Predictive Systems for Scheduling Foliar Fungicides on Soybeans

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Disease losses are a major limiting factor in soybean production, particularly in the southern United States. Disease loss estimates published by the Southern Soybean Disease Workers and its 15 member states reported average annual losses of 134,843,250 bu of soybeans valued at $1,230,355,000 during the last 5 years. This loss represents an average annual loss in production of 17.7%. Four diseases have been responsible for 43.5% of the average annual loss and 36.3% of the dollar loss ($371,788,937): anthracnose (*Colletotrichum dematium* (Pers. ex Fr.) Grove var. *truncatum* (Schw.) and *Glomerella glycines* (Hori) Lehman & Wolf), pod and stem blight (*Diaporthe phaseolorum* (Cke. & Ell.) var. *sojae* Wehm.), Cercospora purple seed stain (*Cercospora kikuchii* (T. Matsu. & Tomoyasu) Gardner), and brown spot (*Septoria glycines*, Hemmi).

Seed treatments, resistant varieties, and crop rotation—traditional methods for controlling these soybean diseases—have met with limited success. Fungicidal seed treatments will eliminate most pathogens from soybean seed and thus prevent the spread of seedborne inoculum but will not ensure protection against pathogens that reside in the field. Selection of soybean cultivars genetically resistant to these diseases offers one of the best means of crop protection, but, unfortunately, few cultivars have resistance to foliar diseases. Rotating crops for 2 years or more will control many of these diseases, but long rotations are no longer economically feasible for most growers. Foliar fungicides and predictive systems for their use offer a new dimension in soybean disease control.

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Key to foliar fungicide use

The significance of foliar fungicides was demonstrated in Texas in 1974 when yield responses were obtained from their use. Foliar fungicides have since provided 1) plant pathologists with a method of obtaining information on the significance of certain foliar and stem diseases to soybean production and 2) producers with a method of preventing these diseases.

Foliar fungicides have been shown to reduce potential losses where disease pressure has been severe. Where disease pressure has been light, however, the return of investment from fungicide use has not been realized. The key, then, is to determine when disease pressure is likely to be severe and fungicide application beneficial.

Much effort and research have gone into the development of point, or predictive, systems to assist soybean growers in determining fungicide need. Predictive systems have been successfully developed for a wide array of diverse crops, including apples, potatoes, and peanuts, but interest in developing such systems for fungicide applications to soybeans is relatively new.

Responses to questionnaire

The land-grant university in each of 27 soybean-growing states and five companies with fungicides registered for use on soybean foliage were asked for their views on foliar fungicide use and predictive systems. All but one questionnaire was returned. In some cases, one person completed the questionnaire; in other cases, several colleagues collectively completed the questionnaire. Estimates

Table 1. Use of point (predictive) systems for scheduling foliar fungicide applications on soybeans

State	Fungicide recommendation[a]	Point (predictive) system[b]	Estimates of acreage (%)	
			Needing fungicides	Treated
Alabama	Yes	Yes (1978)[c]	20	2
Arkansas	Yes	Yes (1978)	30–50	8–10
Delaware	Yes(S)[d]	No	5	2
Florida	Yes	No	?	?
Georgia	No	No	<1	1
Illinois	Yes	Yes (1976)	75(S) 30	85–90(S) 5
Indiana	Yes(S)	No	?	5(S) <1
Iowa	Yes(S)	Yes (1983)	10(S)	30(S)
Kansas	No	No	<0.1	<0.1
Kentucky	Yes(S)	Yes (1980)	5(S)	1(S)
Louisiana	Yes	No	40	10
Maryland	Yes(S)	No	?	?
Michigan	No	No	0	0
Minnesota	No	No	3–5	?
Mississippi	Yes	Yes (1978)	30	12
Missouri	Yes	Yes (1976)	10	2
Nebraska	No	No	0	0
North Carolina	No	No	<1	2–3
Ohio	Yes(S)	No	<1	<0.2
Oklahoma	Yes	Yes (1980)	10–20	<10
South Carolina	Yes	Yes (1980)	20	10
South Dakota	No	No	?	?
Tennessee	Yes	No	40–50	5
Texas	Yes	No	30–45	20–40
Virginia	Yes(S)	No	0	1.6
Wisconsin	Yes	No	1	0.1
Companies	Yes = 4 No = 1	Yes = 3 No = 2	5–50	0.5–7.5

