



**Australian Government**  
**Cotton Research and  
Development Corporation**

# FINAL REPORT 2017

For Public Release

## *Part 1 - Summary Details*

---

*Please use your TAB key to complete Parts 1 & 2.*

**CRDC Project Number: DAN1503**

**Project Title: Resilient Cotton-farming Systems in  
Irrigated Vertosols: Soil Quality, Carbon and Nutrient  
Losses, Cotton Growth and Yield in Long-term Studies**

---

**Project Commencement Date:** July 2014    **Project Completion Date:** June 2017

**CRDC Research Program:** 1 Farmers

---

## *Final Report Executive Summary*

---

Global warming is surmised to result in major increases in climatic variability (i.e. severe deficiencies and excesses of water for plant production, higher frequency of sub- and supra-optimal growing season temperatures) and changes in pest incidence. In order to maintain yields and profitability, and thus ensure sustainability of the cotton industry, cotton farming systems need to demonstrate resilience in the face of the abovementioned environmental stresses. Resilience can be improved by using suitable tillage and stubble management systems, and crop rotations to improve soil quality and water conservation. Such improvements can be best demonstrated by monitoring in long-term experiments. Indicators of resilience include improvements in soil carbon and nutrients, water storage, soil physical and chemical quality, yield maintenance/profitability improvements over time, and changes in key soil faunal indicator species.

To maintain the productivity of the Australian Cotton Industry, cropping systems that are resilient to these climatic events and the associated soil processes must be identified. This is best done through long-term experiments that capture seasonal variability. The aim of this project was to continue three on-going long-term experiments on selected cropping systems that include practices such as crop rotations, stubble retention, tillage systems and fallow length. Measurements made on an annual basis will include soil carbon and nutrients,

physical and chemical quality, crop yields and profitability. Collaborative projects with CSIRO, UNE and other research groups will research soil microbial dynamics of resilient cropping systems, carbon storage in the subsoil, disease incidence, nutrient decline and maintenance, and drainage.

During the previous project the short-term benefits of sowing corn on cotton yield, disease control and subsoil increases in soil carbon were observed (refer May 2013 report for DAN 1202). The longer-term impacts of sowing corn in cotton-based farming systems were further investigated in this project. In addition, benefits have been demonstrated in a long term experiment at ACRI with respect to soil faunal indicator species, N, energy use and water conservation in a retained stubble cotton-wheat-vetch system. This long-term investigation is being continued.

Agricultural practices which store carbon in soils and minimise gas emissions might offset global warming. This is one of the cornerstones of the Federal Government's "Carbon Farming Initiative (CFI)". Carbon stored in the soil may then be offset against emissions that occur elsewhere. Key to this is the long-term storage (99 years) of carbon in the soils. Theoretical estimates of soil carbon sequestration do not, however, coincide with measured values of soil carbon. The implementation of intensive agricultural practices across the world has led to a rapid decline in soil carbon reserves (Kirschbaum et al., 2008). Several farm scale studies have reported declines in soil organic carbon (SOC) stocks following the change from native vegetation or pasture to commercial crops (Luo et al., 2010). Conservation farming practices implemented with the assumption that they may reverse these losses, in many instances, have proven to be ineffective (Powlson et al., 2011). The long term experiment in Field D1 at ACRI, for example, has a measured net sequestration rate over ten years in the 0-0.3 m depth of the order of  $0.004 \pm 0.21$  t C/ha per year, but estimated sequestration rates of the various rotations, based on biomass inputs, suggest values ranging between 0.17 and 0.64 t C/ha per year. It may be that post-sequestration losses in irrigated cotton systems are high. Although there are few data on soil carbon losses through erosion processes in furrow irrigated Australian cotton soils, results from the United States suggest that losses could be of the order of 0.02 to 0.05 t C/ha per year. If similar rates of loss were to occur in Australia, then the proportions of sequestered carbon removed by erosion and runoff could range between 5 and 20%. Benefits and value associated with initially sequestered carbon in soil are thus greatly decreased, and the value of soil carbon to offset emissions becomes questionable. It is speculated that losses of sequestered carbon through terrestrial pathways such as runoff, drainage and erosion may be significant. The relative amounts lost have not been studied in the past, and consequently, remain unknown. In addition, relative to annual carbon sequestration, carbon inputs in irrigation water can be significant as it can range from 0.04 to 0.07 t C/ha per year (2011-12 results).

A secondary aim of the project was to provide training for an understudy to primary researcher, with the aim of eventually succeeding the role in the position of soil scientist at ACRI, Narrabri.