FUNGICIDE RESISTANCE: IT'S REAL!

Carl A. Bradley[1]

Introduction

Beginning in the mid-2000s the use of foliar fungicides in field crops such as corn and soybean has increased dramatically. In 2007, approximately 20% of the corn grown in the Midwest was sprayed with a foliar fungicide (Munkvold et al., 2008), and this percentage has remained steady with perhaps some slight increase. In some cases, fungicides are applied solely for hopes of a yield benefit with no regard to disease risk (Bradley and Ames, 2010). With high commodity prices, this non-IPM use of foliar fungicides may increase, which increases the risk of fungicide resistance.

Fungicide Resistance

Fungicide resistance is a function of two factors – the selection pressure applied by the fungicide and the genetic variability within the pathogen population. The magnitude of the selection pressure applied by the fungicide depends on the frequency of application as well as some inherent properties of fungicide active ingredients. The quinone outside inhibitor (QoI) fungicides (also referred to as strobilurins) are the most popular group of fungicides applied to corn and soybean fields in the Midwest. Because the QoI fungicides have a single inhibitory mode of action on fungi, a high risk of selecting individuals in the targeted fungal population with reduced sensitivity (resistance) to QoI fungicide exist. Every time a fungicide is applied, a selection pressure is applied to the targeted fungal population (even if applications are made only once per year). In pathogens that have a high level of genetic variability, even a once-per-season selection pressure may be enough for fungicide resistance to develop.

Case Example – Frogeye Leaf Spot

Frogeye leaf spot of soybean, caused by the fungus *Cercospora sojina*, is a disease that had been controlled quite well with QoI fungicides. However in 2010, *C. sojina* isolates were identified in Tennessee that were resistant to QoI fungicides (Zhang et al., 2012). Additional *C. sojina* isolates from soybean fields in Illinois, Kentucky, and Missouri also have since been identified (Table 1). These isolates are highly resistant to QoI fungicides, and even if use-rates are tripled, QoI fungicide products cannot control these isolates.

Recent research at the University of Illinois was initiated to identify fungicides other than QoIs that could control these QoI fungicide-resistant strains of *C. sojina*. Results of this research indicated that fungicides in the triazole group as well as thiophanate methyl (a benzimidazole fungicide) were effective in controlling the QoI fungicide-resistant strains.

In light of the discovery of QoI fungicide-resistant strains of *C. sojina* as well as the results of research focused on controlling these strains, the following recommendations have been developed:

---

[1]Associate Professor, Dept. of Crop Sciences, University of Illinois, Urbana, IL 61801.

- Only apply a foliar fungicide when necessary, based on disease observations and risk.
- Utilize integrated management strategies when controlling diseases such as frogeye leaf spot that combine strategies such as resistant varieties, tillage, and crop rotation along with fungicides.
- If a fungicide will be used, consider applying a fungicide that contains effective active ingredients with different modes of action or tank-mixing effective fungicides with different modes of action.

Table 1. Locations of confirmed strobilurin fungicide-resistant strains of *Cercospora sojina*.

State	County	Year(s) resistance identified
Illinois	Gallatin	2010, 2011
	Pope	2010, 2011
Kentucky	Caldwell	2010 (no samples from 2011)
	Calloway	2011
	Carlisle	2011
	Hickman	2011
	Livingston	2011
	Marshall	2011
Missouri	Pemiscot	2011
Tennessee	Dyer	2011
	Gibson	2010, 2011
	Lauderdale	2010, 2011
	Lawrence	2011

References

Bradley, C.A., and K.A. Ames. 2010. Effect of foliar fungicides on corn with simulated hail damage. Plant Dis. 94:83-86.

Munkvold, G.P., T. Doerge, and C. Bradley. 2008. IPM is still alive for corn leaf diseases: look before you spray. In: Proc. 62nd Ann. Corn Sorghum Res. Conf. Chicago. CD_ROM, American Seed Trade Association, Alexandria, VA.

Zhang, G.R., M.A. Newman, and C.A. Bradley. 2012. First report of the soybean frogeye leaf spot fungus (*Cercospora sojina*) resistant to quinone outside inhibitor fungicides. Plant Dis. 96:(In press).