	1	2
Mecklenburg	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Middlesex	0	0	0	0	0	0	1	0	1	2	0	0	2	4
New Kent	0	0	0	0	0	0	0	0	3	0	0	0	0	3
Northampton	2	0	5	0	8	0	8	0	12	0	5	0	0	40
Northumberland	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Nottoway	0	0	0	0	0	0	2	0	0	0	0	0	0	2
Prince George	0	0	0	0	0	0	0	0	1	0	0	0	0	1
Southampton	0	0	0	0	0	0	1	0	1	0	0	0	0	2
Suffolk	0	0	0	0	0	0	1	0	11	0	0	0	0	12
Surry	0	0	0	0	0	0	1	0	3	2	0	0	2	6
Sussex	0	0	0	0	3	0	1	0	5	2	0	0	2	11
Virginia Beach	0	0	0	0	2	0	2	0	1	1	0	0	1	6
Westmoreland	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Total	**5**	**0**	**11**	**0**	**25**	**0**	**40**	**0**	**62**	**12**	**11**	**0**	**12**	**166**

* - equals number of samples negative for soybean rust; + equals number positive.

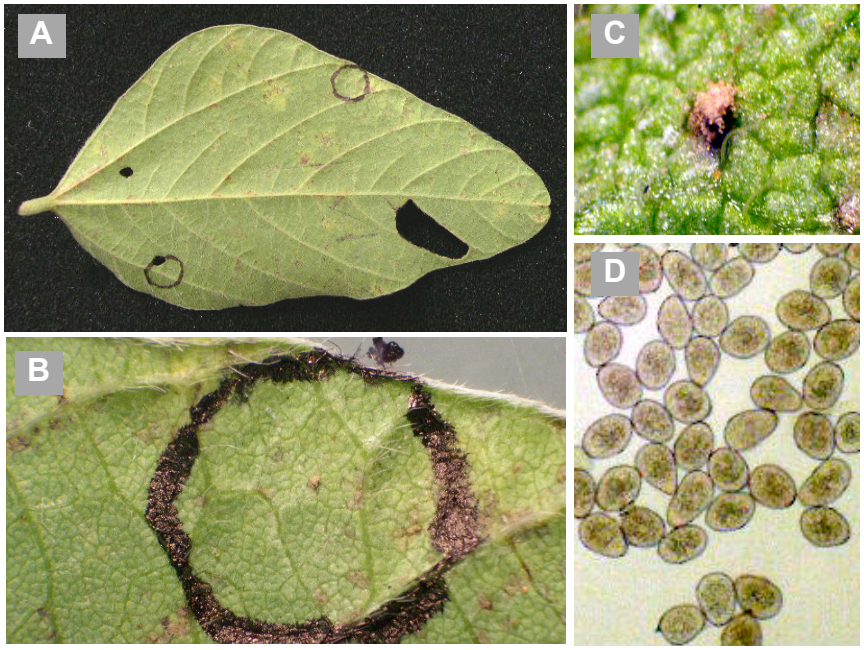

Fig. 3. A) Soybean rust pustules circled on leaflet; B) pustule under dissecting scope; C) pustule highly magnified under dissecting scope; and D) rust spores magnified under compound microscope.

WET AND AIR DEPOSITION SPORE TRAPS

Fig. 4. Wet deposition trap.

Five spore traps each for monitoring wet deposition and air deposition of spores were used from June through September for detection of rust spores moving into Virginia. Spore traps were located at the Tidewater AREC (Suffolk), Eastern Virginia AREC (Warsaw), Northern Piedmont AREC (Orange), Eastern Shore AREC (Painter) and Virginia Tech (Blacksburg). Samples were collected from the wet deposition spore traps (Fig. 4) on an 8 micron filter after significant rain events. These samples were sent to Dr. Erik Stromberg (Virginia Tech) for PCR analysis of filter contents. A total of only three filters from wet deposition spore traps were positive for spores of soybean rust.

Greased slides were used in five dry deposition spore traps to sample air continuously for one week intervals. Each week a single greased slide was removed from the traps and sent to Dr. John Rupe at the University of Arkansas for examination. Spores of soybean rust were not found on any of the greased slides from dry deposition traps. These results were based on the absence of rust spores with morphological traits matching that of the Asian soybean rust fungus, *Phakopsora pachyrhizi*.

The presence of soybean rust spores was responsible for detection of *Phakopsora pachyrhizi* in wet deposition traps by PCR tests. However, it is not known if the spores were capable of germination and causing infection.

Table 4. Detection of *Phakopsora pachyrhizi* in wet deposition spore traps, 2007.

Trap location	Number of samples submitted	Positive results*	Trap dates of positive results	Rain amount (in.)
TAREC, Suffolk.....	12	1	Aug 7 - 14	2.00
NPAREC, Orange	9	0	--	--
ESAREC, Painter	3	0	--	--
Virginia Tech, Blacksburg	9	0	--	--
EVAREC, Warsaw.....	11	1	Aug 6 - 10	0.81
		1	Aug 27-Sep 11	0.21

*Results confirmed by PCR.

