Australian Government
Cotton Research and Development Corporation

TRAVEL & CONFERENCE REPORT

Part 1 - Summary Details

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

CRDC Project Number: DAQ1206

Project Title: Disease surveys in commercial cotton in the Ord River Irrigation Area

Project Commencement Date: 4 Sept 2011 **Project Completion Date:** 11 Sept 2011

Select Research Program (from CRDC Strategic R&D Plan 2008-2013):
- Please Select One - Farming Systems

Part 2 – Contact Details

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Part 3 – Travel Report

(Maximum two pages)

1. A brief description of the purpose of the travel.

The 2011 season is the first season of commercial cotton production in the Ord region for 10+ years, making this year a suitable time for establishing baseline frequencies and severities of endemic diseases. Given the rotations with horticulture and the problems that have been encountered with aphids in cotton this season, it is also a good opportunity to further road-test the 'proof of absence' protocols for insect vectored diseases such as Cotton Bunchy Top and Cotton Leaf Curl Disease. Working together, Plant Pathologists Linda Smith and Cherie Gambley have knowledge of all endemic and key exotic diseases of cotton and methods for their surveillance. As well as conducting surveys, in a manner similar to that undertaken in the eastern states, Linda and Cherie will share their knowledge of surveying methods with local research agronomist, Penny Goldsmith, Ag WA. The aim of this travel is to begin building capacity in WA for the surveys to run each year in the region if cotton becomes a stable inclusion in the farming system.

2. What were the:

a) major findings and outcomes

Major findings:

Virus - Cotton surveys Kununurra, September 2011

There were approximately 1000 ha of cotton grown in the Ord irrigation area in the 2001 season. Most of the area is located to the north north west of the township, with one property to the north north east. It is common for single properties to produce a range of crops, simultaneously, including cotton, cucurbits, chia, chickpea and sorghum. The production blocks of different commodities are normally adjacent to each other and are sometimes rotated, for example chickpea grown on a block previously used for cotton. All observed production was irrigated.

The cotton varieties grown were mostly 71 BRF or 24 BRF with areas of refuge and trap crops. Of the 20 blocks currently in production 17 were inspected for virus diseases during these surveys. In some cases multiple surveys per block were completed with 25 surveys in total completed. Each survey consisted of inspection of 300 plants along the outside edges. No virus diseases were detected on any of the blocks. A selection of random samples were collected for CLCuD testing but given the absence of symptoms and Silverleaf biotype B (SLW), the major vector of the disease, it is expected the samples will test negative for CLCuD. Further samples were collected of possible *Tobacco streak virus* and Cotton bunchy top virus. However, the symptoms observed on these samples were very atypical and are more likely physiological disorders than virus infections. The samples were given to Mr Murray Sharman for testing.

Five of the cotton production properties also had cucurbit cultivation and in most cases this was adjacent or very near to the cotton production. All cucurbit cultivation areas had viral diseases. It is presumed the viruses affecting the cucurbits are the known endemic aphid-transmitted species but this requires laboratory testing for confirmation. The symptoms induced in cucurbits by these aphid-transmitted viruses are easily confused with those induced by CLCuD pathogens. Therefore, visual inspections for CLCuD in these crops alone was insufficient to generate CLCuD absence data, so instead random samples of symptomatic plants were collected and all samples tested negative for begomovirus through laboratory indexing.

High aphid populations were observed on many blocks of cotton and cucurbits. Whitefly was rarely seen and only a single sample of approximately 12 insects was collected for identification. It is presumed the species is the native whitefly known to be in the area and not SLW which is thought not to occur in northern Australia. Mealybugs were observed on three properties, one of which was quite severely infested along an outside row. A sample was collected and dispatched to Toowoomba for identification. A previous sample collected by Ms Penny Goldsmith was identified as the Solenopsis spp. present in other growing regions. Recommendations were made to Penny to collect a representative aphid samples from the cotton and cucurbit crops for identification and insecticide resistance testing. These samples will be sent to Grant Herron at EMAI, NSW. Native malvaceous species were common in the area, in particular a single species was often found on or nearby cultivation areas. Representative samples were collected for identification by the WA herbarium. Several plants were inspected but none had symptoms of viral infection.

