

An Orchard System for Monitoring and Modeling Apple Scab, Disseminating Apple Scab Model Data Regionally, and Managing Orchard Fungicide Use

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In 2003, James O'Brien (Brooksby Orchard), Steve Ware (Bolton Orchard), Richard Bartlett (Bartlett Orchard), Tom Clark (Clarkdale Fruit Farm), Maurice and Phyllis Tougas (Tougas Family Farm), William Broderick (Sunnycrest Orchard), and I received an Agro-Environmental Technology grant from the Massachusetts Department of Agricultural Resources (DAR) to purchase and install Spectrum Technologies (23839 West Andrews Rd., Plainfield, Illinois) weather stations in their orchards. What follows is the narrative of the Final Report I submitted to DAR in December, 2003. The complete report is available on the UMass Fruit Advisor, www.umass.edu/fruitadvisor/clements/ and from the DAR Agro-Technology web site, www.state.ma.us/dfa/programs/agroenviro/.

A simple system for apple growers to monitor environmental weather data (temperature and leaf wetness particularly) to be used in models for predicting apple scab infection periods would make their fungicide applications more timely and accurate, thereby potentially reducing pesticide use, improving disease control, and saving money. Additionally, raw weather data and model output can now be shared regionally via the Internet to be used by neighboring growers. Such a system has recently become feasible with the availability of inexpensive electronic weather data monitors, personal-computer (PC)-based models, e-mail delivered weather data, and models by commercial services, and grower familiarity with PC's and the Internet.

Objectives

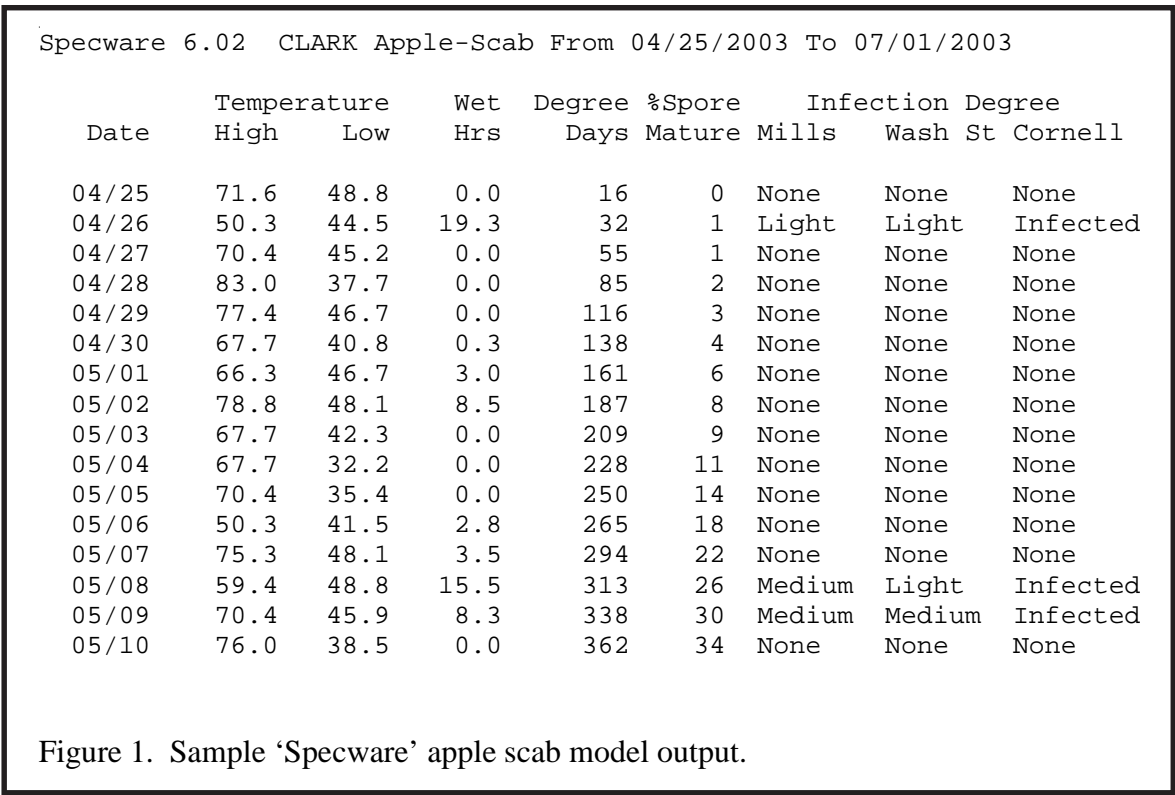
1. Establish a series of onsite weather stations that collect data, which can be used in models to predict

