Cotton Pathology 2011-2012

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Commercial cotton crops across NSW and Queensland were inspected in November-December 2011 and February-April 2012. Crops in North Queensland were inspected in January and May, 2012. 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 100 and 66 fields that were surveyed in NSW and Queensland respectively. This represents the 29th consecutive season of quantitative disease surveys of cotton in NSW and the 10th consecutive season of cotton disease surveys in Queensland.

The 2011/2012 season featured mean daily maximum temperatures (Table 1) and mean daily minimum temperatures (Table 2) that were below normal in most cotton production areas in December, January and February - particularly in December! Monthly rainfall throughout the season was above average for most areas (Table 3) and many fields in NSW cotton production areas were subjected to flooding. The incidence and severity of those diseases of cotton observed in the 2011/2012 season can generally be explained by the weather patterns experienced.

Cotton growers that have been impacted by the extremely severe symptoms of Verticillium wilt, the increasing incidence of Fusarium wilt, the surprise occurrence of Sclerotinia and or the prevalence of boll rots and leaf spots can be confident that a more 'normal', hotter and drier season next year would reduce the incidence and severity of these diseases.

Table 1. Difference (^{0}C) from the long term mean daily maximum temperature for December 2011, January 2012 and February 2012.

	Dec. 2011	Jan. 2012	Feb. 2012
Emerald	**- 2.4**	**- 0.7**	**- 0.4**
Dalby	**- 3.0**	**- 1.3**	**- 0.2**
St George	**- 5.6**	**- 2.7**	**- 3.4**
Goondiwindi	**- 3.6**	**-.2.9**	**- 0.6**
Moree	**- 4.8**	**- 3.2**	**- 3.4**
Narrabri	**- 4.9**	**- 3.0**	**- 2.5**
Trangie	**- 3.6**	**- 1.8**	**- 2.5**
Hillston	**- 0.7**	**- 0.9**	**- 1.7**

Source: Australian Government Bureau of Meteorology 'Climate Data Online'

Table 2. Difference (^{0}C) from the long term mean daily minimum temperature for December 2011, January 2012 and February 2012.

	Dec. 2011	Jan. 2012	Feb. 2012
Emerald	**- 1.2**	**- 1.1**	**- 0.8**
Dalby	**- 1.5**	**- 1.0**	**- 0.8**
St George	**- 2.0**	**- 1.7**	**- 1.9**
Goondiwindi	**- 1.3**	**- 1.1**	**- 0.5**
Moree	**- 0.6**	**+ 0.2**	**- 0.4**
Narrabri	**- 1.5**	**- 1.8**	**- 1.0**
Trangie	**- 1.8**	**- 1.7**	**- 1.5**
Hillston	**+ 0.2**	**- 0.1**	**- 1.6**

Source: Australian Government Bureau of Meteorology' Climate Data Online'

Table 3. Difference (mm) from the long term average monthly rainfall.

	Oct. 2011	Nov. 2011	Dec. 2011	Jan. 2012	Feb. 2012	Mar. 2012
Emerald	**- 16.7**	**+ 1.6**	**+ 30.7**	**+ 42.1**	**+ 1.7**	**+ 109.9**
Dalby	**+ 57.2**	**- 38.6**	**- 39.5**	**- 27.7**	**- 6.0**	**+ 6.0**
St George	**+ 11.2**	**+ 122.2**	**+ 26.0**	**+ 33.6**	**+ 153.8**	**-47.4**
Goondiwindi	**+ 41.2**	**+ 19.6**	**+ 91.8**	**+ 54.6**	**- 39.2**	**-26.8**
Moree	**+ 24.2**	**+ 169.2**	**+ 77.8**	**+ 64.2**	**+ 139.4**	**- 49.0**
Narrabri	**- 6.6**	**+ 88.8**	**+ 49.8**	**+ 85.6**	**+ 143.7**	**- 47.0**
Trangie	**+ 41.2**	**+ 38.0**	**+ 7.0**	**+ 27.4**	**+ 10.5**	**+ 72.1**
Hillston	**- 18.5**	**+ 11.4**	**+ 59.0**	**+ 21.8**	**+ 82.5**	**+ 208.8**

Source: Australian Government Bureau of Meteorology 'Climate Data Online'

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 45 farms in NSW and 25 farms in Queensland during November and December of 2011 (Table 4). 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.

