Chapter 14

Secondary Effects of Fungicides

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A variety of insects and mites are pests of soybean throughout North America. Many of these pests can become infected with naturally occurring fungi. In some instances, these fungi, called entomopathogenic fungi, are key mortality factors keeping plant-damaging insects and mites from reaching damaging levels. Entomopathogenic fungi can either be specialists, such as *Pandora neoaphidis,* that attack only aphids or generalists, such as *Beauveria bassiana,* that attack a wide range of insect species.

Fungicides applied to soybean put all entomopathogenic fungi at risk. The suppression of entomopathogenic fungi due to application of fungicide can cause a population response in the pest, but this response will depend on environmental conditions and the frequency of fungicide application. Insect and mite pests of soybean that are often infected with entomopathogenic fungi include the two-spotted spider mite, velvetbean caterpillar, green cloverworm, soybean looper, bean leaf beetle, and soybean aphid.

Fungicides have been implicated in the suppression of beneficial fungi in many cropping systems. In potato, where fungicide use is as frequent as every five days, disruption of entomopathogenic fungi can be so severe that aphid populations flare.

Although soybean will not be treated with fungicides as frequently as potato, care must be exercised when applying fungicides to any crop where entomopathogenic fungi are known to be a key mortality factor. For example, two-spotted spider mite outbreaks in soybean are usually associated with drought conditions, but when there is sufficient humidity, mite populations are held in check by the entomopathogenic fungus, *Neozygites floridana.* Fungicides used for rust control appear to cause mite populations to flare, resulting in a yield loss.

Recent work in Minnesota has focused on the impact soybean rust fungicides have on the fungal pathogens of soybean aphid. All fungal pathogens found infecting soybean aphids in Minnesota belong to the class Entomopthorales. These fungi require specific environmental conditions of moderate temperatures (60°F to 85°F) and high relative humidity (98 to 100 percent) to infect their hosts — conditions that would also favor development of soybean rust. Typically, soybean aphids are most heavily infected with entomopathogenic fungi late in the growing season, but infected aphids can be isolated during early reproductive plant growth stages when fungicides for soybean rust might first be applied in the north central states.

In 2005, in Lamberton, Minnesota, several rust fungicides, including strobilurin, triazole, and chloronitrile-based fungicides and mixtures of two or more active ingredients, were evaluated for their effect on the prevalence of diseased soybean aphids in replicated field trials. All fungicides tested, which included four different fungicide treatment programs ranging from applying one to three foliar sprays (Table 14.1), lowered incidence of diseased soybean aphids compared to an untreated control (Figure 14.1). On the two sampling dates with the highest disease prevalence (Aug. 30 and Sept. 2), aphids collected from fungicide-treated plots had 89 and 81 percent less infection (Figure 14.1; note: all fungicides reduced prevalence of disease in soybean aphid, and thus data were combined for clarity).

All fungicides tested proved to be detrimental to the entomopathogenic fungi infecting soybean aphid in the field, and this also has been confirmed in laboratory studies. Yet, aphid populations in soybean did not flare up as we have observed in potato. Fungicides were applied to soybean during mid-reproductive stages (R2 to R4), but aphids collected from treated plots late in the growing season, weeks after the last foliar spray, were infected less often (Figure 14.1). We concluded from these limited data that fungicide use in soybean may not always result in an increase in aphid density on soybean, but that the incidence of diseased aphids will be significantly reduced.

Recent research in New York State showed that soybean aphids collected from buckthorn were more likely to be infected with entomopathogenic fungi than those collected in soybean. Our work in Minnesota did find high levels of disease in aphids on soybean, but only late in the growing season at a time of the year when aphids would be leaving soybean and migrating to buckthorn to begin the sexual phase of the aphid's life cycle. Intense fungicide use across the landscape, which might occur during a soybean rust outbreak, might dramatically lower the incidence of diseased aphids on buckthorn.

Further work is required to confirm these results and to determine how fungicides might affect soybean aphid population dynamics, both on the crop and in the overwintering habitat.

Clearly, fungicides are detrimental to this important group of natural enemies of arthropod pests found in soybean, and unnecessary fungicide applications should be avoided to preserve these beneficial fungi.

Table 14.1: Fungicide Treatments Applied to Small Plots in Lamberton, Minnesota, in 2005. All Applications Were Made at the Labeled Rate.