Virus - Surveys Darwin, September 2011

A brief survey of potential CLCuD hosts in urban areas of Darwin was completed. Of note was the detection of two stands of cotton plants growing in the Darwin botanical gardens. These plants showed no symptoms of disease. In addition to the cotton the gardens also had several cucurbit and solanaceous CLCuD potential hosts

grown in a permaculture garden. Several of these plants showed signs of virus infection, presumably of known endemic viruses but this will be confirmed using laboratory assays. The botanic gardens are a useful sentinel survey site to monitor for potential incursions of CLCuD.
Surveys of natural park areas in and around Darwin such as the Charles Darwin National Park and the Holmes Jungle Nature Park failed to detect potential CLCuD hosts. Potential ornamental hosts of CLCuD, for example hibiscus, are common within urban and park areas of Darwin. No whitefly species were detected during any of the Darwin surveys.
Overall, the establishment potential of CLCuD within the urban environment of Darwin is considered very low, particularly with an absence of the major pathogen vector. However, what is not known is the likelihood of establishment in agricultural areas and natural environments outside Darwin.

Plant Pathogens - Cotton surveys Kununurra, September 2011

A total of 20 fields were viewed in the Kununurra cotton region; of which 13 were surveyed for endemic and exotic diseases. Fields not surveyed had been irrigated, preventing movement in the field. Table 1 summarises details of the location, cotton variety, coordinates of location and observations made during survey.

Table 1. Summary of fields surveyed in Kununurra Ord River region

Property	Field	Variety	WP	Coordinates	Observations
Bothkamp East	41-3	71BRF	040	S 15° 39'25.7" E 128° 44'53.0"	No bolls open, trace of *Alternaria* in top of canopy, black sooty mould on lower third of canopy due to sticky residue honeydew secreted by aphids 80% of leaves infected, aphids present, hormone damage in one corner of field, next to trap and refuge crop, crop stage 5.
	44-1	71BRF	042	S 15° 39'22.0" E 128° 14'53.7"	No bolls open, trace of *Alternaria*, aphids present but no black sooty mould.
Bothkamp West	51-2	71BRF			No bolls open, trace of *Alternaria* in upper canopy, growth stage 5, next to trap and refuge crop in field.
	51-1	71BRF	043	S 15° 37' 29.7" E 128° 43' 37.9"	No bolls open, heavy *Alternaria* in upper half of canopy 5 to 15 lesions per leaf however when a single plant was present in mound little *Alternaria* observed - less humidity, possible Solenopsis mealy bugs found along edge of crop (identification to be confirmed), herbicide damage at edge of crop, no volunteer cotton in crop or along roadside or channels, growth stage 5. Solenopsis mealy bug has been confirmed previously.
Oasis Farm	52B	24 BRF Okra leaf	044	S 15° 38' 18.8" E 128° 43' 59.7"	No bolls open, a lot of *Alternaria* in the upper half of crop with majority of leaves with lesions, plant canopy dense, leaf drop due to *Alternaria* in Okra leaf from lower canopy didn't observe this in normal leaf cotton, no weeds or volunteers in crop, a lot of small bols on ground in addition to leaves with *Alternaria*, a few weeds along roadside, growth stage 5.
	37	71 BRF			Irrigated, couldn't access.
Pacific Seeds Cave Springs Farm	136B	24BRF Okra leaf	046	S 15° 33" 56.2" E 128° 47' 32.1"	1 cracked boll (0.1% open), okra leaf volunteer in channel, some aphids present, growth stage 6 (mostly 5).
	136A	24BRF			Irrigated, couldn't access.
	135	24 BRF			Irrigated, couldn't access.
	137	71BRF	048	S 15° 33' 54.4" E 128° 48' 16.2"	No open bolls, dead plants with no roots look like wireworm damage, growth stage 5. 71 RRF refuge at end of field.
Barradale East	112-2	BRF/RRF	049	S 15° 34' 57.0" E 128° 46' 25.1"	Irrigated, couldn't access.
	112-3	71 BRF			Irrigated, couldn't access.
	112-1	71 BRF	050	S 15° 35' 27.7" E 128° 46' 3.0"	No bolls open, very dusty crop leaves coated in red dust, 2 mealy bugs found in volunteer cotton along edge of crop, growth stage 5.
	114-2	71BRF	051		Irrigated, couldn't access. Next to Chia crop. 1 ha of trap crop.
Pacific Seeds Rumu Farm	73-3	71BRF	052		Weeds along edge of crop and in taildrain, no bolls open, trace of *Alternaria* generally one spot on leaf, aphids present with sticky residue and black sooty mould, growth stage 5. 71 RRF refuge crop at end of field.
	73-2	24BRF	053	S 15° 36' 37.0" E 128° 46' 11.3"	No open bolls, sooty mould in lower canopy, sticky aphid residue, no *Alternaria*, plants a lot more spaced out than other okra leaf crops observed, growth stage 5.
Auto Farm	60A	71BRF	054	S 15° 39' 37.3" E 128° 45' 58.9"	No bolls open just forming bolls, no *Alternaria*, no aphids, crop looks good.
	65-1	71BRF	055	S 15° 39' 24.7" E 128° 46' 15.5"	No bolls open, no *Alternaria*, aphids present, black sooty mould on lower canopy on some plants but not severe, mealy bug infestation on the edge of field, 56/100 plants had mealy bugs on outside row, growth stage 5.
Ceres Farm Packbaddle Road	?	71 BRF?			No bolls open, trace of *Alternaria*, volunteer watermelon in crop, one mealy bug on edge of row, growth stage 5.
Ivanhoe Farms Ivanhoe Road	566	71 BRF	056	S 15° 43' 58.9" E 128° 42' 25.9"	Irrigated, couldn't access. High level of *Alternaria* in top half of crop 10 lesions per leaf.

