

# Cotton pathology 2012–13

KA Kirkby<sup>1</sup>, PA Lonergan<sup>1</sup>, BR Cooper<sup>1</sup>, SE Roser<sup>1</sup>,  
LJ Smith<sup>2</sup>, LJ Scheikowski<sup>3</sup>, B Bauer<sup>2</sup>, J Lehane<sup>3</sup> and  
SJ Allen<sup>4</sup>

<sup>1</sup>NSW DPI, Locked Bag 1000, Narrabri NSW

<sup>2</sup>DAFF Queensland, Ecoscience Precinct, GPO Box 46, Brisbane, Qld

<sup>3</sup>DAFF Queensland, 203 Tor Street, Toowoomba, Qld

<sup>4</sup>Cotton Seed Distributors Ltd., PO Box 17, Wee Waa NSW

Commercial cotton crops across NSW and Queensland were inspected in October–December 2012 and February–April 2013. The incidence and severity of those diseases present were assessed and field history, ground preparation, cotton variety, planting date and seed rate were recorded for each of the 112 and 48 fields that were surveyed in NSW and Queensland respectively. This represents the 30th consecutive season of quantitative disease surveys of cotton in NSW and the 11th consecutive season of cotton disease surveys in Queensland. Daily maximum temperatures were well above average from planting through to the end of January, 2013 and then average or below average from February to harvest. The daily maximum temperature exceeded 45°C in many areas in mid-January, 2013. At Bourke, in western NSW, temperatures exceeded 35°C on 111 days and over 45°C on 24 days between 1st October, 2012 and 20th April, 2013.

In contrast the cold spell and rainfall that occurred in NSW cotton production areas on 11th and 12th October, 2012 interrupted planting and produced problems with stand establishment. Widespread rainfall in late January, associated with Cyclone ‘Oswald’, was accompanied with a drop in daily maximum temperatures. The cooler weather was further accompanied by above average rainfall in February and March, 2013.

The incidence and severity of plant diseases is determined by environmental conditions. The cooler and wetter 2011/2012 season favoured the appearance of Sclerotinia stem and boll rot, severe Verticillium and Fusarium wilt and problems with boll rot in central Queensland. The hot and dry conditions experienced during much of 2012/2013 suppressed the development of most diseases of cotton. However, the cooler and wetter autumn weather did allow late development of severe Verticillium wilt.

## Volunteer cotton – (carry-over from the previous season)

Information on the occurrence of volunteer cotton was collected during the annual disease surveys and is based on visits to 54 farms in NSW and 21 farms in Queensland during October and December of 2012 (Table A). The number of farms with (1) mature cotton plants surviving along roadsides, fence lines, along channels and in tail water return systems or drains, (2) volunteer cotton in fallow or rotation fields and (3) mature cotton plants surviving from the previous season or regrowth

from stubs (Ratoon cotton?) in current cotton crops, were recorded.

The presence of volunteer plants surviving over from the previous season enables pests and pathogens such as aphids, mealy bug and cotton bunchy top to overwinter and initiate new outbreaks in the spring. Volunteer cotton plants were observed on 59 of the 75 farms visited during the disease surveys (79%).

## Cotton Industry Biosecurity Plan – Crop Surveillance for Priority Pests

*During these surveys particular attention was given to surveying fields for the presence/absence of exotic diseases including Cotton Leaf Curl Virus, Blue disease, Phymatotrichopsis (Texas) root rot, the hypervirulent strains of the bacterial blight pathogen, the defoliating strains of the Verticillium wilt pathogen and exotic strains of the Fusarium wilt pathogen. None of these diseases and/or pathogens were observed.*

## Seedling mortality

As part of the disease survey an estimate of the number of seeds planted per metre is compared to the number of plants established per metre. This comparison produces an estimate of seedling mortality which includes the impact of seedling disease (Rhizoctonia and Pythium etc.) as well as seed viability, the activity of soil insects such as wireworms, physical problems such as fertiliser or herbicide burn and the effects of adverse environmental conditions.

Mean seedling mortality (Figure 1) for the crops inspected in NSW and Queensland was 32.1% and 26.6% respectively in the 2012–13 season, (32.3% and 29.6% in 2011–12 and 31.9% and 25.8% in 2010–11).