[a] Is foliar fungicide use on soybeans recommended in your state/company?
[b] Is a point (predictive) system used for scheduling fungicide applications?
[c] Year point (predictive) system introduced.
[d] (S) = soybeans grown for seed.

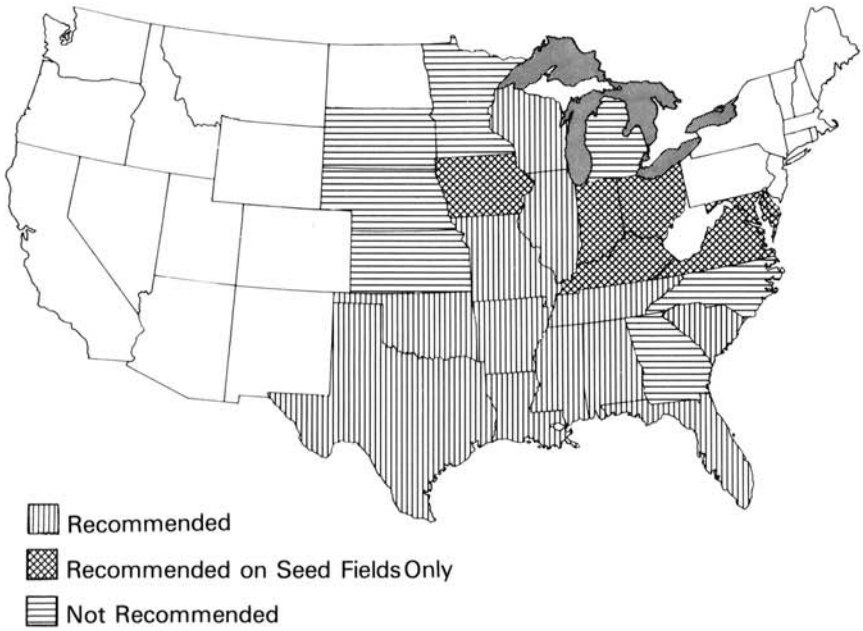

Fig. 1. State recommendations for use of foliar fungicide applications on soybeans.

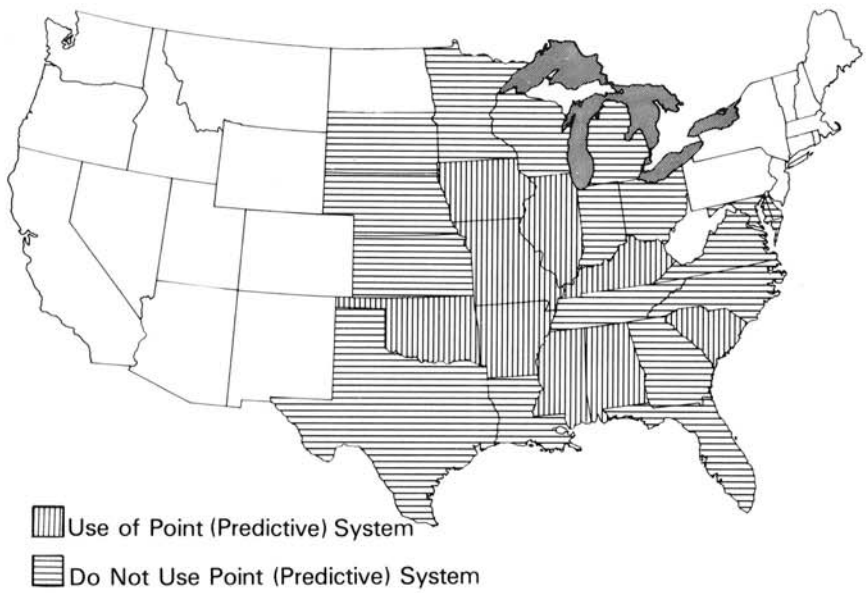

Fig. 2. Existence of state point (predictive) systems for scheduling of foliar fungicide use on soybeans.