SEASONAL AIR TEMPERATURES AND RAINFALL IN 2007. Moderate to severe drought stress occurred across much of eastern Virginia in 2007 and at locations of fungicide trials on soybeans. Periods of dry weather stress in July and September and above normal temperatures in July and August and September were believed to be responsible for reduced yields and the late appearance of soybean rust in South Carolina, North Carolina, and Virginia in 2007. Unlike 2006 when tropical storm Ernesto brought soaking rains at the end of August, no tropical storms brought rainfall into the Coastal Plain or Piedmont areas of Virginia in 2007. Table 5 summarizes seasonal temperatures at locations where fungicide trials were conducted on soybean in 2007. All locations reported below normal rainfall for the period from May through October. Weather data in Suffolk and Skippers were obtained from the Peanut/Cotton InfoNet (http://www.ipm.vt.edu/infonet). The Virginia Agricultural Experiment Station Mesonet (http://www.ahnrit.vt.edu/research/weather.html) collected weather data at the Eastern Virginia AREC at Warsaw and the Eastern Shore AREC at Painter. Normal rainfall records were obtained from annual reports by the Virginia Agricultural Statistics Service.

Table 5. Weather summary for locations of fungicide trials in 2007.

Location	Month	2007 Air Temperatures (F) Avg.	Max	Min.		Rainfall (in.) 2007	Normal
Tidewater AREC, Suffolk	MAY	65.4	76.5	54.9		2.16	3.82
	JUN	74.2	85.5	63.7		3.00	4.33
	JUL	76.3	88.3	65.9		1.71	5.87
	AUG	77.4	89.3	67.6		5.00	5.71
	SEP	70.7	83.9	58.5		0.43	4.52
	OCT	66.0	79.1	54.8		5.26	3.52
	Mean	**71.7**	**83.7**	**60.9**	**Total**	**17.56**	**27.77**
Hawkins Farm, Skippers	MAY	67.1	78.6	55.7		3.36	3.85
	JUN	75.8	87.3	65.0		3.14	3.57
	JUL	77.6	91.0	66.3		1.62	4.96
	AUG	80.5	94.2	69.8		2.53	4.63
	SEP	72.7	86.2	60.6		0.69	4.15
	OCT	66.0	79.6	54.7		4.52	3.06
	Mean	**73.3**	**86.1**	**62.0**	**Total**	**15.86**	**24.22**
Eastern Shore AREC, Painter	MAY	63.4	73.4	53.3		1.90	3.38
	JUN	72.7	81.3	63.9		5.21	3.61
	JUL	75.9	84.6	67.2		1.66	4.74
	AUG	76.7	85.6	68.1		3.38	4.12
	SEP	71.1	80.4	60.9		1.49	3.64
	OCT	67.0	75.9	58.1		3.65	3.69
	Mean	**71.1**	**80.2**	**61.9**	**Total**	**17.20**	**23.18**
Eastern VA AREC, Warsaw	MAY	65.3	76.6	53.7		1.19	4.05
	JUN	74.0	84.5	63.5		2.14	3.61
	JUL	76.3	88.1	65.8		1.88	4.60
	AUG	77.7	88.1	68.3		2.58	4.46
	SEP	70.4	82.8	58.7		1.09	4.24
	OCT	65.4	76.4	55.1		1.27	3.43
	Mean	**71.5**	**82.8**	**60.9**	**Total**	**10.15**	**24.39**

The optimum temperature range for leaf infection and development of rust pustules is 68° to 77º F. In addition to favorable temperature, the fungus requires moisture (leaf wetness or ≥ 95% RH) for spore germination and infection of leaflets. In an attempt to determine when conditions were favorable in 2007, the number of days with daily average temperatures between 60° to 77º F and short-term rainfall totals were ≥0.5 in. in the previous 5 days, ≥1 in. in the previous 10 days, or periods of relative humidity were ≥95% for 12 or more hours. According to data collected at the Tidewater AREC, favorable conditions for infection were recorded for 8 days in May, 12 days in June, 18 days in July, 14 days in August, 10 days in September, and 13 days in October. The longest periods of favorable conditions for infection occurred for 16 of 22 days beginning in July (Jul 12 to Aug 2) and 14 of 19 days in late September and early October (Sep 20 to Oct 8). The latter period appears to be the most plausible for explaining the first detection of soybean rust on October 19 in Virginia.

FUNGICIDE TRIALS:

Plots were 30-ft long and 12-ft wide. Row spacing ranged from 18- to 30-in. depending upon location. A randomized complete block design was used with four replications of treatments. Fungicides were applied with either a CO_2-pressurized backpack sprayer in a 6-ft spray swath, or a Lee Spider sprayer in a 12-ft spray swath. Both sprayers were equipped with 8002VS or Tee Jet 11015 nozzles spaced 18- in. apart and delivered a volume of 16.5 to 20 gal/A at 30 to 42 psi depending upon the location. Disease and yield data were collected from the central, 4.75-ft by 30-ft long section in each plot. Plots were harvested with a self-propelled, small-plot combine.

