VIRGINIA SOYBEAN BOARD - RESEARCH PROPOSAL

Title: Pre-mixes of fungicides and grower-advisory models for improved profitability of sprays on soybeans

Date: 01/30/2013

Co-Principal Investigators: Pat Phipps, Steve Rideout, and David Holshouser

Starting Date: 1 July 2013 **Duration:** 12 months

Objectives:

1. To compare new pre-mixes of fungicides and weather-based advisory models for more efficient timing of fungicide application(s) in control of foliar diseases.

2. To monitor soybean sentinel plots, commercial fields for early detection of soybean rust (SBR), and foliar diseases in sentinel plots

3. To assess the risk for yield loss due to premature defoliation caused by Corynespora leaf spot (target spot) of soybean in Virginia.

Justification/Practical Importance:

Soybean in 2012 was harvested on 580,000 acres in Virginia and yields are expected to average 42 bu/A. Cash receipts are projected to reach 353.2 million dollars based on an average value of $14.50/bu. High yields at the Tidewater AREC were attributed to minimal drought stress during seed development (growth stages R_3 to R_6). Rainfall from May 1 thru October 30 totaled 34.89 in. which was 7.23 in. above normal. Average minimum temperatures were 3 °F above normal in May, July, and October, 2 °F above normal August, 4 °F below normal in June, and 3 °F below normal in September. Average maximum air temperatures were near normal (±1 °F) in June, August and September, 5 °F above normal in July, 4 °F above normal in May, and 3 °F degrees above normal in October. Normal represented an average of the previous 79 years of records at the Tidewater AREC.

Above-normal air temperatures and extended periods of drought stress in Gulf Coast States suppressed and delayed development of soybean rust (SBR) and its spread into Mid-Atlantic States. SBR was first detected on October 12 in sentinel plots at the Tidewater AREC in 2012. By the end of October, only low levels of SBR were confirmed in eight counties of Virginia (Suffolk, Chesapeake, Isle of Wight, Southampton, Sussex, Dinwiddie, Prince George and Accomack). No losses of yield to SBR were expected since the disease was not present prior to the full-seed stage of development (R_6). Excesses of moisture in Mid-Atlantic States during the growing season favored development of common foliar diseases such as Cercospora blight, brown spot, pod/stem blight, and anthracnose in 2012. Corynespora leaf spot, commonly called target spot, was found for the first time in Virginia causing defoliation in the lower and mid canopy of soybean and cotton in August and into mid October (R_6).

Common leaf spot diseases and soybean rust are caused by fungi that cause infection and disease at temperatures between 59 and 84° F in periods with excess moisture provided by rainfall, dew or high relative humidity ≥95%. Hourly records of air temperature, relative humidity, and rainfall from 2006 through 2011 at the Tidewater AREC have provided an opportunity to develop disease advisory models for application of foliar fungicides. Determinations of when to apply a fungicide spray were based on weather factors (air temp, hours of humidity ≥95%), disease scouting, and crop growth stage (R1=flowering, R3=beginning pod, R4=full pod, R5=beginning seed, and R6=full seed). Critical periods of favorable weather conditions for disease were when daily air temperatures averaged ≥65 and ≤78° F and periods of relative humidity ≥95% were ≥10 hrs/day when soybean plants were in growth stage R_3 and up to R_6. When favorable conditions for disease occurred on two or more consecutive days, a fungicide spray was applied. Using these parameters, numbers of favorable days for infection were determined from 2006 through 2012 (Table 1). SBR was first found in the southern U.S. in 2005 but not in Virginia until 2006. During the period from R_3 to R_6, the number of favorable days for infection by SBR and common foliar diseases were high in 2006, 2007, 2009, 2011 and 2012. The absence of SBR in 2010 and 2011 was a result of hot, dry weather in Gulf Coast States which suppressed disease development and low inoculum levels for spread to Mid-Atlantic States. This data represents a valuable step in recognition of high risk factors for disease spread and forecasting when fungicide sprays are likely to be needed for control of SBR and other common foliar diseases (i.e. Cercospora blight, target spot, etc.).

