Part II
Decision-Making Factors for Fungicide Use
Decision-Making Process for Applying a Foliar Fungicide

To ensure success, the decision to apply a fungicide to a field crop should be based on several factors. The farmer or applicator should consider economics, field production practices, weather conditions (both before and after the crop enters a vulnerable growth stage), and the present or potential risk for disease. The greatest chance of success comes when a fungicide is applied to prevent yield loss in a field at high risk for disease. A farmer who applies a fungicide in a low-risk or low-disease environment must manage expectations about the profitability of that application.

Key Factors

Economics

Economic factors must be considered in the decision-making process for fungicide application. Those factors include the market price of the crop and the costs of application, including labor, machinery, fuel, and fungicide materials. As mentioned previously, crop prices have increased dramatically since 2005.

However, the cost of application for several crops has also increased 60–70% since that time (Table 3).

Environmental factors can influence disease development, and potential yield losses from disease should be calculated to determine if fungicide application is warranted. In cases in which fungicides are used for benefits other than disease control or are used as insurance against potential disease threats, farmers must at least recoup the investment of the fungicide application to break even. This break-even point will fluctuate from year to year based on the market price of the crop and the costs of application. Examples of the break-even costs for corn are provided in Table 4.

Disease Severity and Risk

For many crops, the decision to apply a fungicide can be based on the presence of disease prior to the application. Making this decision must be specific to the disease and the crop. However, some diseases can be managed only by applying a fungicide before seeing visible symptoms on the crop.

To understand what diseases may be problematic, it is important to know the disease risk factors present in the field and the upcoming weather conditions. Having this information will help determine if preventive applications are required (for example, for white mold of soybean) (Fig. 17) or if scouting and thresholds can be used to aid in the decision-making process for fungicide application (for example, for rust on sunflower) (Fig. 18). Thresholds do not exist for every crop–disease combination, so it is important to contact local extension service personnel to get the

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**TABLE 3. Average custom applicator costs for spraying corn and soybean: 2000 and 2011, Iowa (in U.S. dollars)**

<table>
<thead>
<tr>
<th>Application Type</th>
<th>2000</th>
<th>2011</th>
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<tbody>
<tr>
<td>Ground, broadcast</td>
<td>$4.30/acre ($10.62/ha)</td>
<td>$6.80/acre ($16.80/ha)</td>
</tr>
<tr>
<td>Aerial</td>
<td>$5.25/acre ($12.97/ha)</td>
<td>$8.90/acre ($21.98/ha)</td>
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aData from Edwards et al. (2000, 2011).
bCosts do not include the cost of spray material.

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Fig. 17. Preventive fungicide applications work best for diseases such as white mold on soybean. (Courtesy Daren S. Mueller)
latest information on disease thresholds for the crop of interest.

Numerous research trials have shown that the greatest benefit from fungicide applications to field crops occurs when fungicides are used in response to the presence of disease or to an immediate threat of disease. Certain fields and crops are more likely to develop disease based on particular risk factors, and the risk of disease increases for each factor that is present in a single field. Priority for disease management should be given to fields with the highest number of factors that favor disease development.

### Factors That Increase the Risk of Disease Development

**Cultivar Selection**

Crop breeders emphasize incorporating genetic resistance to common diseases into commercial cultivars, but not all cultivars are resistant to all diseases (Fig. 19).
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Knowing the inherent susceptibility of a given cultivar to common root diseases may affect the decision to use a seed treatment and perhaps what seed treatment to use. Similarly, if a cultivar is susceptible to a foliar disease, the risk of that disease developing will increase if environmental conditions are favorable, thus increasing the likelihood that application of a foliar fungicide will be necessary.

**Production Practices and Inoculum Level**

Conservation tillage prevents soil erosion and conserves soil moisture. However, this practice leaves crop residue on the soil surface after harvest, providing food and habitat for certain plant pathogens. Infested crop residue is an important inoculum source and may increase the likelihood of disease developing. Continuous cropping or rotating to crops susceptible to the same pathogen will also increase the amount of crop residue that can harbor pathogens and thus increase inoculum. Fields with short crop rotations or reduced tillage are at higher risk for the development of disease (Fig. 21).

The best ways to determine if a fungicide application is necessary are (1) to be aware of the diseases that affect crops regionally or even nationally and (2) to scout fields regularly (Fig. 20). Awareness of key issues and risks for disease development during the growing season will aid in the decision-making process for applying a fungicide. Extension personnel frequently report on current trends and disease issues during the growing season in newsletters and online posts.

Knowing what diseases are present in neighboring counties or states may provide a starting point for knowing what to look for when scouting. Scouting allows farmers to decide whether fungicides are needed and, if they are, when they should be applied to target the stage at which the crop is most vulnerable to economic loss. Applications timed to protect the crop during this window of opportunity are often more profitable than applications scheduled too early or too late.

Scouting will also help develop field disease histories for individual fields, which can be used for future management.

Fig. 20. Farmers should scout regularly and stay informed of local disease and weather conditions. (Courtesy Marcia McMullen)

Fig. 21. Corn seedlings growing through corn residue from the previous year. (Courtesy Kiersten A. Wise)
Environment

Environment and weather play a critical role in the process of fungal infection and disease development. For example, the development of many foliar diseases is favored by rainy and humid weather (Fig. 22). In growing seasons when these conditions prevail, the risk for disease development increases. Conversely, even when other risk factors for disease are present, unfavorable weather conditions for a given fungus will prevent infection from occurring or limit disease development in a crop. In some instances, predictive models are available to aid in assessing the weather conditions prior to fungicide application and can be used to help determine whether an application is justified.

Some fields have a history of high disease severity, which can influence the need for a fungicide application. Fields in river bottoms, low areas, and sections surrounded by trees may be more prone to developing foliar diseases, whereas fields with heavy, compacted soil and poor drainage are more prone to developing certain soilborne diseases.

Some management practices—including adjustments to the planting date, row spacing, and plant population—may affect the environment in which the crop grows, which can in turn affect disease development. Also, irrigated fields have a higher risk for certain diseases, since free moisture on plant tissue and wet soils create a more conducive environment for disease development (Fig. 23).

Fig. 22. Foliar disease development can be favored by rainy or humid weather. (Courtesy Daren S. Mueller)

Fig. 23. Moisture on plant tissue creates a more conducive environment for disease development. (Courtesy Tamra Jackson-Ziem)