CURRENT AND FUTURE TRENDS – A DISEASE UPDATE

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Introduction

The results of annual disease surveys in both NSW and Queensland continue to provide useful data on the distribution, incidence and importance of diseases of cotton in Australia. Plant pathologists at Narrabri, Brisbane, Toowoomba, Armidale, Canberra, Melbourne and Sydney are continuing to investigate the relationships between the host, the pathogens and the environment and are continuing to develop and promote strategies for disease control. (See Acknowledgments)

Observed trends in disease incidence and severity over time and space are cause for concern. Recent trends in farming practices may also impact on disease incidence and severity. A farming system is a complex assemblage of interacting components and changes to any one component can have significant effects.

Trends

Increasing Distribution and Incidence of Fusarium Wilt

Despite the reduced area planted to cotton during the 2007/08 season there were two new reports of Fusarium wilt in Queensland and one new report in NSW. Although the rate of spread has been slower than originally predicted, the disease has now been confirmed on 82 farms in NSW including 43% of the farms visited during the annual disease surveys in NSW. Fusarium wilt has also been observed on 52% of farms visited during disease surveys in Queensland.

Fusarium wilt of cotton is most prevalent in irrigated crops on the Darling Downs of Queensland where the mean incidence for 2007/08 was 11.4% of plants affected. In all other areas the mean incidence is usually less than 3%.

Increasing Distribution and Incidence of Black Root Rot.

Black root rot of cotton was first reported in Australia in 1990 and has since been observed in all of the cotton production regions of NSW and Queensland. The disease was observed in 50% of fields and 24% of plants surveyed in the major valleys of NSW (Macintyre, Gwydir, Namoi, Macquarie) during the 2007/08 season. The Namoi Valley was again the worst affected with black root rot present in 85% of fields inspected and the mean incidence estimated to be 45% of plants infected.

The distribution of black root rot has expanded in the Lachlan and Murrumbidgee Valleys in recent years. The mean incidence of the disease in the Murrumbidgee Valley increased to over 17% in the 2007/08 season.

Increasing Incidence of Verticillium Wilt in the Namoi Valley? Is it a trend?

In March-April 2008, the mean incidence of Verticillium wilt across NSW was 11.2% of plants affected (4.9% and 3.4% in the previous two seasons). This result included the incidence of Verticillium wilt in the Namoi Valley, where it was estimated that 28.9% of plants were affected (10.4% and 10.1% in the previous two seasons).

This significant increase in disease incidence resulted from the cool conditions experienced during the 2007/08 season. In cotton production areas the monthly average maximum temperatures during summer were up to 8^0C below the long term averages. The host plant resistance to Verticillium wilt in Australian cotton varieties is temperature sensitive and resistant varieties become susceptible in cool seasons. In the Verticillium wilt nursery at the Australian Cotton Research Institute near Narrabri the mean incidence of Verticillium wilt in Sicala V2 was 49% in 2006/07 and 85% in 2007/08. There were 401 less day-degrees accumulated during the 2007/08 season than during the 2006/07 season.

Increasing/Decreasing(?) Adoption of Farm Hygiene Practices

The adoption of farm hygiene practices minimizes the chance of introducing, or further dispersing, pathogens, pests and weeds. There has been a suggestion that some growers, contractors and consultants are becoming complacent and argue that “black root rot and Fusarium wilt are everywhere anyway!”

Decreasing use of the FREE Fusarium diagnostic service provided by QDPI&F

Relatively fewer samples are being submitted to the QDPI&F staff at Indooroopilly for confirming a diagnosis of Fusarium wilt. Most samples submitted are negative for Fusarium wilt and many farmers have been concerned unnecessarily. Alternatively, an early diagnosis allows the initiation of strategies that will minimise further spread of the pathogen.

Emergence of New Diseases

Tobacco Streak Virus (TSV) has emerged as a significant problem for sunflower and mung bean growers in Central Queensland. According to Dr Murray Sharman of the QDPI&F at Indooroopilly, TSV is widespread in cotton but probably of minor importance. The virus is present in most populations of parthenium weed and is transferred to cotton in pollen carried by thrips.

Anthracnose, which is caused by *Colletotrichum capsici*, has been recognized on cotton in Queensland for many years. It is commonly associated with boll rot and tight-lock symptoms that occur when maturing bolls are exposed to wet weather. *Colletotrichum capsici* was found on bolls collected from farms in the Gwydir, Namoi, Macquarie and Lachlan Valleys of NSW during the annual 2007/08 disease survey. Previously, the only record of this pathogen in NSW was a 1923 report from Richmond near Sydney.

Increasing Diversity of Rotation Crop Options

Winter Cereals

Wheat, or winter cereals, has been the most common rotation crop option used by cotton growers in Australia. There is evidence that the pathogen that causes Fusarium wilt of cotton can increase on cereal residues just as quickly as it increases on cotton. If Fusarium wilt of cotton is present, then cereal residues should be incorporated as soon as possible after harvest, so that they can break down quickly. Alternatively, cereal residues could be baled or burnt.

Legumes

There is considerable interest in incorporating, either summer, or winter, legumes into the cotton rotation. Pigeon pea has been commonly used for insect management in cotton. Legumes are alternative hosts for the black root rot pathogen and legume residues are an ideal substrate for increasing Fusarium wilt of cotton. Seedling diseases caused by *Pythium* sp. and *Rhizoctonia* sp. may be more severe following legumes.