apple scab infection periods. Such models will help growers determine the need (or lack of) for fungicide sprays to control apple scab based on accurate environmental information previously unavailable to them.

2. Post weather and apple scab infection period information from these orchards on the Massachusetts Fruit Growers' Association web site (<http://www.massfruitgrowers.org>) for neighboring growers access and use in helping *them* make fungicide application decisions.
3. Compare weather data collected by onsite weather stations in trial orchards to SkyBit E-Weather information, particularly when used in models to predict apple scab infection periods. Survey trial growers to ascertain their preference, and be able to make recommendations to other growers based on their preference.

Procedures

In late April 2003, Spectrum Technologies weather stations (either 3610TWD 'Watchdog' Leaf Wetness/Temperature Logger or 3684PDSR 'Watchdog' Plant Disease Station) were installed in the cooperating grower orchards. Spectrum Technologies PC software (3656 SpecWare 6.0) for collecting and displaying weather data and analyzing apple scab infection periods (3656AS Apple Scab IPM) were installed on cooperating growers computers, and they were given coaching in its use. Growers were instructed to collect weather data, run the apple scab model, and post the results to the Massachusetts Fruit Growers' Association (MFGA) web site at weekly intervals via FTP (File Transfer Protocol) (Figure 1).



For the months of April, May, and June, 2003, SkyBit Inc. E-Weather Combo (Forecast & Summary) and IPM Apple Disease products were received by cooperating growers via daily e-mails (Figure 2). Growers were instructed in interpreting the SkyBit E-Weather information and comparing it to the weather data collected on-site. It was assumed and suggested that growers would use the environmental information from both sources to help determine the need for and the timing of orchard fungicide sprays for apple scab.

During the growing season, contact was maintained with grower cooperators to make sure the weather stations were functioning properly and accurately and that apple scab model data were being posted to the MFGA web site. In late September 2003, an on-line survey was developed for cooperating growers to give feedback on their experience with the weather equipment, SkyBit E-Weather, and using the information to make spray decisions.

In general, installation and use of the Spectrum Technologies weather data loggers/stations went smoothly. On occasion, growers had trouble downloading and saving data to their personal computers; in one instance data was lost and unrecoverable. In addition, growers found it easy to upload model data to the website; however, timeliness

and frequency of uploading could be improved.

As a rule, cooperating growers used the Spectrum weather stations to collect orchard weather data successfully, and then used the information in models to predict if apple scab infection periods occurred. They also monitored daily SkyBit E-Weather information to evaluate predicted spray conditions and the disease/insect models. Survey results suggest growers preferred the on-site weather stations to SkyBit E-Weather.

Survey results suggested, however, that growers may not have used the models to predict apple scab infection periods and help them make spray decisions as often as one would hope. One concern expressed by growers was the time it takes to evaluate the information ('information overload'), particularly during the 2003 wet spring and early-summer scab spray season. In fact, it was so wet during this season, that sprays to control apple scab had to be applied on a weekly basis. At least one grower, however, said he should have paid better attention to the model output, which predicted he should have applied fungicides more often than he did.