Diseases not observed

No Fusarium wilt, Verticillium wilt, TSV or Bunchy top was observed in plants surveyed. None of the six exotic diseases surveyed for were detected.

***Alternaria* leaf spot**

In 2007, *Alternaria* leaf spot was reported as the most prevalent and important disease of cotton in northern Australia, and this hasn't changed. It is generally associated with the late-season development of cotton, during senescence of leaves. It overwinters on leaves and other plant residue colonized during the previous season. Conidia are windblown or dispersed by splashing onto healthy tissue. Spores infect during periods of warm wet weather and high humidity. Susceptibility of cotton plants to *Alternaria* leaf spot is increased by any factor that increases stress, including drought, damage from pests and deficiency of nutrients, particularly potassium.

In five fields, cotton had traces of *Alternaria* leaf spot in the upper half of the canopy. In three fields, *Alternaria* was severe with 5 to 15 lesions per leaf on 80% of leaves in the upper half of the canopy (Figures 1 and 2).

Figure 1. *Alternaria* leaf spot infecting cotton cultivar Sicot 71 BRF

Figure 2. *Alternaria* leaf spot infecting Sicot 71 BRF

Leaf samples were taken from several fields for pathogen isolation and confirmation. Leaves were surface sterilised with 70% ethanol and leaf lesions were excised and plated onto ¼PDA/S media and incubated at room temperature. Cultures (Figure 3) were examined under the microscope for conidiophores and conidia typical of *Alternaria* (Figure 4). Conidia observed (Figure 5) confirms presence of *Alternaria* in leaf spot.