Results

Tidewater AREC, Suffolk, Trial 107 (Phipps). The field site was planted to RT 5450N on 24 May. The soil type was Nansemond fine sandy loam that was planted to soybean from 2004 through 2006. Plots were eight, 30-ft rows spaced 18-in. apart. Roundup Ultra Max at 28 fl oz/A was used on 20 June for weed control and Baythroid XL at 3 fl oz/A on 14 August for insect control. All fungicide treatments were applied with a Lee Spider sprayer. The timing of fungicide application was designed to evaluate one spray at R_3 (22 August), unless soybean rust was present within 100 mi. of the location prior to R_3. Plots were harvested on 3 October. None of the treatments caused chemical injury on leaves, stems or pods. Cercospora blight was the only disease to show a significant reduction in disease by treatments (Table 6).

Table 6. Soybean fungicide trial 107, Suffolk.

Treatment and rate/A[z]	Brown spot[y] (18 Sep)	Cercospora blight[y] (18 Sep)	Downy mildew[y] (18 Sep)	% defoliation[x] (18 Sep)	Yield[w] (bu/A)	*P*-value of yield vs. check	100 seed wt. (oz)[v]	% purple seed stain[v]
Check	15.0	6.5 a	1.3	37.5	27.7	--	.4857	1.0
LEM17 200SC 9.6 fl oz	11.5	3.5 bc	0.3	40.0	28.1	.9219	.4887	0.5
LEM17 200SC 9.6 fl oz + YT669 2.08SC 4 fl oz + Induce 2.56 fl oz	11.0	3.5 bc	0.5	40.0	24.2	.3898	.4643	0.0
LEM17 200SC 9.6 fl oz + Punch 3.3EC 3 fl oz	7.3	2.3 cd	0.0	31.3	23.2	.2719	.4824	1.3
YT669 2.98SC 6 fl oz + Induce 2.56 fl oz	10.8	4.5 b	0.3	35.0	26.4	.7441	.4699	0.3
Punch 3.3EC 4 fl oz	8.5	2.8 b-d	0.3	43.8	22.1	.1773	.4873	1.0
Punch 3.3EC 3 fl oz + Headline 2.09EC 4.5 fl oz + Induce 2.56 fl oz	3.0	1.5 d	0.0	32.5	24.6	.4546	.4741	0.3
Absolute 500SC 5 fl oz	21.5	4.5 b	0.5	48.8	20.2	.0757	.4596	0.0
Quilt 1.67SC 14 fl oz + COC 20.5 fl oz (1% v/v)	6.5	3.3 b-d	0.5	33.8	25.4	.5686	.4893	0.3
Headline 2.08EC 4.7 fl oz + Folicur 3.6SC 3.1 fl oz	5.8	2.0 cd	0.3	31.3	27.3	.9219	.5024	0.5
P-value	.3886	.0003	.1034	.2430	.6126	--	.3331	.2059

[z]A single application was applied at beginning pod (R3) on 22 Aug. [y]Data are based on visual estimates of percentages of leaf area with disease. [x]Defoliation rating scale: 0=none, 100= no leaves on plants. [w]Yields are weight of soybeans with 13.5% moisture. Soybeans were harvested on 3 Oct. [v]Random samples of seed were collected at harvest for determining 100 seed wt and percentages of seed with purple seed stain. Means followed by the same letter(s) are not significantly different according to Fisher's Protected LSD at *P*=0.05. Arcsine transformation of visual estimates of disease was made in analysis to determine statistical significance.

Soybean rust was not detected at the test site. Sprays of Punch + Headline w/Induce provided the most effective control of Cercospora blight, based on disease ratings on September 18. No treatment significantly delayed defoliation or increased yield.

Tidewater AREC, Suffolk, Trial 207 (Phipps). The variety, planting date, cultural practices, and location of this trial were the same as Trial 107. Fungicide treatments were applied with a Lee Spider Spray on 22 August (R_3). All fungicide treatments resulted in significant reductions in incidence of brown spot and Cercospora blight (Table 7). Soybean rust was not detected in the trial. Defoliation rating on 19 October was suppressed the greatest by treatments with Quilt plus COC. None of the treatments caused visible evidence of leaf, stem or pod injury. The trial was harvested on 3 October. None of the fungicide treatments significantly increased yield.

Table 7. Soybean fungicide trial 207, Suffolk.

Treatment and rate/A[z]	Brown spot[y] (19 Sep)	Cercospora blight[y] (19 Sep)	Downy mildew[y] (19 Sep)	% defoliation[x] (19 Sep)	Yield[w] (bu/A)	*P*-value of yield vs. check	100 seed wt. (oz)[v]	% purple seed stain[v]
Check	18.8 a	8.3 a	2.3 ab	46.3 a	30.0	--	.4915 bc	1.8 a
Domark 1.9ME 3 fl oz	6.3 bc	5.3 b	1.8 bc	28.8 bc	36.1	.1194	.4964 a-c	0.3 bc
Domark 1.9ME 4 fl oz	6.3 bc	4.0 b-d	1.8 bc	40.0 ab	32.0	.6003	.4986 ab	0.8 a-c
Domark 1.9ME 5 fl oz	4.3 cd	3.3 c-e	1.0 c	40.0 ab	29.2	.8386	.4852 bc	0.0 c
Laredo 2EC 7 fl oz	7.0 bc	4.8 bc	1.5 bc	31.3 bc	31.1	.7795	.5087 ab	1.3 ab
Folicur 3.6SC 4 fl oz	8.8 b	4.5 bc	2.0 ab	46.3 a	26.6	.3847	.4643 c	1.0 a-c
Quilt 1.67SC 14 fl oz + COC 20.5 fl oz	4.0 cd	2.0 e	1.5 bc	17.5 c	34.7	.2267	.4929 bc	0.0 c
Headline 2.08EC 6 fl oz + Folicur 432SC 3.1 fl oz	4.0 cd	2.5 de	2.8 a	31.3 bc	29.0	.7929	.4777 bc	1.0 a-c
Absolute 500SC 5 fl oz	2.0 d	2.3 de	1.8 bc	28.8 bc	35.5	.1588	.5270 a	0.5 bc
Stratego 250EC 10 fl oz + Induce 2.56 fl oz	4.0 cd	3.3 c-e	1.5 bc	27.5 bc	34.0	.3063	.5071 ab	0.5 bc
P-value	.0001	.0001	.0778	.0055	.2399	--	.0323	.0398

[z]A single application was applied at beginning pod (R3) on 22 Aug. [y]Data are based on visual estimates of disease incidence and leaf area affected. [x]Defoliation rating scale: 0=none, 100= no leaves on plants. [w]Yields are weight of soybeans with 13.5% moisture. Soybeans were harvested on 3 Oct. [v]Random samples of seed were collected at harvest for determining 100 seed wt and percentages of seed with purple seed stain. Means followed by the same letter(s) are not significantly different according to Fisher's Protected LSD at *P*=0.05, except downy mildew was analyzed at *P*=0.10. Arcsine transformation of visual estimates of disease was made in analysis to determine statistical significance.

Tidewater AREC, Trial 307, Suffolk (Phipps). The field site was planted to Pioneer 95M50 on 24 May. The soil type was Suffolk loamy sand that was planted to cotton, peanut and corn in 2006, 2005 and 2004, respectively. Plots were eight, 30-ft rows spaced 18-in. apart. Roundup Ultra Max at 28 fl oz/A was applied on 20 June and 12 July at 22 fl oz for weed control. All treatments were applied using a Lee Spider sprayer at R_3 on 22 August. Plots were harvested on 11 October with a small-plot combine. None of the treatments caused symptoms of chemical injury on leaves, stems or pods. Soybean rust was not detected in the trial. Brown spot, frogeye leaf spot, Cercospora blight and downy mildew occurred at low levels on 19 September, but were not believed to reduce yield (Table 8). All treatments significantly reduced incidence of Cercospora blight and brown spot based on percentages of leaf area with symptoms of disease on 19 September. Orthogonal contrasts of treatment yields to the non-treated check indicated that Folicur increased yield significantly (*P*=0.0385). Incidence of purple seed stain was found in trace amounts only, but the weight of 100 seed was increased significantly by Folicur, Absolute, Stratego plus Induce, and Headline plus Folicur.

Table 8. Soybean fungicide trial 307, Suffolk.

Treatment and rate/A[z]	% leaf area with disease (19 Sep)[y]				% defol-iation[x] (19 Sep)	Yield[w] (bu/A)	*P*-value of yield vs. untreated	Wt./100 seed (oz)
	Brown spot	Cercos-pora blight	Frogeye leaf spot	Downy mildew				
Untreated	13.8 a	3.0 a	1.8	2.0	23.5	37.1	--	.4833 c
Folicur 3.6SC 4 fl oz	3.8 b	1.3 b	1.3	2.0	1.5	49.2	.0353	.5169 ab
Quadris 2.08SC 14 fl oz + COC 20.5 fl oz	2.0 b	1.5 b	1.0	1.5	3.5	33.6	.5267	.4850 bc
Quilt 1.67SC 14 fl oz + COC 20.5 fl oz	3.5 b	1.8 b	0.8	1.8	4.8	36.4	.8936	.4909 bc
Absolute 500SC 5 fl oz	3.0 b	1.5 b	1.5	2.8	1.3	44.1	.2111	.5266 a
Stratego 250EC 10 fl oz + Induce 2.56 fl oz	2.3 b	1.3 b	1.0	2.0	1.0	41.2	.4575	.5259 a
Headline 2.08EC 6 fl oz + Folicur 432SC 3.1 fl oz	2.5 b	1.3 b	1.3	2.3	1.3	42.6	.3259	.5238 a
Laredo 2EC 7 fl oz	5.3 b	2.0 b	1.0	1.5	10.5	38.7	.7720	.4966 a-c
Domark 1.9ME 5 fl oz	2.0 b	1.5 b	1.3	1.8	11.5	36.6	.9289	.4947 a-c
P-value	.0001	.0753	.2699	.2689	.2454	.1865	--	.0279

[z]A single application was applied at beginning pod (R3) on 22 Aug. [y]Data are based on visual estimates of disease incidence and leaf area affected. [x]Defoliation rating scale: 0=none, 100= no leaves on plants. [w]Yields are weight of soybeans with 13.5% moisture. Soybeans were harvested on 11 Oct. Means followed by the same letter(s) are not significantly different according to Fisher's Protected LSD at *P*=0.05. Arcsine transformation of visual estimates of disease was made in analysis to determine statistical significance.

