Evaluating a Wetness-Based Warning System and Reduced-Risk Fungicides to Control Summer Diseases of Apple in Illinois, 2005

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Introduction

Sooty blotch (*Peltaster fructicola*, *Leptodontium eliatus*, and *Geastrumia polystigmatis*), flyspeck (*Zygophiala jamaicensis*), black rot (*Botryosphaeria obtusa*), bitter rot (*Glomerella cingulata*), and white rot (*Botryosphaeria dothidea*) are common summer diseases of apples in Illinois. Other diseases that usually develop in spring and continue spreading in summer are scab (*Venturia inaequalis*), cedar-apple rust (*Gymnosporangium junieri-virginianae*), fire blight (*Erwinia amylovora*) and powdery mildew (*Podosphaeria leucotricha*). These diseases could cause yield losses of up to 100%. Sooty blotch and flyspeck, which occur together, are the most important summer diseases of apples in Illinois. The objectives of this study were: (i) to evaluate the success of a wetness-based disease-warning system and (ii) to determine the efficacy of reduced-risk fungicides for control of summer diseases of apple.

Materials and Methods

Trials were conducted in four apple orchards located at Belleville (St. Clair county), Dixon Springs (Pope county), Speer (Marshal county), and Urbana (Champaign county) (Table 1) to evaluate performance of a wetness-based disease-warning system for control of summer diseases. A Spectrum Technologies Wetness/Temperature sensor was placed at a 5 ft height and a 45-degree angle under the canopy of a representative tree within a selected block of trees at each orchard. All trees in the orchards were sprayed according to the standard spray schedule through the first cover spray. After the first cover spray, a 10-tree block of the same apple cultivar was set aside to receive the second cover spray after accumulation of 175 hours of wetness (IPM block). The data from the sensor were downloaded weekly, or more often, and used to determine the accumulated hours of wetness. When the number of hours was close to 175, the grower was asked to apply fungicides to the IPM block, as they would spray the rest of the orchard (Table 1).

Another trial was conducted at the University of Illinois Pomology Research Farm at Urbana to evaluate reduced-risk fungicides for control of apple diseases. The experimental design was a randomized complete block with four replications (2-tree block each) of six treatments. The treatments included were an untreated check; a conventional control (Topsin-M 70WSB at 6 oz/100 gal + captan 50WP at 1 lb/100 gal); Sovran (kresoxim-methyl), a reduced-risk fungicide,

at 1.6 oz/100 gal alternated with Topsin-M + captan; and Kaligreen (potassium bicarbonate), an organic fungicide, at 3 lb/100 gal. These chemicals were applied every two weeks from the second cover-spray (4 June) until 8 September (a total of 7 sprays). Additionally, we tested the disease-warning system with the input of on-site (Spectrum Technologies Leaf Wetness/Temperature logger) weather data. For these treatments, Topsin-M + captan was applied at first cover spray, but the second cover spray was not applied until the threshold of leaf wetness hours (LWH) had accumulated. Treatments included in the disease-warning system were: (1) application of Topsin-M + captan after 175 LWH according to the on-site sensor and (2) Sovran alternated with Topsin-M + captan after 175 LWH according to the on-site sensor. Following the second cover-spray, the trees were sprayed on a two-week schedule until 8 September, approximately two weeks before harvest. Sprays were applied to both sides of the tree rows with a hydraulic hand-gun tractor sprayer.

At the end of season, 60 apples from each tree were examined for the incidence (percentage of fruit infected) and severity (percentage of surface area of fruit with disease symptoms) of sooty blotch and flyspeck. In each tree, five apples from each of upper, middle, and lower canopies on each of the four sides (northern, eastern, southern, western) were examined. Also, occurrence of fruit rots (black rot, bitter rot, white rot), scab, rust, fire blight, and powdery mildew on fruit and foliage was determined. Incidence of fruit rot and scab was assessed as percent of fruit affected. Severity of rust, fire blight, and powdery mildew was assessed as percent leaf area or percent foliage affected.

Results and Discussion

The weather-based system predicted for the second cover spray later than the conventional two-week spray schedule. The disease prediction system saved the growers from 1 to (mean 3.25) - 14 to 71% (mean 46%) - sprays on a two-week spray schedule (Table 1). Overall, sooty blotch and flyspeck (SBFS) were the most widespread summer diseases in Illinois in 2005 (Table 2). The incidence and severity of other diseases were none to moderate (Table 3).

The disease warning system effectively prevented incidence of summer diseases in 3 of 4 orchards (Table 2). Occurrence of SBFS, fruit rot, rust, and fire blight in Dixon Spring was due to failure in on-time applications of fungicides in May and June. The diseases were present in both IPM block and the rest of the orchard that received conventional spray applications (Tables 2 and 3). There was no significant difference in disease incidence between IPM block and trees received conventional fungicide applications.

The tested IPM system appeared to be effective against summer diseases in Illinois and its implementation could lower the costs of production considerably, reduce pesticide risk to the environment and human health, and prevent or delay development of resistance to fungicides in the pathogens.

In the trial at the University of Illinois Pomology Research Farm at Urbana, only sooty blotch and flyspeck occurred in only the untreated plots (Table 4). The incidence and severity of sooty blotch and flyspeck were significantly higher in untreated plots than treated plots. Fruit rots,

scab, rust, fire blight, and powdery mildew were not observed in the plots. The reduced-risk fungicide, Sovran, and the organic fungicide, potassium bicarbonate (Kaligreen) provided control of summer diseases equal to the conventional control (Topsin-M plus captan) (Table 4).

Table 1. Location, apple cultivar, cover spray dates, and wetness hours for cooperating orchards in Illinois in 2005.