Figure 3. Plate culture of *Alternaria* isolated from cotton leaf lesion

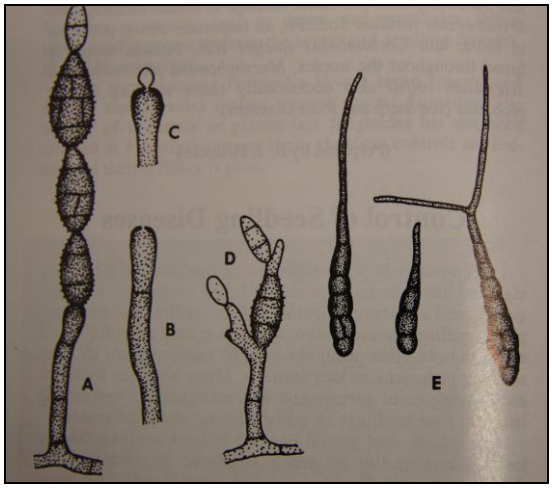


Figure 4. Conidia and conidiophores of *Alternaria*. A and D, conidiophores and chain of conidia; B, simple conidiophore, showing apical pore; C, proliferating conidium; E, conidia. (From H.L Barnett and Barry Hunter, 1998 illustrated Genera of Imperfect Fungi, 4th Edition, The American Phytopathololological Society, St. Paul, MN).

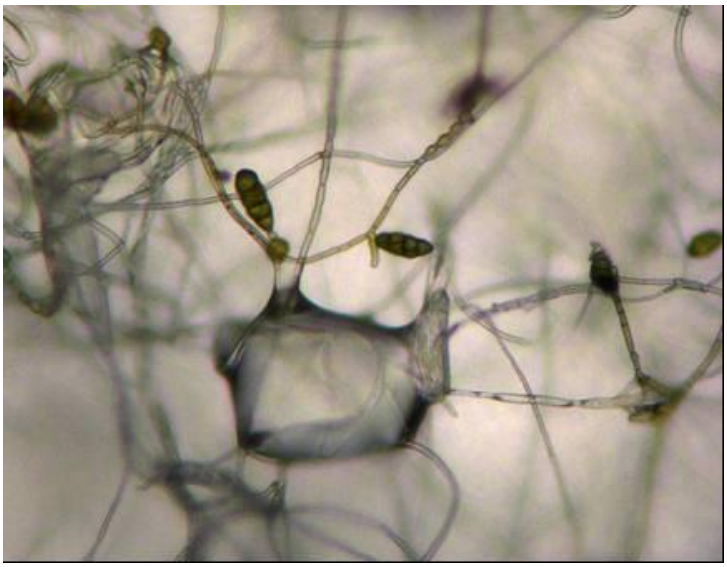


Figure 5. Conidia of *Alternaria* spp. cultured from a lesion on a cotton leaf sample collected at Kununurra, WA

There is limited information concerning the management of *Alternaria* leaf spot on cotton in Australia, probably because it has not been a major disease in established cotton growing regions. Review of the current literature for control of this disease includes burying crop residues as this increases the rate of decomposition and decreases survival of the pathogen, and reducing plant stress, especially potassium deficiency, as this delays primary infection and leaf spot severity.

Mealybugs
The exotic Solenopsis mealybug was first detected in Australian cotton in the Burdekin in the 2008-09 cotton-growing season. In the 2009-10 season Emerald experienced an outbreak of the Solenopsis mealybug (*Phenacoccus solenopsis*). In 2010 the impact of the Solenopsis mealybug stunted cotton plants, and in severely infested fields, this resulted in the death of plants. While a high proportion of fields were infested, the area of severely damaged crop was relatively small. Since these outbreaks, Solenopsis mealybugs have also been identified throughout the Darling Downs and St George; although only individual or small infestations have been found at these locations.

During the Ord River survey, mealybugs (which looked like Solenopsis) were observed on the edge row of three cotton fields. Solenopsis mealybugs have been confirmed previously when cotton was grown in this region. Specimens were collected and sent to Melina Miles (Toowoomba) and Solenopsis has been confirmed. Susan Maas (DEEDI, Emerald) was notified and it was suggested she discuss management strategies with Penny Goldsmith.

Figure 6. Mealybug infestation and damage

Management
Throughout winter, mealybugs persist on broadleaf weeds, ratoons and volunteer cotton in and around the fields. In-crop weediness over winter appears to be closely associated with the size of the infestation in the following cotton season. Where excellent weed management is achieved very low levels of mealybugs are observed in the following season.

Overseas, mealybugs are reported to move on air currents in the small crawler stage; through irrigation and tail water; and by contaminated vehicles and personnel entering fields. Infestation by crawlers may be alleviated by controlling weed hosts in and around cotton fields. Managing the movement of vehicles and people in and between infested fields also needs to be a priority.

