2010–2011

Soybean Rust

suggested fungicide practices to prevent yield losses

MISSISSIPPI STATE UNIVERSITY™
EXTENSION SERVICE

Soybean rust (SBR), formerly known as Asian Soybean Rust (ASR), was first identified in the continental United States in November 2004 in a soybean research plot near Baton Rouge, Louisiana. A few days later, SBR was positively identified in late-planted soybeans in several Mississippi counties, including Adams, Holmes, Jefferson, Warren, and Washington.

Fortunately, the arrival of SBR late in the growing season had no measurable yield impact on the overall soybean crop in Mississippi, because most of the crop was already harvested. This confirms how a wind-borne pathogen can cover a large area quickly.

This publication will help develop detection and management strategies for Mississippi soybean producers, consultants, and/or distributors. The following are guidelines based on currently available information on product efficacy, economics, response to foliar fungicides in the absence of rust, and resistance management. Suggestions are likely to change as we learn more about SBR and the products used for yield loss prevention.

Always follow the manufacturer's label for rates, compatibility with other products, sprayer setup, spray volumes, spray intervals, use of adjuvants, and other pertinent information. If you have specific questions, contact your local county Extension office. In addition, reference materials that include information on some of the above topics can be found at http://oardc.osu.edu/soyrust/.

Detection Strategies

Indicator crops, or sentinel plots, have proven to be effective as an early detection system throughout the world. A system of sentinel plots, specifically established to monitor the progression of SBR, were initially used in Africa. These consisted of half- to 1-acre sentinel plots planted about 1 month before the commercial crop and established regionally every 20 to 100 miles. In this sytem, plots were surveyed daily for SBR after flowering began. This strategy protects the commercial crop because SBR can be detected at sentinel locations before the commercial crop reaches the most susceptible growth stages, which are considered to be flowering (R1) or later.

The sentinel plot strategy has proven to be effective in Mississippi because the majority of our soybean crop is grown in the northern half of the state (north of I-20). Strategically located sentinel plots planted from late February through mid-April have served as an effective detection tool because the anticipated path of SBR movement will be northward from overwintering sites along the Gulf Coast.

Sentinel plots have been established annually at approximately 20 locations throughout Mississippi since 2005. Planting generally begins in late February, weather permitting, and sites have generally been located along the Gulf Coast and west to the Mississippi River, northward to DeSoto County in the western part of the state and Alcorn County in the eastern part of the state, and throughout central and north Mississippi.

From 2005 to 2007, SBR was detected in soybean sentinel plots before being detected in production soybeans. In 2006, nine counties were positive for SBR, while in 2007, 26 counties were positive. In 2008 and 2009, an increasing number of counties had infected plant material (either kudzu or soybeans), with 79 and 82 counties infected, respectively. In 2010, 24 sentinel plots were planted to aid in monitoring the progression of SBR in Mississippi.

The weather service is continuing to forecast an El Niño for the state, suggesting cooler and wetter conditions than normal. These conditions are favorable for the development of SBR, so the occurrence of rust in 2010 will depend on spores of the causal fungus being blown from overwintering sites into the state.

Fungicide suggestions, if deemed necessary, will be tailored to the specific situation in Mississippi and will be based on all of the available information. If we positively identify SBR, we will notify producers and other agricultural professionals via multiple media sources, including television, a free telephone hotline (1-866-641-1847), radio, websites (www.msucares.com, www.sbrusa.net), and popular press. We will also notify all county Extension offices through an email list. The telephone hotline is a joint venture with Arkansas and Louisiana and is sponsored by the Mississippi Soybean Promotion Board and BASF.

When SBR is threatening and periods of leaf moisture have been moderate to high, producers should intensively scout all fields, especially during all reproductive growth stages (flowering to full pod). Symptoms generally start in the lower canopy, so scout lower leaves first. Send suspect samples to the Plant Disease and Nematology Diagnostics Laboratory at Mississippi State University, 190 Bost North, Mississippi State, MS 39762-9655. Call the lab

at (662) 325-2146 if you have questions. Because a large number of samples may need to be processed, a fee may be required for each sample you submit. Place plant samples in a sealed plastic bag, along with a dry paper towel to control excess moisture, and keep the bag at room temperature. If SBR is present on the sample, pustules should form spores in 1–3 days. Actively sporulating rust pustules can be identified using a 20× hand lens.

Early detection is essential because a yield loss may have already occurred with as little as 10 percent disease incidence in the lower canopy.