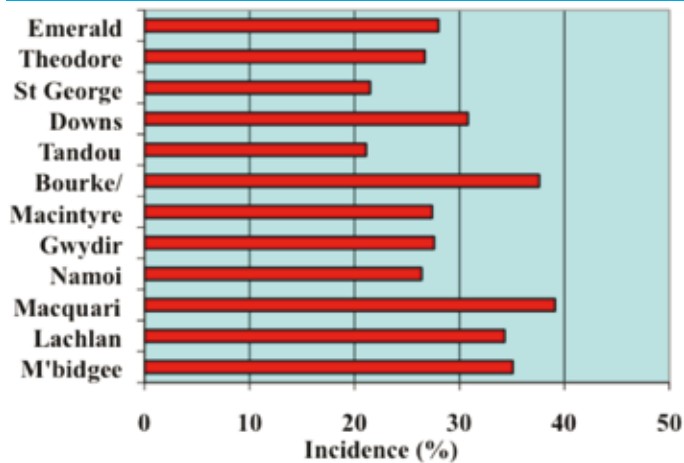
Mean seedling mortality was lowest (21.1%) in the Tandou and St George/Dirranbandi areas and highest in-crops in the Macquarie Valley (39.1%) and Bourke/Walgett (37.6%). Problems with crop establishment included wireworm, symphlids, the necessity to flush irrigate while seedlings were still emerging, uneven moisture in the seed bed resulting from rain prior to planting as well as the activity of the seedling disease pathogens.

In southern NSW the most affected fields were those that were either sown into moisture or watered up on 5th and 6th October, 2012 and then received rainfall on 11th and 12th October along with daily minimum soil temperatures < 12°C between 11th and 14th October. The mean seedling mortality in these fields was approximately double (50.5%) that observed in other fields planted either before or after 5th and 6th October, 2012.

**TABLE A: The occurrence of volunteer cotton plants surviving from the previous season on farms in NSW and Queensland in the spring of 2012**

	1. Along channels, roads, fences	2. In fallows and rotation crops	3. In the current crop (regrowth from stubs)	TOTAL
In NSW	22/54 (41%)	13/49 (26%)	40/54 (74%)	44/54 (81%)
In Qld	11/21 (54%)	2/21 (9%)	11/21 (54%)	15/21 (71%)
Total	33/75 (44%)	15/70 (21%)	51/75 (43%)	59/75 (79%)

**FIGURE 1: Mean seedling mortality in the 2012/13 season. Seedling mortality is derived from the difference between the number of seed planted and the number of plants established.**



### Fusarium wilt

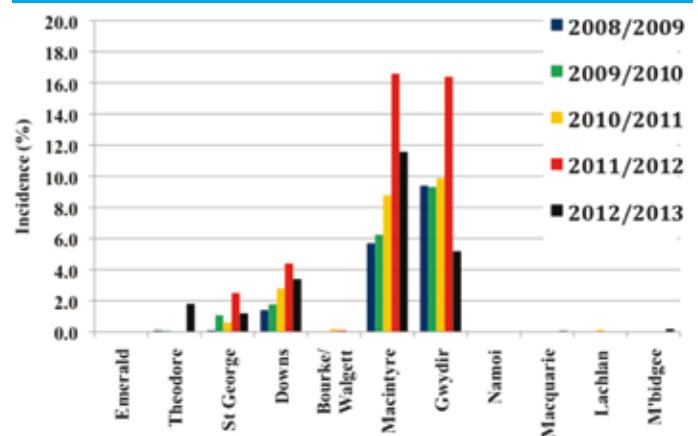
Fusarium wilt (*Fusarium oxysporum* Schlecht f.sp. *vasinfectum* Atk. Sny. & Hans.) is most severe when October/November rainfall is above normal and when temperatures are below normal – as was experienced during the 2011–12 season. The disease is least severe when it is hot and dry in spring. The widespread adoption of the new, more resistant, varieties reduced the potential impact of the disease. Fusarium wilt was again obvious during early season surveys. Later in the season common symptoms included gaps in the stand, stunted growth and a dark brown discoloration of the vascular tissue in the stem. Wilting, dead and dying plants were not always present as was observed in previous years with more susceptible varieties. There was one new report of Fusarium wilt ('Downs' strain) on a farm in the Murrumbidgee Valley. This new report was confirmed by Dr Linda Smith (DAFF Queensland) who provides a free, confidential diagnostic service for Fusarium wilt of cotton funded by the Australian cotton industry. This represents the first report of Fusarium wilt of cotton in the Murrumbidgee Valley.