Outcomes:

Established baseline frequencies and severities of endemic diseases. Diseases of note found were *Alternaria* leaf spot and Solenopsis mealybug.

Road-tested the 'proof of absence' protocols for exotic insect vectored diseases. No exotic diseases or exotic insect vectored diseases were detected.

Worked with local research agronomist, Penny Goldsmith, Ag WA to begin building capacity in WA for undertaking disease surveys in cotton.

b) other highlights

None

3. Detail the persons and institutions visited, giving full title, position details, location, duration of visit and purpose of visit to these people/places. (NB:- Please provide full names of institutions, not just acronyms.)

We visited Penny Goldsmith, a Research Officer with the Department of Agriculture and Food. Penny is based at the Frank Wise Institute of Tropical Agricultural Research, Durack Drive, PO Box 19, Kununurra WA 6743, Phone: 08 9166 4000 Fax: 08 9166 4066.

The purpose of this visit from the 4th -11th September 2011 was to survey irrigated cotton fields for endemic and exotic diseases; to road-test the 'proof of absence' protocols for exotic insect vectored diseases; and to begin building capacity in WA for undertaking disease surveys in cotton.

A total of 20 fields were viewed (Figure 1) in the Kununurra cotton region; of which 13 were surveyed for endemic and exotic diseases. Fields not surveyed had been irrigated, preventing movement in the field. A total of 17 fields were surveyed for virus diseases.

