PEST MANAGEMENT: A PLANT PATHOLOGIST'S PERSPECTIVE

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Abstract

As in any crop, managing diseases is important for successful cotton production. Despite the weak market price producers are currently receiving for their cotton, disease management cannot be ignored. Fortunately, there are several practices that producers can use to manage most diseases that add little to production costs. There are also practices that can be used to reduce fungicide or nematicide costs or maximize the benefits of fungicides and nematicides. These practices include crop rotation, planting disease resistant cultivars, and employing other cultural practices such as delaying planting, proper fertility, and insect and irrigation management.

Introduction

Diseases account for significant cotton losses each year. The Cotton Disease Council estimates that over 2.5 million bales of cotton were lost to diseases in 1998. Most losses are caused by seedling diseases, nematodes (root-knot, reniform, and in localized areas Columbia lance), and boll rots. Other diseases causing losses include Fusarium and Verticillium wilt, Phymatotrichum root rot, and various leaf blights. With the current narrow margin for profit with cotton production, management of disease losses may mean the difference between a profitable corp and one that is produced at a loss. Fortunately, there are several cultural practices that add little to production costs, but can reduce the incidence of diseases. Chemical control practices may also be more cost effective when used judiciously as a part of an overall management program.

Discussion

Crop Rotation

Crop rotation is a simple practice that can be used to reduce the incidence and severity of plant diseases. Rotations reduce disease by breaking the disease cycle and reducing the survival of plant pathogens in cotton fields. Crop rotation is more effective and easier to use with pathogens that have a narrow host range or pathogens that survive for short periods in the soil. The longer the rotation, the more effective it will be in reducing disease. Cotton pathogens that have a narrow host range include the Fusarium wilt (*Fusarium oxysporum* f. sp. *vasinfectum*) and bacterial blight pathogens (*Xanthomonas campestris* pv. *malvacearum*). Essentially, planting any crop other than cotton will break the disease cycle of these pathogens. Unfortunately, managing Fusarium wilt with rotation is difficult because of the pathogen's ability to survive for long periods in the soil in the absence of cotton.

Cotton nematodes (*Meloidogyne incognita*, *Rotylenchulus reniformis*, and *Hoplolaimus columbus*), and the Texas root rot (*Phymatotrichum omnivorum*) and Verticillium wilt (*Verticillium dahliae*) pathogens have broad host ranges that makes managing these diseases with crop rotation more difficult, but not impossible. Rotation crops for reniform nematode include corn, sorghum, peanuts, and rice. There are also some soybean cultivars with good resistance. The winter grains crops, wheat, oats, and barley, are non-hosts and make excellent rotation crops, although they do not lower nematode populations as dramatically as non-host crops that are produced during the summer months. The root-knot nematode is more difficult to manage because of its extensive host range, but peanuts and root-knot resistant soybeans are effective. Peanuts are not a host for the lance nematode and are an excellent rotation crop for managing this nematode. Verticillium wilt is also difficult to control through rotation because of its broad host range that includes over 400 plant species. Grain crops, such as barley, wheat, and sorghum, are non-hosts and will reduce the incidence of Verticillium wilt. Crop rotation has not proved effective against the Texas root rot pathogen, because of its extensive host range and the ability of the sclerotia to survive for long periods in the soil.

Fallowing, which is a type of rotation, can be effective in reducing diseases, but fallowing is often not feasible because of the failure to provide any income. Also, for many pathogens clean fallowing is necessary to control weeds that may be hosts and contribute to disease in the subsequent cotton crop.

The use of crop rotation in cotton has been made easier with the availability of transgenic cotton cultivars with resistance to herbicides. Prior to the adoption of these cultivars, rotation often resulted in the introduction of a different spectra of weeds that were difficult to control in cotton production systems. However, the ability to plant herbicide-resistant cottons that permit over- the-top applications of glyphosate and bromoxynil will make controlling weeds in crop rotation systems easier.

Planting Resistant Cultivars

Planting resistant cultivars is the easiest and most economical method of disease control. Although cotton cultivars with resistance to all diseases do not exist, there are cultivars with some degree of resistance to Fusarium wilt, Verticillium wilt, the root-knot nematode, and bacterial blight. Resistance to the other major diseases in cotton does not exist.

Reprinted from the *Proceedings of the Beltwide Cotton Conference*
Volume 1:28-29 (2000)
National Cotton Council, Memphis TN

Many commercial cotton cultivars have slight resistance to the root-knot nematode. The most resistant cultivars for production in the eastern part of the Cotton Belt are Stoneville LA887 and Paymaster 1560. The transgenic cultivar Paymaster 1560BG is not as resistant as Paymaster 1560. In the west, Acala Nemx has comparable resistance. These cultivars should be used whenever possible, particularly in fields with a history of root-knot nematode. There is currently no resistance to the reniform or lance nematodes in commercial cotton cultivars.