Fusarium wilt was observed in 18 of the 112 crops surveyed in NSW including nine of the 12 crops inspected in the Macintyre Valley and seven of the 14 crops surveyed in the Gwydir Valley. The incidence of Fusarium wilt (Figure 2) averaged 11.6% and 5.2% (respectively), for these two production areas (16.6% and 16.4% in 2011–12; 8.8% and 9.9% in 2010–11) and exceeded 30% of plants affected in two of the 18 fields. Though Fusarium wilt is known to be present and widespread in the Macquarie Valley and the upper Namoi Valley it has not been prevalent in fields surveyed in any of the last four seasons.

It is interesting to note that black root rot was also present in 17 of the 18 fields in NSW where Fusarium wilt was recorded. The incidence of black root rot exceeded 40% in 11 of the 18 fields. The disease was observed in 20 of the 48 crops surveyed in Queensland including 11 of the 12 irrigated crops inspected on the Darling Downs. Fusarium wilt was not observed in the rain grown crops that were inspected. The incidence of Fusarium wilt averaged 3.4% and 1.2% respectively, for the Darling Downs and St George areas compared to 4.4% and 2.4% in the previous season (Figure 2).

Disease survey results over the last five seasons (Figure 2) reveal

**FIGURE 2: The mean incidence of Fusarium wilt of cotton in the five seasons from 2008-09 to 2012-13. Fusarium wilt is present in all cotton production areas listed.**



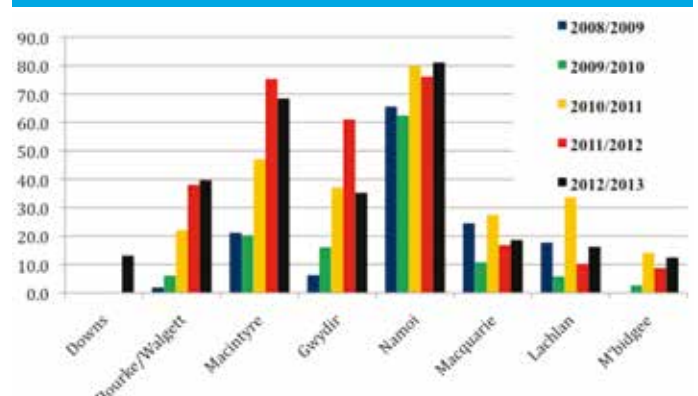
the impact of favourable weather conditions in the 2011–12 season and the trend in increasing disease incidence that is particularly evident in-crops surveyed in the Macintyre Valley and on the Darling Downs.

Transects have been established in fields near Emerald, Theodore, Moura, St George, Boggabilla, Moree, Boomi, Narrabri and Gunnedah. The incidence of Fusarium wilt is assessed along these transects in seasons when cotton is grown in these fields. Assessments during the 2012–13 season showed a decrease in disease incidence in eight of the ten transects. Factors contributing to this observed decrease include the use of varieties with the highest level of resistance and the less favourable hot seasonal weather conditions during the 2012–13 season compared to the cooler and wetter 2011–12 season.

### Black root rot

Black root rot of cotton (*Thielaviopsis basicola* [Berk.] & Br.) is favoured by cool weather conditions early in the season. The pathogen colonises the root surface, suppresses the development of secondary roots and stunts seedling growth. When temperatures rise the tap root expands and the blackened root surface is sloughed off and disappears. Black root rot of cotton was apparent early in the 2012–13 season but the severity of symptoms declined with the above average spring temperatures – except where the warm temperatures caused seed beds to dry back too quickly and an extra irrigation was required to establish the crop.

**FIGURE 3: The incidence of black root rot of cotton in the five seasons from 2008-09 to 2012-13.**



Disease survey results over the last five seasons (Figure 3) reveal the impact of favourable weather conditions in the 2011–12 season and the trend in increasing disease incidence that is particularly evident in-crops surveyed in the Bourke/Walgett area, Macintyre Valley, Gwydir Valley and Namoi Valley.