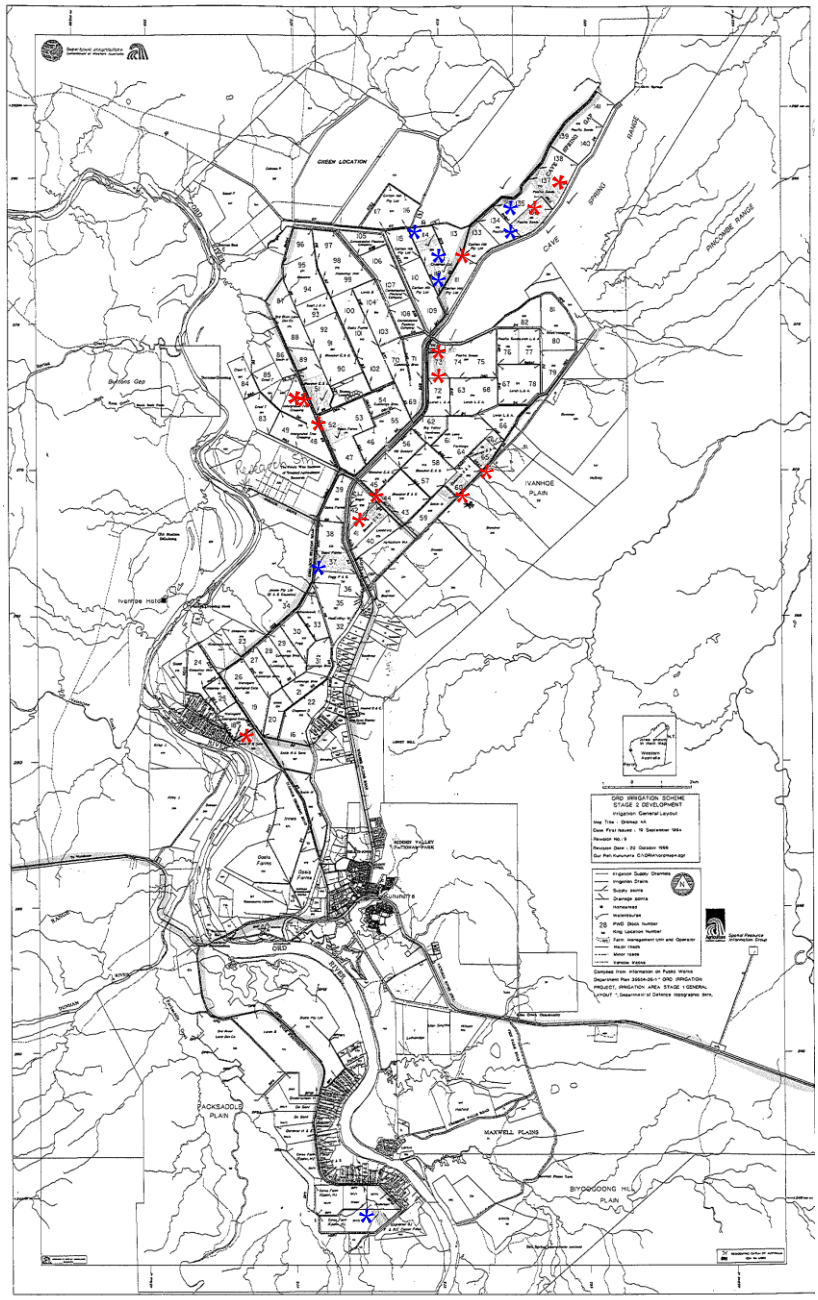


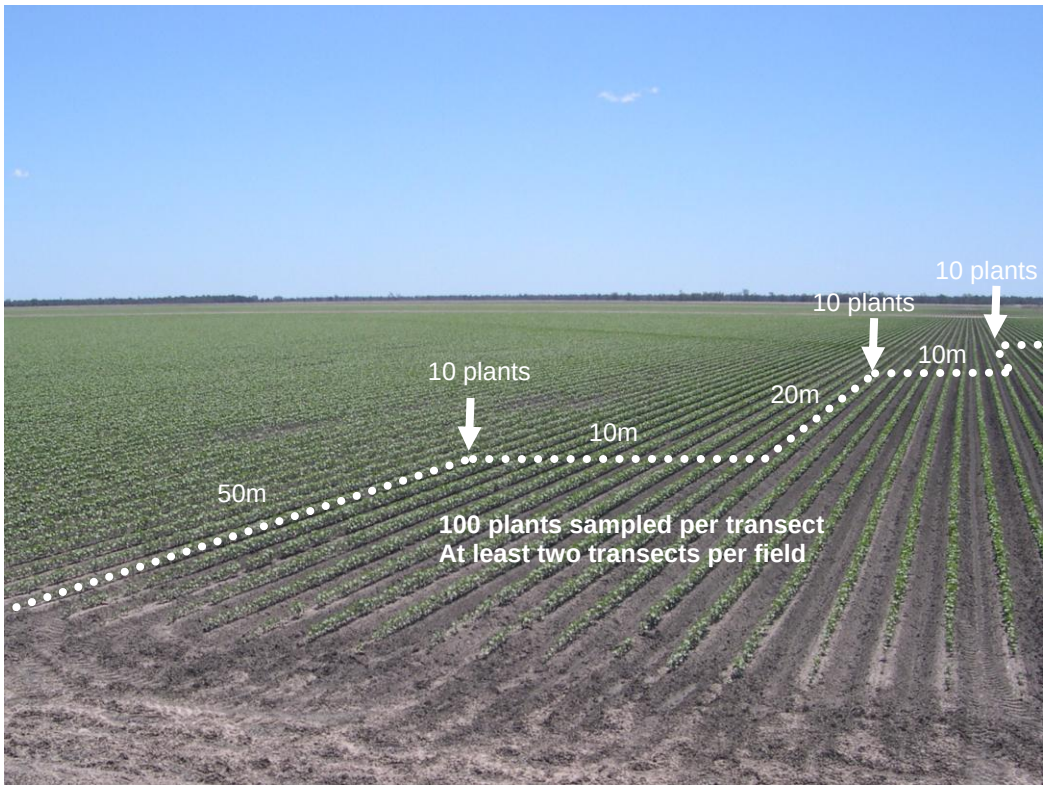
Figure 1. Map of the Ord River irrigation area
* indicates field planted with cotton that was entered and 100 plants surveyed for endemic and exotic diseases
* indicates cotton recently irrigated that was not entered and surveyed for endemic and exotic diseases

Disease Survey Methodology for Endemic and Exotic Diseases
Commercial cotton crops Queensland are inspected twice each season; early and late season. The incidence and severity of those diseases present are assessed, and field history, ground preparation, cotton variety, planting date and seed rate are recorded. Cotton areas surveyed include Emerald/Theodore, The Darling Downs, St George/Dirranbandi and the Burdekin.

