Can We Predict Flyspeck Development?

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Flyspeck, caused by *Schizothyrium pomi* and sooty blotch, caused by a group of fungi including *Peltaster fructicola, Leptodontium elatius,* and *Geastrumia polystigmatis* are two common summer diseases of apple in New England. Recently, summer diseases have become more problematic due at least in part to the decreased use of fungicides such as mancozeb and captan, attributable to increased label restrictions, cost cutting, and the implementation of IPM programs (Rosenberger, *Proc. New England Fruit Meetings* 102:51-57, 1997). In July and August, growers are limited to a few fungicide applications, generally using captan with or without a benzimidazol. Growers could more effectively control sooty blotch and flyspeck within the confines of an IPM program if they were able to time their sprays better so as to correspond to infection and the eventual appearance of these diseases. Specifically, a more economical and effective application of fungicides could be accomplished if growers were able to predict the appearance of flyspeck disease and sooty blotch. It would then be possible to replace a preventative spray program with one or more eradicant sprays timed to thwart the appearance of these diseases.

In North Carolina, Brown and Sutton (*Plant Disease* 79:1165-1168) have developed a model for the prediction of sooty blotch and flyspeck disease symptoms on apples. The model is based on leaf wetness data collected at three different sites in North Carolina from 1987 through 1994, coupled with known biological information about the fungi involved. From these data, the researchers concluded that the best estimate of flyspeck and sooty blotch symptom occurrence was based on the cumulative hours of leaf wetness during periods of at least four hours duration, beginning from the first rainfall at least 10 days after petal fall. Brown and Sutton chose to include periods of at least four hours because they had previously demonstrated that the pathogens required about four to five hours of constant wetting in order to germinate (*Plant Disease* 77:451-455). Under these conditions, the researchers found that flyspeck and sooty

Table 1. Leaf wetness accumulation from 10 days after petal fall until the first symptoms of sooty blotch or flyspeck. Table derived from Brown and Sutton (*Plant Disease* 79:1165-1168).

Year	Petal fall date	Beginning date	Symptoms observed	Accumulated wetting (hrs)
1987	27-Apr	5-May	15-Jun	265
1988	28-Apr	11-May	26-Jul	304
1989	26-Apr	9-May	23-Jun	276
1990	25-Apr	6-May	16-Jul	289
1991	25-Apr	6-May	4-Jun	267
1992	1-May	13-May	15-Jun	310
1993	7-May	17-May	6-Jul	209
1994	29-Apr	14-May	21-Jun	242

blotch symptoms occurred after an average of 270 hours of accumulated leaf wetting. They believe this that information is useful for timing eradicant (benzimidazole) fungicide spraying. An admitted limitation of this model is the questionable relevance it has for regions outside the southeastern United States. Sooty blotch and flyspeck disease pressure are extremely high in the Southeast. Weather there is particularly favorable for these diseases. Therefore, the model might fail to predict accurately the onset of sooty blotch and flyspeck symptoms for several reasons: 1) summer temperatures and relative humidities in New England are usually lower than in North Carolina; 2) the precision and accuracy of different leaf wetness sensors can vary considerably; and 3) infection of apple trees with the fungi causing flyspeck occurs about one month later in New England than in North Carolina. However, the existance of an empirical model predicting flyspeck and sooty blotch diseases anywhere raises the possibility of constructing such a model in New England.

While noting the limitations and possible sources of error, Brown and Sutton's model is still a good starting place. Additionally, one only needs hourly leaf wetness data available over the course of at least one year in order to use their model. These leaf wetness data are readily available from records taken from hygrothermographs or Campbell computerized weather stations located in several Massachusetts orchards. Thus, beginning with leaf wetness data collected from nine different orchards in 1995 and 1996, we tested Brown and Sutton's model for the prediction of flyspeck and sooty blotch.

Table 1 from Brown and Sutton's article shows wetness data collected from 1987 through 1994. Symptom occurrence ranged from late June through early July, with a mean wetness duration of 270 hours between the beginning date and symptom occurrence. Note that Brown and Sutton began counting wetness hours starting from the first significant wetness period at least 10 days after petal fall. Thus, their starting date ranged from early to mid May.

In contrast, Table 2 shows data collected from Massachusetts orchards during 1995 and 1996. Using Brown and Sutton's criteria, the mean leaf wetness accumulation of four hours or greater from 10 days after petal fall to symptom occurrence was 366 hours (standard deviation = 120 hours; the larger the standard

Table 2. Leaf wetness accumulation from 10 days after petal fall to the first symptoms of flyspeck in Massachusetts.

Year	Site	Petal fall date	Beginning date	Symptoms observed	Data source	Accumulated wetting (hrs)
1995	Broderick	25-May	4-Jun	8-Aug	Hygrothermograph	258
1995	HRC	24-May	3-Jun	7-Aug	Hygrothermograph	348
1995	Clark	28-May	7-Jun	17-Aug	Hygrothermograph	264
1996	HRC	26-May	5-Jun	24-Jul	Hygrothermograph	236
1996	Lincoln	27-May	6-Jun	29-Jul	Hygrothermograph	295
1996	Tuttle	26-May	5-Jun	31-Jul	Hygrothermograph	331
1996	Simeone	26-May	6-Jun	30-Jul	Campbell	484
1996	Sholan	26-May	5-Jun	14-Aug	Campbell	586
1996	HRC	26-May	5-Jun	24-Jul	Campbell	275
1996	Rice	23-May	5-Jun	2-Aug	Campbell	422
1996	S. Deerfield	26-May	5-Jun	1-Aug	Campbell	522

deviation the more variable the sample was). The mean for the 1995-1996 hygrothermograph data alone was much closer to Brown and Sutton, however, with a mean of 289 hours (standard deviation = 44 hours). Thus, using data most favorable to the Brown and Sutton model, approximately 19 more hours of wetting occurred in Massachusetts, on average, than in North Carolina before flyspeck and sooty blotch symptoms occur. These measurements support the idea that the Brown and Sutton model may indeed be useful for disease prediction in Massachusetts. The Campbell data, however, do not provide as much support. In addition, note that the significant events of petal fall, beginning of wetness measurement, and symptom occurrence happened later in Massachusetts than in North Carolina.

Judging from the differences between the two data sets as well as the previously noted regional differences between New England and the Southeast, it is reasonable to conclude that other factors besides leaf wetness are responsible for the onset of flyspeck and sooty blotch in New England. This certainly could account for the rather large variability in the New England data. A regression analysis of other weather measurements like temperature and relative humidity with disease onset may suggest some additional factors. This will be the focus of future research. It is also important to note that there is a disparity between the Campbell weather station wetness data and the hygrothermograph wetness data, and it cannot be ruled out that the measuring instruments themselves may be a source of error. There is no easy solution to this problem, and it may be that different empirical wetness-hour estimations may have to be made for use with different wetness sensors, or an easily accessible, standard weather station will have to be used.

In conclusion, it is believed that an empirical model predicting flyspeck disease and sooty blotch of apple based upon the Brown and Sutton model should be created for use by New England apple growers. Such a model would be useful to Massachusetts growers for timing eradicant fungicide spraying for these diseases in a more timely and efficient manner, and may also provide researchers with further insight into the ecology of the pathogens involved.

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