Northern Australia cotton disease survey report

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Summary

* Seedling diseases are unlikely to be a serious issue unless wet weather is experienced after sowing. Seedling pathogens favoured by cool conditions (eg *Rhizoctonia*) should be less prominent than those favoured by warm conditions (eg *Macrophomina*). High soil (sand) temperatures (up to 80 degrees C at the surface) in the Broome area, could cause direct seedling deaths because of heat damage to hypocotyls.

* Although Alternaria leaf spot is widely distributed in the north, its severity will be determined by the frequency of overnight dews with cool conditions and nutritional stress in cotton (especially potassium and phosphorus). Even with the exceptionally cool conditions this year the disease was not severe if crop nutrition was good.

* The presence of *Verticillium* at Kununurra indicates that mid-season conditions are favourable for that soilborne pathogen. Other soilborne diseases, including Fusarium wilt and black root rot pose a significant threat to cotton production if introduced.

* The origin of Verticillium wilt at Kununurra is uncertain. However, it is almost certain that the pathogen arrived as a result of agricultural activity, possibly in seed of other crops.

* The exclusion of Fusarium wilt, black root rot and other diseases is a very real and achievable prospect for each of the three regions that we visited.

* There seemed to be a general lack of knowledge or complacency that pathogens and weed species can be introduced to new areas. Bacterial blight was introduced to Broome in trial seed. We were not challenged on any occasion in Kununurra or Katherine as to the hygiene of our shoes and equipment (although we were at pains to point out the procedures that we had taken). This year the cotton trials at Katherine and Kununurra were visited by large numbers of 'tourists' from the cotton industry with little thought given to transfer of pathogens or weed species. It should be relatively easy to develop BMP for visitors and movement of trial seed to these geographically isolated areas but it may already be too late.

Background

With the formation of the new Australian Cotton CRC and the possible expansion of cotton growing in the Northern Territory and in the north of Western Australia, we were requested to conduct a cotton disease survey in these areas. This survey was conducted during 28 July - 4 August 1999. We visited the Katherine area in the Northern Territory and Kununurra and Broome areas in Western Australia.

Katherine, Northern Territory

We were hosted by Dr Stan Bellgard, Plant Pathologist with Northern Territory Department of Primary Industry and Fisheries, at the Katherine Research Station (**KRS**).

About 10 ha of cotton trials were inspected at Katherine Research Station which were being managed by Michael Kahl. These trials had been planted about April 10 and had suffered 70 continuous cold shock days up to the 28 July (minimum temperatures as low as 2.8, maximum mid 20s). There were some compaction problems in parts of the trial field causing variability in plant height.

We were not able to assess seedling diseases but we were informed that there was about an 80% stand establishment based on planting rate. Soil temperatures at the time of planting were very conducive to rapid germination and emergence. Significant stand loss was observed in areas with severe soil compaction. Michael Kahl noted that excessive tillage had resulted in soil crusting at KRS in the past but was avoided this year by planting into a covercrop of rice with minimum tillage, thus enhancing stand establishment.

As a result of cold shock conditions there was little fruit set on the cotton but Michael was confident that given the warmer conditions top fruit set would be significant.

There was a 100% incidence of Alternaria leaf spot *(Alternaria macrospora)* with about a 15% severity on lower leaves and defoliation of a few leaves on some plants. This would have been exacerbated by the overhead irrigation used in some plots. However, the severity of Alternaria leaf spot in plots with trickle irrigation was only slightly less than plots with overhead watering, indicating that overnight dew associated with the cool nights was the most important environmental factor. Michael Kahl indicated that in previous cotton trials temperatures were much warmer than in 1999 and that Alternaria leaf spot was much less severe.

Charcoal rot *(Macrophomina phaseolina)* was found in one small dead plant. No other diseases were detected.