Treatment	Active Ingredient	Product Name	Application Timing
1	Pyraclostrobin + Tebuconazole	Headline SBR®	Growth stage R2
	Pyraclostrobin + Tebuconazole	Headline SBR®	14 DAT*
2	Pyraclostrobin + Tebuconazole	Headline SBR®	Growth stage R2
	Pyraclostrobin + Tebuconazole	Headline SBR®	14 DAT*
	Chlorothalonil	Bravo Weatherstik®	28 DAT*
3	Azoxystrobin + Propiconazole	Quilt®	Growth stage R2
	Azoxystrobin + Propiconazole	Quilt®	14 DAT*
4	Trifloxystrobin + Propiconazole	Stratego®	Growth stage R5

* DAT: Days after application of first treatment.

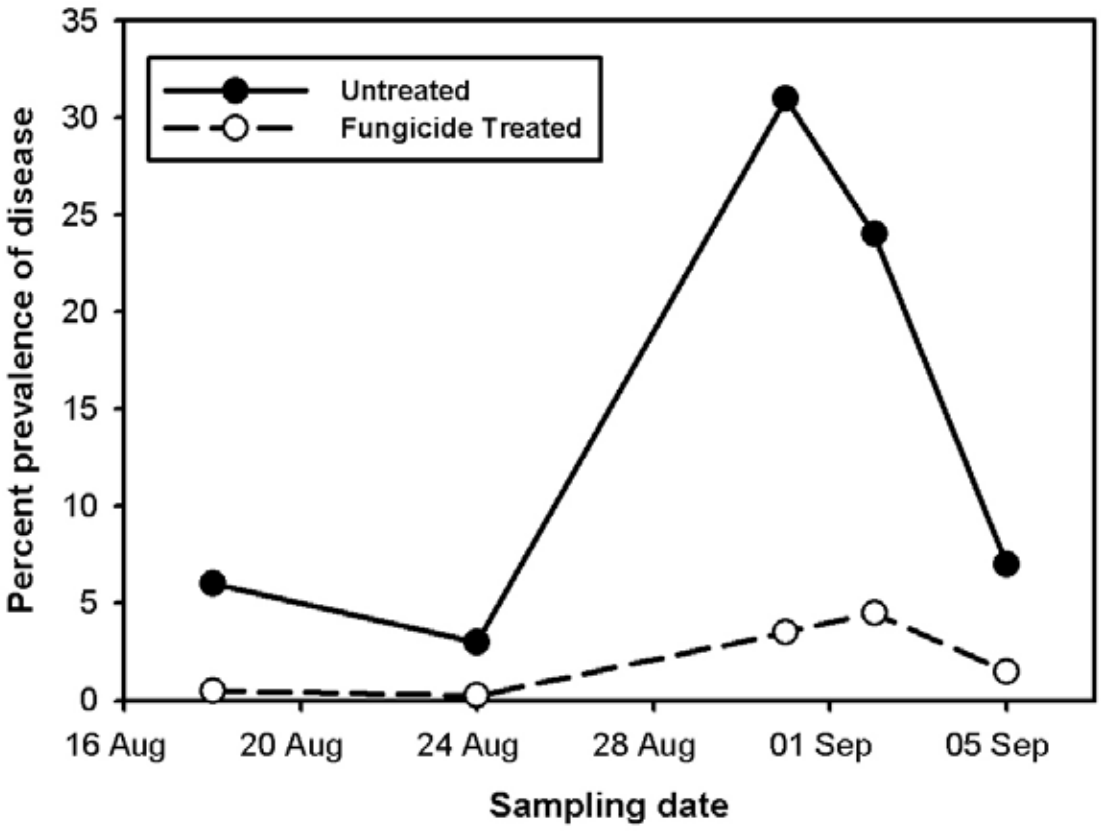

Figure 14.1: Percent prevalence of disease in soybean aphid in untreated (solid line) and fungicide-treated (dashed line) plots in Lamberton, Minnesota, in 2005. Fungicide treatment lowered the prevalence of disease up to 89 percent when compared to the untreated control. All fungicides tested were detrimental to entomopathogens and thus data were combined for clarity. Courtesy: Karrie Koch (graduate student), David Ragsdale, Professor of Entomology, University of Minnesota, St. Paul, Minn. Used with permission.