FARMING SYSTEMS USING CEREAL STUBBLE

A Summary of Current Trial Results and Industry Practices

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What are the potential Benefits Growers are looking for when planting Cotton into Wheat Stubble?

Since the introduction of effective knock-down herbicides, farmers all over the world have tried to use zero-tillage practices to achieve better water infiltration, to improve soil structure as well as to reduce the risk of soil erosion through wind or water run-off and pesticide movement off field.

Zero-till practices have been well accepted in dryland situations in Australia for quite a while. Dryland growers have been able to increase their yield potential by reducing run off and storing more water in their soils prior to planting as well as during the growing season.

Could similar technology be used in furrow irrigated cotton fields in Australia? Do the potential benefits outweigh the potential problems like more difficult weed control, stubble handling and plant establishment? Are zero-till systems practical or are they too difficult to handle in a commercial production system? Should we concentrate on the simple and effective systems rather than trying to solve our problems using too sophisticated and complicated systems?

In the week starting April 9 2000, Philip McLellan, Gus Shaw and myself were given the opportunity to travel around the cotton areas with the aim to compile the current developments in Cotton-Farming Systems using wheat stubble as a cover crop. We interviewed 17 cotton growers, one researcher and one industry development officer with experience using wheat stubble. The information collected from the interviewed people was put together into a video available at the local NSW Agricultural offices. In addition to the interviewed people, four industry researchers provided their trial data to be used for this paper.

Experiments in the Emerald area in the 1997/98-cotton season produced very encouraging and in part also unexpected results. Not only were soil erosion, pesticide and nutrient movement reduced significantly, standing stubble had also a surprising effect on pest and beneficial insects early in the season. These results as well as evidence from similar situations in other growing areas sparked a renewed interest in the cotton industry. In the Emerald region alone, the area of cotton grown under wheat stubble increased from a couple of trial fields in the 96/97 season to probably around 1000 ha in the 99/00 season.

Whilst all the growers interviewed used similar systems, the motivation to grow cereal stubble as a cover crop for cotton was quite different from location to location:

The dryland growers we interviewed, successfully tried to reduce runoff and improve infiltration rates to **increase the soil moisture stored** under their crops. As a matter of fact, all the dryland operations we saw seemed to be very balanced and sustainable. Zero-till practices seemed to fit in very well into their management system.

The original trials in Emerald were located on rather steep irrigation fields and were originally aimed at **reducing soil erosion and off-farm movement of nutrients and pesticides**. Because of the climatic conditions in central Queensland the growers were able to harvest the wheat crop before planting cotton into the standing stubble. Under these special conditions growers were also aiming at an **increased cash flow**. The additional benefits of **decreased early season pest pressure** came as a surprise in the first trial year but is now one of the main reasons for planting cotton crops into stubble.

Growers on hard setting soils in the Macquarie Valley tried mainly to slow down water flow in the furrows and **increase water infiltration rate**.

The growers farming on the more traditional self-mulching cotton soils had similar goals in mind like the Emerald farmers. Silt movement off the fields into channels and ditches is not as obvious as an erosion gully on a dryland field but incurs high de-silting costs and is a major source for off-target pesticide contamination. The main concern for farmers on those soils was to achieve the potential benefits of this system without causing water logging by slowing the water down too much.

All the growers we met were encouraged by the results from the Emerald trial sites and at least as a secondary goal, tried to **reduce early season pest pressure and therefore Endosulfan usage**.

Existing Trial Results

The effect of cover crops on soil erosion, pesticide and nutrient movement

Dave Waters, now based in Toowoomba as the senior Hydrologist of the Department of Natural Resources, received CRDC funding for a three-year project to evaluate the benefits and potential difficulties of cotton grown in wheat stubble. He started his trial program in the Emerald area during the 97/98 cotton season on a property called "Liskeard" owned by Scott Black.

In the first trial year in Emerald, it was found that wheat stubble did not reduce the amount of water that was running off the field but that soil erosion decreased by 70%. Because both Phosphorus and Endosulfan are tied to clay particles in the water, the reduction in soil movement also helped reducing the nutrient and pesticide load in the runoff water. The area planted into wheat stubble showed 50% less Endosulfan and 30% less Phosphorus being moved from the field.

