THE INCREASING DISTRIBUTION AND INCIDENCE OF FUSARIUM WILT OF COTTON IN AUSTRALIA

S. J. Allen
Cotton Seed Distributors Ltd.
Narrabri, NSW Australia

Abstract

The results of annual disease surveys indicate that Fusarium wilt of cotton is not spreading as fast as it was when first reported. The use of more resistant varieties, unfavorable seasonal conditions and improved farm hygiene may be contributing to this slower distribution. The increasing incidence of Fusarium wilt has been monitored annually in six commercial cotton fields. The impact of various farming practices and the influence of seasonal weather conditions on disease incidence is apparent.

Introduction

Fusarium wilt of cotton (*Fusarium oxysporum* f.sp. *vasinfectum*) was first reported in Australia in 1993 (Kochman, 1995). By 2003 it was being suggested that the disease would be affecting 90% of farms in NSW by 2010 (Allen, 2007). The results of the 2007/2008 disease survey confirm that the progress of the epidemic has slowed considerably. Fusarium wilt has now been confirmed on only 40% of farms surveyed in NSW (Allen et al., 2008). There have been only eight new reports of Fusarium wilt in NSW in the last five seasons and only six new reports of the disease in Queensland over the same period.

Factors that may have contributed to this slower spread of the disease include the use of more resistant varieties, the impact of drought and substantial improvements in farm hygiene. Originally, Sicot 189 was the variety with the highest level of resistance to the Fusarium wilt pathogen. All varieties now available are more resistant than Sicot 189. Severe drought has affected Australian cotton production for the last six seasons with the area sown to cotton reduced by an average of approximately 60%. When irrigation water is limited then cotton growers are less likely to plant in fields with disease problems. Australian cotton growers are generally aware that plant pathogens and weeds can be dispersed in soil and crop residues attached to vehicles and machinery. Most growers have established wash-down areas to enable vehicles and machinery to 'GO CLEAN' and 'COME CLEAN' when moving between farms.

The distribution of a disease describes its geographic spread while the incidence of a disease is the proportion of plants with symptoms of the disease. Monitoring the incidence of a disease over time provides an indication of the effect of seasonal weather and the impact of farming practices and disease control strategies employed by the grower.

Materials and Methods

Changes in the incidence of Fusarium wilt over several seasons were monitored for each of six commercial cotton fields. The stems of ten plants in every tenth row along a set path or 'transect' across each field, were split open and the incidence of the disease was assessed based on the presence or absence of vascular browning. The position of each transect was defined by distance from either the 'head ditch' (irrigation channel supplying water to the field) or the 'tail drain' (drain for removing excess water from the field) and all transects were perpendicular to the planted rows. The location, in-field position and length of transects are indicated in Table 1. Disease assessments were completed at crop maturity (after the final irrigation and before defoliation).

Results and Discussion

The results for each of the six transects is presented in Table 1 and further information for each of the locations is provided below. Morella, Theodore and Ashwood have always had sufficient water to meet irrigation requirements and the cooler weather conditions during the 2007/2008 season favoured the development of symptoms of Fusarium wilt. Northcote, Mundine and Alcheringa have been subject to several drought-enforced fallows with no crop planted.

Table 1. The location, in-field position and length of transects established in six commercial cotton fields to monitor the changing incidence of Fusarium wilt and the cropping sequence (where known) and incidence of Fusarium wilt in those cotton crops where assessments were made. The stems of ten plants, in every tenth row, along the transect, were split open and assessment of disease incidence was based on either presence or absence of vascular browning.

Farm/field	Morella E2	Theodore	Ashwood 4	Northcote 14	Mundine 10	AlcheringaC4
In-field position	300m (tail)	50m (tail)	200m (head)	50,150,300m	50m (tail)	50m (tail)
Transect length	1760m	150m	510m	3 x 200m	850m	420m
1994/1995	cotton 12.3%	*	*	*	*	*
1995/1996	barley fallow	*	*	*	*	*
1996/1997	Long fallow	*	*	*	*	*
1997/1998	Cotton 3.4%	*	*	*	Cotton 9.3%	Cotton 20.0%
1998/1999	Cotton 5.6%	Cotton 0.1%	*	*	Cotton 13.0%	Cotton 52.1%
1999/2000	Cotton 13.1%	Cotton	*	Cotton >50%	Legume incorporated	Cotton 41.0%
2000/2001	Cereals Legumes	Cotton	*	Summer Flood	Cotton 18.0%	*
2001/2002	Cotton 12.2%	Cotton	*	Cotton 0.8%	Cotton 34.5%	Soybean
2002/2003	Fallow	Cotton	*	Cotton 1.9%	Long fallow No crop	Cotton 43.1%
2003/2004	Cotton 8.9%	Cotton	*	Barley Fallow	sorghum	*
2004/2005	Cereal Fallow	Cotton 0.7%	*	Cotton 9.5%	Long fallow No crop	Cereal fallow
2005/2006	Cotton 10.6%	Cotton	Cotton 0.1%	Cotton 9.8%	Cotton 5.8%/14.8%	Cotton 5.2%
2006/2007	Barley fallow	Cotton 0.7%	Cereal fallow	Cotton 9.2%	Long fallow No crop	Long fallow No crop
2007/2008	Cotton 19.0%	Cotton 6.7%	Cotton 19.4%	Long fallow No crop	Long fallow No crop	Sorghum