The endemic diseases monitored include Fusarium wilt, Verticillium wilt (non-defoliating), *Alternaria* leaf spot, TSV and boll rots, plus anything unusual. Absence data for six exotic diseases are also recorded (exotic strains of Fusarium wilt, defoliating Verticillium wilt, Cotton leaf curl virus, Blue disease, Texas root rot, Hyper-virulent bacterial blight). Other data collected includes rating of herbicide damage and noting presence of volunteer cotton and weeds.

Survey Protocol:

- Start each field away from edge (approx 10 – 20 rows in).
- Check 10 plants, skip 10 rows, check another 10 plants, etc until 100 plants have been surveyed i.e. move diagonally through the field (stratified walk)



Late Season Survey
In the late season survey the proportion of plant affected by *Alternaria* leaf spot and the approximate leaf area within that proportion affected is recorded e.g. 25% of leaves on lower 1/3 of plant. The presence of Verticillium and Fusarium Wilts are recorded. Plants encountered that are wilted or have leaf symptoms are split and cut to determine if there is internal discoloration and the number of plants are recorded. Samples are collected for pathogen confirmation. The % of bolls open and the number that have boll or seed rot are recorded. The number of plants that have TSV, and level of plants expressing early senescence is also recorded.

4. a) Are there any potential areas worth following up as a result of the travel?

It would be beneficial to conduct an early season survey next season to gauge the importance of seedling diseases on plant stand in this region. This would provide an opportunity to show Penny Goldsmith the full spectrum of potential disease issues.

If further studies on the effect of foliar applications of potassium and fungicides on *Alternaria* leaf spot incidence, severity and cotton yield have not been conducted since 2004, further trials should be considered. In 2007 it was reported that foliar applications of potassium significantly reduced disease incidence, severity and leaf drop. Fungicidal trials in Kununurra with Mancozeb were not conclusive as there was a lack of disease on the crop. In the US the fungicidal products HEADLINE 2.09 and TWINLINE are registered to control

Start of Project (normally 1st July)

Alternaria leaf spot and boll rot disease. The active fungicides of these products are pyraclostrobin and pyraclostrobin + metconazole respectively. The strobilurin fungicides are synthetic analogues of naturally occurring fungitoxic metabolites produced by the woodland basidiomycete *Stobilurus tenacellus*. This new fungicidal chemistry may show promise against *Alternaria* leaf spot.

As cucurbits and cotton are grown side-by-side there is a need to conduct virus studies in vegetables as they can harbour cotton leaf curl that can be spread to cotton, however little whitefly, the vector of cotton leaf curl, was observed during this initial survey. It is important to monitor the level of whitefly present in these crops.

b) Any relevance or possible impact on the Australian Cotton Industry?

If the infestation of Solenopsis mealybug is not managed then there is potential for this pest to spread and for yield loss to occur. It is important that early season volunteers are not present as this enables the mealybug population to grow rapidly. Because cotton has not been in production for many years volunteer cotton is not a serious issue at present. The Ord River growers have an opportunity to remain clear of volunteers if they are diligent in removing these unwanted plants when they are young, as they are so much harder to manage once they become mature plants in channels/roadsides etc that have been growing for many seasons.

There may be economic loss in those fields with high levels of *Alternaria* leaf spot where significant premature plant defoliation resulting from the disease was observed.

5. How do you intend to share the knowledge you have gained with other people in the cotton industry?

Article in the Australian cotton grower?

6. Please list expenditure incurred. *(Double click inside the table to enter the data)*

Date	Description	Amount excl GST	GST	Total
	flights	2,719.11		2,719.11
	Accommodation	1,968.69		1,968.69
	Travel Allowance	1,021.65		1,021.65
	Car Hire Darwin	46.72		46.72
	Car Hire WA	631.87		631.87
	Fuel	29.72		29.72
	internet	19.95		19.95
	Taxi	147.52		147.52
	Freight - samples	30.00		30.00
				0.00
			TOTAL	**6,615.23**