The results in the second season were not quite as dramatic mainly because the ground cover from the cover crop was not nearly as good as in the first year and could not cope well enough with the very high in-season rainfall. The differences between the results from the two trial years show the importance of a good cover crop.

Figure 1: Percent Runoff from Irrigation and Rain at "Liskead" Emerald

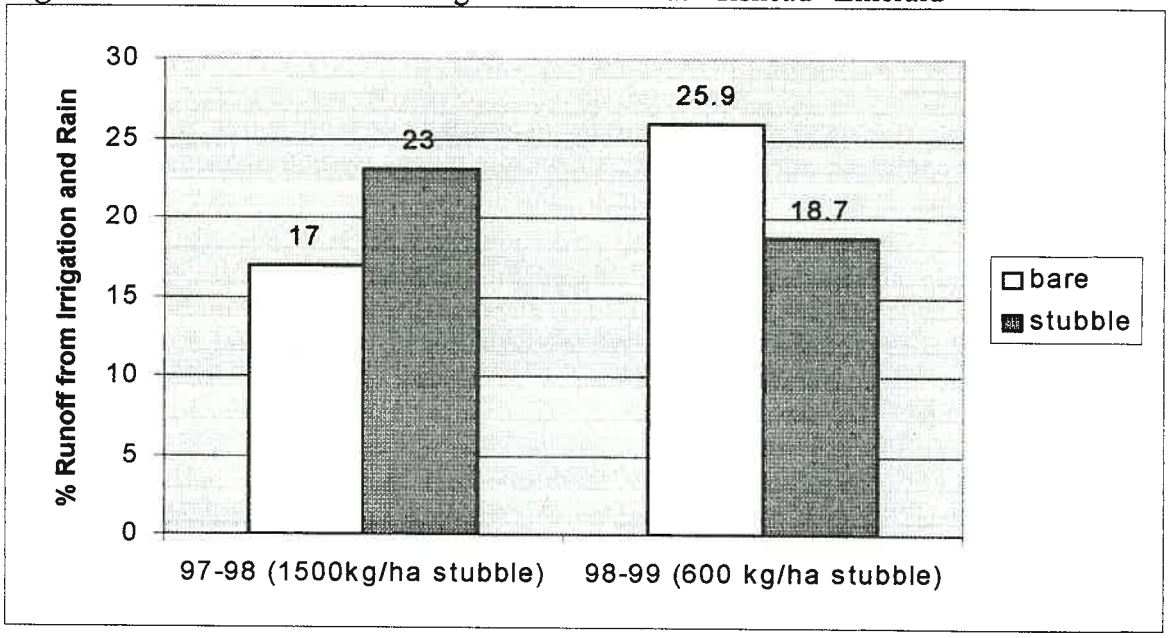
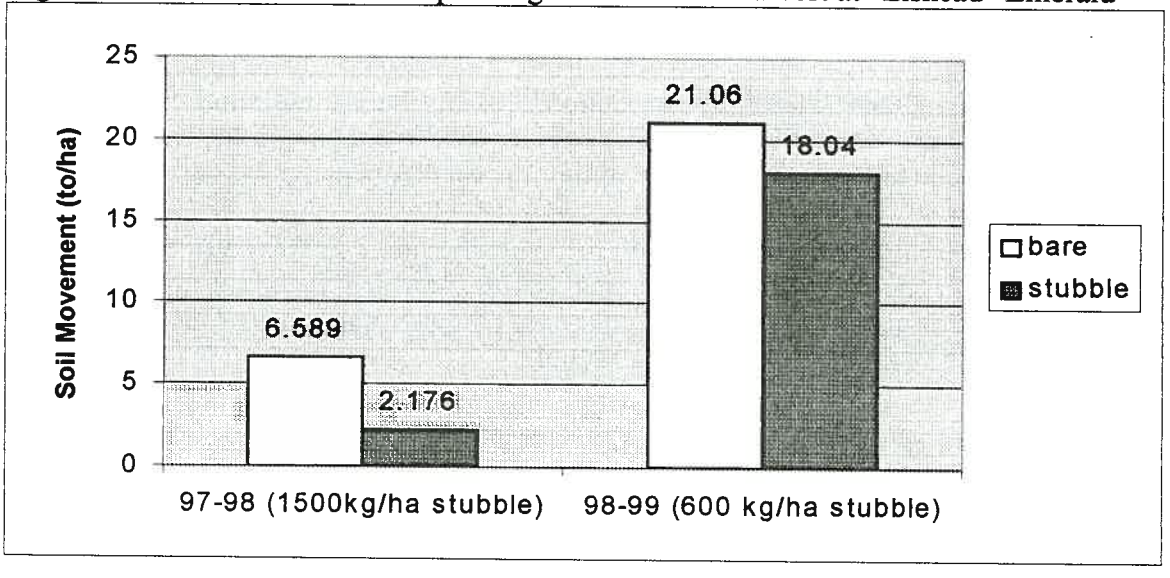
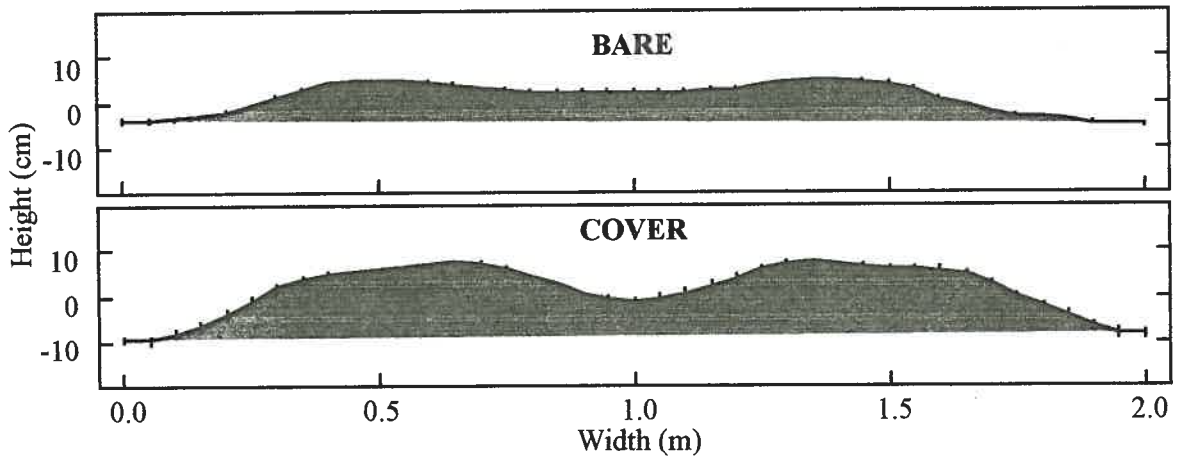