Control

Currently, no commercial soybean variety has resistance to SBR. Early detection and fungicides are the only ways to prevent losses. **Table 1** lists fungicides active against the fungus that causes SBR. Currently, all of the products are fully labeled with the exception of one Section 18 (emergency exemption) labeling for flutriafol (Topguard). A Section 3 has been granted at the federal level and should follow for Mississippi during summer 2010.

Fungicides for SBR management fall into three general categories: triazoles, strobilurins, and chlorothalonil. Marketed mixtures of triazoles and strobilurins also are available.

Triazoles offer some curative properties and can be used before infection or after limited infection. But all products are BEST used PREVENTIVELY. In addition, triazoles offer varying levels of residual protection that generally last 14 to 20 days, depending on the product and rate. Curative fungicides will act on the fugus after it has infected the plant but before it forms new rust pustules. Triazoles, however, are not broad spectrum enough to prevent losses from other late-season diseases.

Strobilurins are **NOT** curative. Strobilurins offer good residual prevention of SBR if applied before rust is detected as a PREVENTIVE measure. They also offer broad-spectrum prevention of many other diseases. Yield responses averaging 5.9 bushels per acre have been documented in Mississippi with strobilurin-based fungicides. They are applied to prevent losses from late-season diseases other than SBR and are most effective when applied from the R3 through R4 growth stages (see **Table 4** for a description of these growth stages).

We strongly encourage strobilurin-based fungicide sprays at the R3/R4 growth stages to high-yield-potential (generally, irrigated) soybeans in the absence of SBR. It is critical that producers initiate spray programs when SBR is detected in the region, if warranted. Significant yield losses are likely to occur if SBR develops before a fungicide is applied. **Tables 2** and **3** help determine critical intervals of soybean development under several different production situations and will help match the length of product residual with the various soybean growth stages. **Table 4** specifically describes each growth stage. Remember, if SBR is present, residual control from fungicides likely will be necessary through the R6 growth stage to prevent yield losses.

Canopy coverage is essential for good disease prevention. As a general rule of thumb, apply fungicides at no less than 5 gallons per acre (GPA) by air and 15 GPA by ground. Refer to specific product labels for guidelines. Adjuvants may improve plant coverage and disease prevention. However, specific labels may differ on adjuvant selection or use. Droplet sizes of 285 to 335 microns are best for most fungicide applications. Refer to the nozzle manufacturer's specifications and set up sprayers to obtain this droplet size. Good disease prevention can be achieved only through good plant coverage and canopy penetration by the optimum GPA, pressure, and droplet size.

Using Control Option Sheets

Find the option sheet below that best fits the specific situation. Choose the option (1 or 2) that best suits the management strategy based on presence of rust and the soybean growth stage. Selection A should be considered the best selection. If selection A is unavailable, move down to the next choice. If that choice is unavailable, move to the next choice, and so forth. When a product has been selected for the first application, move to the right for the second and third (**ONLY** if necessary) application choices. Use this same elimination method to select the appropriate fungicide type for second and third applications.

Option Sheet 1. Rust NOT detected in field, vicinity, or sentinel plots. Soybeans have NOT reached R3 growth stage.

OPTION 1: Do nothing.

OPTION 2: Use this preventive spray program:

First Application	Second Application	Third Application
At flowering, R1 to R2 growth stage. Some triazoles provide good residual activity and are likely more economical than strobilurins at early growth stages. Yield responses to strobilurins and triazoles applied before R3 have been limited where rust is absent. Indeterminate soybeans will have significant vegetative growth remaining at this stage. Determinates will have already produced most of their vegetative growth, so strobilurins may be better on determinates at this growth stage (not documented).	14 to 21 days later. Refer to specific product labels for suggested spray interval. Should coincide with R3 to R4 growth stages. Strobilurin-based programs used at this timing increase the likelihood of yield increases from prevention of diseases other than rust. Triazoles control rust but are generally less effective on other diseases.	Only if rust persists and pod fill is not complete (pre-R6). Refer to specific product labels for suggested spray interval. Late applications may improve seed quality and protect against weathering events; however, results from studies on this practice have been sporadic. Confirm preharvest intervals.
A. Triazole: Can be used before or after initial infection and signs of disease.	A. Strobilurin: **ONLY** if rust still has NOT been detected.	A. Triazole B. Strobilurin–triazole mixture
	B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole B. Strobilurin–triazole mixture