We also looked for wild *Gossypium* species and malvaceous weeds to determine if they were hosts for cotton diseases. We also made contact with the Rangers at Nitmuluk National Park and one of them (Richard Hope) was a weeds expert. He helped us identify *Hibiscus heterophylla, Hibiscus menzeliae, Sida cordifolia* and *Sida cienta.* He was also able to show us one *G. hirsutum* plant (feral cotton as he called it)

growing at a ranger's house and told us than many of the ranger stations around the Northern Territory had cotton plants as ornamentals or garden-escapes.

We did not find any diseases on these weed species, or on an ornamental *Hibiscus* species, but we did find that the roots of the "feral" *G hirsutum* were sheathed in a fungus with some similarity to *Rhizoctonia* but with other features (clamp connections) suggesting that it was not *Rhizoctonia solani.* The fungal sheath also extended up the main stem of the plant for 3 to 4 cm in as a black canker-like infection. A sample of the sheathed roots and the stem canker was preserved in alcohol for further investigation at the plant pathology laboratories at ACRI. Dr Bellgard will attempt to isolate the organism from the remaining roots at the DPIF laboratories in Darwin, and to maintain the single plant specimen alive in pot culture. If this fungus is pathogenic then it may represent a new disease. Its significance to the cotton industry is uncertain at this time.

Gossypium australe was common in the Katherine area but no pathogens were found on it. *Gossypium sturtianum* may have been present but was not observed. Herbarium specimens of the Malvaceae at KRS were examined for the presence of foliar diseases. Leaf spots were present in two of these specimens, *Abelmoschus ficulaneus* and *Malachra fasciata*, but microscopic examination did not indicate the presence of *A. macrospora*.

A one hour seminar on the epidemiology of Fusarium wilt, black root rot and the risks of introduction of soilborne diseases was jointly presented to researchers at KRS. The main message of the seminar was 'prevention is better than cure'.

Kununurra, Western Australia

We travelled from Katherine to Kununurra with Ms Rowena Eastick, an Officer with Agriculture Western Australia investigating the possibility of exotic gene (Bt) escape into wild *Gossypium* species. We were hosted by Dr Dhananjay Singh, Cotton Agronomist/Physiologist with the CSIRO Plant Industry, at the Frank Wise Institute (**FWI**) at Kununurra.

Several cotton crops were inspected at the FWI and at farms with crops managed by Gary Coulton of Twynam. Crops at Kununurra varied in maturity and boll load but, having experienced only 18 cold shock days, appeared to be generally in much better shape than those at Katherine.

Verticillium wilt was found in Field 9A and in a variety trial and in a nutrition trial in Field 10A2 at the FWI, but not elsewhere in the valley. This represents the first record of Verticillium wilt in cotton in northern Australia. The disease occurred in scattered clusters of a few plants and its severity was very low in all plants bar one, suggesting that the pathogen (*Verticillium dahliae*) had recently entered those fields. Staff at the FWI reported that Field 9A was sown to maize (a non-host) the year before and had not had cotton previously. The very sporadic distribution and low severity of Verticillium wilt in Field 9A could be accounted for by either (i) the

introduction of small amounts of infested soil on implements and machinery or (ii) carryover of a small amount of inoculum from a previous susceptible crop. The latter case seems least likely but the field history back to the 1960's would need to be checked. Samples of infected plants were collected to enable future comparison of strains.

Alternaria leaf spot was widespread but generally less severe than at Katherine. South of the FWI at the Ceres Farm (Michael Eppler), Alternaria leaf spot was more severe in a crop with a heavy boll load on sandy soil, than in a crop with few bolls that was sown later in a clay soil. Reddening of leaves in the crop with more bolls was indicative of the onset of potassium deficiency, hence increasing susceptibility to *A. macrospora*. The weed *Sida spinosa* was present in these fields but did not appear to be a host for *A. macrospora*. North of the FWI, at David Menzel's farm there was almost no Alternaria leaf spot in a crop sown late (23-24 April). Nearby at 'Oasis', there was little Alternaria leaf spot in an early crop with a relatively high boll load. However, fertiliser was applied 3 weeks after emergence as a side dressing and there was no sign of potassium deficiency.

