Fungicide Recommendations for Phytophthora Blight Management in Tennessee in Light of Newly Discovered Fungicide Resistance

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Introduction

Phytophthora blight, caused by a fungus-like organism named *Phytophthora capsici,* is a common vegetable disease throughout Tennessee. Primarily, this disease affects cucurbits, such as squash, cucumber, pumpkin and melons, and peppers but can infect a wide range of other hosts as well. Signs and symptoms of *Phytophthora* blight are root rot, crown rot, fruit rot, rapid wilting and circular necrotic lesions, which often have white spores present on the surface of the plant. See UT Extension publication "Managing Phytophthora Blight of Peppers and Cucurbits W 810" for more information on *Phytophthora* blight symptoms and diagnostics. *Phytophthora* blight is soilborne and thrives in wet and temperate soils. Disease spread occurs through the movement of spores found in infested soil, plant material, surface water (such as irrigation ponds and streams) and farm equipment. Once *Phytophthora* blight infests a field it can be difficult to manage. The disease can spread rapidly within a field and can persist in the soil for many years. Several methods are recommended to manage the disease, including avoidance, cultural controls and chemical controls (W810).

Fungicides are an important tool for *Phytophthora* blight management, and several fungicide products are available. However, fungicide resistance has been observed in *P. capsici,* which limits the potential effectiveness of these chemical controls. Fungicide resistance in *P. capsici* varies among regions so it is very important to test local populations in order to track the development of resistance. For this reason, we screened samples of *P. capsici* from Tennessee farms to document fungicide resistance.

Information on the products tested in this study can be found in Table 1. A complete list of fungicides labeled for *Phytophthora* blight management can be found in the Southeastern U.S. Vegetable Crop Handbook. An analysis of costs associated with a *Phytophthora* blight fungicide program in commercial peppers is available in the UT Extension publication "Sample Budgets for Large-scale Bell Pepper Operations and the Impact of Phytophthora Blight on Farm Revenue and Costs, 2019 W 831."

Summary of experiments

In 2018 and 2019, we collected samples of cucurbit and pepper plants infected with *Phytophthora* blight from Rhea, Bledsoe, Putnam and Lincoln Counties. A total of 184 pathogen samples were screened for fungicide resistance. The fungicides included in the experiments were Ridomil (mefenoxam), Ranman (cyazofamid), Forum (dimethomorph), Presidio (fluopicolide), Revus (mandipropamid), and Orondis (oxathiapiprolin) (Table 1), which were six of the most effective fungicides available at the time of testing. Samples were tested in the lab with a series of fungicide concentrations from high to low concentrations. *Phytophthora* growth was

compared on treatments with and without a fungicide. The amount of fungicide necessary to reduce the growth of each *P. capsici* sample was calculated, and each sample was classified as resistant, moderately sensitive or sensitive to each fungicide.

Results

Populations of *P. capsici* in Tennessee have developed resistance to some of the most commonly used fungicide products. Results are summarized in Figures 1, 2 and 3. Of the six products tested, four of them had at least some reduced effectiveness. Seven of 184 samples (4 percent) were resistant to Ridomil, and these were all collected in Rhea County. Eighty-six of 184 samples (47 percent) were resistant to Presidio and were collected in Rhea, Bledsoe and Putnam Counties. Thirteen of 184 samples (7 percent) were resistant to Ranman and were also collected in Rhea, Bledsoe and Putnam Counties. One sample (less than 1 percent) was resistant to Orondis and it was collected in Rhea County. Some samples were resistant to multiple fungicides. Six samples were resistant to Presidio and Ranman, four samples were resistant to Presidio and Ridomil, and one sample was resistant to Presidio and Orondis. Many more samples were moderately sensitive to these products. This means that the products had reduced effectiveness but still offered better control than no fungicide at all in laboratory tests.