Table 4. *The occurrence of volunteer cotton plants surviving from the previous season on farms in NSW and Queensland in the spring of 2011.*

	1. Along channels, roads, fences	2. In fallows and rotation crops	3. In the current crop (regrowth from stubs)	TOTAL
In NSW	20/45 (44%)	16/45 (36%)	25/45 (56%)	32/45 (71%)
In Qld	11/25 (44%)	2/25 (8%)	5/25 (20%)	13/25 (52%)
Total	31/70 (44%)	18/70 (26%)	30/70 (43%)	45/70 (64%)

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 45 of the 70 farms visited during the disease surveys (64%).

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 32.3% and 29.6% respectively in the 2011-12 season, (31.9% and 25.8% in 2010-11, 32.5% and 25.8% in 2009-10; 28.8% and 24.9% in 2008-09). Seedling mortality exceeded 50% in 16 of the crops surveyed. CSD Ltd estimated that 10% of the total area planted had to be replanted.

Seedling mortality is usually lowest (< 20%) in the Burdekin Valley where planting takes place in late December. The mean seedling mortality for the Burdekin in the 2011/12 season was 27.4%.

Problems with crop establishment included wireworm, uneven moisture in the seed bed resulting from rain prior to planting and poor emergence as a result of crusting due to rain soon after planting. Allelopathy was apparent where cotton was planted into freshly incorporated, un-weathered plant residues, (eg rice straw). The highest mean incidence of seedling mortality was 38.4% in crops in the Macquarie Valley and the lowest incidence was 24.2% in crops in the St George area.

Some concern has been expressed about the impact of seed density on stand establishment. Sicala 74BRF has significantly lighter seed than Sicot 71BRF. In Queensland cotton production areas the mean seedling mortality was found to be 28.4% for Sicot 71BRF (25 fields) and 27.6% for Sicala 74BRF (21 fields). In NSW the mean seedling mortality was found to be 32.3% for Sicot 71BRF (39 fields) and 32.5% for Sicala 74BRF (45 fields).

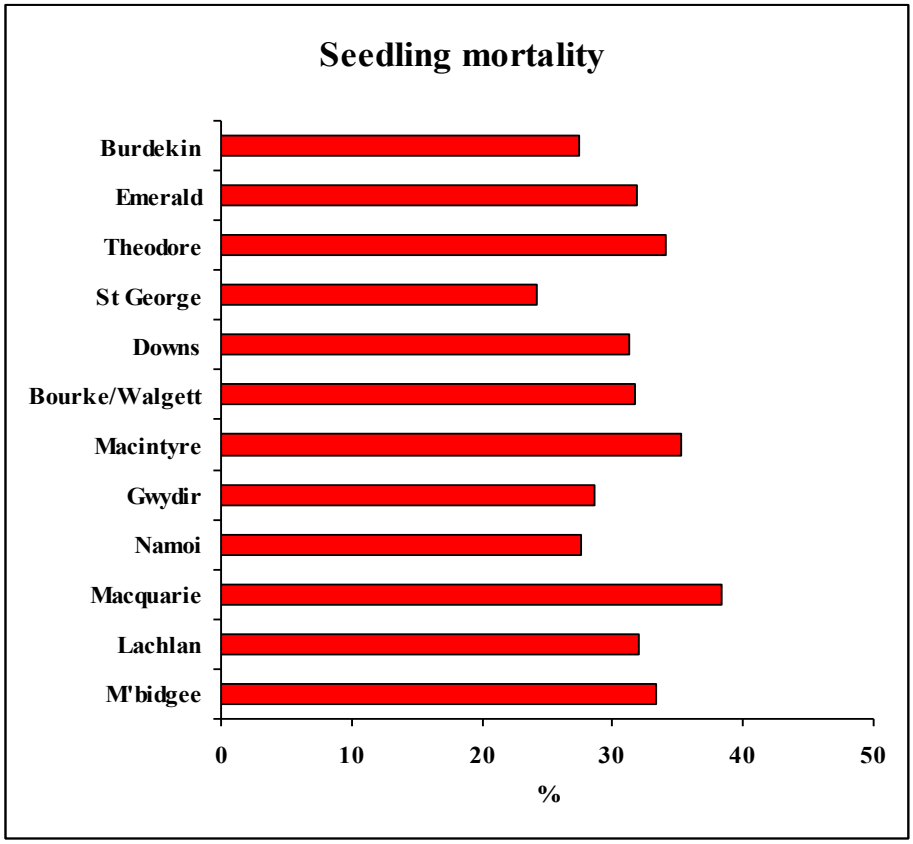

Figure 1. *Mean seedling mortality in the 2011/12 season. Seedling mortality is derived from the difference between the number of seed planted and the number of plants established.*

