Some Principles Of Fungicide Resistance III: Factors That Enhance Risk

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This is the third in a series of articles on fungicide resistance.

In the previous installment of this series, I covered how higher disease pressure can result in higher risk of fungicide resistance. Higher disease pressure can come at you from several directions, including:

• Disease-favorable weather conditions;
• Agronomic management; and,
• Characteristics of fungal pathogens themselves.

Disease-Favorable Weather

Many fungal diseases are favored by moisture. In contrast, some diseases are more aggressive under drier conditions. Whatever the weather conditions that favor a particular disease, those conditions also increase the risk of fungicide resistance. See Figures 1-2 for a reminder of how increased fungal activity results in increased risk of fungicide resistance.

Agronomic Management

Virtually every agronomic practice potentially can have an impact on development of one disease or another. The most common agronomic factors that affect disease development include: site selection, previous crop; variety selection; planting date; tillage program; and fertility. Other factors can include row orientation, seeding depth, harvest practices, seed treatment, compaction management, etc., etc., etc. So we have seen before, anything that increases disease pressure increases the risk of fungicide resistance.

Characteristics of the Fungus

Some fungi pose a greater risk than others for the development of resistance. Here are some examples of pathogen characteristics that can influence resistance buildup:

• Some fungi, such as rusts, powdery mildews, downy mildews and leaf spots and blights, produce spores in multiple cycles during the growing season. These are called polycyclic (“many cycles)”. Others, like Fusarium head blight of wheat and the many smut diseases, only have one infection cycle per season (monocyclic). Polycyclic pathogens have an advantage, because if a resistant spore occurs in a field, it can buildup much more rapidly than can a monocyclic pathogen, because it may produce a new generation of spores as quickly as every week or two.

• Fungicide resistance in airborne fungi poses a greater threat than in soilborne fungi. The reason is that fungal spores that disperse with air movement (Figure 3) can sometimes move very long distances: from field to field, across the county, or even among states. A resistant fungal colony that develops in a soilborne fungus tends to move around much more slowly. It may only move a few feet per year, as it is commonly moved around by implements that work the soil. Of course, soilborne spores may move further, maybe from one farm to the next on tractors and on fertilizer spreaders. However, spores in the soil only move as far as the soil itself is moved. In contrast, airborne fungi can travel very long distances.

• Some fungi seem to have a strong genetic tendency to adapt quickly to fungicides. Botrytis cinerea, the cause of gray mold in many different plants, is a notorious example. In this fungus, resistance to several fungicide groups (=FRAC Codes) is common in many locations throughout the USA. Controlling gray mold with fungicides is a perennial challenge for many producers, because of resistance problems. Some species of Cercospora fungi are also highly adaptable genetically. For example, resistance to QoI fungicides in the frogeye leaf spot pathogen of soybean occurs in numerous locations in Kentucky and the region. However, not all fungi are so genetically adaptable. For example, there is preliminary evidence that the Cercospora that causes gray leaf spot of corn may not adapt so easily to QoI fungicides. Plus, mutation rates may vary from one fungus to the next. Thus, each fungus has its own unique genetic capability to generate fungicide-resistant strains. Some are better at it than others.

Bottom line

Numerous factors increase the risk of fungicide resistance. Some of these, like agronomic factors, are under our control. Others – like the weather and the genetic characteristics of the fungus – are outside the range of human control. As was emphasized in last week’s article, wise use of fungicides continues to be a cornerstone for reducing the risk of fungicide resistance. Δ

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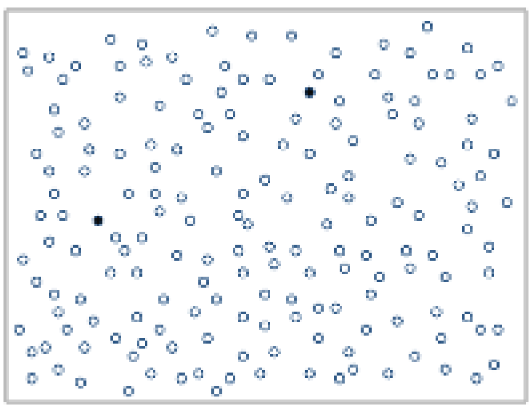

Figure 1. Initial step in fungicide resistance development: Occurrence of mutant spores with resistance to the fungicide (filled circles). Note that there are two resistant spores in this imaginary crop field.

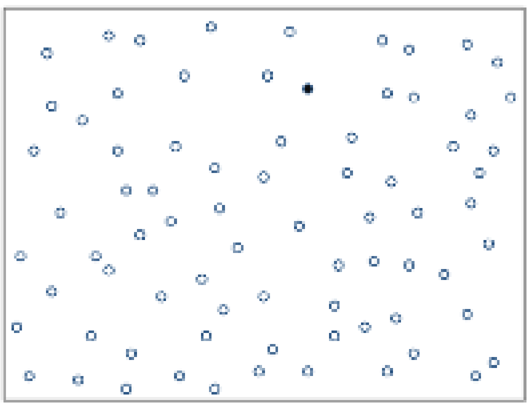

Figure 2. Imagine that this a second crop field, with lower disease pressure. Consequently, the population of infectious spores is about half that of Figure 1. Even though the mutation rate is the same in both fields, only one mutant spore with resistance has occurred, instead of the two mutants that emerged in Field 1.

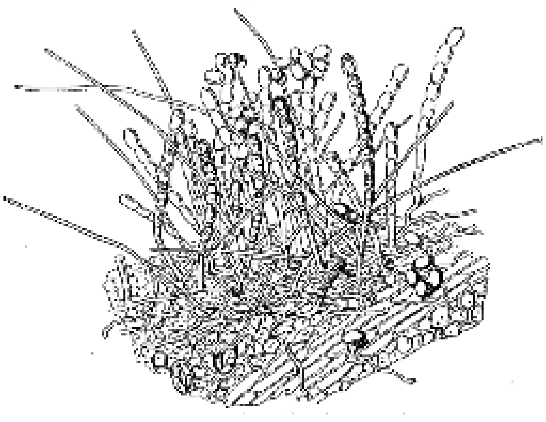

Figure 3. Chains of spores of a powdery mildew fungus growing above a leaf surface. These spores are easily broken off and dispersed by air movement. From E.C. Large, 1940, Advance of the Fungi, Holt & Company.