Table 1. Number of days favorable for infection of leaves by common foliar disease and soybean rust (SBR) at the Tidewater AREC.*

Year	Month					Favorable days (R_3-R_6)	Favorable days (Aug-Oct)	Counties w/SBR** (1^{st} found)
	Jun	Jul	Aug	Sep	Oct			
2006	17	13	19	22	6	18	47	18 (Oct 9)
2007	7	12	12	19	13	16	44	9 (Oct 19)
2008	0	1	1	3	0	2	4	10 (Oct 1)
2009	7	4	10	17	4	16	31	15 (Sep 18)
2010	0	0	4	5	3	2	12	0
2011	2	2	7	17	3	11	27	0
2012	1	3	14	8	4	15	26	8 (Oct 12)

* Favorable days had average temperatures between 65 and 78° F and relative humidity ≥95% for 10 hrs or longer.
** Number of counties in Virginia with confirmed outbreaks of SBR and the first date of initial infection.

The highest numbers of favorable days for infection occurred in August and September of 2006, 2007, 2009 and 2012 when soybeans were in beginning pod (R_3) to full seed (R_6) stages. Numbers of favorable days were lowest in 2008 and 2010 when maximum temperatures averaged 4 to 6° F above normal, and total rainfall was below normal. Common foliar diseases of soybean showed low incidence in 2008 and 2010, whereas 2006, 2007 and 2009 were years of high disease incidence.

Fungicide trials from 2006 to 2012 were evaluated for control of common diseases and soybean rust. The yield response to a single application of a pre-mix fungicide averaged 2.2 bu/A in 27 field trials (Fig. 1). More important, yields were increased an average of 5.4 bu/A in 7 trials by application of pre-mix fungicides in fields with significant disease and these increases ranged from 2.9 to 9.4 bu/A. These results indicated that the crop response and profitability of treatments depended upon the disease pressure in each field, seasonal weather conditions, yield potential of each field and the market value of soybeans.