	C. Triazole: Can be used before or after initial infection and signs of disease. However, these are best used prior to symptom expression.	A. Triazole: Use different triazole than used in previous two sprays. B. Strobilurin–triazole mixture C. Strobilurin: **ONLY** if rust still has NOT been detected.
B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Strobilurin: **ONLY** if rust still has NOT been detected.	A. Triazole
	B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole
	C. Triazole: Can be used before or after initial infection and signs of disease. However, these are best used prior to symptom expression.	A. Triazole B. Strobilurin–triazole mixture C. Strobilurin: **ONLY** if rust still has NOT been detected.
C. Strobilurin: Must be used BEFORE the onset of disease.	A. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease	A. Triazole
	B. Triazole: If rust has been detected.	A. Triazole B. Strobilurin–triazole mixture

D. Chlorothalonil: Will provide only short-lived leaf surface protection. The interval between this application and the second application may be shorter than with other products because of limited residual. Refer to label.	A. Strobilurin: **ONLY** if rust still has NOT been detected.	A. Triazole B. Strobilurin–triazole mixture
	B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole B. Strobilurin–triazole mixture C. Strobilurin: **ONLY** if rust still has NOT been detected.
	C. Triazole: Can be used before or after initial infection and signs of disease. However, these are best used prior to symptom expression.	A. Triazole B. Strobilurin–triazole mixture C. Strobilurin: **ONLY** if rust still has NOT been detected. D. Chlorothalonil
	D. Chlorothalonil	

Option Sheet 2. Rust NOT detected in field, vicinity, or sentinel plots. Soybeans have reached R3.

OPTION 1: Do nothing.

OPTION 2: Use this preventive spray program:

First Application	Second Application	Third Application
Apply at beginning pod (R3 to R4 growth stage). Strobilurin-based programs used at this growth stage will protect against rust and likely increase yields by preventing other diseases; however, results from studies on this practice have been sporadic. Triazoles control rust but are generally less effective on other diseases.	14 to 21 days later. Refer to specific product labels for suggested spray interval. Seed fill (R5 to R6 growth stage) should be underway. Some triazoles may provide enough residual protection to make it through pod fill at a fairly economical cost. Strobilurins used where there is no rust at this growth stage provide good protection, may still improve yields, and may improve seed quality; however, results have been sporadic. Note that strobilurins will likely be more expensive.	This application will likely NOT be needed. The second application should provide enough residual to complete pod fill, but the duration of residual varies by product. Under high yield situations and heavy rust pressure, this application may be warranted. Refer to label for suggested spray intervals. Strobilurin fungicides applied at this growth stage may enhance seed quality; however, results have been sporadic. Confirm preharvest intervals.
A. Strobilurin: Must be used BEFORE the onset of soybean rust.	A. Triazole: Can be used before or after initial infection and signs of disease. However, these are best used prior to symptom expression.	A. Triazole B. Strobilurin–triazole mixture
	B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole
	C. Strobilurin: **ONLY** if rust still has NOT been detected.	A. Triazole

B. Strobilurin–triazole mixture: Can be used before initial infection and signs of disease.	A. Triazole: Can be used before or after initial infection and signs of disease. However, these are best used prior to symptom expression.	A. Triazole B. Strobilurin–triazole mixture C. Strobilurin: **ONLY** if rust still has NOT been detected.
	B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole
	C. Strobilurin: **ONLY** if rust still has NOT been detected.	A. Triazole
C. Triazole: Can be used before or after initial infection and signs of disease.	A. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole B. Strobilurin–triazole mixture C. Strobilurin: **ONLY** if rust still has NOT been detected.
	B. Strobilurin: **ONLY** if rust still has NOT been detected.	A. Triazole B. Strobilurin–triazole mixture

	C. Triazole: Can be used before or after initial infection and signs of disease. However, these are best used prior to symptom expression.	A. Triazole: Use different triazole than used in previous two sprays. B. Strobilurin–triazole mixture C. Strobilurin: **ONLY** if rust still has NOT been detected. D. Chlorothalonil
	D. Chlorothalonil	
D. Chlorothalonil: Will provide only short-lived leaf surface protection. The interval between this application and the second application may be shorter than with other products because of limited residual. Refer to label.	A. Strobilurin: **ONLY** if rust still has NOT been detected.	
	B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	
	C. Triazole: Can be used before or after initial infection and signs of disease. However, these are best used prior to symptom expression.	
	D. Chlorothalonil	

Option Sheet 3. RUST DETECTED in field, vicinity, or sentinel plots. Soybeans have NOT reached R3.