Conclusion

Some of the fungicide products available for *Phytophthora* blight may have reduced efficacy in managing this disease in Tennessee. It is important to note that these results reflect laboratory tests, but they indicate the possibility of reduced field-effectiveness as well. This is especially true for Presidio, for which a high level of resistance was common and widespread in Tennessee. Some of these resistances were widespread, such as Ranman and Presidio, and some were localized to one area, such as Ridomil and Orondis. The widespread occurrence and prevalence of resistance to Ranman and Presidio in Tennessee means growers may experience reduced field-effectiveness of these products for managing *Phytophthora* blight. Additionally, continued use of these products may encourage increased resistance. If growers continue to use these products it is critical that they rotate or tank mix fungicides belonging to different Fungicide Resistance Action Committee (FRAC) groups to avoid increasing resistance (Table 1). This is even more important given that samples with cross resistance to two products were found in the state as represented in Figure 2. Resistance to Orondis and Ridomil was much less common and widespread, so these products are still good choices for managing *Phytophthora* blight in Tennessee. However, the observation of resistance to each of these reinforces the importance of fungicide resistance management so that these products can remain effective into the future. There was no resistance found to Revus or Forum. However, Forum's overall field-effectiveness is poor according to the 2021 Southeastern U.S. Vegetable Crop Handbook, but it may have value as a rotation partner for resistance management. Pathogen populations are constantly evolving and adapting to disease management tactics. As fungicides are applied each growing season, there continues to be a threat for selecting for fungicide resistance. For this reason, it is very important to rotate the use of fungicides with different FRAC codes (modes of actions) to reduce the likelihood of developing fungicide resistance and the occurrence of disease control failures in the future.

Table 1. Fungicides labeled for *Phytophthora* blight management included in this study

Product*	Active ingredient(s)	FRAC code	Resistance found in Tennessee	Efficacy
Orondis Gold 200	oxathiapiprolin	49	yes	good
Forum 4.17SC	dimethomorph	40	no**	poor
Revus	mandipropamid	40	no	good/fair
Presidio	fluopicolide	43	yes	good/fair
Ridomil Gold SL, Ultra Flourish	mefenoxam	4	yes	fair
Ranman	cyazofamid	21	yes	fair

**All products listed are labeled for use on peppers and cucurbits. This list only includes products tested in this study. A complete list of fungicides available for* Phytophthora *blight management can be found in the Southeastern U.S. Vegetable Crop Handbook.*

