



# ACDC

## Australian Cotton Disease Collaboration



### Research in Focus

**A collaborative approach to cotton disease research to reduce the economic impact of current and emerging diseases**

*The ACDC's mission is to reduce the impact of diseases in cotton to less than 5% of the cost of production through research on key areas.*

Disease is a high-priority issue for the Australian cotton industry. It contributes to significant yield losses and undermines long-term confidence in growing cotton. In extreme cases, some growers have opted out of growing cotton in response to severe and escalating disease pressure.

The Australian Cotton Disease Collaboration (the ACDC) is the \$13 million research, development and extension program initiated by the Cotton Research and Development Corporation (CRDC) to minimise the impact of disease in cotton.

CRDC has developed long-term strategic partnerships with the University of Southern Queensland and the Department of Primary Industries, Queensland, to co-design and lead projects on key research areas such as systems-based disease control, understanding pathogen behaviour, spatial data analytics, fungicides and plant defense mediators.

The Domains have been identified to build upon fundamental research and focus on industry need in four key areas. Projects in each Research Domain have been co-designed by the ACDC Strategic Partners.



- A** Systems-based disease control
- B** Understanding pathogen behaviour
- C** Spatial data analytics and modelling
- D** Fungicides and plant defense mediators

### Tier 1 diseases

Black root rot, *Fusarium* and *Verticillium* wilt and *Alternaria* leaf spot

### Tier 2 diseases

Rhizoctonia rot, reoccurring wilt, target spot, grey mould and boll rot

#### A1.2 Irrigation and nutrition management to reduce cotton wilt disease incidence

**Location:** North Star (Qld) and Darling Downs (Qld) for field sites, Toowoomba (Qld) for glasshouse trials, and Brisbane and Toowoomba for researcher locations

**Lead:** Linda Scheikowski (Qld DPI), A/Prof Joseph Foley (UniSQ)

Impacts of irrigation and nutrition have a huge impact on wilt cotton diseases, but are currently based on anecdotal evidence in Australia. This project aims to quantify the impacts of *Verticillium* and *Fusarium* wilt and incorporate this into grower management recommendations.

This will contribute to reduced yield loss through understanding improved wilt management options, increased water use efficiency when irrigating with a higher soil water deficit, and increased profit through reduced fertiliser application and reduced disease incidence.

#### A2.1 Diagnostic development, diagnostic support and cotton pathology collection

**Location:** Brisbane and Toowoomba, Qld

**Lead:** Dr Dinesh Kafle (Qld DPI), Dr Murray Sharman (Qld DPI)

In this project, modern rapid molecular diagnostics are being developed and validated for all major soil-borne and leafspot pathogens affecting Australian cotton production (including new production regions in far northern Australia) to reduce the time for accurate disease diagnostics and increase the effectiveness of disease management strategies.

Representative isolates of various pathogens will be stored, and pathogenicity assays will be conducted to confirm new and emerging pathogens. The isolates will be available for future genetic diversity studies, pathogenicity tests, and population genetics studies.

#### A2.2 Contribution of cotton residues to inoculum carryover (Phase 1)

**Location:** Brisbane and Toowoomba, Qld

**Lead:** Linda Scheikowski (Qld DPI)

The pathogens that cause *Verticillium*, *Fusarium*, and *Eutypella* wilts can survive in cotton residues. Currently, there is no clear understanding of the contribution these have on inoculum build-up and disease. To understand the persistence of pathogens on cotton trash after various levels of decomposition, molecular methods to quantify the pathogens are required.

In this project, the literature is being reviewed to identify suitable methodologies to quantify pathogens in cotton residues. Potential project partners with specialist skills to quantify pathogen inoculum in plant residues are also being identified.

