AN UPDATE ON VERTICILLIUM WILT IN AUSTRALIA

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Abstract

Pathologists from the New South Wales (NSW) Department of Primary Industries have been monitoring the distribution, incidence and severity of diseases in commercial cotton fields in all the cotton production areas of NSW for 28 consecutive years. Quantitative data has been collected and stored in a disease survey data base that includes the incidence and severity of Verticillium wilt and black root rot. The increasing incidence of Verticillium wilt associated with the widespread adoption of reduced tillage practices prior to 1990 and the decreasing incidence of the disease following the release of cultivars with resistance to Verticillium wilt in 1990 was reported at the 1997 Beltwide Cotton Conference. Disease survey results since then suggests that the incidence of Verticillium wilt is increasing again in the Namoi Valley. Survey results also show that the incidence of black root rot has increased dramatically since 1999.

The recent observation that a high incidence of Verticillium wilt at the end of the season is commonly associated with a high incidence of black root rot early in the season suggests that there may be an interaction between the two pathogens. The control of Verticillium wilt in cotton requires management for earliness while black root rot delays crop maturity. The possible contribution of some tillage and irrigation practices is also discussed.

Introduction

The 2010/2011 cotton season marked the 28th consecutive year that bi-annual (early and late season) disease surveys have been conducted on commercial cotton crops (Bourke/Walgett, Macintyre Valley, Gwydir Valley, Namoi Valley, Macquarie Valley, Lachlan Valley and Murrumbidgee Valley) of NSW. Quantitative data on the distribution, incidence and severity of cotton diseases in NSW indicate the impact of the adoption of resistant varieties and other control strategies. Information gathered from these surveys has been compiled into a database that provides an invaluable resource for pathologists. Importantly, the results assist in prioritizing future research efforts, whilst also indicating the impact of farm management practices on disease incidence and severity. Disease survey results from Australia were reported at the 1997 Beltwide Cotton Conference for the season 1995-1996 (Allen & Lonergan, 1997). This paper presents an update on the Verticillium wilt since then.

Disease survey results indicate that the mean incidence of Verticillium wilt and black root rot caused by the pathogens *Verticillium dahliae* (Kleb.) and *Thielaviopsis basicola* (Berk. and Br.) Ferraris, respectively, is much higher in the Namoi valley than in any of the other production areas.

Verticillium Wilt

Allen and Lonergan, (1997, 1998) reported that the incidence of Verticillium wilt had reached a peak in the 1989/90 season when the incidence of the disease in NSW and the Namoi Valley was found to be 16.6% and 31.2%, respectively (Table 1). The increasing incidence of Verticillium wilt was associated with the widespread adoption of permanent bed systems and reduced tillage. The release and rapid adoption of high yielding commercial cultivars with resistance to Verticillium wilt resulted in a significant decline in the incidence of the disease over the next 10 years. The mean incidence of Verticillium wilt for NSW and the Namoi Valley in the 1998/99 season were found to be 2.9% and 3.6%, respectively. The reduction in wilt incidence in fields in the Namoi Valley, where disease incidence was previously very high, was outstanding.

Since 1998/99 the incidence of Verticillium has increased (Figure 1). In the 2010/11 season the mean incidence of Verticillium wilt in the Namoi valley was 13.1% compared to 4.1% for all of NSW.