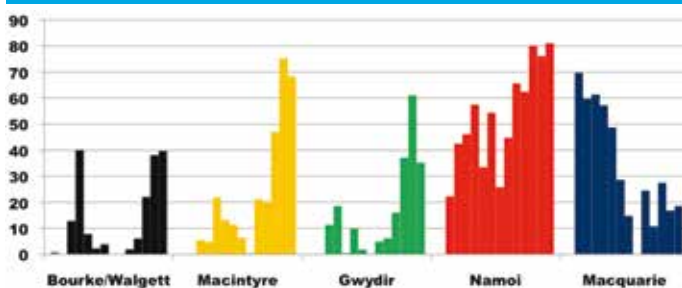
The average incidence of black root rot within fields was 40% for NSW. This included 48 fields where more than 50% of plants were affected and four fields in the Namoi Valley, three fields in the Macintyre Valley, one field in the Murrumbidgee Valley and one field at Tandou where all plants were infected. The disease was found in all of the fields visited in the Namoi and Macintyre Valleys, 86% of fields surveyed in the Gwydir Valley; 64% of fields in the Bourke/Walgett area, 50% of fields in the Tandou area, Macquarie Valley and Lachlan Valley and 21% of fields in the Murrumbidgee Valley. Verticillium wilt was present in seven (78%) of the nine fields that had a high incidence of black root rot.

Assessment of disease severity is based on the proportion of each tap root that is blackened where '0' indicates healthy and '10' indicates 100% of the tap root blackened. The mean severity of black root rot for fields in the Namoi, Gwydir and Macintyre Valleys was 3.6, 1.1 and 3.5 respectively (3.0, 2.4 and 3.1 in 2011–12).

Black root rot has previously been recorded in all Queensland cotton production areas except the Burdekin. The disease was observed in eight of the 14 fields surveyed on the Darling Downs and two of the 15 fields surveyed in the St. George/Dirranbandi area. The mean incidence of black root rot in-crops on the Darling Downs was estimated to be 13.1%.

A review of the mean incidence of black root rot in the established cotton production areas of NSW since the 2000–01 season (Figure 4) indicates that black root rot was more prevalent in the Macquarie Valley than in the Namoi Valley prior to the drought years between 2003 and 2010. The reduced cropping and enforced long fallows during the drought resulted in a dramatic reduction in the mean incidence of black root rot. The impact of the drought was least severe in the Namoi Valley and most severe in the Bourke/Walgett area. As mentioned previously – during the last five seasons since the drought the incidence of black root rot has increased significantly.

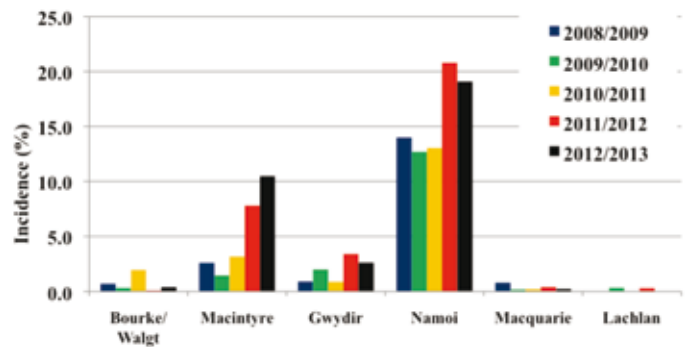
**FIGURE 4: The incidence of black root rot of cotton in NSW production areas in the 13 seasons from 2000-01 to 2012-13. The impact of the drought between 2003 and 2010 is very obvious.**



**Verticillium wilt**

Verticillium wilt (*Verticillium dahliae* Klebahn) is also favoured by cooler weather and is rarely observed in Queensland production areas. The disease was observed in 38% of fields surveyed in NSW during the 2012–13 season. However, the average incidence was only 5.3% of plants infected (Figure 5). This can be compared with average incidences of 6.8%, 3.7%,

**FIGURE 5: The distribution and incidence of Verticillium wilt of cotton 2008-09 to 2012-13. The disease was present in many areas but the incidence was generally low.**



3.8% and 4.1% in the 2011–12, 2010–11, 2009–10, and 2008-09 seasons (respectively). Symptoms of Verticillium wilt observed during the 2012–13 season were not as severe as those seen in the cooler and wetter 2011–12 season.