A patch of dead seedlings with charcoal rot was found at David Menzel's farm but it was clearly associated with cultivation damage, indicating that the pathogen gained entry through root wounds and that climatic conditions were otherwise unfavourable for infection in the rest of the crop.

Two soil samples from Ceres farm were examined for the presence of nematodes but no plant pathogenic species were observed.

Bacterial blight may have been present in seed crops being screened by Deltapine Australia but these crops were not inspected.

No other diseases were detected at Kununurra. A one hour seminar on the epidemiology of Fusarium wilt, black root rot and the risks of introduction of soilborne diseases was again given as a joint presentation to researchers at KRS. Again the main message of the seminar was 'prevention is better than cure'.

Broome, Western Australia

We were hosted by Ivan McLeod, Greg Nicol and Greg Aldridge of Queensland Cotton, at Shamrock Station, 150 km (by road) south of Broome. Soils at Shamrock Station are sandy at the surface with 12 to 15 % clay being present deeper in the profile. There were 17 ha of cotton trials, all irrigated with bore water through drip tape buried at 20 cm in depth.

Cotton at Shamrock Station was sown either in early March or in May, experiencing 11 and 6 cold shock days respectively. Cotton sown in March was tall and had heavy boll loads. Soil temperatures were high at sowing (46 °C at 10 cm depth in March) and seedlings had emerged within 4 days.

Alternaria leaf spot was virtually absent in the May-planted trials. It was widespread at low levels in the March planted crops, except in the nutrition experiment where there was more leaf spot and significant defoliation of primary leaves on the main stem in both the low P and low K plots, and to a lesser extent in the low N plots. The cotton cultivars were ranked from most to least susceptible as follows: L23I = line 954418 = line 96403 = line 96456 > CS51i = Devil = NuCotn 37 = line 96480 > CS189 = line 96479.

A leaf spot was observed in an unidentified malvaceous plant, possibly a wild *Gossypium* or a *Sida*, that was growing as a weed in the cotton plots. Microscopic examination confirmed the presence of *Alternaria macrospora*. As an alternative host to cotton, this plant is likely to provide a constant source of inoculum for Alternaria leaf spot in cultivated cotton.

Bacterial blight was observed in NuCotn 37 planted in March. Ivan suggested that it coincided with a single rainfall event that occurred in otherwise very dry atmospheric conditions. The pattern of blight on the leaves (lesions on a few leaves at a similar level, low in the canopy) was consistent with infection at a single point in time. Blight was not observed in NuCotn 37 planted in May.

No other diseases were observed in cotton at Shamrock Station.

Conclusions

Cotton production in the north faces different climatic conditions to those experienced in the established industry in NSW and QLD and the potential threats from disease are likely to vary accordingly. Under current practices, cotton is sown at the start of the dry season when temperatures are warm, experiences cooler temperatures mid-season and finishes with warm temperatures. Rainfall is minimal during the season.

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Recommendations

* If the incidence and severity of Verticillium wilt continues to increase at Kununurra then growers should switch from Siokra L23 to cultivars with more resistance.

* Alternaria leaf spot should be managed by appropriate fertilisation and the use of more resistant cultivars.

* Strains of *Verticillium* at Kununurra should be compared to strains from NSW and QLD to determine their genetic relatedness.

* The potential pathogenicity of the unidentified fungus on "feral" cotton at Katherine should be investigated.

* Growers and researchers in all three regions should immediately develop and, together with contractors and tour operators, implement revised protocols to prevent further incursions of cotton diseases into their areas. They are in an ideal position to do so.

* Regular monitoring of the incidence and severity of diseases in cotton in all northern areas is needed to enable appropriate responses to the spread of existing pathogens, the introduction of new pathogens from overseas (eg Indonesia) and the possible development of new diseases as cotton monoculture increases.