FUNGICIDE BASICS

Walter R. Stevenson[1/]

Fungicides play an important and often critical role in the production of most crops around the world. While fungicide treatments often complement other crop and pest management measures, there are times when the use of fungicidal chemistry provides the deciding factor in economical control of a plant disease. Complementary disease management options often include regulatory measures (quarantines, seed tolerance, seed certification programs), cultural activities (early or delayed planting date, rotation, sanitation to destroy crop debris and sources of inoculum, irrigation and nutrition management), biological and physical controls and host resistance. Developing a fully integrated disease management program utilizing these broad based options including chemical controls helps to greatly reduce the risk of economic losses to plant diseases.

A wide selection of fungicide chemistries are currently available for managing plant diseases. Each of these chemistries has its own unique mode of action affecting critical processes necessary for fungal survival, multiplication and host infection. While some fungicides affect a single enzyme or pathway, other fungicides affect multiple sites within the pathogen targets. Single site toxicants are often prone to pathogen resistance problems while multi-site toxicants are much less prone to resistance and are often effectively used for generations.

There are a variety of methods used for fungicide application. Depending on the target pathogen, the crop and the label registration, fungicides may be applied on seed or propagative units such as potato seedpieces, to the soil as broadcast or in-furrow treatments, as foliar or fruit sprays and dusts, and as post harvest treatments in sprays, dips or aerosols. Fungicide labels provide detailed information on rates, schedules, target pathogens and resistance management guidelines. A thorough knowledge of the plant host, the pathogen and how the environment affects crop development and health is useful in achieving high levels of product efficacy.

The use of fungicide controls dates back to at least 1000 B.C. when sulfur was used for control of wheat rust. Lime sulfur was used in the early 1800s for control of grape downy mildew and in 1883, the use of Bordeau mixture (copper sulfate and quicklime) was reportedly used on grapes for control of downy mildew. The year 1932 is widely regarded as the dawn of the organic fungicide era. Since 1932, significant resources have been invested in developing a wide array of fungicide active ingredients. Today there are literally hundreds of registered fungicidal products on the market, some with broad purpose uses and others with highly specific targets. In an effort to group fungicidal materials by activity, EPA and the FRAC (Fungicide Resistance Action Committee) has developed a fungicide classification system based on fungicide Modes of Action (MOA). In the scheme of organization, there are currently over 40 fungicide groups listed on the FRAC web site (www.frac.info/). New labels are beginning to reflect this classification system, with the Fungicide Group Code prominently displayed on the label.

[1/] Friday Chair for Vegetable Production Research and Extension Plant Pathologist, Dept. of Plant Pathology, Univ. of Wisconsin, 1630 Linden Dr., Madison, WI 53706, Phone: 608-262-6291; Fax: 608-263-2626; Email: wrs@plantpath.wisc.edu

When discussing fungicides and the concepts related to their use, there are a few key terms that are useful to understand.

Fungicide Terms

- Preventative – prevents establishment of pathogen
- Curative – interrupts development of established infection which is not showing symptoms
- Eradicant – interrupts further development of established infection which is showing symptoms
- Antisporulant – prevents or decreases inoculum production without stopping vegetative growth
- Systemic – movement of fungicide in plant; locally systemic or translocated through plant via xylem or phloem

Preventative fungicides generally adhere to the plant surface and provide a barrier to invasion of the plant tissues by the pathogen. This group of fungicides must be present on the plant surface before the pathogen arrives or at least before the pathogen begins the germination and plant penetration process. A preventative fungicide is of little value once the pathogen has entered the plant and begins to use the host for nutrients. Since preventative fungicides are not absorbed or translocated by the plant, they are often subject to weathering from UV irradiation or washoff by rain and irrigation. Consequently they must be reapplied during periods of high plant susceptibility and environmental conditions favorable for pathogen dispersal and disease development. Some of the older preventative fungicides such as mancozeb continue to be relatively inexpensive and are often looked at by producers as cheap insurance against unexpected disease development.

In contrast, curative fungicides are usually systemic, entering the plant to protect local areas or in some cases, moving throughout the plant to protect both old and new tissues from infection. The period after plant infection by the pathogen when a fungicide treatment with a curative fungicide is still considered effective, is termed the kickback period. It presents a window of opportunity that is normally 12-48 hours in duration depending on the fungicide, the host, the pathogen and the environmental conditions present during this period. Once a fungicide is systemically dispersed within plant tissues–be it a leaf or group of leaves or the entire plant–these tissues are protected for a finite period against infection depending on the fungicide and the pathogen target. Since many of the newer fungicides with systemic properties are quite specific in terms of their modes of action and are prone to resistance management problems, manufacturers generally recommend that growers should not apply these products once disease symptoms are present and disease progress is observed.

There are many issues related to fungicide efficacy that are common to the management of other pest problems. Fungicide coverage is critical for optimum control, especially when using non systemic protective fungicides. Growers need to consider when the plant is most susceptible to specific pathogens and how to achieve maximum plant coverage. This often entails careful selection of spray equipment including nozzles and precise calibration to insure accurate delivery of the recommended and effective rate of pesticide. It also entails timing issues to maintain coverage during periods of rapid plant growth and adverse weather conditions so that the crop remains protected during critical periods. Resistance management issues continue to be an issue, especially with newer materials having a single targeted mode of action. Growers need to be aware of this issue and carefully read and follow label directions related to resistance management. Finally there are safety issues related to protecting the applicator, consumer and

environment. Using the correct fungicide at labeled rates with careful timing for management of economically important diseases goes a long way toward effective and safe disease management.

Finally, there are many useful references on the internet. Some of the references that I commonly consult include the following:

- Greenbook – source of labels and MSDS safety information on all pesticides used in U.S.
  - http://www.greenbook.net/

- CDMS Ag Chem Information Services
  - http:// www.cdms.net/

- Fungicide Resistance Action Committee (FRAC)
  - http://www.frac.info/

- University of Wisconsin – Extension Publications
  - http://www.uwex.edu/topics/publications/