Use the curative/protective program below:

First Application	Second Application	Third Application
At flowering, R1 to R2 growth stage. Some triazoles provide good residual activity and are likely more economical than strobilurins at this growth stage. Yield responses to strobilurins and triazoles applied prior to R3 have been limited in the absence of rust; however, results from studies on this practice have been sporadic. Indeterminate soybeans will have significant vegetative growth remaining at this stage. Determinates will have already produced most of their vegetative growth. Therefore, strobilurins may be more beneficial on determinates at this growth stage. However, this has not been documented.	14 to 21 days later. Refer to specific product labels for suggested spray interval. Should coincide with R3 to R4 growth stages. Strobilurin-based programs used at this timing increase the likelihood of yield increases because they prevent diseases other than rust. Triazoles will control rust but generally are less effective on other diseases.	Only if rust persists and pod fill is not complete. Refer to specific product labels for suggested spray interval. Late applications may improve seed quality and protect against weathering events; however, results from studies on this practice have been sporadic.

A. Triazole: Can be used before or after initial infection and signs of disease.	A. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole B. Strobilurin–triazole mixture
	B. Triazole: Can be used before or after initial infection and signs of disease.	A. Triazole: Use different triazole than used in previous two sprays. B. Strobilurin–triazole mixture
B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole
	B. Triazole: Can be used before or after initial infection and signs of disease.	A. Triazole B. Strobilurin–triazole mixture

Option Sheet 4. RUST DETECTED in field, vicinity, or sentinel plots. Soybeans at R3 or later.

Use the curative/protective program as outlined below. Less than 10 percent disease incidence in lower canopy. If disease is in the mid-canopy or is greater than 10 percent incidence, yield losses will occur, and you must make decisions to spray based on yield potential of the particular field.

First Application	Second Application	Third Application
Apply between beginning pod (R3) and full seed (R6) growth stages. A strobilurin-triazole mixture (pre-mix or tank mix) will provide both some curative and preventive benefits if the disease is detected.	14 to 20 days later. Refer to specific product labels for suggested spray interval. Seed fill (R5 to R6 growth stage) should be under way. Some triazoles may provide enough residual protection to complete pod fill at a fairly economical cost. Strobilurin-triazole mixes provide good curative protection, but will likely cost more.	This application likely will NOT be necessary. The second application should provide enough residual to complete pod fill, but the residual varies by product. Refer to label for suggested spray intervals. Fungicides applied at this growth stage likely will enhance seed quality; however, data regarding this specific objective has proven to be sporadic. Confirm preharvest intervals.
A. Strobilurin: Can be used before or after initial infection and signs of disease. However, if applied after the disease has been detected, the fungicide will only provide preventive benefits to those leaves that have NOT been previously infected by the fungus. Past experiences have determined the use of a strobilurin would likely maintain upper leaves on the plants and, depending on the growth stage, might		

benefit the plants and prevent further yield loss, but this will likely depend on the level of infection in the plant canopy as well as penetration of the fungicide if and when applied.		
B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole: Can be used before or after initial infection and signs of disease.	A. Triazole B. Strobilurin–triazole mixture
	B. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole
C. Triazole: Can be used before or after initial infection and signs of disease.	A. Strobilurin–triazole mixture: Can be used before or after initial infection and signs of disease.	A. Triazole B. Strobilurin–triazole mixture
	B. Triazole: Can be used before or after initial infection and signs of disease.	A. Triazole: Use different triazole than used in previous two sprays. B. Strobilurin–triazole mixture

Table 1. Fungicides approved or pending approval in Mississippi for soybean rust prevention in 2010.

Please note there are some products that are registered but no longer being marketed for soybean rust prevention that are not included on this list. In addition, this list does not include products considered to be "biofungicides" because only limited data is available on their activity. All generics are likely not included on this list. Contact the Extension Service for the registration information pertaining to generics because there are some that are not currently labeled for use in Mississippi, even though they have a federal label.

