FUNGICIDE RESISTANCE MANAGEMENT GUIDELINES FOR VEGETABLE GROWERS IN THE MID-ATLANTIC STATES

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Project Summary

Because of the vast number of fungicides available and the potential difficulty in understanding FRAC groups and their importance in developing a proper fungicide resistance management programs for vegetable production a Fungicide Resistance Management Guide has been developed and distributed annually to vegetable growers in the mid-Atlantic and surrounding region. Since 2007, over 8,000 FRAC guides have been distributed to vegetable growers, extension agents and specialists, crop consultants, and industry representatives in the mid-Atlantic representing an estimated 100,000 acres of vegetable production. The objective of this project is to develop and distribute a new fungicide resistance management for vegetable crops grown in the mid-Atlantic region in 2011. The anticipated impacts of this project are to i) promote the importance and understanding of FRAC groupings in fungicide resistance management ii) prevent the misuse of specific fungicides with a high-risk for resistance development and iii) provide the tools and knowledge to allow growers to develop vegetable disease control programs with an emphasis towards fungicide resistance management.
Project Description:
Problem, background and justification

In the mid-Atlantic region (NJ, MD, VA, DE, PA) of the United States approximately 221,000 A of fresh-market and processing vegetable crops are grown each year (NASS, 2003-4). Over the past decade, a number of new fungicide chemistries for use in vegetable production have been released in the US. Many of these fungicides have specific modes-of-action (MOA) that target pathogen development at a single site (McGrath, 2001). Fungicides with a single-site MOA are often considered at- or high-risk fungicides because the chances for fungal resistance to develop are much higher than fungicides with multiple MOA’s (McGrath, 2001). In recent years, fungicide resistance in important diseases of vegetable crops, such as gummy stem blight and powdery mildew in cucurbits and Phytophthora blight in bell pepper, have been detected in the mid-Atlantic region. Unfortunately, some growers become concerned about managing resistance only after it has developed. Vegetable growers do not recognize that the primary goal of resistance management is to delay its development rather than to manage resistant strains (McGrath, 2001). The vast number of fungicide chemistries available and differences in mode-of-action can make it very difficult for vegetable growers to develop and follow fungicide resistance management programs on their farms. This grant proposal fills categories in the NE-IPM needs and priorities to 1) expand the adoption of IPM through addressing the needs of all types of vegetable growers, 2) centralize vegetable IPM through the Northeast IPM Center database, 4) develop updated vegetable IPM guidelines or check lists and 6) support training and communication across the region for agricultural professionals in vegetable IPM.

In 2002, the NAFRAC (North American Fungicide Resistance Action Committee) was established to i) coordinate and identify resources for contact between government, universities, and the public on fungicide resistance management issues, ii) assist in the creation of new working groups in North America for other areas of chemistry, as they are needed and iii) serve as a spokesman for the industry view on fungicide resistance management issues by providing an outlet for comments and position papers from members. Each year the FRAC group publishes a list of FRAC codes for most fungicides and fungicide chemistries. FRAC codes group fungicide chemistries according to class, mode-of-action and resistance-risk. To date, there are 43 numbered and 3 lettered FRAC groups for 61 listed chemical groups and ~180 common names of fungicides (FRAC code, 2010). Accordingly, fungicides listed within a given FRAC group share a similar mode-of-action, therefore, have i) similar risks for resistance development, ii) similar use patterns on multiple crops and iii) exhibit the potential for cross-resistance development.

Fortunately, most fungal pathogens can be controlled by more than one fungicide chemistry and rotations between fungicides with different modes-of-action can easily be accomplished. However, in many cases, fungicides within a given FRAC group are listed for control of the same pathogen. Often, this can lead to serious confusion by vegetable producers when it comes to developing a seasonal fungicide application program for specific diseases. For example, gummy stem blight is an important disease in cucurbit crops in the mid-Atlantic region, as well as, the rest of the US. In the mid-Atlantic region, fungicide chemistries such as azoxystrobin and pyraclostrobin are listed as recommended options for Gummy stem blight control. However, both fungicides belong to the same FRAC group, FRAC group 11, and each has a high-risk for fungicide resistance development. The development of fungicide resistance in
the field can be very difficult to detect. Unknowingly, a cucurbit grower without the proper knowledge could be selecting for a resistant fungal population with the overuse of any of these chemistries. Importantly, with highly mobile pathogens, such as cucurbit powdery mildew, successful management may require regional implementation. Otherwise, growers using an at-risk fungicide exclusively may select resistant strains and thereby thwart efforts of growers using a resistance management program (McGrath, 2001). More so, cross-resistance can develop in fungicides in FRAC group 11. Cross-resistance occurs when a fungal population that develops resistance one fungicide chemistry can develop resistance to other fungicide chemistries in the group, even if, only one fungicide chemistry has been applied. Unfortunately, resistance to the FRAC group11 fungicides, as well as, others has already been detected for important vegetable pathogens in the northeast (McGrath, 2001).

