

## **Machinery Development - Cotton Industry Guidance Update**

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This is a Cotton Research and Development Corporation funded three year project to consider the following areas and address the issues developed below.

### **Aims:**

- 1) To continue and develop the work begun in the existing project which focuses on residue handling in back to back cotton and rotation crops while optimising the control of diapausing heliothis pupae
- 2) To visit growing areas (irrigated and rainfed) and confirm a basis for other machinery needs in the industry, including planting and cultivation equipment
- 3) Field test equipment changes
- 4) Seek backing from commercial entities to limit funding drain of research moneys
- 5) Pursue the involvement of commercial manufacturers where appropriate to help in the adoption of improved technology.
- 6) To monitor commercialisation of a fully tested computer based guidance system

### **Industry Significance and Initial Research Priorities:**

Wide support was received at grower and industry meetings for work to be done on machinery development specifically for the cotton industry. Areas of immediate need were:

- 1) Stubble handling equipment to leave residue in the most beneficial form in both cotton and rotation crops
- 2) Planting and cultivation equipment capable of allowing high stubble clearance
- 3) Moisture conservation equipment for rainfed cotton while still achieving pupae and stubble management
- 4) Production of a **Machine-pac** which reports on different equipment and residue management options
- 5) Monitoring and improvement of picker efficiency
- 6) Investigation of machinery options - wheel spacing, row spacing, equipment width
- 7) Experimentation and development of bed shaping equipment options.

Work is presently underway on some of these projects, namely stubble management and over wintering pupae control. Field trials will be instigated during the next three years to prove the developments and to provide information flow to farmers. It is important that a move be made towards solutions being applied to problems highlighted during the soil research work done over the last several years. This will assist the adoption of soil management techniques important to the long term viability of the cotton industry.

### Research Proposal Summary:

With the continuing growth of the cotton industry in Australia, and the need to decrease input costs and increase system efficiency, it has become evident that there is a need for work to be done on machinery to help implement the soil principles researched during the last few years. In particular, farmers require support with:

- a) equipment and tooling to achieve their goals in permanent bed and controlled traffic systems
- b) planting equipment for moisture preservation in rainfed cotton areas
- c) planting and cultivation equipment suitable for high residue levels
- d) lower draft row forming equipment
- e) picker efficiency monitoring and improvements

The areas of work to be concentrated on will move with industry requirements, and liaison is needed between the CRDC, ACGRA and the USQ to determine priorities. The CRC rotation and farming systems work also needs to be used as a basis for this position. Extension work and information transfer will be vital to ensure the resulting developments are returned to the growers.

### Objectives to be achieved during the project:

1996/1999

- 1) Continue industry surveys into research priorities listed below.
  - a) Cotton stubble handling in back to back cotton
  - b) Moisture conservation with rainfed cotton while still achieving pupae and stubble management
  - c) Handling of rotation crop residues (linking with current work but enlarging trials)
  - d) Production of a **Machine-pac** on different tillage equipment and stalk management options to help farmers make management decisions
  - e) Monitoring and improvement of picker efficiency
  - f) Machinery options - wheel spacing, row spacing, equipment width
  - g) Bed architecture and shape options - experiments needed
- 2) Initiate engineering solutions to these problems.
- 3) Perform field trials to test engineered solutions.
- 4) Monitor commercialisation of guidance systems.
- 5) Provide information flow to farmers resulting from developments.

To date, work has concentrated on the gathering of information in the following areas.

- a) Cotton stalk and rotation crop residue processing equipment
- b) Management strategies in different growing areas, including weed control, irrigation management and erosion control
- c) Rotation cycles currently used to implement management strategies
- d) Pupae management strategies in cotton and rotation crops
- e) Other new machinery options for the future of cotton farming

## Preliminary Results

The type of practice encountered for residue handling varied between growing areas, but the following trends are in evidence.

Farmers are generally conservative in their approach, with the growing areas summarised as follows.

a) Emerald growers use a range of machinery and processes, including blade slashers, mulchers, some flail slashers with raking and burning still widely implemented. Tillage cycles are somewhat intensive and conservative in nature but more than comply with cultivation levels necessary for pupae control. Some innovative developments in the area of bed renovation and preparation were observed. Most farmers sow back to back cotton with an occasional wheat rotation as water allows. Controlling wheel track position is a low priority in a relatively conservative area. Wide beds are not used due to subbing problems in sloping fields. Compaction is removed most years with deep tillage operations.

Weed control is implemented by chemical and mechanical means, with some farmers opting to cultivate rather than use a pre-emergent herbicide. Fallow control was obtained generally by mechanical means.

In the irrigated areas, erosion during heavy rains continues to be an issue due to the higher slopes farmed in the Emerald area. This combined with a lack of organic matter promotes down slope soil movement. Some rotation crops may help in this, combined with an optimum stalk handling cycle. Dryland growers are being progressive with erosion control and combined with down slope controlled traffic implementation, is showing positive benefits.

b) Darling Downs and St George growers are biased towards raking and burning, something that the current wet season facilitates to a large degree. Bed preparation is traditional with little permanent bed or controlled traffic implementation. Some new slashers are widening residue handling options, but the cotton stalk is still widely considered as a problem. Some farmers are showing a desire to utilise the stalk and wish to retain it in their system, but are still unsure of the best option. There is a large area sown with back to back cotton. Rotations include wheat, soybeans, oats, sorghum, and some manure crops. Most tillage options observed are more than suitable for pupae control.

Weed control is implemented by chemical and mechanical means, with some farmers opting to cultivate rather than use a pre-emergent herbicide. Fallow control was obtained generally by mechanical means. The recent rain is causing some regrowth and winter weed concerns, with chemicals being used to help conserve moisture.

Erosion is less of a concern in St George than on the Downs, with most farms well established and only localised erosion resulting from heavy rains. The Downs suffered this year with consistent heavy rain on an extremely full profile. Large overland flows damaged large areas of land and many mature crops suffered numerous drenchings. Significant soil loss occurred across the Downs, highlighting the lack of planning in some areas with the increased area sown to cotton without rotation residue protection. There were other localised contributing factors, but lack of cover was a general observation.

c) Moree growers are variable in practices employed, with most of the area intensively cultivated between crops. Controlled traffic and permanent bed technology is not fully implemented in most of the area. Tillage practices are heavy with little work done in conservation tillage areas. Soil compaction is seen as something that needs to

be removed rather than exploited as an advantage. Some water use and management strategies were unique, maximising yield for available water. Rotations varied from wheat to heavy green manure crops, some soils responding to the greatly increased organic matter levels. Residue handling machinery is based around flail type slashers and some mulchers.

Weed control is implemented by chemical and mechanical means, with some farmers opting to cultivate rather than use a pre-emergent herbicide. Fallow control was obtained generally by mechanical means. Cultivation directly after slashing controlled emerging weeds which were a result of recent general rain.

Erosion is less of an issue in the Moree area except in river high flow areas. On farm erosion and soil movement is relatively minor. Water reticulation systems maximise irrigation efficiency and limit farm runoff.

d) Narrabri growers have seen the benefits of permanent wide beds and different tillage cycles on some of the best cotton soils in the country. Depending on soil conditions, tillage is used to prepare the soil by mainly conservative means. Tillage is increased during drier years, but is generally adequate for pupae control.

Weed control is implemented by chemical and mechanical means, with some farmers opting to cultivate rather than use a pre-emergent herbicide. Fallow control was obtained generally by mechanical means.

e) Gunnedah growers utilise different rotations and fertilizer application methods, with some bed tillage options of interest. Tillage is relatively intensive and surpasses pupae control requirements. Rotations include corn, wheat, oats and sorghum, with some growers using three year in one or two year out cycle. Earliness is an important consideration due to the cool weather, and early bed preparation essential. Residue handling equipment is based around existing and newer flail type slashers, with some growers using cutoff discs to shorten the root section.

Weed control is implemented by chemical and mechanical means, with some farmers opting to cultivate rather than use a pre-emergent herbicide. Fallow control was obtained generally by mechanical means.