Isle of Wight County, Trial 407, Carr farm (Phipps). Soil at the field site was Slagle fine sandy loam and planted to corn in 2004 and 2006 and soybean in 2005. The variety was DP94M80 planted in rows spaced 18 in. apart on 24 May. Plots were 9-ft wide by 30-ft long and treatments were replicated in four randomized complete blocks. Cultural practices included Roundup Ultra Max at 22 fl oz/A on 15 August for weed control and Baythroid 3 fl oz/A for insect control. All fungicides were applied with a Lee Spider sprayer in a single application at beginning seed (R_3) on 1 August. Plots were harvested on 2 October with a small-plot combine. None of the treatments caused symptoms of chemical injury to leaves, stems or pods. Soybean rust was not detected in the trial. All fungicide treatments resulted in significant suppression of brown spot and Cercospora blight (Table 9). All fungicide treatments, except Domark, showed significantly lower defoliation than the untreated check on 18 September.

Table 9. Soybean fungicide trial 407, Isle of Wight County.

Treatment and rate/A[z]	% leaf area with disease (18 Sep)[y]			% defoliation[x] (18 Sep)	Yield[w] (bu/A)	*P*-value of yield vs. check	Wt./100 seed (oz)	% purple seed stain[v]
	Brown spot	Cercos-pora blight	Downy mildew					
Untreated	9.5 a	3.5 a	0.8	88.8 a	20.1	--	.5294	2.5 a
Quilt 1.67SC 14 fl oz + COC 20.5 fl oz	1.5 c	0.3 b	0.3	66.3 b	21.6	.6143	.5391	1.0 bc
Stratego 250EC 10 fl oz + Induce 2.56 fl oz	1.8 c	0.5 b	0.5	67.5 b	22.6	.3983	.5403	1.3 a-c
Absolute 500SC 5 fl oz	2.5 c	0.3 b	0.3	70.0 b	24.5	.1351	.5545	0.8 c
Headline 2.08EC 4.7 fl oz + Folicur 3.1 fl oz	1.5 c	0.8 b	0.5	65.0 b	23.9	.1975	.5528	0.0 c
Domark 1.9ME 5 fl oz	5.3 b	1.0 b	0.8	82.5 a	18.1	.4887	.5490	2.3 ab
P-value	.0001	.0042	.3891	.0001	.2572	--	.1951	.0541

[z]A single application was applied at beginning pod (R3) on 1 Aug. [y]Data are based on visual estimates of disease incidence and leaf area affected. [x]Defoliation rating scale: 0=none, 100= no leaves on plants. [w]Yields are weight of soybeans with 13.5% moisture. Soybeans were harvested on 2 Oct. [v]Random samples of seed were collected at harvest for determining 100 seed wt and percentages of seed with purple seed stain. Means followed by the same letter(s) are not significantly different according to Fisher's Protected LSD at *P*=0.05, except purple seed stain was analyzed at *P*=0.10. Arcsine transformation of visual estimates of disease was made in analysis to determine statistical significance.

Greensville County, Trial 507, Hawkins Farm (Phipps and Hu). Soil at the field site was Craven clay loam, and planted to soybean in 2005 and 2006. Seed of RT 5450N were planted in rows spaced 18-in. apart on 23 May. Standard practices for production of glyphosate-resistant soybeans were followed after planting. Plots were 13-ft wide by 30-ft long and treatments were replicated in four randomized complete blocks. A single application of treatments was made with a backpack sprayer at beginning pod stage (R_3) on 23 August. Soybeans were harvested on 8 October. All treatments reduced incidence of brown spot and Cercospora blight significantly according to ratings on 19 September (Table 10). Treatments did not cause any plant injury and did not have a significant effect on defoliation or yield. Seed weight was increased significantly by treatments with Absolute and Stratego plus Induce. All treatments suppressed purple seed strain significantly, except Domark.

Table 10. Soybean fungicide trial 507, Hawkins Farm, Greensville County.

