

# Integrated disease management

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## Introduction

A plant disease occurs when there is an interaction between a plant host, a pathogen and the environment. When a virulent pathogen is dispersed onto a susceptible host and the environmental conditions are suitable then a plant disease develops and symptoms become evident.

Disease control strategies must therefore focus on the host, the pathogen and/or the environment. 'Integrated Disease Management' involves the selection and application of a harmonious range of control strategies that minimise losses and maximises returns. Each of the disease control strategies by itself is not able to provide adequate control. However, when several such strategies are used in combination then acceptable control is achieved.

Effective disease management must be integrated with management of the whole farm. The absence of symptoms does not indicate an absence of disease. Basic strategies should be implemented regardless of whether or not a significant disease problem is evident. These basic strategies should focus on the host, the pathogen and the environment.

## The host

A particular plant may be immune, resistant or susceptible. Breeders also use the term 'tolerance' to imply good performance (yield) despite the presence of the disease. Examples of disease control strategies that focus on the host include:

### The use of resistant varieties

Australian upland cotton varieties are completely resistant to Bacterial blight. Some have good resistance to Verticillium wilt and some have some resistance to Fusarium wilt. Use varieties with good seedling vigour.



Cotton symptoms guide app now available.

When the Black root rot pathogen is present, use the more indeterminate varieties that have the capacity to catch up later in the season. Avoid growing susceptible varieties in fields that contain infected residues.

### Balanced crop nutrition

A healthy crop is more able to express its natural resistance to disease. Adopt a balanced approach to crop nutrition, especially with nitrogen and potassium. Both deficiencies and excesses provide better conditions for the development of diseases such as Verticillium and Alternaria. For more information on cotton nutrition see NUTRIpak available from the Cotton CRC.

### Replanting

Replanting decisions should be made on the basis of stand losses, not on the size of the seedlings.

### The pathogen

A pathogen must be present in the area, capable of surviving the inter-crop period and adapted for effective dispersal between host plants if a disease is to occur. Disease control strategies that focus on the pathogen include:

### Monitoring

Be aware of what diseases are present, where they are present and whether or not the incidence is increasing. Do your own disease survey in November and February of each season. Train farm staff to be observant and report back on possible disease occurrences.

### Practice good farm hygiene

Minimise the movement of pathogens onto and off your farm, and between fields within your farm. Clean down machinery and vehicles of mud, crop and weed residues between fields and farms. Minimise movement of crop residues in tailwater recirculation systems. Encourage all visitors to 'COME CLEAN' and 'GO CLEAN'. For more information refer to myBMP.

### Use rotation crops that are not hosts

Develop a sound crop rotation strategy. Successive crops of cotton can contribute to a rapid increase in disease incidence – especially if susceptible varieties are used. Use rotation crops that are not hosts for the pathogens present. The Verticillium wilt pathogen has a large host range and most legume crops are hosts of the Black root rot pathogen.

### Control alternative hosts and volunteers

The pathogens that cause Verticillium wilt, Fusarium wilt, Black root rot, Tobacco Streak Virus and Alternaria leaf spot can also infect common weeds found in cotton growing areas. Control alternative hosts to prevent build up of inoculum and carry over of disease from one season to the next.

Cotton volunteers and cotton ratoons can significantly increase the risk of disease carry over between seasons. Ensure weed management strategies for fallows and rotation crops consider the need for volunteer control, particularly in systems where herbicide tolerant crops are grown. Manage cotton stubble to avoid the occurrence of ratoon cotton as herbicides are rarely cost effective or highly efficacious.

### Crop residues

Manage crop residues to minimise carryover of pathogens into subsequent crops. The pathogens that cause Verticillium wilt,



Aerial photo of fusarium damage.

Fusarium wilt, Black root rot, boll rots, seedling disease and Alternaria leaf spot can all survive in association with crop residues. Incorporate cotton crop residues as soon as possible after harvest, except where Fusarium wilt is present. Where Fusarium is present residues should be slashed and retained on the surface for at least one month prior to incorporation. The Fusarium wilt pathogen can also survive and multiply on the residues of non-host crops such as cereals. Currently recommendations are that residues should be buried or baled as soon as possible after harvest.

#### Application of fungicides

Examples include seed treatments for seedling disease control and foliar sprays for the control of Alternaria leaf spot on Pima cotton. For more details see Tables 35 and 36 on page 131.

#### Biofumigation

In addition to fixing substantial quantities of nitrogen, vetch has a biofumigation effect against Black root rot. As the vetch breaks down in the soil, ammonia is released in sufficient quantities to kill spores of the Black root rot pathogen. In contrast, vetch residues can increase the activity of Fusarium wilt in the following cotton crop.

The success of biofumigation depends on the growth of the biofumigant crop and good incorporation (at least 4 weeks before planting). Biofumigant crops can be grown and incorporated a year before planting the following cotton crop.

#### Control of insect vectors

Diseases caused by a virus or phytoplasma can often be prevented by controlling the vector that carries the pathogen. Cotton Bunchy Top (CBT) can be transmitted by aphids feeding on infected plants then migrating to healthy plants. Transmission of Tobacco Streak Virus (TSV) to plants relies on the virus from infected pollen entering plant cells through the feeding injury caused by thrips. Many species of thrips are potentially capable of transmitting TSV. For more information on these diseases, see the following section. Aphid and thrip thresholds can be found on pages 14 and 30.

#### The environment

Pathogens have optimum temperature, relative humidity, leaf wetness and/or soil moisture content requirements for infection to occur and for the disease to spread and multiply in the host plant. When environmental conditions are not optimal then the

rate of disease development is reduced.

It may appear difficult to manipulate the environment but it can be achieved by altering row or plant spacing, irrigation method or frequency or by changing the sowing date. Possible disease control strategies that focus on the environment include:

#### Good bed preparation

Plant into well prepared, firm, high beds to optimise stand establishment and seedling vigour. Carefully position fertiliser and herbicides in the bed to prevent damage to the roots. Fields should have good drainage and not allow water to back-up and inundate plants.

#### Sowing date

Delay sowing as late as possible within the planting window to avoid cool, wet conditions that favour disease. Sowing when the soil temperature is above 20°C would be best for reducing cotton's susceptibility to disease, but generally this is not practical. Time planting to coincide with soil temperatures of at least 16°C and rising. Refer to *Cotton Production Manual* for more information on crop establishment.

#### Irrigation scheduling

Applying water prior to planting provides better conditions for seedling emergence than watering after planting.

Watch for signs of water stress early in the season if the root system has been weakened by disease (eg. Black root rot) and irrigate accordingly. Avoid waterlogging at all times, but especially late in the season when temperatures have cooled. Irrigations late in the season can result in a higher incidence of Verticillium wilt.

#### Agronomic management

High planting rates can compensate for seedling mortality however a dense canopy favours development of bacterial blight, Alternaria leaf spot and boll rots. Avoid rank growth and a dense canopy with the use of growth regulators. Manage irrigations, nutrition and insects for early maturity as many pathogens are favoured by cool conditions at the end of the season.

In fields where Fusarium wilt is present avoid inter row cultivations after seedling stage as mechanical damage to the roots provide a site for infection by the pathogen.

#### Soil health

Fields where soil borne pathogens cause chronic disease in cotton are not 'unhealthy' as healthy cereal crops could be grown in the same field. These diseases are not present because the soil has been mistreated, the presence of the pathogen creates a problem with the health of the plants but not a problem with the health of the soil.

