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Fungicides: Triazoles

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Abstract
The fungicide group, demethylation inhibitors (DMI), which contain the triazole fungicides, was introduced in the mid-1970s. Triazoles consist of numerous members, of which several are labeled or are in the process of being labeled for use on field crops in Iowa--cyproconazole, flusilazole, flutriafol, metconazole, myclobutanil, propiconazole, prothioconazole, tebuconazole, and tetraconazole.

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Plant Diseases

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by Daren Mueller, Department of Plant Pathology

Third in a series

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Triazoles are used on many different types of plants in Iowa including field crops, fruit trees, small fruit, vegetables, and turf. These fungicides are highly effective against many different fungal diseases, especially powdery mildews, rusts, and many leaf-spotting fungi.

How do they inhibit fungi?

The triazole fungicides inhibit one specific enzyme, C14-demethylase, which plays a role in sterol production. Sterols, such as ergosterol, are needed for membrane structure and function, making them essential for the development of functional cell walls. Therefore, these fungicides result in abnormal fungal growth and eventually death.

Each triazole compound may act in a slightly different part of the biochemical sterol-producing pathway. While the results are similar in various fungi—abnormal fungal growth and death—there are great differences in the activity spectra of these fungicides.

Triazoles have no effect against spore germination because spores contain enough sterol for the formation of germ tubes. Some spores even have enough sterol to produce infection structures so, in some cases, triazoles may not be effective against infection of the host tissue.

When should triazole fungicides be applied?

Triazoles may be applied preventively or as early-infection treatments. When applied as an early-infection treatment, applications must be made early in the fungal infection process. Some triazole fungicides have anti-sporulant properties, which means they inhibit spore production and therefore help to slow disease development. However, if a fungus begins to produce spores on an infected plant, triazole fungicides are then not effective.

An air-assist sprayer moves through a soybean field. *(Tristan Mueller)*

Where do triazole fungicides move in the plant and how long do they last?

Although the triazoles don't have the degree of systemic movement of many herbicides, they are locally systemic and more mobile in plant tissues than QoI fungicides. Following application, the active ingredient is readily taken up by leaves and moves within the leaf. Studies have shown that three droplets of a labeled rate of triazole fungicide applied to a soybean trifoliate leaf covered the entire leaf within one day.

Note, however, that triazole fungicides are not necessarily transported from one leaf to another leaf or from one part of the plant to another part. They also do not move down plants through the phloem. Most triazoles have a residual period of approximately 14 days.

Is there injury associated with triazole applications?

There have been scattered reports of injury on soybean associated with triazole applications, especially tebuconazole. Of the reports of tebuconazole injury, applications were made during hot and dry conditions and with a surfactant.

Do we worry about fungicide resistance?

Yes, because their site of action is very specific, there are resistance concerns. Resistance has occurred on other plant pathogens, even some rusts. Some of the triazoles have disappeared from the marketplace as resistance to them developed and they no longer provided any benefit or advantage in a disease control program.

Recommendations for avoiding fungicide resistance:

- Repeated use of triazoles alone should be avoided, especially under high disease pressure or against rapid cycling diseases such as rust.
- When multiple applications are required, alternate or tank mix triazole fungicides with fungicides with a different mode of action (not just different triazoles). The other fungicide has to provide effective disease control. Refer to label recommendations for rates.
- Apply triazole fungicides according to manufacturers' recommendations for the target disease at the specific crop growth stage indicated. Use during the critical parts of the growing season or crop growth, especially when alternative fungicides are not available or effective.
- If possible, apply triazole fungicides preventively or as early as possible in the disease cycle. While some triazole fungicides have early-infection activity, do not rely on management of diseases when fungicides are applied well after disease has progressed.
- Reduced rate programs accelerate the development of resistant populations and therefore must not be used.

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To be determined: Ear row numbers and kernels per row in corn

by Roger Elmore and Lori Abendroth, Department of Agronomy

Want to increase corn yield potential? Aim for increasing kernel numbers! Yield is a function of kernel number and kernel weight. The number of kernels per acre will vary based on other components including plants per acre, ears per plant, and kernels per ear. We discussed the proper seeding rates in an April 10 *ICM* article, "What is the best seeding rate for corn based on seed prices and yield level? (pages 82–83). The number of ears per plant is primarily influenced by hybrid. Most hybrids grown in Iowa have one dominant ear, although some "prolific" hybrids are available that produce more than one ear per plant at normal seeding rates.

The number of kernels per ear is a function of ear length (kernels per row) and kernel rows per ear. Each of these begins development sometime between V6 and V8 as the ear shoots are formed. Let's talk for a bit about both of these components of kernels per ear.

Kernels per row: The maximum number of ovules (potential kernels) per row is set a week or so before silks emerge. Some researchers estimate there are up to 1,000 potential ovules per ear. An ovule develops into a kernel when its silk receives pollen, is fertilized, and then develops without aborting. Ear length is based on a hybrid's genetics but can be significantly altered based on stresses. Potential kernels per row are highly dependent on growing conditions prior to silking while actual kernels per ear are determined by conditions during and after silking.

A 16-row ear (left) and a 14-row ear (right). Number of rows per ear is influenced mainly by a hybrid's genetics and some by growing season stresses. ***(Roger Elmore)***