FUSARIUM WILT

Fusarium wilt is most severe when October/November rainfall is above normal and when temperatures are below normal – as was experienced during the 2011/2012 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 second farm in the Lachlan Valley. This new report was confirmed by Dr Linda Smith (Agriscience Queensland, DAFF) who provides a free, confidential diagnostic service for Fusarium wilt of cotton funded by the Australian cotton industry.

Fusarium wilt was observed in 16 of the 100 crops surveyed in NSW (Figure 2). including nine of the 12 crops inspected in the Macintyre valley and six of the 11 crops surveyed in the Gwydir valley. The incidence of Fusarium wilt averaged 16.6% and 16.4% respectively, for these two production areas (8.8% and 9.9% in 2010/11) and exceeded 60% of plants affected in four of the

16 fields. Though Fusarium wilt is known to be present and widespread in the Macquarie valley and the upper Namoi valley it was not detected in these areas in any of the last three seasons.

It is interesting to note that black root rot was also present in all 16 of the fields in NSW where Fusarium wilt was recorded. The incidence of black root rot exceeded 50% in 14 of the 16 fields.

The disease was observed in only 15 of the 64 crops surveyed in Queensland including nine of the 12 irrigated crops inspected on the Darling Downs. Fusarium wilt was not observed in any of the rain grown crops that were inspected. The incidence of Fusarium wilt averaged 4.4% and 2.5% respectively, for the Darling Downs and St George areas and only exceeded 5% in five fields (Figure 2).

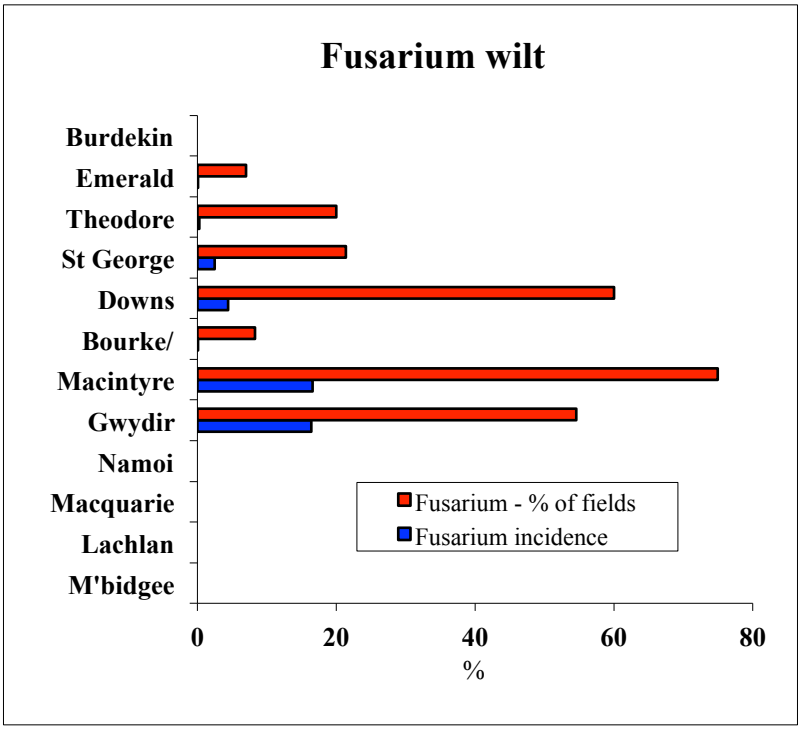

***Figure 2**. The distribution and mean incidence of Fusarium wilt of cotton in the 2011/12 season.*

Transects have been established in fields near Emerald, Theodore, Moura, St George, Boggabilla, Moree and Gunnedah. The incidence of Fusarium wilt is assessed along these transects in seasons when cotton is grown in these fields. Assessments during the 2011/12 season show a significant increase in disease incidence in fields near Boomi, St George and some of the fields near Boggabilla but little or no increase in fields near Moura and in other fields near Boggabilla.