The level of Fusarium wilt resistance in most cultivars is moderate. Again, Stoneville LA 887 and Acala Nemx have the highest levels of resistance in commercial cultivars. Since Fusarium wilt is more severe in root-knot nematode infested fields, and root-knot nematodes can induce susceptibility to wilt in normally resistant cultivars, Fusarium wilt resistance alone may not be adequate in fields heavily infested with root-knot nematode. Cultivars with resistance to both pathogens are necessary to manage the Fusarium wilt/root-knot nematode disease complex.

Most cotton cultivars have low to moderate levels of resistance to Verticillium wilt that reduce the incidence and severity of disease. Acala Prema, Acala Royale, and Acala Maxxa released in California have high levels of resistance.

Nearly all of the commercial cotton cultivars have moderate to high levels of resistance to bacterial blight. The planting of resistant cultivarsand acid-delinted cotton seed has reduced the occurrence of bacterial blight in cotton significantly across the Cotton Belt.

Delay Planting

Despite advances over the last thirty years, seedling diseases continue to cause significant losses in cotton. The best management practice for seedling disease is to plant under conditions that promote rapid germination and seedling emergence. Under these conditions, the seedlings are able to escape infection. Avoid planting into cool, wet soils that favor pathogen growth over seedling growth. A general rule is to wait until minium soil temperatures are at least 68°F for several days before planting and cool, wet weather is not forecast for five days after planting. Also, plant the highest quality seed available. High quality seed will germinate faster and emerge quicker. Other conditions to avoid include planting in compacted soils or planting too deep. Caution also should be taken when applying recommended herbicides. Improper application or application at incorrect rates may injure cotton seedlings and contribute to seedling disease severity.

In-furrow and hopper-box fungicides can effectively control seedling diseases, and, along with seed treatments, represent the primary fungicide inputs for disease control. The benefits of in-furrow and hopper-box treatments can be maximized by observing soil temperatures and forecasted weather conditions. At temperatures above 68°F, particularly later during the planting season when cold fronts are less likely, lower labeled rates of in-furrow fungicides or the use of hopper-box materials may be sufficient to control seedling diseases. In very warm soils, in-furrow fungicides may be deleted altogether. Remember, there is always some risk associated with planting cotton without using a fungicide, and never use a fungicide below the recommended labeled rate.

Soil Sampling

Nematode populations in the field can be quantified and identified through soil sampling. By knowing the species and density of parasitic nematodes in the soil, a grower can customize the application of nematicides to control nematodes. If sampling determines that nematodes are not present, the application of nematicides can be omitted.

The analysis of soil samples is only as effective as the sample. Samples from cotton fields are best taken at the end of the season near harvest. Sampling areas should consist of the same cropping history and soil texture. It is best to divide the field into units of five to ten acres. A total of 20 to 30 soil cores at a depth of six to eight inches, containing soil and embedded root tissue should be collected from each sampling block. All the cores from a sampling area should be combined, mixed thoroughly, and a one quart sub-sample submitted for analysis.

Samples should be handled with care and processed as soon as possible. Overnight shipping is suggested. Prior to shipping, keep the sample cool, but do not freeze. Avoid extreme heat, direct sunlight, and do not let the samples dry out.

In the future, the employment of global positioning may permit variable rate application of nematicides within fields. This would result in more economical, efficient, and environmentally safe application of nematicides to infested fields

Insect Management

Insect management is a component of any successful cotton production program. However, controlling insects also plays a part in disease management. Early season insects, particularly thrips, as well as nematodes, retard seedling growth and increase the severity and incidence of seedling diseases. Management of these pests should be a part of any seedling disease management program.

Insect damage also plays an important role in boll rots. Controlling boll rots through the application of fungicides has proved unsuccessful, but the application of insecticides to

control insects will reduce boll rots. Insects injure bolls and permit the entrance of boll rot pathogens.

Fertility and Irrigation Management

Maintaining proper fertility and irrigation regimes will help maintain healthy, vigorous plants. Healthy plants are better able to tolerate disease infection. In addition, proper fertilization and irrigation will prevent rank growth that makes plants more susceptible to boll rots.

Summary

The severity and incidence of cotton diseases can be reduced through the application of cultural practices that add little to production costs. These practices include crop rotation, planting resistant cultivars, and delaying planting, along with proper insect, fertility, and irrigation management. Although these practices can be used independently, they are generally most effective if they are integrated into an overall management program. Integrated disease management involves the use of all available methods of control for a disease or diseases of the crop.

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