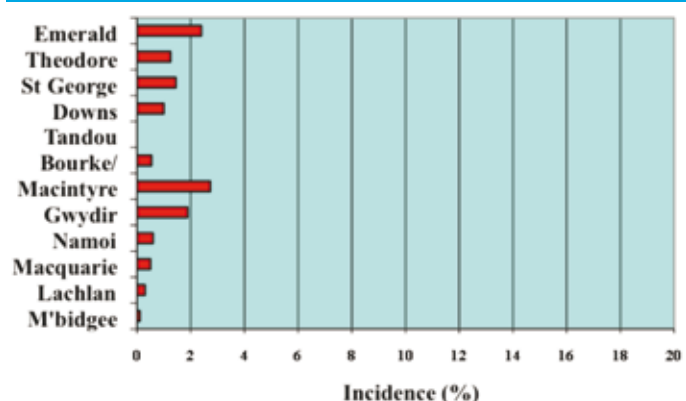
Verticillium wilt was observed in all of the fields surveyed in the Macintyre Valley during the 2012–13 season and the average incidence was 10.5% of plants affected (Figure 5). The disease was observed in 86% of fields surveyed in the Namoi valley, 57% of fields in the Gwydir Valley and 21% of fields in the Bourke/Walgett area where the average incidence of the disease was 19.5%, 2.6% and 0.6% (respectively). Two fields in the Namoi Valley had over 75% of plants with symptoms and both of these fields had been severely affected by black root rot earlier in the season.

The distribution and incidence of Verticillium wilt has increased significantly in-crops in the Namoi, Gwydir and Macintyre Valleys in the 2011–12 and 2012–13 seasons (Figure 5). The disease was observed for the first time in the Murrumbidgee Valley during the 2011–12 season.

**Boll rots**

The average incidence of boll rots in the 2012–13 season was recorded as 0.9% for NSW and 1.5% for Queensland; (1.6% and 6.8% in 2011–12; 0.7% and 2.7% in 2010–11; 9.7% and 7.3% in 2009–10). Only 2.6% of bolls were affected in-crops in the Macintyre Valley and 2.4% of bolls in-crops in the Emerald area. It should be remembered that the disease surveys are completed in February and the final incidence of boll rots at harvest may be significantly higher.

**FIGURE 6: The average incidence of boll rots in each of the cotton production areas for the 2012-13 season.**



The most common boll rot in NSW production areas is *Phytophthora* boll rot, which develops when soil is splashed up onto low opening bolls. Boll rots are most severe in Emerald and Theodore when opening bolls are subjected to extended periods of wet and cloudy weather and harvest is delayed. Rainfall in Emerald exceeded 2.0mm on only three days in January, 2013 and five days in February, 2013 compared to eleven days in January, 2012 and seven days in February, 2012. Despite the fact that many of the crops in the Emerald area were planted in September and early October, 2012 and bolls were maturing and opening in January, 2013 the mean incidence of boll rots (2.4%) was well below the mean incidence of boll rots observed in the previous season (16.7%).

### Reniform nematode

Stunted seedlings and roots with 'nodules' (Figure 7) were collected from fields near Theodore in Queensland during the annual disease survey in November, 2012. Nematologist Jenny Cobon of DAFF Queensland confirmed the presence of the reniform nematode (*Rotylenchulus reniformis*).

Subsequent intensive sampling has found the nematode to be widespread in the Theodore area. The reniform nematode had previously been observed in a field near Emerald during the November, 2003 disease survey and was still present in this and other adjacent fields in 2012–13. Reniform nematode is considered to be a major pest of cotton in parts of the USA.

### Other diseases and disorders

**Bunchy top** was observed in only two (4.2%) of the fields surveyed in Queensland production areas and in 31% of fields surveyed in NSW with the average incidence only 0.01% in Queensland and 1.7% in NSW. It was estimated that 24.5% of plants were affected in one field in the Walgett area of NSW.

**FIGURE 7: Egg sacks of the reniform nematode on seedling roots.** (Photo: Damien Erbacher)



**Seed rot** was observed in 23 of the 48 (48%) crops inspected in Queensland. The average incidence was only 0.4% although 4.5% of bolls were affected in one field near Emerald.