were frequently the best information available, and although factual data are generally lacking, trends and comments are noteworthy.

Of the 26 states responding, 12 recommended using foliar fungicides on soybeans grown for grain, seven recommended their use primarily on soybeans grown for seed, and seven did not recommend the practice for grain or seed (Table 1). Interestingly, one of the five companies did not recommend use of its registered fungicide on soybeans. Only nine of the 26 states have a point (predictive) system developed and implemented. However, Texas, which does not have a point system, recommends that all soybean fields in certain areas (yield potential greater than 25 bu/acre) be treated, and several other states without a point system recommend fungicide use when moisture occurs at critical stages of plant growth.

The parameters of the predictive systems used by the states and companies included yield potential, rainfall, dew, humidity, cultivar, cropping history, planting date, disease presence, seed production, temperature, tillage, seed quality at planting time, irrigation, yield history, expected soybean maturity date, weed presence, disease potential, disease history, and field location. Moisture, cultivar, yield potential, and seed production were listed most frequently.

Estimates of the U.S. soybean acreage that would benefit economically from foliar fungicide use in an average year varied from 0 to 50%, depending on the state. When only seed beans were considered, estimates ranged as high as 75%. Actual fungicide use estimates ranged from 0 to 45% for commercial grain and as high as 90% for seed beans. Responses from 14 states indicated that fewer acres were treated than would benefit from fungicide use, and responses from five states indicated that more acreage was treated than was justified. All of the three companies responding to the question believed that less acreage was being treated than needed to be. The most frequent reasons given for the discrepancy were low soybean prices, failure to budget money for fungicides, difficulty in applying a preventive program to an unseen and unknown pest, and failure to consistently realize a good return on the investment. Other reasons were lack of grower awareness of disease loss, confusion among university disciplines on benefits, company competition, cost of fungicide treatment, weather uncertainty, lack of yield response, marketing efforts, failure to reliably predict need for fungicides and economic return, difficulty in marketing a preventive program, difficulty in application (small fields, surrounded by trees, etc.), absence of visual results, farmer-tenant relationships, skepticism, system used as insurance against a wet delayed harvest, lack of appreciation for economic advantages, newness of practice, fungicide promotion before research was done, and lack of lending agency awareness.

When asked if their point (predictive) system had been evaluated for reliability, six of nine states responded affirmatively and three negatively. Of the three company responses, two were affirmative and one was dependent on particular state evaluations. Tested systems were estimated to be 80–100% reliable. Responses to what would be the largest area in which a point system could be developed and still retain its usefulness were county = 1, state = 8, state or region = 5, region = 10, and nation = 0.

The common objective

With the exception of Georgia and North Carolina, states not recommending foliar fungicide use are in the northern and western regions of the soybean-growing area of the nation (Fig. 1). States recommending fungicides for seed beans only are, with the exception of Iowa, clustered in a band bound by the East Coast, Virginia, Kentucky, and Indiana. Predictive systems are most popular in the central region of the soybean-growing area, from the Gulf Coast to Iowa and Illinois (Fig. 2). South Carolina is an exception.

Much effort is being directed toward developing and refining point systems, but more is needed. Through continued efforts in research, extension, and industry, as exemplified in the Southern Soybean Disease Workers, advancements can be made toward the common objective: the ability to predict when fungicide use is economically beneficial to the soybean grower.