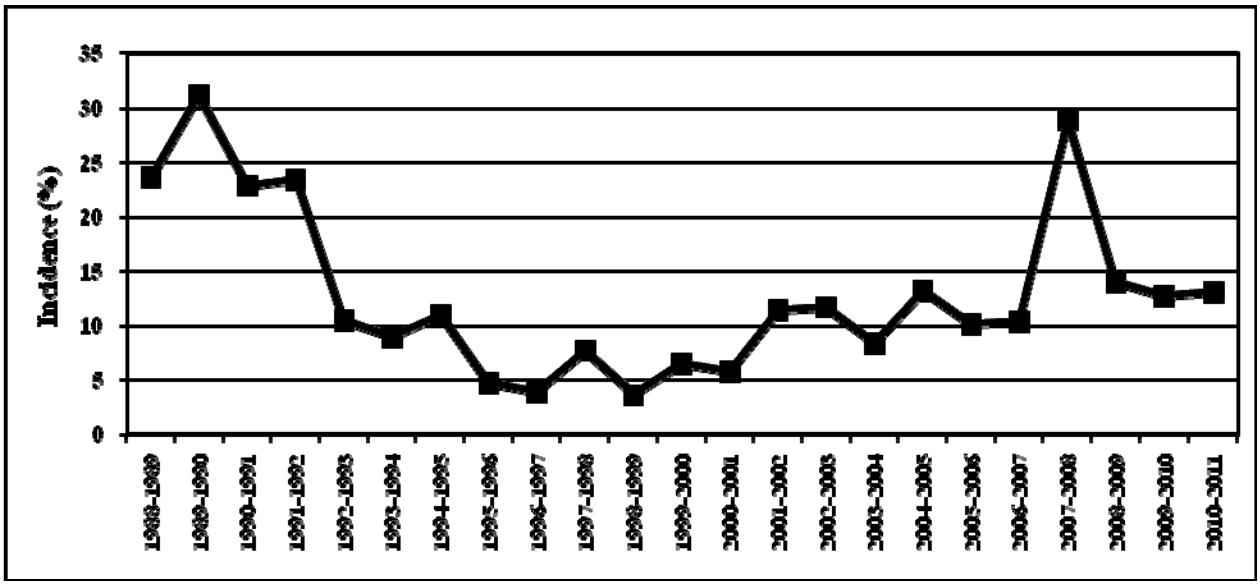

Figure 1. The incidence of Verticillium wilt (%) in commercial cotton fields grown throughout the Namoi Valley region of Australia.

Black Root Rot

Black root rot in cotton is caused by the soil-borne fungus *Thielaviopsis basicola* (Berk. & Br.) Ferraris. The disease was first recorded in Australian cotton in 1989 (Allen, 1990) and by 2002, was established on 97% of cotton farms surveyed in NSW (Nehl et.al 2004). The incidence of black root rot has risen significantly over the past 10 years (Figure 2). Black root rot is widespread and found in all major cotton growing regions within NSW. The disease was found in all fields that were inspected in the Namoi Valley during the 2010/11 season with a mean incidence of 80% of plants affected.

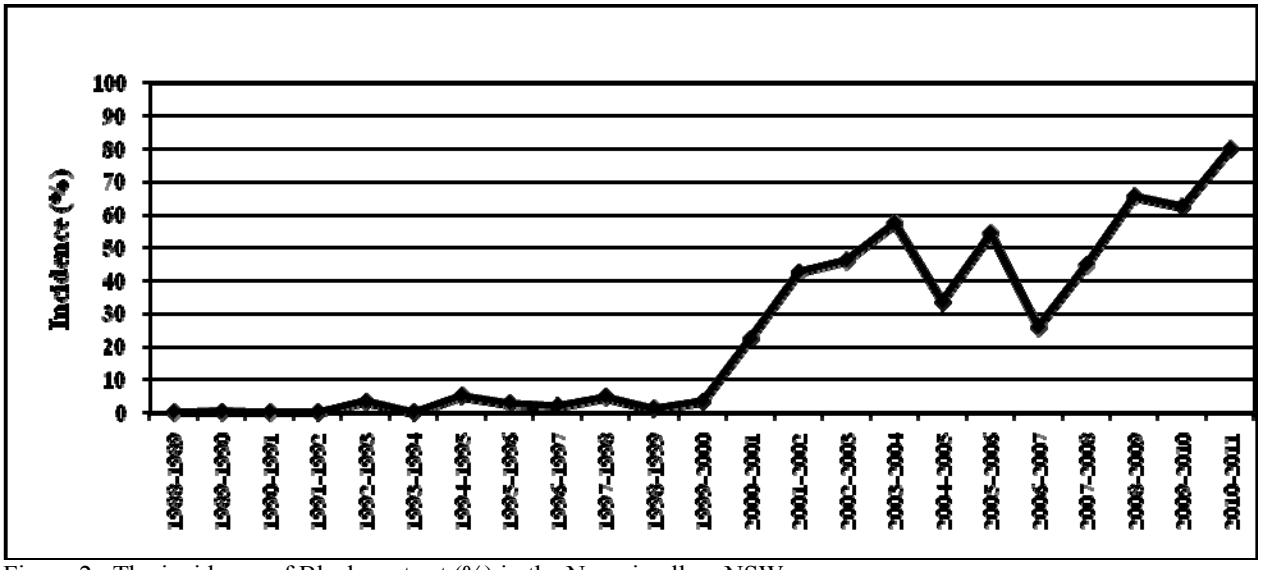

Figure 2. The incidence of Black root rot (%) in the Namoi valley, NSW.

A possible interaction?

Disease surveys early in the season provide an opportunity to assess the incidence of black root rot. Disease incidence and severity are determined for 200 seedlings in each field surveyed using the step-point method described by Nehl et. al., (2004). The incidence of Verticillium wilt is estimated by inspecting 200 plants during the survey at the end of the season just prior to defoliation. Data from field transects are collected at a similar time to the disease surveys. A transect is a set track across a field located by GPS reference to enable repeated assessments

along the same track season after season. Ten plants are inspected in every tenth row across the entire field at each assessment.

Results from disease surveys and field transects in commercial cotton fields (Table 1) have shown that a high incidence of Verticillium wilt at the end of the season frequently corresponds with a high incidence of black root rot early in the season. Data for Table 1 was collected from the Namoi Valley in 2008/09, 2009/2010 and 2010/2011 seasons.