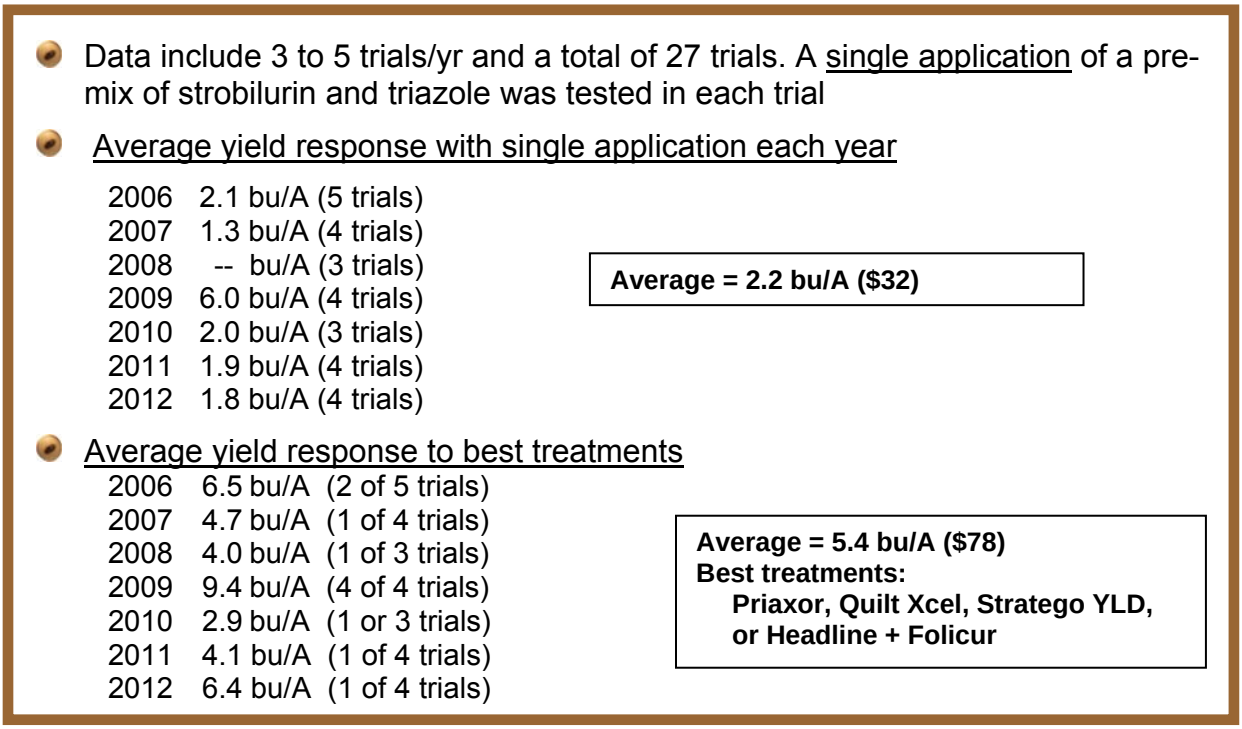

Fig. 1. Summary of yield response in fungicide trials, 2006-2012.

To effectively manage SBR and common foliar diseases of soybean in Virginia, it is necessary to underscore the importance of scouting, early disease detection, critical timing of fungicide application, and weather conditions that trigger infection and disease development. Fortunately, previous research since 2006 has identified diseases most likely to reduce yield, weather-related parameters that create a high risk for disease, and the most effective fungicides for disease control. Because foliar diseases are highly dependent upon favorable weather conditions for infection, the timing of fungicide sprays needs to coincide with conditions that favor infection, disease development, and spread. Our goal in this research is to make the most efficient use of fungicides for improving disease control and increasing profit. It is also important to know that the growth stages from beginning pod (R_3) up to full seed (R_6) are when soybeans are most likely to sustain yield losses to foliar disease. This period generally occurs over a three to four week period from mid-August to mid-September in full-season plantings and from early September to early October in double-crop plantings.

Other goals in this project are to utilize existing clinical services, field scouting and sentinel plots for early detection and crop damage by SBR, common foliar diseases, and Corynespora target spot of soybean. Additional questions that need to be addressed in 2013 include the following: Will target spot become a common disease in Virginia, or only problematic in certain weather conditions, varieties, or regions? In addition to monitoring SBR sentinel plots and commercial fields for this disease, new pre-mixes of fungicides will be evaluated for control of target spot, SBR, and common foliar diseases of soybean in the region.

Procedures:

Sentinel plots for detection of SBR, Corynespora target spot and common diseases: Tracking SBR from Gulf Coast States northwards to Virginia will be monitored weekly using the national SBR site (http://www.sbrusa.net/) in 2013. Like other states, Virginia commentaries on our findings will be posted on the website. Sentinel plots will be located in Suffolk (Tidewater AREC), Painter (Eastern Shore AREC), and commercial fields in Virginia.

Diagnostic tests will be conducted on leaf samples from sentinel plots and commercial fields during the growing season for early detection of SBR and common diseases. Leaflet samples will be evaluated from flowering (R_1) to maturity (R_8) and processed weekly for detection of disease. Observations and tests of leaflets will be performed in diagnostic laboratories at the Tidewater AREC in Suffolk and the Eastern Shore AREC. A goal of this effort is to provide growers with early warnings of disease, and recommendations on the need for a fungicide spray.

Soybean fungicide advisories: Weather-based advisory models will be used daily for detection of periods when air temperatures and relative humidity are favorable for infection, disease development and spread. Whenever favorable conditions for disease occur on two consecutive days from R_3 (beginning pod) to R_6 (full seed), the first spray of fungicide will be applied. A protection period of 21 days after a fungicide application will be observed before making a second application to compare benefits of one spray versus two sprays. The second application will be needed only when two consecutive days are favorable for disease and soybeans have not reach the R_6 growth stage. Reference standards in field trials will include an untreated check and plots treated with a single spray at R_3.

