

Progress Report for the Southern Region Small Fruit Consortium

Title: 2017-2018 Botrytis Fungicide Resistance Profiles

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Gray mold, caused by the fungus *Botrytis cinerea*, drives the spray program for strawberry and other small fruit producers. The disease is primarily controlled with fungicides. A push by USDA and Extension Specialists for increased use of reduced-risk fungicides has improved disease management and reduced the risk to farm workers, environment and consumers. However, the single site mode of action of these products make them vulnerable to resistance development in the pathogen. Our research has shown that, if not managed properly, selection for resistance can lead to disease outbreaks resulting in yield loss, and eventually to the loss of reduced risk fungicides. Information about location-specific resistance is critical for producers to identify ineffective fungicides and monitor the consequences of their management practices (rotation, mixture, frequency of fungicide applications).

The Schnabel lab at Clemson University offers a free service for growers in the Southeastern U.S. to identify ineffective and effective spray materials. Producers send freeze-damaged flowers in early spring to the lab for analysis and, within a week, will receive a report that details resistance and disease management advice. Producers may also send cotton swabs with spores from infected fruit later in the season. Instructions for sampling and shipment are online at the 'Clemson Schnabel lab' website or can be obtained from the authors (schnabe@clemson.edu). This resistance-profiling program has been offered to small fruit growers in the Southeast since 2011 and is supported by commodity boards as well as the Southern Region Small Fruit Consortium.

During the 2017-2018 season, we received and processed a total of 371 gray mold isolates from 45 samples of seven states (SC, GA, AR, MD, OH, and VA; **Table 1**).

	Strawberry
North Carolina	78
South Carolina	92
Virginia	82
Maryland	80
Georgia	6
Ohio	26
Total	371

Table 1. Origin and number of gray mold samples (and corresponding isolates) collected from strawberries.

Most isolates came from strawberry flowers. We examined sensitivity to thiophanate-methyl (t-methyl; Topsin M), cyprodinil (Scala; one of two components of Switch), fenhexamid (Elevate), iprodione (Rovral), boscalid (major botryticide component of

Pristine), fludioxonil (major botryticide component of Switch), penthiopyrad (Fontelis), and fluopyram (major botryticide component in Luna Sensation and other Luna products). Resistance to t-methyl and pyraclostrobin was found in virtually all strawberry samples, while resistance to fluopyram, penthiopyrad, or fludioxonil was rarely detected (**Fig. 1**). Resistance to fludioxonil is low in frequency (less than 2%) and has not increased in recent years. However, results varied between farms and sometimes between fields of the same farm. Most isolates had multi-fungicide resistance phenotypes and were resistant to 2, 3, or 4 fungicides. Very few were resistant to 5 or 6 chemical classes of fungicides (**Fig. 2**).

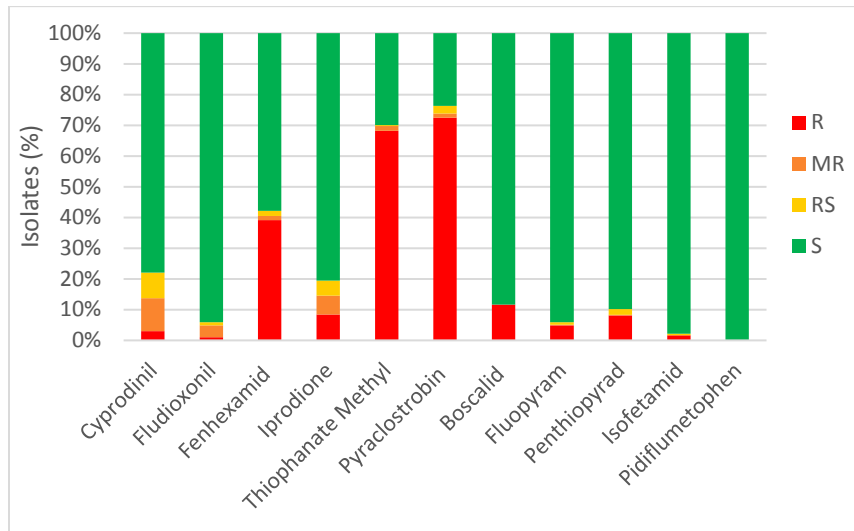


Figure 1. Frequency of isolates resistant to fungicides.

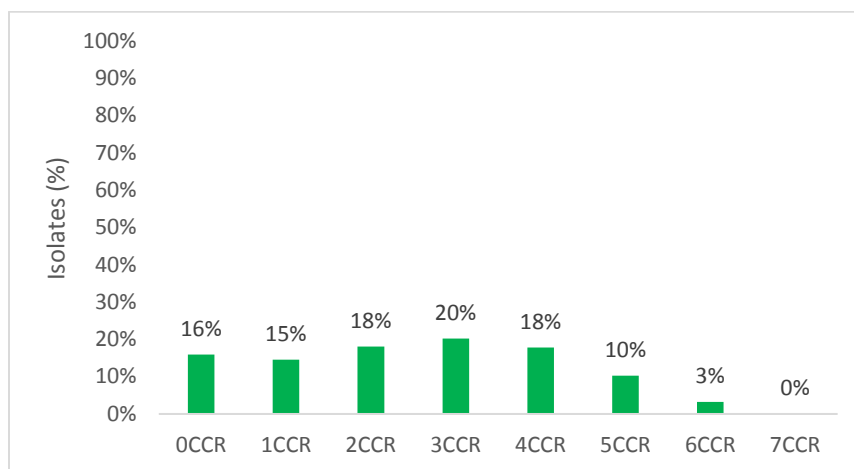


Figure 2. Percentage of isolates with 0, 1, 2, 3, 4, 5, 6, or 7 chemical class resistance (CCR).

Based on results of this monitoring program, specialists from NC, SC, and VA produced a spray guide that outlines effective practices for managing resistance

selection and gray mold disease. This spray guide is shared with growers at regional meetings and via email in conjunction with the resistance profile report we send to the individuals submitting samples for testing. **Table 2** shows the active ingredients and FRAC codes of fungicides currently registered for gray mold management on strawberries. Please use our spray guide at www.smallfruits.org and download our MyIPM smartphone app (MyIPM) for more information.

Table 2. Active ingredients and FRAC codes of fungicides used for strawberry gray mold management

	Active ingredient(s)	FRAC code(s)
Elevate	fenhexamid	17
Captevate	fenhexamid; captan	17; M4
Ph-D, OSO and generics	polyoxin D zinc salt	19
Rovral and generics	iprodione	2
Fontelis	penthiopyrad	7
Kenja and generics	isofetamid	7
Luna Sensation	fluopyram; trifloxystrobin	7; 11
Merivon	fluxapyroxad; pyraclostrobin	7; 11
Pristine	boscalid; pyraclostrobin	7; 11
Luna Tranquility	fluopyram; pyrimethanil	7; 9
Scala	pyrimethanil	9
Switch	cyprodinil; fludioxonil	9; 12
Thiram and generics	thiram	M3
Captan and generics	captan	M4