Since 2007, over 8,000 FRAC guides have been distributed to vegetable growers (representing an estimated 100,000 + acres of vegetable production in the mid-Atlantic and surrounding region) helping them to understand the importance of knowing FRAC codes and improve their fungicide resistance management strategies. This resistance management guide, the first of its kind for U.S. vegetable production, continues to be a valuable asset to vegetable growers, crop advisors, crop consultants and industry representatives in our region(Wyenandt et al, 2009). Importantly, this guide serves as useful model in which other states and regions can develop FRAC tables for vegetable fungicide recommendations. The collaborators of this proposal have also developed FRAC tables for specific crops, such as tomato and cucurbits, which can be utilized by vegetable growers throughout the entire Northeast region (Wyenandt et al., 2009; 2010).

Objectives and anticipated impacts

The objective of this project is to develop and distribute a fungicide resistance management guide for vegetable crops grown in the mid-Atlantic region in 2011. The anticipated impacts of this project are to i) promote the importance and understanding of FRAC groupings in fungicide resistance management ii) prevent the misuse of specific fungicides with a high-risk for resistance development and iii) provide the tools and knowledge to allow growers to develop vegetable disease control programs with an emphasis towards fungicide resistance management.

Approach and procedures

FRAC tables for the 30 crop groups listed in the 2011 Commercial Vegetable Productions Recommendations Guide for the mid-Atlantic region will be developed for an updated fungicide resistance management guide. Each table will consist of all fungicides recommended for a particular crop (or crop group) in the 2011 recommendations guide along with FRAC and risk management codes, diseases for that particular crop or crop group and fungicide resistance management guidelines for each particular FRAC group. A table for fungicide resistance management guidelines for pumpkin and winter squash crops grown in the mid-Atlantic region, such as the one in Appendix A, has already been constructed. From the 2009 version of the guide, 19 labeled fungicides that include 12 different FRAC codes are listed with risk management codes (L, M, H) for eight common pumpkin and winter squash diseases in the mid-Atlantic region. Fungicide, chemical names, FRAC groups and risk management guidelines will be color-coordinated by group to help distinguish differences based on FRAC code. The 2011 version of the guide will also include inherent resistance risks for the particular
pathogens listed in each crop section (Appendix A). Like the fungicides listed, the pathogen-risk will be denoted by L, M, or H designations in accordance for the potential of a particular pathogen developing resistance to certain fungicide chemistries (Appendix A). Most importantly, where a pathogen has a high risk for resistance development and a fungicide chemistry has a high potential for resistance to develop to it, the designated x’s will be colored red to highlight the fact that particular combination has a very-high risk for resistance development. The far right-hand column of each table will include fungicide resistance management guidelines for each particular FRAC group with specific instructions on risk assessment and/or application instructions. Each reference guide will be spiral-bound so it can be placed in a pesticide shed or weighing area for easy reference. Included in each guide will be a space where notes on applications, specific FRAC group use and dates can be recorded for specific crops. An example of this table is presented in Appendix B with an example of a production schedule for disease control in a pumpkin crop. Although growers are required by law to keep a record of applications, little if any emphasis is put in keeping track of specific fungicide chemistry use in terms of resistance management. Without keeping track of such information, growers could unknowingly apply fungicides against label restrictions. A simple-to-use reference guide and method for keeping track of FRAC group use would help growers i) learn the importance of FRAC codes, ii) apply different fungicide chemistries appropriately, iii) reduce the potential for fungicide resistance development and iv) reduce the potential for economic losses due to fungicide resistance development. In addition to the hardcopy format the 2011 guide will be made available on-line through state extension websites.

**Evaluation plans**

The fungicide resistance management reference guide will be available to growers at winter and spring meetings in the mid-Atlantic region in early winter of 2011. The guide will be distributed for free to vegetable growers in the mid-Atlantic states (NJ, DE, MD, PA and VA) during the 2011 production season and be used as a promotional tool for twilight meetings, field days and on-farm tours. During these meetings, collaborators from each state will promote the use of the fungicide resistance management reference guide. Each collaborator will help to i) explain the importance of learning and knowing how to use FRAC groups ii) help explain the FRAC tables and resistance management guidelines and iii) answer any related questions related to the resistance management reference guide from vegetable growers. Between the cooperators and the number of twilight tours, field days and regional meetings given each year in each state it is estimated that between 1,500 and 2,000 vegetable growers from the region learn the importance of and know how to implement FRAC groups in fungicide resistance management decisions. At each meeting growers will be questioned on i) their prior knowledge of FRAC groups, ii) if FRAC groups are currently being used in development their fungicide programs iii) their use of the reference manual if they have used it in the past iv) how the use of the reference guide has changed their management programs and v) their suggestions on improving the fungicide resistance management guide. A logic model for this proposal is included in Appendix C.
Literature Cited:


