

# Fungicide Resistance in Field Crops FAQs

## Can the fungi that cause common field crop diseases develop fungicide resistance?

Yes. In fact, researchers in several North Central states have confirmed that the fungus that causes frogeye leaf spot in soybean has developed resistance to the quinone-oxidoreductase-inhibiting (QoI/strobilurin) fungicide group (Figure 1).



**Figure 1.** Populations of the fungus that causes frogeye leaf spot in soybean have developed resistance to QoI/strobilurin fungicides.

## How do fungi become resistant to specific fungicides?

Fungicide applications do not cause resistance. Resistant fungal strains are already present in the fungal population. Such resistance is caused by naturally-occurring genetic mutations.

Fungicide applications select for these resistant fungal mutants — the fungicides kill the fungicide-sensitive population and only the resistant mutants survive. Eventually, the population of the resistant fungal strains increases and replaces the sensitive fungal population (Figure 2).



**Figure 2.** This figure demonstrates the selection for resistant (red spots) fungal strains among fungicide sensitive strains (blue spots) with repeated applications of the same fungicide active ingredient.

Once the population of the fungicide-resistant mutants is predominant, efficacy of a specific, fungicide active ingredient may be reduced or lost.

## Why should I worry about fungicide resistance?

When fungicide resistance occurs in a fungus, fungicide applications of a specific active ingredient may no longer effectively control the particular disease the fungus causes. Several fungicide active ingredients are at high risk for developing fungicide resistance, especially in the QoI/strobilurin group.

## How many fungicide groups are currently available?

There are multiple fungicide groups available for use on field crops, but the majority of available fungicide products fall into two groups: the QoI group and the demethylation inhibitor (DMI) group (Table 1).

Fungicide group names represent different target sites within specific modes of action. A mode of action is how the fungicide's active ingredient inhibits fungal development. For example, a fungicide may work by inhibiting respiration in the fungus. A target site is the specific location at which the fungicide works in the fungus.

The Fungicide Resistance Action Committee (FRAC) developed a numerical code for classifying fungicides. Each number represents a specific target site or group name (Table 1). Fungicide labels include these "FRAC Codes." If a fungus is resistant to a specific fungicide active ingredient, then it may be resistant to all of the fungicide active ingredients that have the same FRAC Code.

**Table 1. Example of Fungicide Resistance Action Committee (FRAC) fungicide classification for azoxystrobin and propiconazole.**

Active Ingredient	FRAC Code	Group Name	Chemical Group	Mode of Action
azoxystrobin	11	quinone-oxidoreductase inhibitor (QoI)	methoxy-acrylates (strobilurin) <sup>1</sup>	Fungal respiration inhibitor
propiconazole	3	demethylation inhibitor (DMI)	triazole	Inhibits sterol biosynthesis in membranes of fungal cells

<sup>1</sup>Fungicides in this group are commonly referred to as strobilurins, however, the FRAC no longer specifies these active ingredients as strobilurins.

## How can I delay fungicide resistance?

Take the following steps to delay fungicide resistance:

- Apply a fungicide only when necessary and in response to increased disease risk.
- Avoid applying fungicides that contain only one FRAC code.
- Tank-mix or use pre-mixed fungicides that have different FRAC codes.
- Only apply labeled rates. Applying a sub-lethal dose of a fungicide increases the risk of fungicide resistance.
- Scout fields within two weeks after any foliar fungicide application. Determine if the fungicide is adequately managing the disease. Contact your local extension specialist if you believe fungicide resistance may be an issue in your field.

## Find out more

The Crop Protection Network (CPN) is a multi-state and international collaboration of university and provincial extension specialists, and public and private professionals who provide unbiased, research-based information to farmers and agricultural personnel. Our goal is to communicate relevant information that will help professionals identify and manage field crop pests.

Find crop management resources at [CropProtectionNetwork.org](http://CropProtectionNetwork.org).

Find information about identifying soybean diseases and fungicide efficacy from the Soybean Research and Information Initiative at [soybeanresearchinfo.com/resourcelibrary.html](http://soybeanresearchinfo.com/resourcelibrary.html).

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