BLACK ROOT ROT

Black root rot of cotton 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. The seasonal conditions in November were generally warmer and wetter than normal and temperatures in December of 2011 were well below average.

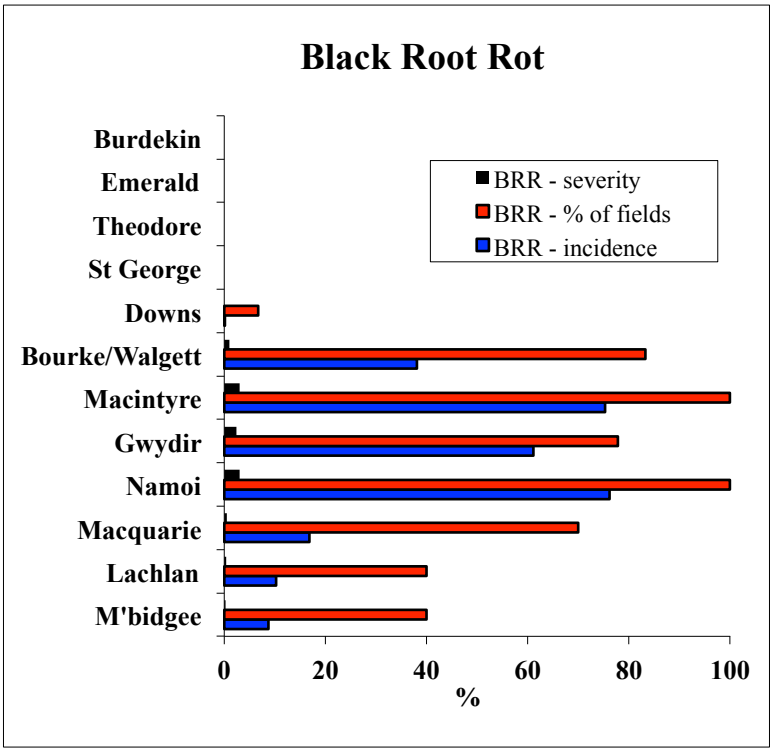

Figure 3. *The distribution, incidence and severity of black root rot in cotton in the 2011/12 season.*

Black root rot was observed in 73% of the fields surveyed in NSW (Figure 3) including all of the fields visited in the Namoi and Macintyre Valleys. The average incidence within fields was 38% which included 33 fields where more than 50% of plants were affected. Two fields in the Namoi Valley and one field in the Gwydir Valley had over 99% of plants affected. Verticillium wilt was present in 24 (72%) of the 33 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 3.0, 2.4 and 3.1 respectively.

Black root rot has previously been observed in all Queensland cotton production areas except the Burdekin. There were several reports of black root rot in cotton crops on the Darling Downs but it was only recorded in one of the fields surveyed.

VERTICILLIUM WILT

Verticillium wilt is also favoured by cooler weather and is rarely observed in Queensland production areas. The disease was observed in 51% of fields surveyed in NSW. However, the average incidence was only 6.8% of plants infected (Figure 4). The average incidence of

Verticillium wilt of cotton in NSW was estimated in previous surveys to be 4.1%, 3.8% and 3.7% for the 2008/09, 2009/10 and 2010/11 seasons.

It has long been recognized that the resistance of cotton to the pathogen that causes Verticillium wilt is temperature sensitive. Resistant varieties become completely susceptible when temperatures drop by 5^0C**.** It is not unusual to see cotton plants with severe foliar symptoms and stunting if the weather in November is cool but symptoms generally disappear during December, as the season warms up. However, summer temperatures in 2011/2012 were well below normal (Tables 1 & 2) and symptoms of Verticillium wilt became even more severe. In the upper Namoi some fields of cotton were exposed to 22 days in December when overnight minimum temperatures were below 15^0C and 100% of plants were infected in some patches**.**