Treatment and rate/A[z]	% leaf area with disease (19 Sep)[y]			% defoliation[x] (19 Sep)	Yield[w] (bu/A)	*P*-value of yield vs. check	Wt./100 seed (oz)	% purple seed stain[v]
	Brown spot	Cercospora blight	Downy mildew					
Untreated	15.0 a	4.3 a	1.5	32.5	15.8	--	.4349 cd	1.8 b
Quadris 2.08SC 6 fl oz + COC 20.5 fl oz	3.0 d	1.0 cd	1.0	20.0	16.0	.9443	.4270 d	0.3 cd
Quilt 1.67SC 14 fl oz + COC 20.5 fl oz	1.8 d	0.3 d	1.3	25.0	16.3	.7802	.4320 d	1.3 bc
Stratego 250EC 10 fl oz + Induce 2.56 fl oz	6.0 bc	2.0 bc	1.0	12.5	17.4	.4052	.4589 ab	0.0 d
Absolute 500SC 5 fl oz	4.3 cd	1.8 c	1.0	16.3	16.3	.7802	.4622 a	0.0 d
Folicur 432SC 4 fl oz	6.0 bc	2.3 bc	1.0	18.8	16.2	.8342	.4375 b-d	1.0 b-d
Headline 250EC 6 fl oz	4.0 cd	1.8 c	1.0	13.8	13.4	.0233	.4547 a-c	0.5 cd
Headline 2.08EC 4.7 fl oz + Folicur 3.1 fl oz	2.8 d	1.3 cd	0.8	22.5	17.8	.2844	.4302 d	0.5 cd
Laredo 2EC 7 fl oz	7.5 b	3.3 ab	1.0	17.5	16.3	.8070	.4475 a-d	1.8 b
Domark 1.9ME 5 fl oz	4.3 cd	1.5 cd	1.0	23.8	13.4	.8615	.4318 d	3.0 a
P-value	.0001	.0007	.9536	.1237	.6071	--	.0177	.0003

[z]A single application was applied at beginning pod (R3) on 23 Aug. [y]Data are based on visual estimates of disease incidence and leaf area affected. [x]Defoliation rating scale: 0=none, 100= no leaves on plants. [w]Yields are weight of soybeans with 13.5% moisture. Soybeans were harvested on 8 Oct. [v]Random samples of seed were collected at harvest for determining 100 seed wt and percentages of seed with purple seed stain. Means followed by the same letter(s) are not significantly different according to Fisher's Protected LSD at *P*=0.05. Arcsine transformation of visual estimates of disease was made in analysis to determine statistical significance.

Eastern Shore AREC, Painter (Rideout and Waldenmaier).

The trials were conducted on a Bojac fine sandy loam soil (organic matter <1%) at the Eastern Shore Agricultural Research and Extension Center, Painter, VA. Standard practices for weed and insect control were followed and trials were planted to V39N4RR. The conventional-tillage, full-season trial was planted on 16 June and the double-cropped trial was planted on 6 July following wheat harvest. Plots consisted of two, 30-ft rows spaced 30 in. apart bordered by two non-treated rows. Treatments were arranged in a randomized complete block design with four replications. Treatments were applied with a CO_2-pressurized backpack sprayer which delivered 20 gal/A at 42 psi. The spray boom had four Tee Jet 11015 nozzles spaced 18-in. apart. Treatments were applied to the full-season soybeans on 8 August when 75% of the soybeans were at reproductive stage R_3 and no-till soybeans on 8 September at stage R_3. Percent defoliation was evaluated in the full-season beans on 14 September. Soybeans were harvested and weighed on 28 November in full-season and 30 November in double-cropped. A 100-seed sample was collected from each plot during harvest to assess seed weight and percent discolored seeds.

Results

Full – Season Soybean Trial - Dry weather predominated throughout the season with precipitation amounting to 1.8, 3.7, 1.3 and 3.8 in. for Jul, Aug, Sep and Oct, respectively. Less than 1 inch of rainfall occurred during the first four weeks in July and less than 0.4 inch of rainfall fell from mid-September to the end of October. Consequently, disease pressure was low and no differences in foliage retention, yields 100 seed count weight were observed (Table 11).

Table 11. Soybean yields and percent discolored seed from a full-season soybean fungicide trial conducted at the ESAREC in Painter, VA in 2007.

Treatment (Rate/A)	% Defoliation (14 Sep)	Yield (bu/A)	Seed wt. g/100 seed	Discolored Seed (%)
Nontreated Control	46	23.4	20.43	37.94
Quadris 2SC 6 fl oz + COC 1 % v/v	46	27.3	21.55	34.18
Quilt 1.66SC 14 fl oz + COC 1% v/v	51	26.3	20.60	35.79
Quilt 1.66SC 20 fl oz + COC 1% v/v	40	34.8	20.88	37.77
Quilt 1.66SC 14 fl oz + Quadris 2SC 2 fl oz + COC 1% v/v	46	29.7	20.73	29.07
Quadris 2SC 6 fl oz + Tilt 3.6EC 4 fl oz + COC 1 % v/v	33	28.8	20.60	31.56
Stratego 2EC 10 fl oz + Induce 0.125% v/v	44	27.7	21.25	28.60
Headline 2EC 6 fl oz	49	26.3	21.10	32.44
Headline 2EC 6 fl oz + Folicur 430SC 3.1 fl oz	49	25.3	21.03	33.72
Folicur 430SC 4 fl oz	54	27.3	20.40	33.33
Punch 3.3EC 3 fl oz + Headline 2EC 4.5 fl oz	37	32.1	20.30	29.50
Punch 3.3EC 4 fl oz	45	27 1	19.83	34.33
Absolute 500SC 5 fl oz	60	29.4	20.58	31.63
Laredo 2EC 7 fl oz + Induce 0.125% v/v	56	28.0	20.33	36.34
Domark 230ME 5 fl oz	38	28.8	20.63	36.23
LSD (P=.05)	17.05	6.14	0.95	10.16

Means within each column followed by the same letter are not significantly different (P= 0.05, Fisher's LSD).

