Working With Disease Prediction Models for Bitter Rot of Apple

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Bitter rot of apple is a disease caused by several species within the fungal genus *Colletotrichum.* The pathogen overwinters in plant material, including fruit mummies, and begins to produce spores in the spring. Once the fruit becomes susceptible to infection (20 days post petal fall), spores begin to infect the fruit during conducive infection conditions. This pathogen prefers a temperature of 70°-90°F and a moist environment. Spores are dispersed by rain events which allow them to reach the fruit surface for infection. Once a fruit becomes infected, the pathogen remains latent until the fruit begins to ripen, then the typical rot symptoms will begin to appear in the field (Figure 1). Spores will form on the surface of these rotting fruits and continue to infect new fruits through harvest; this is why early disease control is so important. Current management relies on a calendar-based, intensive fungicide program while the fruits are susceptible. Fungicides are applied every 14 days or 2 inches of rain, whichever comes first. This type of program is costly and will often result in unnecessary spray applications. Applying fungicides frequently also increases the risk of fungicide resistance development. Rotating FRAC codes each spray application and combining single site fungicides with broad spectrum fungicides are good methods to reduce the risk of fungicide resistance development, however, the fungicide toolbox is very limited for growers. Effective rotational fungicide options include Omega (FRAC 29), Aprovia (FRAC 7), Merivon (FRAC 7+11), Pristine (FRAC 7+11), Luna Sensation (FRAC 7+11), and Flint Extra (FRAC 11). These higher resistance risk fungicides should be tank mixed with a broad-spectrum fungicide such as Captan (FRAC M04), or Ziram (FRAC M03).

Figure 1. Bitter rot symptoms appearing on an apple in the field with orange spores on the lesion.

Bitter rot is becoming one of the most significant apple diseases that growers are struggling with on the East coast. Growers have reported up to 100% crop loss in some varieties due to this disease. Development of effective disease control methods for bitter rot are essential for growers to better manage this disease. Tree fruit growers in New Jersey are currently using fruit tree disease prediction models available through resources such as NEWA and Rimpro to control apple scab and fire blight, while reducing unnecessary fungicide and antibiotic inputs. If a disease prediction model were available for bitter rot, it could provide improved disease control through more precise fungicide timing.

Currently, there is not a model that has been tested and proven to work for predicting bitter rot infections in our climate, however there are four disease prediction models developed to predict infection by *Colletotrichum* species in other crops such strawberry, wine grapes, and Glomerella leaf spot of apple. These four models were tested during the 2025 growing season to determine if they can be used to improve bitter rot management while reducing fungicide applications.

Materials and Methods

Trials were conducted at research farms in Virginia, New Jersey and New York during the 2025 growing season. At each location the four models were compared to a grower standard and an untreated control on two different apple varieties. Fruits inoculated with the two most prevalent *Colletotrichum* species for each location were hung above each tree to ensure there would be sufficient disease pressure (Figure 2). An experimental website was developed for this project to determine when each model forecasted infection. At 20 days post petal fall we applied our first fungicide in the grower standard treatment with follow-up applications every 14 days or 2 inches of rain, whichever came first.

Our model treatments received a fungicide application prior to predicted infection periods. If there were back-to-back infection periods, we waited until we had 2 inches of rain or 14 days had passed to complete another fungicide application when the model predicted infection. All treatment fungicide applications were with Captan applied at 3 lb/A. When symptoms first appeared, we began to rate fruit for infection incidence. Fruits were rated a second time closer to harvest.

Results

A statistical analysis comparing the four models to the grower standard showed that all models worked equally as well as the grower standard at preventing bitter rot infection. This held true for all states where this trial was completed. Untreated control trees reached up to 90% disease incidence, which was significantly higher than the grower standard and all four model treatments. In New Jersey and Virginia, the models required 1-2 fewer spray applications than the grower standard treatment. In New York, the models required 2-4 fewer spray applications than the grower standard treatment.

Figure 2. Infected apples hung in onion bags above each tree.

Conclusions

The trend of this year's results suggests that disease prediction models provide equal or better control to the grower standard while reducing unnecessary spray applications. Reducing the number of spray applications reduces grower inputs allowing more profit and reduces the risk of fungicide resistance development. These trials will be continued for at least one more growing season to gain confidence under variable environmental conditions. Further analysis will be completed during the winter to compare climate data with model predictions and determine which models may perform the best for grower use.

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