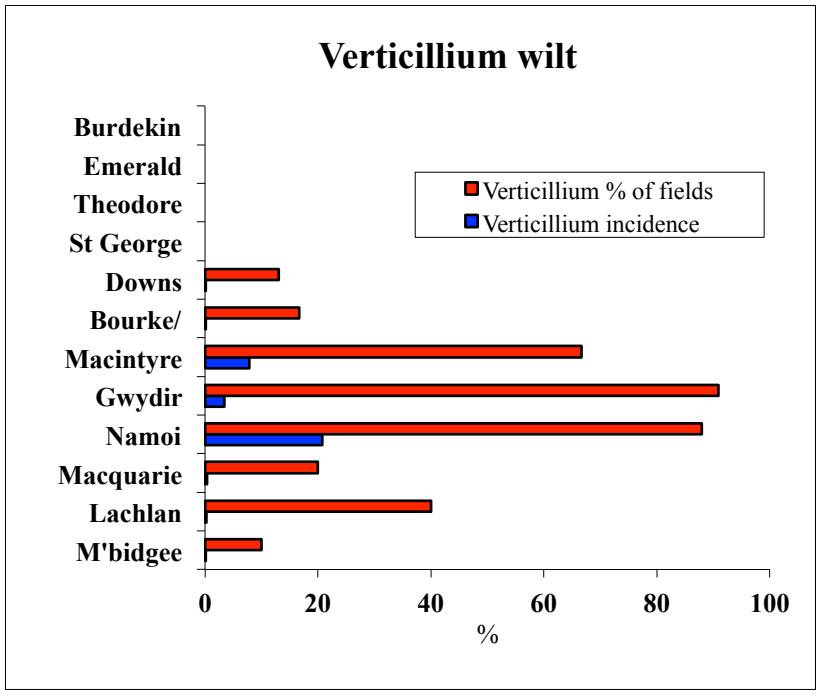

Figure 4. *The distribution and incidence of Verticillium wilt of cotton in the 2011/12 season. The disease was present in many areas but the incidence was generally low.*

Verticillium wilt was observed in 88% of fields surveyed in the Namoi valley where the average incidence of the disease was 20.8% of plants infected (compared to 14.0%, 12.7 and 13.1% in the previous three seasons). Two fields in the Namoi Valley had over 80% 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 increased significantly in crops in the Gwydir and Macintyre Valleys in the 2011/12 season. The mean incidence of the disease in crops in the Macintyre Valley was estimated to be 7.8% which is higher than that recorded previously and the disease was observed in 67% of the fields inspected. Verticillium wilt was recorded in 90.1% of fields surveyed in the Gwydir Valley with the mean incidence estimated to be 3.4%. 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 was recorded as 1.6% for NSW and 6.8% for Queensland; (9.7% and 7.3% in 2009/10, 0.7% and 2.7% in 2010/11).

Boll rots were particularly prevalent in crops in. the central highlands of Queensland where the average incidence was 16.7% with over 20% of bolls affected in four of the 11 crops surveyed in late February. These boll rots developed when bolls that were maturing and opening were exposed to wet weather in late January and early February. Wet weather in March further delayed harvest and resulted in some instances where seeds germinated in the bolls and fibre quality was significantly downgraded.

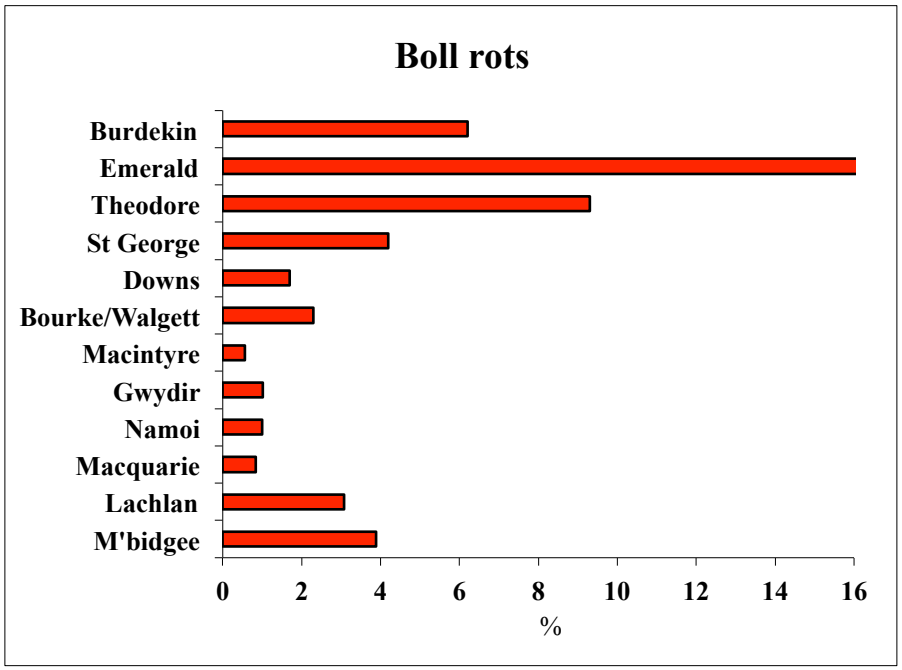

Figure 5. *The average incidence of boll rots in each of the cotton production areas for the 2011/12 season.*