Double – Cropped Soybean Trial – Dry weather predominated throughout the season as in the full- season trial. Disease pressure was low and no differences in foliage retention or yields according to treatment were observed (Table 12). No differences in 100 seed count weight or percent discolored seed were noted.

Table 12. Soybean yields and percent discolored seed from a double-cropped soybean fungicide trial conducted at the ESAREC in Painter, VA in 2007.

Treatment (Rate/A)	Yield (bu/A)	Seed wt. g/100 seed	Discolored Seed (%)
Nontreated Control	29.4	16.63	10.55
Quadris 2SC 6 fl oz + COC 1 % v/v	36.8	16.50	5.01
Quilt 1.66SC 14 fl oz + COC 1% v/v	32.7	16.65	7.89
Quilt 1.66SC 20 fl oz + COC 1% v/v	35.0	16.00	8.32
Quilt 1.66SC 14 fl oz + Quadris 2SC 2 fl oz COC 1% v/v	29.8	16.03	8.61
Quadris 2SC 6 fl oz + Tilt 3.6EC 4 fl oz + COC 1 % v/v	33.4	15.85	7.91
Stratego 2EC 10 fl oz + Induce 0.125% v/v	32.0	16.63	8.21
Headline 2EC 6 fl oz	29.3	16.13	8.60
Headline 2EC 6 fl oz + Folicur 430SC 3.1 fl oz	34.3	16.85	8.46
Folicur 430SC 4 fl oz	30.1	16.20	7.27
Punch 3.3EC 3 fl oz + Headline 2EC 4.5 fl oz	34.7	17.55	7.97
Punch 3.3EC 4 fl oz	33.1	16.28	11.91
Absolute 500SC 5 fl oz	36.3	16.33	8.06
Laredo 2EC 7 fl oz + Induce 0.125% v/v	34.8	16.70	6.77
Domark 230ME 5 fl oz	31.4	16.35	7.62
LSD (P=.05)	6.26	1.162	4.37

Means within each column are not significantly different (P= 0.05, Fisher's LSD).

Eastern Virginia AREC, Warsaw (Stromberg).
Summary for 2007 Soybean Fungicide Trials – FULL SEASON (Table 13)
Soybean cultivar Vigoro V48N5RR
Full season soybeans planted on 6 June 2007
Herbicides: Python 0.9 oz/A + Dual 1.0 pint/A PPI
Fertilizer: 0-60-60 per acre
Postemergence herbicide: RoundUp 1 qt/A on 25 July 2007

Fungicide applications:
Treatments applied at R3 on 7 August 2007
Treatments applied at 14 and 21 days after R3 applications were made on 21 and 28 August, respectively.
Insecticide: Warrior T 3.84 oz/A on 21 August 2007 for corn ear worm and stink bugs
Plots were harvested on 17 October 2007.

Table 13. Soybean yields and seed weight from a full-season soybean fungicide trial conducted at the Eastern Virginia AREC at Warsaw in 2007.

Treatment in product fl. oz. / A	Application Growth Stage	500 Seed wt (g)	Bu/A (13.5% H_2O)
Non-treated	--	61.85	28.93
Quadris 2.08SC 6 fl oz + COC 1.0% v/v	R3	62.73	57.30
Quilt 1.67SC 14 fl oz + COC 1.0% v/v	R3	58.63	44.98
Stratego 250EC 10 fl oz + Induce 0.125% v/v	R3	64.30	51.43
Domark 230ME 5 fl oz	R3	62.95	56.03
Headline 2.09EC 6 fl oz	R3	64.28	49.68
Headline 2.09EC 4.7 fl oz + Folicur 432SC 3.1 fl oz	R3	63.53	42.98
Folicur 3.6SC 4 fl oz	R3	65.90	47.80
Laredo 2.0EC 7 fl oz + Induce 0.125% v/v	R3	64.13	59.10
Absolute 500SC 5 fl oz	R3	64.65	35.88
Punch 3.3EC 4 fl oz	R3 + 14 da	62.13	43.05
Punch 3.3EC 3 fl oz + Headline 2.09EC 4.5 fl oz	R3 + 14 da	62.03	60.75
Folicur 3.6SC 4 fl oz	R3 + 21 da	62.25	40.55
Stratego 250EC 10 fl oz + Induce 0.125% v/v	R3 + 21 da	62.10	49.93
Absolute 500SC 5 fl oz	R3 + 21 da	61.75	51.63
Quadris 2.08SC 6.2 fl oz + Alto 100SL 4 fl oz + NIS 0.25% v/v	R3	63.15	57.18
Quadris Extra 2.34SC 4 fl oz + NIS 0.25% v/v	R3	61.68	46.58
LSD (P=0.05)	--	5.99	24.32

Means are not significantly different (P=0.05, Student-Newman-Keuls).