Table 1. Field transect and disease survey results for typical commercial cotton fields in the Namoi Valley during the 2008/09, 2009/10 and 2010/11 seasons showing a high incidence of Verticillium wilt at the end of the season and a high incidence of Black root rot at the beginning of the seasons.

Season	Assessment	Black root rot (%)	Verticillium wilt (%)
2008/09	Field transect	52	49
2008/09	Field transect	100	45
2009/10	Field transect	99	83
2009/10	Disease survey	95	85
2009/10	Disease survey	100	52
2010/11	Disease survey	97	71
2010/11	Disease survey	68	41

Black root rot is most apparent early in the season and can significantly reduce seedling growth. Control strategies for black root rot include delayed planting to avoid cool conditions early in the season and crop management to allow affected plants to 'catch up' late in the season (Kirkpatrick & Rothrock, 2001). Verticillium wilt is particularly significant late in the season when it is favoured by cool autumn temperatures. The control of Verticillium wilt requires crop management for earliness (Kirkpatrick & Rothrock, 2001). When a crop is affected by both Black root rot and Verticillium wilt the slow early season growth caused by black root rot contributes to delayed maturity that exposes the crop to conditions that are more favourable to Verticillium wilt.

This observation raises the question: Does the delayed maturity resulting from the presence of both black root rot and Verticillium wilt result in higher levels of inoculum in the soil and consequently an increasing incidence of Verticillium wilt? Research efforts will focus on this question. It will be necessary to determine the delays in development and maturity and to monitor soil inoculum concentrations for both diseases and the pathogens that cause them.

Other possible explanations?

Cotton growers in the Namoi Valley, who have changed their irrigation systems from the traditional furrow irrigation system to an overhead lateral move system, have noticed that Verticillium wilt has become more apparent. Observations on the distribution of roots under the two irrigation systems (Figure 3) indicate a proliferation of root development in the top 15cm of the soil profile with overhead irrigation compared to furrow irrigation. An irrigation system that encourages root development in that part of the soil profile where inoculum concentrations are highest could be expected to favour increased disease development.

Disease survey results over the last 15 seasons do confirm a significant increase in the incidence of Verticillium wilt under overhead irrigation. However, removing the few results from fields with overhead irrigation did not remove the trend to increasing incidence of Verticillium wilt.

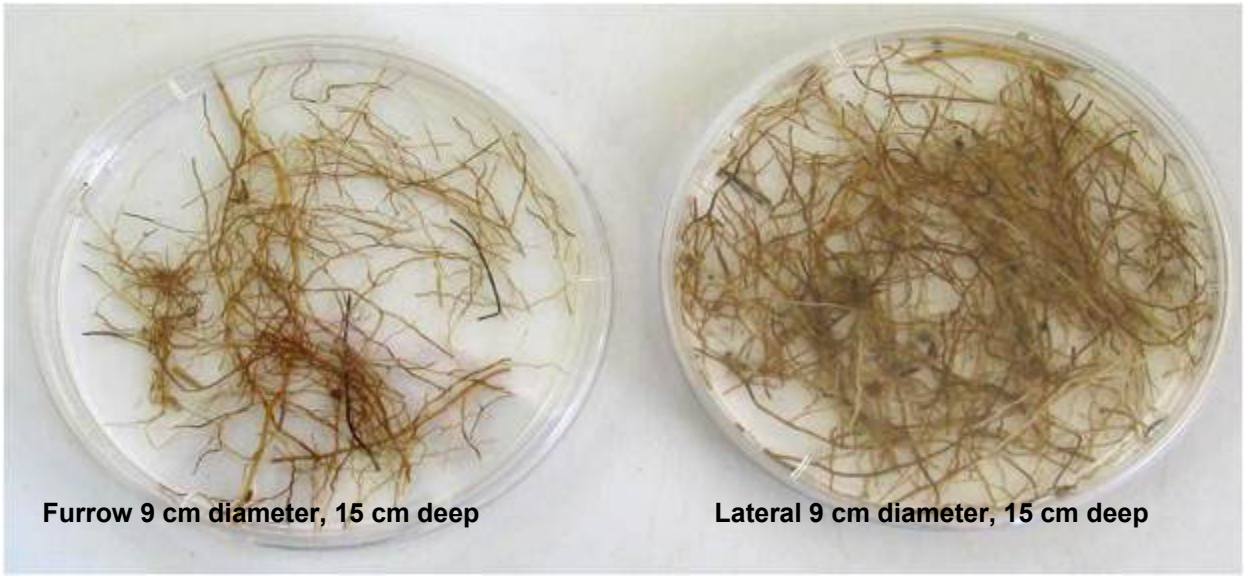

Figure 3. Comparison of root development of cotton plants grown under furrow irrigation (left) and lateral irrigation systems (right).

Acknowledgements

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