Legumes, Sorghum and Canola

Various market forces and currency exchange rates, as well as prevailing weather patterns, have contributed to an increased diversity of rotation crop options. Allelopathy and the herbicides used on these rotation crops may impact on cotton seedling vigour. The incorporation of fresh or unweathered, residues of sorghum, canola and many legumes can have significant deleterious, allelopathic effects on germinating cotton seedlings. Allelopathy is the inhibitory effect of one plant against another.

Increasing interest / use of overhead irrigation

Cotton plants grown under lateral move or centre pivot irrigation have a root distribution pattern which differs from that produced under furrow irrigation (Table 1). Secondary root development is more prolific in the top 15cm of the soil profile. Common crop residue management practices place crop residues, and consequently pathogen inoculum, in the top 15cm of the soil profile.

Table 1. – A comparison of secondary root distribution under furrow and lateral move irrigation systems. (Number and length of secondary roots are a mean of five plants)

	Furrow	**Lateral move**
Fresh weight secondary roots in top 15cm mid furrow(9cm core)	0.27g	1.11g
No. of secondary roots attached to top 5cm of tap root	11.6	25.2
Length of secondary roots attached to top 15cm of tap root	83.2cm	208cm

Previous work with Fusarium wilt of cotton showed that pathogen inoculum was concentrated in the top 16cm of the soil profile and plant survival was reduced by 70% when a mulch was used to encourage shallow root development.

Will the use of lateral move and centre pivot irrigation systems result in a higher incidence of black root rot, Verticillium wilt and/or Fusarium wilt?

Positive trends

Increasing host plant resistance to Fusarium wilt

Cotton breeding teams have made significant progress in increasing the host plant resistance to Fusarium wilt. Conventional and Bollgard varieties with F.ranks in excess of 130 are now available to cotton growers.

Global warming?

If global warming means higher temperatures then the incidence and severity of seedling diseases, black root rot, Verticillium wilt and Fusarium wilt should decline?

Increasing awareness of soil ecology and the importance thereof

The current significant diseases affecting cotton are soil borne and the increasing distribution and incidence of Fusarium wilt and black root rot drew attention to the importance of issues such as 'soil health', then soil biology, and finally soil ecology which combines soil biology, chemistry and physics. Numerous products and strategies have been promoted and a major research effort has been initiated. This effort includes attempts to relate variation in disease incidence to variations in soil parameters such as electric conductivity, sodium and the Ca/Mg ratio.

We must remember that plant pathogens are the weapons of a 'healthy' soil defending itself against an imposed monoculture and restoring greater biodiversity. The control of soil borne diseases is not an issue of correcting a soil imbalance but a challenge to adjust the ecological balance to the detriment of the pathogen.

Increasing surveillance and biosecurity awareness

Plant Health Australia along with the cotton industry has developed a Cotton Biosecurity Plan which identifies the most significant exotic pests and pathogens that threaten Australian cotton production. Apart from planned responses to incursions the plan includes training to increase awareness of the priority pests and pathogens and increased surveillance in commercial crops. Hence, Texas root rot, cotton leaf curl virus, blue disease, defoliating Verticillium, hypervirulent bacterial blight and exotic Fusarium wilt are now listed on survey sheets for the annual survey.

Increasing acceptance of Integrated Disease Management

There are no single effective strategies for controlling black root rot, Verticillium wilt and/or Fusarium wilt of cotton. However, pathologists have identified a range of control strategies that each provide partial control. It may not be possible to apply all of the strategies listed for a particular disease but the application of those that can be applied will help reduce the impact of disease on the farm.

Acknowledgments

Researcher	Area of research	Institution/Location
Elizabeth Aitken Joy Conroy Jennifer Whan	Pathogenicity factors in Fov Defense responses in cotton	University of Queensland
Stephen Allen Greg McNamara	Disease surveys – Queensland Disease control strategies Integrated Disease Management	CSD/CSIRO, Narrabri
Chris Anderson	Disease surveys – NSW Seedling pathogens and Fusarium wilt	NSW DPI, Narrabri
Augusto Becerra Marc Ellis	Markers for resistance	CSIRO, Canberra
Robyn Heath Jillian Hinch James Mckenna Neil Forrester	Transgenics for disease control	Hexima Ltd University of Melbourne
Lily Pereg-Gerk Joelle Coumans-Moens Jason Moulynox	Black root rot – control strategies Host-pathogen interaction	University of New England
Alison Seyb	Soil ecology and black root rot Impact of lateral moves and centre pivots	NSW DPI, Narrabri
Murray Sharman Cherie Gambley	Tobacco Streak Virus Virology	QDPI&F, Indooroopilly
Linda Smith	Disease surveys – Queensland Fusarium wilt Diagnostic service Nutrition and Fusarium wilt	QDPI&F, Indooroopilly
Linda Scheikowsky	Disease surveys – Queensland Rotation crop options – Fusarium wilt	QDPI&F, Toowoomba
Bo Wang	Soil ecology and Fusarium wilt Population genetics Evolution of virulence	CSIRO, Canberra