* - no record

Morella E2

The first report of Fusarium wilt in NSW was from Morella E2 in 2004/2005. An estimated 12.3% of plants were found to be infected in a susceptible variety. Rotation through a barley crop and 23 months of bare fallow plus the use of a more resistant variety resulted in a reduction in disease incidence, to only 3.4%. After three consecutive crops of cotton the incidence had risen to 13.1%. The grower then instituted a crop rotation strategy with cotton grown only in every second year. The incidence of Fusarium wilt has varied between 9% and 19% in the last 4 cotton crops.

Theodore

In 1998/1999, when the first small patch of plants was observed, the grower established a protocol to restrict further spread of the pathogen. The affected area was prepared last, planted last and cultivated last. All machinery was cleaned after working in the affected area. Irrigation water was limited to minimise run-off from the affected area. Despite continuous cropping to cotton there was negligible spread of the disease until this last season when there was a ten-fold increase in incidence.

Ashwood 4

Several small patches of infected plants were observed in the 2005/2006 crop. The incidence of Fusarium wilt increased to 19.4% in 2007/2008 despite a crop rotation strategy. It is likely that this rapid increase in disease

incidence has been facilitated by the adjacent water storage that collects contaminated water running off the field after an irrigation and then provides the same water for the subsequent irrigation of the affected field.

Northcote 14
Flooding the field in the summer of 2000/2001 significantly reduced, but did not eliminate, Fusarium wilt from the field. Transects were established at 50, 150 and 300m from the head ditch. Only 0.8% of plants were infected in the first crop of cotton after flooding, increasing to 1.9% in the second crop. Despite a barley fallow rotation the incidence increased five-fold in the following season to 9.8%. There has been no further increase in disease incidence in the last two seasons.

Mundine 10
Fusarium wilt was first reported in Mundine 10 in the1997/1998 season. After four crops of cotton in five seasons the incidence of Fusarium wilt had increased to 34.5%. After three years of drought-enforced bare fallows and a sorghum crop the field was divided into two and planted to the resistant cotton variety, Sicot F1 and the moderately resistant variety, Sicot 71. Disease incidence was found to be 5.8% and 14.8% respectively.

Alcheringa C4
Consecutive crops of cotton allowed Fusarium wilt to become well established in this field. A two-year crop rotation that included a crop of soybean did not reduce the incidence of the disease. A further two-year crop rotation and the application of an integrated disease management strategy (use of the resistant variety – Sicot F1, delayed planting and seed treatment with Acibenzolar-S-methyl) resulted in the disease incidence being reduced from 43.1% to 5.2%.

The use of resistant varieties such as Sicot F1 can provide significant control of Fusarium wilt. Unfortunately the variety is not popular because it is a conventional variety and has a lower yield potential than other varieties. Cotton breeders are trying to develop high-yielding, transgenic varieties with the same level of resistance.

Summary

The distribution of Fusarium wilt of cotton in Australia continues to expand, though at a much slower rate than originally projected. The use of more resistant varieties, the impact of drought and the widespread adoption of better farm hygiene have been suggested as possible reasons for this slower spread.

The rate of increase in the incidence of the disease in individual fields has been affected by various factors including, seasonal weather, crop rotation strategy, and variety selection. In some fields there has been a more than ten-fold increase in disease incidence in the last few seasons while in those fields where an integrated control strategy has been applied there has been significant reductions in disease incidence.

While the use of transects to monitor changes in disease incidence over time in individual fields does not provide data equivalent to that produced by replicated field experiments, it does provide useful information on the progress of an epidemic and does give some direction in planning the research effort and control strategies.

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