Trade Name	Active Ingredient	Type of Label	Rate Range	PHI	Chemical Group
Preventive					
Headline	Pyraclostrobin	Section 3 (Full)	6–12 fl oz/a	21 days	Strobilurin
Quadris	Azoxystrobin	Section 3 (Full)	6–15.5 fl oz/a	14 days	Strobilurin
Evito 480 SC	Fluoxastrobin	Section 3 (Full)	2 - 5.7 fl oz/a	No later than R5	Strobilurin
Curative/Penetrant					
Alto 100 SL	Cyproconazole	Section 3 (Full)	2.75 - 5.5 fl oz/a	30 days	Triazole
Bumper 41.8 EC	Propiconazole	Section 3 (Full)	4–6 fl oz/a	No later than R6	Triazole

Domark 230 ME	Tetraconazole	Section 3 (Full)	4–5 fl oz/a	Apply before R6	Triazole
ᵛFolicur	Tebuconazole	Section 3 (Full)	3–4 fl oz/a	21 days	Triazole
ᵛOrius 3.6F	Tebuconazole	Section 3 (Full)	3–4 fl oz/a	30 days	Triazole
ˢProline	Prothioconazole	Section 3 (Full)	2.5–3 fl oz/a	21 days	Triazole
Punch	Flusilazole	Section 3 (Full)	3–4 fl oz/a	30 days	Triazole
TebuStar 3.6L	Tebuconazole	Section 3 (Full)	3–4 fl oz/a	21 days	Triazole
Tilt	Propiconazole	Section 3 (Full)	4–6 fl oz/a	Apply up to R6	Triazole
Topguard	Flutriafol	Section 18 (Emergency)	7 fl oz/a	21 days	Triazole
Curative/Preventive					
Quadris Xtra	Cyproconazole + Azoxystrobin	Section 3 (Full)	4–6.8 fl oz/a	30 days	Triazole + Strobilurin
Stratego	Propiconazole + Trifloxystrobin	Section 3 (Full)	7–10 fl oz/a	21 days	Triazole + Strobilurin

Quilt	Propiconazole + Azoxystrobin	Section 3 (Full)	14–20.5 fl oz/a	21 days	Triazole + Strobilurin
Quilt Xcel	Propiconazole + Azoxystrobin	Section 3 (Full)	14–21 fl oz/a	Apply up to R6	Triazole + Strobilurin
Avaris	Propiconazole + Azoxystrobin	Section 3 (Full)	14–20.5 fl oz/a	21 days	Triazole + Strobilurin
Preventive/Topical					
*Bravo Weather Stik	Chlorothalonil	Section 3 (Full)	1–2 pt/a (3 app.) 1.5–2.25 pt/a (2 app.)	42 days	Chloronitrile
*Echo 720	Chlorothalonil	Section 3 (Full)	1–2 pt/a (3 app.) 1.5–2.5 pt/a (2 app.)	42 days	Chloronitrile
*Echo 90DF	Chlorothalonil	Section 3 (Full)	0.875–1.625 lb/a (3 app.) 1.25–2 lb/a (2 app.)	42 days	Chloronitrile
*Equus 500 Zn	Chlorothalonil	Section 3 (Full)	1.5–2.75 pt/a (3 app.) 2.25–3.25 pt/a (2 app.)	42 days	Chloronitrile

*Equus 720 SST	Chlorothalonil	Section 3 (Full)	1.0–2.0 pt/a (3 app.) 1.5–2.5 pt/a (2 app.)	42 days	Chloronitrile
*Equus DF	Chlorothalonil	Section 3 (Full)	0.9 - 1.4 lb/a (3 app.) 0.9 - 1.4 lb/a (2 app.)	42 days	Chloronitrile
*Echo Zn	Chlorothalonil	Section 3 (Full)	1.5–2.75 pints/a (3 app.) 2–3.5 pints/a (2 app.)	42 days	Chloronitrile

[x]Bayer is promoting this product as a tank mix with Stratego at a 10 + 1 fl oz/a rate.

[y]DuPont has withdrawn this product from consideration for a full Section 3 registration. However, remaining product can be used until June 15, 2010, when the section 18 registration expires.

[z]The Section 18 registration on this product will expire May 11, 2010. The Section 3 registration for a federal label has occurred. However, the Mississippi label will likely not be available until some point in the summer.

*Chlorothalonil has only limited activity against rust, but only as a topical protectant. Probably should be used in rotation with more effective products.