Phytophthora boll rot occurs when heavy rain splashes soil up onto low maturing bolls or when low bolls are inundated by water during flooding. The significant rainfall and flooding in Southern NSW late in the season (Table 3) contributed to a higher incidence of this disease in the Lachlan and Murrumbidgee Valleys.

Another boll rot, identified as Lasiodiplodia (Diplodia) boll rot, has been noticed in crops growing in the Central Highlands of Queensland in recent years. Affected bolls are covered in 'sooty' black spores. It is found throughout the world in the more humid climates.

SEED ROT

Symptoms of seed rot include a soft brown rot of developing seed within the bolls that may not become apparent until the bolls either drop or open prematurely. Only one or two locks, or sometimes the whole boll, can be affected. Seed rot appears to be caused by either bacteria or

fungi that are introduced into the young developing boll by sucking insects such as the green vegetable bug and the cotton lint stainer. Seed rot was observed in 90% of fields inspected in Queensland with a mean incidence of 1.1%. The incidence of bolls affected by seed rot in one field in the Burdekin Valley was estimated to be 6% and the incidence in a field on the Darling Downs was assessed to be 4.3%.

SCLEROTINIA BOLL AND STEM ROT

The extended period of cool, wet weather coinciding with flowering in late January and early February resulted in numerous reports of Sclerotinia boll and stem rot in crops growing under lateral move and centre pivot irrigation in the Macintyre, Namoi and Macquarie Valleys. The disease was also reported in a few furrow irrigated crops. The NSW disease survey found the disease in three fields in the Namoi Valley, five fields in the Lachlan Valley and one field in the Murrumbidgee Valley. The incidence of the disease was generally low with up to 2% of bolls affected in some crops.

Sclerotinia has been seen previously on rare occasions in Australia and is not referred to as a disease of cotton in the international literature. When it does occur it is usually in areas of the field were growth is rank and humidity in the canopy is higher.

The pathogen that causes this disease is widespread, has a large host range which includes sunflower, canola and legumes and can survive for years in the soil as resistant black sclerotia that may vary in size from a few millimeters to several centimeters across.

The sclerotia germinate to produce apothecia (small cream coloured ‘golf tees’ – not to be confused with bird’s nest fungi!) which release clouds of microscopic spores that can only infect the plant through dead or dying flower petals or dead leaves ‘hung up’ in the canopy. The fungus then grows into healthy plant tissue such as the developing boll and down the fruiting branch towards the main stem producing the hard black sclerotia in and on bolls and on infected branches. The presence of sclerotia is a distinctive feature of Sclerotinia boll and stem rot.

Another fungus that thrives when it is cool and wet or humid is *Botrytis* sp. which may produce a grey powdery mould on dead flowers and leaves. There was some confusion between *Botrytis* sp. and *Sclerotinia* sp.. *Sclerotinia* sp. only produces spores in the apothecia on the soil surface while Botrytis produces spores on dead plant material within the canopy.

BUNCHY TOP

In contrast with the previous season, the incidence of ‘bunchy top’ was quite low. Bunchy top was observed in 18.6% of the fields surveyed in Queensland production areas and in 25% of fields surveyed in NSW with the average incidence only 0.05% in Queensland and 0.7% in NSW. It was estimated that 8.5% of plants were affected in one field in the Lachlan Valley.

OTHER DISEASES AND DISORDERS

Tobacco Streak Virus was observed in seven of the 14 crops inspected in central Queensland in November 2011. The average incidence of the virus was 0.1% with 0.5% of plants with symptoms in two fields.

Alternaria leaf spot was present at low levels in almost all crops and was generally of minor significance except in crops in the Burdekin Valley where leaf spots caused significant defoliation of lower leaves.

Premature senescence was noted in 58% of the crops surveyed in Queensland. However, the average incidence was only 1.6%.

ACKNOWLEDGMENTS

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