**Tobacco Streak Virus** was observed in two of the 11 crops inspected in central Queensland in November 2012. The incidence of the virus was very low.

**Alternaria leaf spot** was present at low levels in almost all crops and was generally of minor significance.

**Premature senescence** was noted in 29% of the crops surveyed in Queensland. However, the average incidence was only 0.7%.

**Sclerotinia boll and stem rot** was not observed during disease surveys in the 2012–13 season.

**Acknowledgments:** These surveys were made possible with the financial support of the Cotton Research & Development Corporation, Cotton Seed Distributors Ltd., NSW Department of Primary Industries and the Department of Agriculture, Fisheries and Forestry Queensland. The cooperation of cotton growers is greatly appreciated.

## Put your best foot forward.



## Come Clean Go Clean

Best Practice

**SENDING A SAMPLE FOR DIAGNOSIS BY A PATHOLOGIST – ATTACH A COMPLETED FORM TO EACH SAMPLE**

Collected/Submitted by: (e.g. Cotton Extension Officer)

Address/Email/Fax/Telephone:

Property name and field number:

Date collected:

Grower/Agronomist

Grower's address or area/locality:

Mark (X) as appropriate

SYMPTOMS	DISTRIBUTION	INCIDENCE/SEVERITY	CROP GROWTH STAGE
<input type="checkbox"/> Poor emergence or seedling depth	<input type="checkbox"/> One field only	<input type="checkbox"/> All plants	<input type="checkbox"/> Irrigated
<input type="checkbox"/> Leaves: spots or dead areas	<input type="checkbox"/> In several fields	<input type="checkbox"/> Scattered single plants	<input type="checkbox"/> Dryland/rain-grown
<input type="checkbox"/> Leaves: discoloured	<input type="checkbox"/> In all fields	<input type="checkbox"/> Scattered patches of plants	<input type="checkbox"/> Seedling stage
<input type="checkbox"/> Leaves: mottled	<input type="checkbox"/> One variety only	<input type="checkbox"/> In a large patch (>5 m)	<input type="checkbox"/> Setting squares
<input type="checkbox"/> Leaves or shoots: distorted or curled	<input type="checkbox"/> Several varieties affected	<input type="checkbox"/> In a small patch (1–5 m)	<input type="checkbox"/> Early flowering
<input type="checkbox"/> Plants stunted	<input type="checkbox"/> Some rows more affected	<input type="checkbox"/> In a small patch (<1 m)	<input type="checkbox"/> Peak flowering
<input type="checkbox"/> Plants wilting	<input type="checkbox"/> On lighter soil types	<input type="checkbox"/> Plants dead	<input type="checkbox"/> First bolls open
<input type="checkbox"/> Premature plant death	<input type="checkbox"/> On heavier soil types	<input type="checkbox"/> Plants defoliating	<input type="checkbox"/> Defoliated
<input type="checkbox"/> Bolls: spots or dead areas	<input type="checkbox"/> In poorly drained area(s)	<input type="checkbox"/> One to a few plants only	<input type="checkbox"/> Ready to pick
<input type="checkbox"/> Roots: discoloured, bent, pruned, etc.	<input type="checkbox"/> Other: (please specify)		

**OTHER INFORMATION**

- Cultivar .....
- Paddock History .....
- Nearby crops .....
- Rainfall in last 10 days .....
- Average temperature range over the last 10 years .....
- Date of last irrigation .....
- Date of last cultivation .....

**Please contact 02 6792 4088 for an Australian Cotton Industry Development and Delivery team member or district agronomist to determine the appropriate Pathologist and address for submitting sample**

**IF FUSARIUM WILT IS SUSPECTED, SAMPLES MUST BE SENT TO:**

**Qld DAFF Ecoscience Precinct – contact Linda Smith, Ph 07 32554356, Email: linda.smith@daff.qld.gov.au**

When sending samples:

- Send multiple samples (e.g. more than 1 leaf, stem or plant).
- If possible include a healthy plant as well as the diseased plant material.
- It is better to despatch samples early in the week rather than just before the weekend.
- Never wrap samples in plastic. Dry or slightly dampened newspaper is better.
- When collecting seedlings – dig them up rather than pull them out. Include some soil.
- Several sections of stem (10–15 cm long) are usually adequate for wilt diseases.
- Keep the sample cool and send as soon as possible.