Table 2. Estimated intervals (in days) from planting date to R1, R1 to R3, R3 to R6, and R1 to R6 for various maturity group soybeans with selected planting dates from Stoneville, Mississippi[1].

		interval			
Relative Maturity	Planting Date	PD–R1	R1–R3	R3–R6	R1–R6
		days			
3.9	3/15	48	14	37	51
	4/15	38	17	39	56
	5/15	34	18	38	56
	Avg.	**40**	**16**	**38**	**54**
4.4	3/15	53	15	41	56
	4/15	42	19	41	60
	5/15	37	20	39	59
	Avg.	**44**	**18**	**40**	**58**
4.9	3/15	58	17	43	60
	4/15	47	20	43	63
	5/15	41	20	41	61
	Avg.	**49**	**19**	**42**	**61**

5.4	3/15	64	17	45	62
	4/15	53	19	45	64
	5/15	46	20	42	62
	Avg.	**54**	**19**	**44**	**63**
5.9	4/15	58	22	50	72
	5/15	52	22	43	65
	Avg.	**54**	**22**	**47**	**69**

[1]Data adapted from Zhang et al. (2004) Crop Management.

Table 3. Intervals (in days) between successive reproductive growth stages by maturity group (MG) and planting date (PD) under field conditions at Stoneville, Mississippi.[1]

MG	PD	PD–R1	R1–R2	R2–R3	R3–R4	R4–R5	R5–R6	R6–R7	R7–R8	R1–R8	PD–R8
	month/day	days									
3.9	3/15	48	3	11	7	7	23	19	13	83	131
3.9	4/15	38	3	14	8	7	24	18	13	87	125
3.9	5/15	34	4	14	9	7	22	16	12	84	118
3.9	6/14	33	4	14	8	7	19	14	9	75	108
3.9	7/04	33	4	13	7	6	17	12	7	66	99
4.4	3/15	53	3	12	8	8	25	20	12	87	140
4.4	4/15	42	4	15	8	8	25	18	13	91	133
4.4	5/15	37	5	15	8	8	23	17	11	87	124
4.4	6/14	36	4	14	8	8	20	14	9	76	112
4.4	7/04	35	4	13	7	7	18	12	7	67	102
4.9	3/15	58	4	13	9	8	26	21	14	95	153
4.9	4/15	47	4	16	9	8	26	19	13	95	142
4.9	5/15	41	5	15	9	8	24	17	11	89	130
4.9	6/14	38	5	14	9	7	20	14	10	79	117
4.9	7/04	37	4	13	7	7	18	12	8	69	106

5.4	3/15	64	4	15	9	10	26	22	14	100	164
5.4	4/15	53	4	16	10	9	26	20	13	98	151
5.4	5/15	46	4	16	10	8	24	18	13	93	139
5.4	6/14	41	5	15	8	8	21	14	9	80	121
5.4	7/4	39	4	14	7	7	18	13	8	71	110
5.9	4/15	58	5	17	11	9	27	20	13	102	160
5.9	5/15	50	5	17	10	8	25	18	11	94	144
5.9	6/14	44	5	16	8	8	22	14	10	83	127
5.9	6/29	42	4	15	8	7	20	13	8	75	117

[1]Data adapted from Zhang et al. (2004) Crop Management.

Table 4. Vegetative and reproductive stages of a soybean plant.[1]

Growth Stage	Description
VE	Emergence
VC	Cotyledon
V1	First node
V2	Second node
V3	Third node
V(n)	Etc.
R1	Beginning bloom: One open flower at any node on the main stem.
R2	Full bloom: Open flower at one of the two uppermost nodes on the main stem with a fully developed leaf.
R3	Beginning pod: 3/16-inch pod at one of the four uppermost nodes on the main stem with a fully developed leaf.
R4	Full pod: 3/4-inch pod at one of the four uppermost nodes on the main stem with a fully developed leaf.
R5	Beginning seed: 1/8-inch-long seed in the pod at one of the four uppermost nodes on the main stem with a fully developed leaf.
R6	Full seed: Pod contains a green seed that fills the pod cavity at one of the four uppermost nodes on the main stem with a fully developed leaf.
R7	Beginning maturity: One normal pod on the main stem that has reached mature pod color, normally brown or tan, depending on variety.
R8	Full maturity: 95 percent of the pods have reached their mature pod color. Five to 10 days of drying weather are generally required after R8 before the soybeans have less than 15 percent moisture. This can occur more rapidly in early-planted soybeans in the mid-South under very hot conditions.

Description adapted from How a Soybean Plant Develops, Special Report No. 53., Iowa State University Cooperative Extension Service. Ames, Iowa. June 1997.

NOTES

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The information given here is for educational purposes only. References to commercial products, trade names, or suppliers are made with the understanding that no endorsement is implied and that no discrimination against other products or suppliers is intended.

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