#### A2.3 Pathogen inoculum: spore trapping to detect aerial spores of cotton pathogens (Phase 1)

**Location:** Central and northern Queensland for field sites to conduct spore trapping and Brisbane (Qld), Toowoomba (Qld), Urrbrae (SA) for researcher locations

**Lead:** Dr Dinesh Kafle (Qld DPI)

Spore trapping is a method used to capture airborne spores, primarily for monitoring and detecting fungal diseases in crops, allowing for early intervention and preventative measures.

#### A3.1 Pathology support to cotton growers of the NT and WA

**Location:** NT DAF (Katherine) WA DPIRD (Kununurra)

**Lead:** Dr Dinesh Kafle (Qld DPI), Sarah Nolan-Gorman (WA DPIRD), Dr Edward Mwando (NT DAF)

This project addresses understanding disease pressure in extending cotton cultivation in Northern Territory and Western Australia. The expected industry outcomes and impact are key and emerging cotton pathogens identified in Northern Australia to assist with the development of effective management strategies. The expected output is cotton pathology capacity built through establishment of diagnostic service, disease surveillance and pathology training.

#### A3.2 Pathology support for additional collaborative trials, training & diagnostics NT DAF, WA DPIRD, Qld, NSW & CottonInfo

**Location:** Brisbane, Toowoomba, Northern Territory, Western Australia, NSW

**Lead:** A/Prof Linda Smith (Qld DPI)

This project will produce collaboration to provide pathology support to cotton growing regions in leadership, training, additional surveillance, pathology data collection and diagnostics in research trials.

#### B1.1 Establishing the Australian cotton pathogen collection

**Location:** UniSQ (Toowoomba Campus)

**Lead:** Dr Cassy Percy (UniSQ)

This project will establish a nationalised collection of all pathogens of cotton in Australia, crucial for understanding the evolution and spread of existing and new pathogenic strains and for screening cotton germplasm for broad-spectrum disease resistance. The collection will provide resources for creating reference genomes to identify strain-specific diagnostic markers for rapid disease surveillance, understanding pathogen population dynamics, and the evolution of new strains.

#### B1.2 Pathology support to cotton growers and ACDC project activities in NSW

**Location:** Narrabri, NSW

**Lead:** Prof Sambasivam Periyannan (UniSQ)

There is a lack of pathology support for New South Wales cotton growers. The expected industry outcomes and impact of this project are that NSW cotton growers will have access to disease diagnostics services, and an improved understanding of pathogen spread, evolution and the influence of farming systems on disease outbreaks.



### B1.3 Monitoring pathogen genetic diversity

**Location:** UniSQ (Toowoomba Campus)

**Lead:** Dr Alexandros Georgios Sotiropoulos (UniSQ)

This project, by monitoring the pathogen genomic diversity, will provide fungal cotton pathogen populations to rapidly monitor and compare changes in pathogen migration patterns and adaptation to alternate hosts, new cotton lines, and the environment, identifying diverse and virulent pathogens.

Population genomic resources for cotton fungal pathogens are being created, making it easier to understand virulent fungal populations emerging in a region and creating datasets of pathogen genomes for comparisons in pathogen diagnostics in the future.

### B1.4 Reference genome for cotton pathogens

**Location:** UniSQ (Toowoomba Campus)

**Lead:** Dr Alexandros Georgios Sotiropoulos (UniSQ)

*Berkeleyomyces rouxiae* is a pathogen that impacts cotton yield. *Eutypella* spp. and *Corynespora* spp. are other fungi pathogens causing reoccurring wilt and leaf blight. Generating chromosome-scale assembly and genome annotation provides insight into genome architecture and virulence gene profiles.

Australian cotton growers will have an improved understanding of the virulence of these pathogens and will be better equipped to develop diagnostic markers. The new genomic resources will assist in population studies and will be used as references for monitoring the emergence of highly virulent or mutant isolates that could potentially cause more harm (e.g. epidemics).