Eastern Virginia AREC, Warsaw (Stromberg).
Summary for DC-Soybean Fungicide Trial 2007 – DOUBLE-CROPPED (Table 14)
Cultivar: Vigoro V48N5RR
Planted on 3 July 2007 no-tillage into wheat stubble
Herbicides: Gramoxone 1 pint/A on 3 July 2007 (burndown).
Dual 1 pint/A + RoundUp 1 qt/A on 21 August 2007

Fungicides:
Treatments applied at R3 on 16 August 2007
Treatments following R3 at 14 and 21 days were made on 30 August and 6 September, respectively.
Insecticide: Warrior T 3.84 oz/A on 21 August 2007 for corn ear worms and stinkbug
Plots were harvested on 12 November 2007.

Table 14. Soybean yields and seed weight from a double-cropped soybean fungicide trial conducted at the EVAREC in Warsaw, VA in 2007.

Treatment and rate/A	Application Growth Stage	% Harvest Moisture	Seed Quality (1-5)	100 seed wt in g	Bu/A 13.5% H_2O
Non-treated	--	9.00	2.60	12.43	11.03
Quadris 2.08SC 6 fl oz + COC 1.0% v/v	R3	8.95	2.68	12.33	9.10
Quilt 1.67SC 14 fl oz + COC 1.0% v/v	R3	9.03	2.80	12.18	7.88
Stratego 250EC 10 fl oz + Induce 0.125% v/v	R3	8.65	3.18	11.78	6.80
Domark 230ME 5 fl oz	R3	9.13	2.80	12.10	8.63
Headline 2.09EC 6 fl oz	R3	8.93	3.05	12.85	8.00
Headline 2.09EC 4.7 fl oz + Folicur 432SC 3.1 fl oz	R3	9.48	2.90	12.38	9.68
Folicur 3.6SC 4 fl oz	R3	8.73	3.08	11.73	6.30
Laredo 2.0EC 7 fl oz + Induce 0.125% v/v	R3	9.45	2.83	12.05	10.35
Absolute 500SC 5 fl oz	R3	8.90	3.05	11.85	7.30
Punch 3.3EC 4 fl oz	R3 + 14 da	8.83	2.98	12.08	8.35
Punch 3.3EC 3 fl oz + Headline 2.09EC 4.5 fl oz	R3 + 14 da	9.18	2.83	12.23	8.20
Folicur 3.6SC 4 fl oz	R3 + 21 da	9.00	2.90	12.38	7.58
Stratego 250EC 10 fl oz + Induce 0.125% v/v	R3 + 21 da	9.03	2.75	11.85	9.43
Absolute 500SC 5 fl oz	R3 + 21 da	9.60	2.75	12.60	11.93
Quadris 2.08SC 6.2 fl oz + Alto 100SL 4 fl oz + NIS 0.25% v/v	R3	8.73	2.78	12.03	8.68
Quadris Extra 2.34SC 4 fl oz + NIS 0.25% v/v	R3	9.20	2.68	12.25	10.58
LSD (P=0.05)	--	0.78	0.04	0.73	3.45

Means followed by same letter do not significantly differ (P=0.05, Student-Newman-Keuls).

Summary: Soybean Rust Incidence and the Response of Soybeans to Fungicides in 2007

1. Soybean leaflet samples were collected from 10 regional sentinel plots and 84 commercial fields for detection of soybean rust in 2007.

2. Sentinel plots were located at the Tidewater AREC (Suffolk), Southampton County (Courtland), Eastern Shore AREC (Painter), Northampton County, Shenandoah County, Southern Piedmont AREC (Blackstone), Charles City County, Northern Piedmont AREC (Orange), Eastern Virginia AREC (Warsaw), and Virginia Tech – Kentland Farm (Blacksburg).

3. The first outbreak of soybean rust, caused by *Phakopsora pachyrhizi*, was found in leaf samples from Isle of Wight County on 19 October; thereafter, the disease was confirmed in 9 counties and cities (Chesapeake, Gloucester, Isle of Wight, Matthews, Middlesex, Suffolk, Surry, Sussex, and Virginia Beach)

4. No loss of yield to soybean rust was expected since the disease appeared when soybeans were beyond growth stage R6 (full seed).

5. Above normal temperatures and below normal rainfall in July, August, and September suppressed yield and resulted in unfavorable conditions for soybean rust; except for 16 of 22 days from July 12 to Aug 2 and 14 of 18 days from 20 September to 8 October.

6. Dry weather stress during the season limited development of common diseases in soybeans throughout most of 2007 (i.e. Cercospora blight, purple seed stain, brown spot, frogeye leaf spot, anthracnose, pod and stem blight, etc.).

7. Fungicide treatments with Headline, Absolute, Quadris, Quadris Extra, Quilt, Stratego, Punch, Folicur, Absolute, Domark, Laredo, Folicur, and Headline showed little or no effect on yield in nine replicated field trials in 2007.