***Two percent of samples were moderately sensitive to Forum, but none of the samples were resistant.*

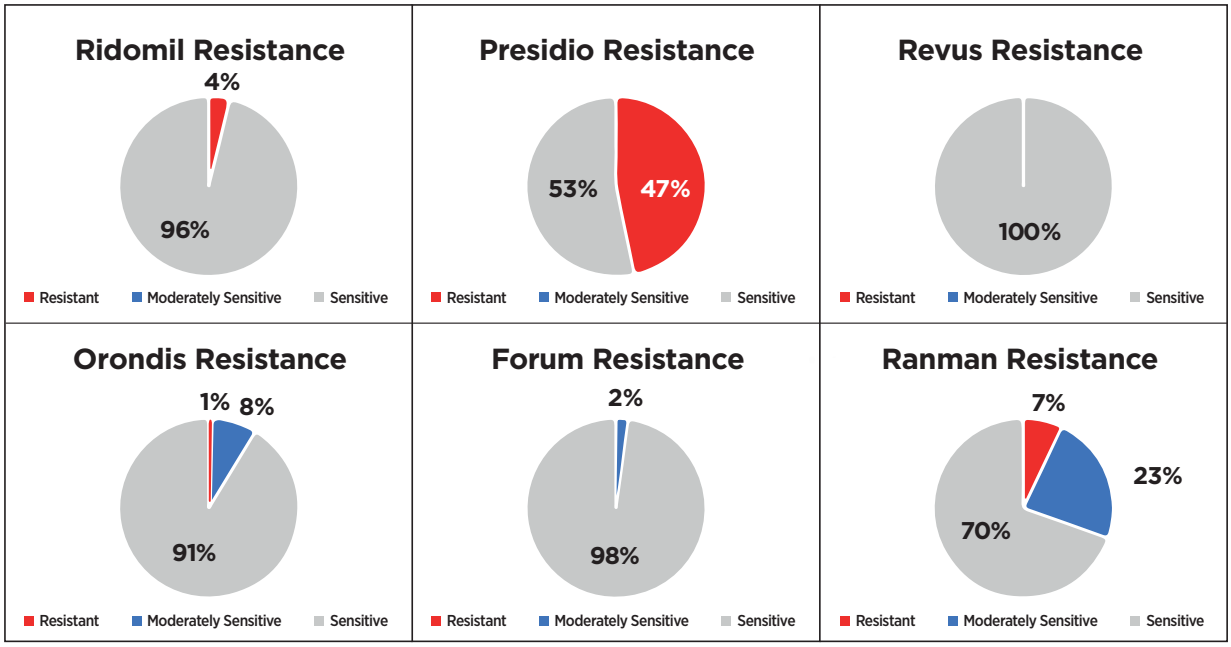

Figure 1. *The percentage of total samples resistant, moderately sensitive, or sensitive to Ridomil (mefenoxam), Presidio (fluopicolide), Revus (mandipropamid), Orondis (oxathiapiprolin), Forum (dimethomorph), and Ranman (cyazofamid).*

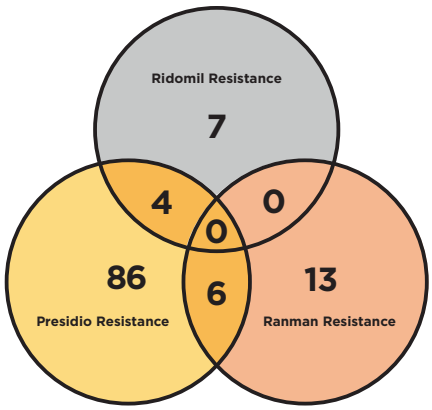

Figure 2. *The number of samples observed with resistance to multiple fungicides. Areas where circles overlap represent samples with resistance to multiple fungicides.*

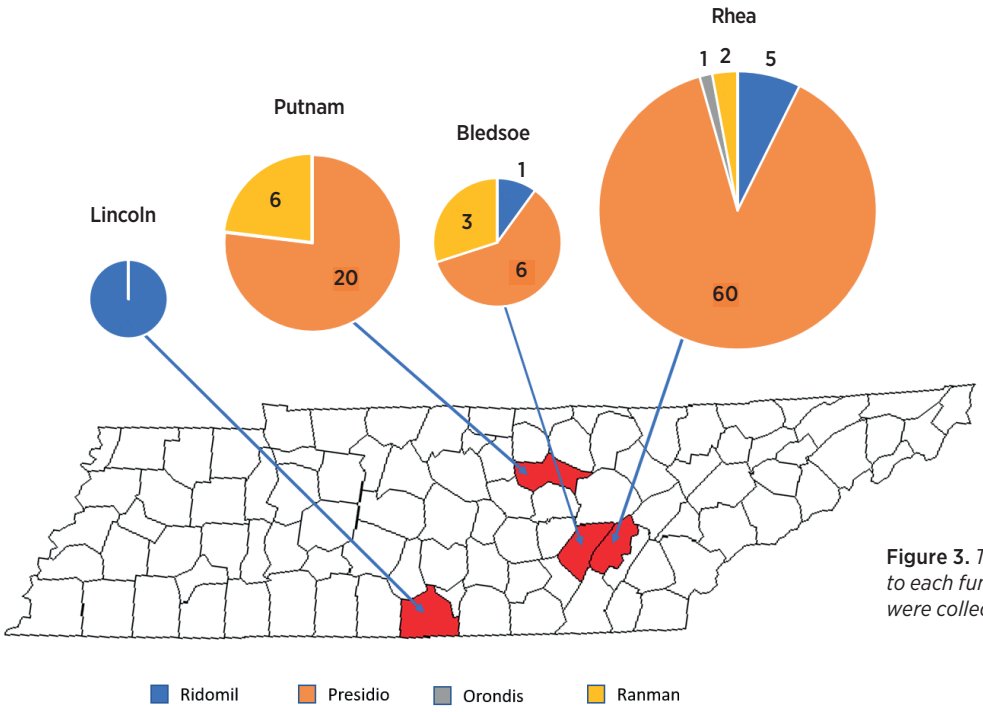

Figure 3. *The number of samples resistant to each fungicide and counties where they were collected.*

Additional Resources

2021 Southeastern U.S. Vegetable Crop Handbook

Managing Phytophthora Blight of Peppers and Cucurbits. University of Tennessee Extension, W810.

Sample Budgets for Large-scale Bell Pepper Operations and the Impact of Phytophthora Blight on Farm Revenue and Costs. University of Tennessee Extension, 2019.

Precautionary statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label.

Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

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