Location				2nd cover spray (calendar-based*)	2nd cover spray (warning system)		Sprays saved (number)
Town	County	Variety	1st cover spray		Date	Wetness hours	
Belleville	St. Clair	Golden Delicious	3-May	17-May	26-July	259	5
Dixon Spring	Pope	Golden Delicious	10-May	24-May	8-June	225	1
Speer	Marshal	Golden Delicious	17-May	30-May	22-July	179	4
Urbana	Champaign	Golden Delicious	20-May	4-June	21-July	175	3
		Mean				**209**	**3.25**

* Sprays applied on a two-week schedule (conventional spray applications).

Table 2. Incidence and severity of sooty blotch and flyspeck in conventional and IPM plots in cooperative orchards in Illinois in 2005.

	Sooty blotch						Flyspeck					
	Incidence (%)[v]			Severity (%)[w]			Incidence (%)[v]			Severity (%)[w]		
Location	Calend[x]	IPM[x]	*LSD*[y]	Calend	IPM	*LSD*	Calend	IPM	*LSD*	Calend	IPM	*LSD*
Belleville	0.0 a	0.0 a	*NS*	0.00 a	0.00 a	*NS*	0.0 a	0.0 a	*NS*	0.00 a	0.00 a	*NS*
Dixon Spring	83.3 a	85.3 a	*NS*	1.74 a	1.67 a	*NS*	78.5 a	78.7 a	*NS*	1.59 a	1.64 a	*NS*
Speer	0.0 a	0.0 a	*NS*	0.00 a	0.00 a	*NS*	0.0 a	0.0 a	*NS*	0.00 a	0.00 a	*NS*
Urbana	0.0 a	0.0 a	*NS*	0.00 a	0.00 a	*NS*	0.0 a	0.0 a	*NS*	0.00 a	0.00 a	*NS*
Mean	**20.8 a**	**21.3 a**	***NS***	**0.44 a**	**0.42 a**	***NS***	**19.6 a**	**19.7 a**	***NS***	**0.40 a**	**0.41 a**	***NS***

[v] Mean percent of 60 fruit per tree (10 trees per treatment) with signs of sooty blotch or flyspeck.
[w] Percentage of surface area of fruit affected.
[x] Calend = sprays applied on a two-week schedule (conventional); IPM = sprays applied after accumulation of 175 hour wetness after the first cover spray.
[y] Least significant difference at P<0.05.
[z] Values for the incidence and severity of each disease in each location followed by the same letter are not significantly different according to Fisher's protected LSD (*P*=0.05). NS = not significant.

Table 3. Occurrence diseases in apple orchards in summer in Illinois in 2005.

Location	Treatment[w]	Disease occurrence				
		Fruit rot (incidence)[x]	**Fruit scab (incidence)[x]**	**Leaf rust (severity)[y]**	**Shoot fire blight (severity)[y]**	**Foliage powdery mildew (severity)[y]**
Belleville	Calendar	0.0	0.0	0.0	0.0	0.0
	IPM	0.0	0.0	0.0	0.0	0.0
	LSD	***NS***	***NS***	***NS***	***NS***	***NS***
Dixon Spring	Calendar	5.0 a	0.0	13.0 a	11.5 a	0.0
	IPM	5.0 a	0.0	13.0 a	11.6 a	0.0
	LSD	***NS***	***NS***	***NS***	***NS***	***NS***
Speer	Calendar	0.0	0.0	1.0 a	0.0	5.0 a
	IPM	0.0	0.0	1.0 a	0.0	5.0 a
	LSD	***NS***	***NS***	***NS***	***NS***	***NS***
Urbana	Calendar	0.0	0.0	0.0	0.0	0.0
	IPM	0.0	0.0	0.0	0.0	0.0
	LSD	***NS***	***NS***	***NS***	***NS***	***NS***
Mean	Calendar	1.2 a	0.0	3.5 a	2.9 a	1.2 a
	IPM	1.2 a	0.0	3.5 a	2.9 a	1.2 a
	LSD	***NS***	***NS***	***NS***	***NS***	***NS***

[w] Calendar = sprays applied on a two-week schedule (conventional); IPM = sprays applied after accumulation of 175 hour wetness after the first cover-spray.

[x] Incidence = mean percent of 60 fruit per tree, 10 trees per orchard.

[y] Severity = percentage of tissues affected.

[z] Values for the incidence and severity of each disease in each location followed by the same letter are not significantly different according to Fisher's protected LSD (*P*=0.05). NS = not significant.

Table 4. Effect of reduced-risk fungicides and reduced-spray programs on the incidence and severity of sooty blotch and flyspeck of apple, 2005.

Treatment	Sooty blotch		Flyspeck	
	Incidence (%)[x]	**Severity (%)[y]**	**Incidence (%)[x]**	**Severity (%)[y]**
Topsin + captan (conventional) ……	0.0 b[z]	0.00 b	0.0 b	0.00 b
Sovran alternated with Topsin-M + captan ……...	0.0 b	0.00 b	0.0 b	0.00 b
Potassium bicarbonate (Kaligreen) ……...	0.0 b	0.00 b	0.0 b	0.00 b
On-site (175 LWH)-based Topsin-M + captan ……...	0.0 b	0.00 b	0.0 b	0.00 b
On-site (175 LWH)-based Sovran alternated with Topsin-M + captan …….….....	0.0 b	0.00 b	0.0 b	0.00 b
Untreated check ……	73.1 a	1.44 a	58.3 a	1.08 a
LSD (P<0.05)	***2.3***	***0.09***	***2.6***	***0.07***

[x] Mean number of 480 apples with SB or FS signs.

[y] Percentage of surface area of fruit affected.

[z] Values in each column followed by the same letter are not significantly different according to Fisher's protected LSD (*P*=0.05). NS = not significant.