Erosion control is effected by limiting growing areas, although some overland flow in lower areas creates problems. Those farmers that have a significant rotation cycle which includes a high residue are better situated when faced with high quantity water flow.

f) Bourke and Warren farmers have tried a lot of options in each part of a growing cycle to maximise yields, including varying bed width and residue management. There have been varying levels of success with implementation of wider or permanent beds and controlled traffic. Some advantage was seen during the recent wet pick in fields that did have compacted laneways in place. There has been a trend on some farms to increased tillage compared to previous years, with managers believing that the yields have responded to the cultivation. It may be that it is response to **drier** tillage rather than increased tillage. Residue handling equipment is based around flail slashers of various types. Tillage levels are seen as sufficient to control pupae.

Weed control is implemented by chemical and mechanical means, with some farmers opting to cultivate rather than use a pre-emergent herbicide. Fallow control was obtained generally by mechanical means.

Erosion is not a large problem in these areas except for flood affected river flats. On farm water management in most areas is configured for maximum water use efficiency and minimum runoff.

## Summary and Future Directions

After due consideration of the current state of development in the industry and observation of existing equipment, the following initial work is proposed.

- 1) Trials of latest equipment available in all areas to confirm shortfalls in existing designs. This will be helped by feedback from existing purchases by farmers in each growing area.
- 2) Modification of existing equipment to overcome some operational requirements for height control in adverse conditions. Ground height sensing would maximise efficiency and minimise mechanical damage to slasher.
- 3) Continue discussion about the rake and burn option, exploring resistance to alternative solutions.
- 4) Continue the development of the required tillage alternatives for pupae control in minimum tillage and controlled traffic regimes for both rainfed and irrigated cotton and rotation crops.
- 5) Trial new ideas for stalk management and pupae control in growing areas
- 6) Work with equipment producers to find new and improved products for the Australian cotton industry.
- 7) Produce a loose leaf updatable **Machine-pac** for distribution among farmers. This would include machinery options without commercial bias, most recent pupae management strategies, and tillage decision tools.
- 8) Begin work on the other aims outlined in this document.

## Conclusion

Work is well underway for the development of **Machine-pac**, with farmer consultation forming a basis for the publication. It is envisaged that during the next three years, the information gained and equipment developed will help farmers make more informed decisions and have the tools to implement them.

A further invitation is extended to all farmers and industry personnel to contribute in any way towards this work. Please feel free to contact me in person, by phone or fax.

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## Guidance Update

Testing of new components were again trailed this last season at six different test sites. We are confident that the software is sufficiently developed to do the job, but that there is a need to trial new hardware including cameras and computers. With the limited resources we had for the refit we trailed new computers in rugged boxes and smaller cameras.

The season was complicated by an erratic season, with very staggered plantings and cultivation timings. Some test sites were not ideal this year, with farmers not always using the tractor for tasks where guidance was needed.

Our major test site near Toowoomba was concentrated on again, with good success. The guidance system was used to plant 1000 acres of dryland cotton, the system following a marker arm scribe mark in the ground. It has since been used for cultivation of corn, sorghum, soybeans and cotton.

We trailed a new planting guidance mechanism at St George this year. The system made use of the furrows, tracking of the sides to steer the tractor. The system was a success (except for some reliability problems) with the planter kept on top of the bed while the system was in use.

The cotton picker units were again installed also, with the new units greatly improved from last year. Improvements included more robust sensors, auto calibration features, and an ability to 'learn' what the desired steering is during calibration. We hope that this is the last year of testing.

As far as commercialisation goes, we are continuing negotiations with Case to have the unit on the market in some form this coming season. The unit has needed a final push over the hill to realise the commercial dream we had as an aim at the beginning of the project. The interest of Case will ensure the continued development of the unit over time.

June 1996. At this stage we are considering the option of fully supporting 10 units in the field for the 96/97 year, with dedicated personnel to care for the devices. Case are supporting the production of these machines and will participate in the monitoring of them.