### B1.5 The black unknown: Linking knowledge and innovation for management of black root rot

**Location:** Charles Sturt University (CSU) (Wagga Wagga) and Cotton Farms (Griffith), NSW

**Lead:** Dr Sadegh Balotf (UniSQ), Dr Ben Stodart (CSU)

Black root rot disease emerged as a serious threat to sustain cotton cultivation in NSW, particularly the southern region. Cotton pathology capacity will be built in southern NSW to understand black root rot disease pressure. The etiology of black root rot will be understood to assist with the development of effective management strategies.

### B2.1 Host range and cotton differential set identification for key cotton pathogens

**Location:** UniSQ (Toowoomba Campus)

**Lead:** Dr Cassy Percy (UniSQ)

Cotton differential sets are not available for all key pathogens, and information on the host range of cotton pathogens is incomplete. Cotton growers will benefit from tactical disease management strategies developed in this project using foundational resources. Cotton germplasm resources and a differential set will improve the capacity to develop resistant cultivars and phenotype key pathogens.

### B3.1 Coinfection assays to study synergistic and antagonistic interactions

**Location:** UniSQ (Toowoomba Campus)

**Lead:** Dr Sadegh Balotf (UniSQ)

Many cotton diseases are caused by multiple pathogens, contributing to complex disease dynamics.

Co-infection complicates disease management and often leads to more severe symptoms and higher seedling mortality rates, which directly impacts yield. This project will equip cotton growers with evidence-based, practical insights on how these pathogens interact and contribute to disease severity, enabling more informed decisions to manage complex disease threats, and providing the tools necessary to detect and quantify co-infection.

### C1.1 Spatial data analytics and advanced modelling for disease prediction and management in Australia

**Location:** UniSQ (Toowoomba and Springfield Campus)

**Lead:** Prof Ravinesh Deo (UniSQ), A/Prof Linda Smith (Qld DPI)

Cotton production in Australia faces significant threats from plant diseases, which can impact yield and profitability. Effective disease management requires accurate tools to predict and monitor outbreaks across varying scales. In this project, new spatial data analytic tools with statistical and artificial intelligence (AI)-driven modelling will be developed and integrated to generate key outcomes to support the Australian cotton industry.

These tools will advance disease management practices through enhanced capability to predict and visualise the disease incidences at multiple spatial and temporal scales, but also by data-driven findings that guide and lead to specific, meaningful strategic intervention.

### C1.2 Develop machine vision systems to detect and differentiate *Verticillium* and *Fusarium* wilts

**Location:** UniSQ (Toowoomba Campus)

**Lead:** A/Prof Alison McCarthy (UniSQ)

Identifying *Verticillium* and *Fusarium* wilt pathogens is of increasing importance as more fields are being confirmed to have both pathogens present. Diagnosing wilt pathogens in a field is still manual. This study aims to develop machine vision sensing to differentiate wilts and predict severity before visual symptoms show. Australian cotton growers will have new technology available to identify the wilt diseases in-field before symptoms are visible. This will enable field mapping to identify predicted high disease areas and implementation of farming practices, such as nutrition and irrigation management

### D1.1 Fungicides and plant defense mediators for the Australian cotton industry inferred from national and global analyses

**Location:** UniSQ (Toowoomba Campus)

**Lead:** Prof Levente Kiss (UniSQ)

This project will provide Australian cotton growers and industry representatives with an improved understanding of the efficacy of the fungicides and plant defence mediators against cotton pathogens. The industry will be provided with a comprehensive and critical analysis of the efficacy of fungicides and plant defence mediators used in cotton production in Australia and overseas.

### D1.2 Evaluation of new & existing fungicides & other plant protection products for improved cotton disease management in Australia

**Location:** UniSQ (Toowoomba Campus)

**Lead:** Prof Levente Kiss (UniSQ)

This project will deliver critically needed (must-have) data on the efficacy of up to 50 fungicides and other plant protection products (PPPs) against up to 14 significant fungal pathogens of cotton in Australia. The industry will be provided with a comprehensive database and critical analysis of the efficacy of a total of up to 50 new and currently registered fungicides and other PPPs against the most important fungal pathogens of the Australian cotton.



# Contacts

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