Based on survey results, the model data uploaded to the MFGA web site was used minimally (if at all) by neighboring growers. Web site page requests to the web server weather directory, however, totaled

E-WEATHER SERVICE						AGWEATHER IPM APPLE DISEASE PRODUCT									
For: MA-BELCHERTOWN-HORTRESCENTER						Date: SUN Jul 13, 2003									
Date	WEATHER					APPLE SCAB 030415				FIRE BLIGHT 030506				SOOTY BLOTCH 030521	
	TMX F	TMN F	PREC in	ARH %	LW hr	ASM %	AW hr	TW F	PW	ADH 65F	AW hr	TW F	PW	ALW hr	PW
====	===	===	=====	===	==	=====	==	===	==	=====	==	===	==	=====	==
BASED ON OBSERVATIONS															
0701	80	57	0.00	64	0	100	0	-	+	225	0	-	-	346	+
0702	83	57	0.00	63	0	100	0	-	+	225	0	-	-	346	+
0703	79	64	0.00	75	0	100	5	65	+	225	5	65	++	351	++
0704	89	64	0.00	71	9	100	9	69	++	225	9	69	++	355	++
0705	86	70	0.08	73	8	100	14	75	++	225	14	75	++	369	++
0706	87	70	0.00	66	10	100	18	75	++	225	18	75	++	373	++
0707	84	64	0.00	70	0	100	5	70	+	225	5	70	++	378	++
0708	85	70	0.00	75	10	100	10	72	++	225	10	72	++	383	++
0709	72	59	0.25	80	14	100	20	63	++	225	20	63	++	403	++
0710	75	57	0.00	71	9	100	23	64	++	225	23	64	++	412	++
0711	65	60	0.94	96	24	100	30	63	++	225	30	63	++	436	++
0712	80	61	0.00	73	10	100	34	63	++	225	34	63	++	440	++
BASED ON FORECASTS															
0713	77	61	0.00	65	0	100	0	-	+	225	0	-	-	440	++
0714	78	56	0.00	68	0	100	0	-	+	225	0	-	-	440	++
0715	82	62	----	69	0	100	3	64	+	225	3	64	++	443	++

Figure 2. Sample 'SkyBit E-weather.

approximately 2,800 for the three-month period April through June.

A press release on June 04, 2003 resulted in articles appearing in at least two newspapers about this project. They included: 'Grant application bears fruit: New Weather station will provide data for area growers,' *The Berkshire Eagle*, June 26, 2003; 'The fruit of his labors: Brooksby Farms teams up with UMass to improve apple growing,' *Gloucester Daily Times*, August 27, 2003.

All six cooperating growers now have functioning orchard weather monitoring stations installed that can be used in upcoming growing seasons. They also have personal computer software to download and store the weather data collected by the stations, as well as disease and insect models. All growers expressed an interest in continuing to collect and use orchard environmental data from the weather instruments in upcoming growing seasons.

Conclusion

The objectives of this project were met. To summarize:

1. Six on-site weather stations were easily established in grower orchards. Growers used models minimally to help assess scab infection periods and time fungicide sprays. The Limitations encountered were occasional weather station/computer software interface problems and lack of time during a busy period for orchard activities to analyze fully all the information available for decision-making.
2. Weather and apple scab infection period information from these orchards were posted on the Massachusetts Fruit Growers' Association web site for neighboring growers access and use in helping them make fungicide application decisions. It is unclear, however, how much this information was used by neighboring growers. A better approach would be to encourage growers to purchase their own weather stations.
3. SkyBit E-Weather information was used by cooperating growers in decision-making, although the consensus appears to favor the use of on-site weather stations for this purpose. A thorough comparison of SkyBit E-Weather model output vs. on-site weather stations still needs to be done; however, it may be irrelevant, as grower preference

clearly favors the on-site weather stations and model output derived from them.

Unfortunately, it is difficult to quantify the real impact, both monetary and environmental, of deployment of these weather stations, and was perhaps beyond the scope of this project. Clearly, however, a basic tenet of IPM is monitoring, and there is no doubt grower use of the technologies explored here has given cooperating growers information to make spray decisions that they would otherwise not have, and therefore, ought to have both favorable economic and environmental impacts.

Finally, although a start was made here, more

education and effort needs to be made giving growers IPM tools that are both accurate and friendly, hence enhancing their adoption. Clearly there is room for improvement in gathering and analyzing weather data to make orchard spray decisions.

Acknowledgements

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