Fungicides: Evaluations of pre-mix fungicides on full-season and double-cropped soybeans will be in field trials at the Tidewater AREC in Suffolk and the Eastern Shore AREC at Painter. Trials will include registered pre-mix fungicides. The application timing standard will be treatment at growth stage R_3 and at growth stage R_3 and R_5. Timings in additional plots may be earlier or later depending upon disease tracking, weather-based advisories, growth stage of soybeans, and incidence of common diseases (i.e. Cercospora blight, anthracnose, frogeye leaf spot, Phomopsis blight), Corynespora leaf spot and SBR. Treatments will be replicated four or five times in a randomized block design. Plots will be 12-ft wide by 30-ft long and replications will be separated by 8-ft alleyways. Row spacing will be according to standard planting practices at each location. Fungicide sprays will be applied by a Spider Sprayer with a 12-ft spray boom or a CO_2-backpack sprayer with a 6-ft spray boom. Applications will be made using nozzles spaced 18 in. apart and calibrated to deliver a volume of 16 to 20 gal/A.

Pre-mix fungicide treatments:

1. Non-treated check
2. Quilt Excel 2.2SC (azoxystrobin + propiconazole) 10.5 fl oz/A
3. Stratego YLD 500SC (trifloxystrobin + prothioconazole) 4 fl oz/A
4. Priaxor 4.17SC (pyraclostrobin + fluxapyroxad) 4 fl oz/A

Optional treatments:
1. Headline 2.09SC 6 fl oz/A
2. Quadris 2.08SC 6 fl oz/A

Data collection: Records of air temperature, relative humidity (≥95% = leaf wetness), rainfall, disease-tracking, and spore movement will be monitored during the growing season. Hourly records of weather data at Suffolk, Skippers, Capron, and Waverly will be collected by Spectrum Technologies, WatchDog Weather Stations. Campbell Instruments weather monitors will collect data at the Eastern Shore AREC.

Disease will be monitored on foliage in the lower and upper canopy of plants in each plot and recorded at 2- to 4-week intervals. Additional sampling of commercial fields may be needed as dictated by SBR tracking and spore movement for early detection of the disease. Every effort will be made to maintain accurate weather data, to precisely time fungicide applications according to disease risk, to monitor plant growth stages, to detect disease problems in early stages of development, and to apply fungicides according to protocols.

Plots will be harvested with a plot combine and yields recorded in bu/A at 13.5 % moisture. Treatment comparisons and the determination of significant differences in treatments will be made by analysis of variance and Fisher's least significant difference test at 95% confidence level. When necessary, orthogonal contrasts will be used to compare treatments for significant differences. Data for determining the impact of treatments will include % of leaf area with disease, % defoliation, the weight of 100 seed and incidence of Phomopsis, purple seed stain, and anthracnose on seed. The profitability of fungicide treatments will be based on the market value of soybeans, yield, and cost of fungicide application. Additional factors for grower consideration will include estimates of added expenses for contract scouting of fields and custom application of fungicides.

Personnel and Finances:

The work outlined in this project will be performed in Virginia, and results will be shared with colleagues in the mid-Atlantic Region and reported at local, state and national meetings. Results of the trials will be reported on the Virginia Tech Extension Resources web page for access by extension agents, growers and other interested parties. Personnel assigned to this project will use equipment at the Eastern Shore AREC at Painter and Tidewater AREC in Suffolk. Funds requested for this project will support 100% of costs for conducting and reporting the results of this research.

Budget (1 Jul 2013 to 30 Jun 2014):

Tidewater AREC (Pat Phipps; David Holshouser)

Research Specialist (1500 hr employee)	$6,095
Fringe Benefits (Classified)	1,905
Materials and Supplies	900
Total	$8,900

Eastern Shore AREC (Steven Rideout)

Hourly Wage Part-Time Employee	$5,661
Fringe benefits	439
Materials and Supplies	900
Total Direct Costs	$7,000

Grand Total $15,900

Note: The total cost of carrying the project in this proposal through completion is $15,900 and 100% of the budget will be funded by the soybean checkoff.

Submitted By: Signature: P. M. Phipps Digitally signed by P. M. Phipps DN: cn=P. M. Phipps, o=Virginia Tech, ou=Tidewater AREC, email=pmphipps@vt.edu, c=US Date: 2013.01.30 09:35:52 -05'00'

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