Figure 2: Soil Erosion from pre-irrigation to cotton harvest at "Liskead" Emerald



David Nehl, Plant Pathologist and Grant Roberts, Farming Systems Researcher, both at the Australia Cotton Research Institute found that the cover crop at a trial site at Auscott Narrabri had a profound effect on bed structure (Figure 3). Between sowing and measurement of the bed profile at the end of November, a total of 62mm of rain fell during three rainfall events and there were no irrigations during this period. This indicates that the beds in the bare plots were slumped due to the rainfall while the structure of the beds in the cover plots was remained. This experiment supports that wheat cover crops have the capacity to maintain bed structure and potentially increase cotton growth, maturity and yield.

Figure 3: Profile of wide beds in cotton at Auscott Narrabri with or without a wheat cover crop. Heights are expressed as the difference from the mean. Vertical bars show standard errors. The cotton planting line was at 0.5 and 1.5m.



The effect of cover crops on early season insect pressure

David Kelly, Development Officer for the Cotton CRC in Emerald collected insect data in a trial on the property "Parker" in the 98/99 season. He found less Helicoverpa eggs as well as grubs early in the season, while the cotton was smaller than the wheat stubble.

Despite the lack of hard data at the moment, the general opinion in the industry is, that the wheat stubble is visually "hiding" the young cotton crop and therefore attracts fewer moths. This seems to be proven by the fact that pest pressure often resumes to comparable levels as soon as the cotton grows above the stubble.

Results from different trials also showed an increase in the number of beneficial insects and spiders in the stubble treatments. For example at the Emerald site there were 20% more predators helping to reduce pest numbers in the stubble.

Figure 4: Helicoverpa Eggs at the property "Parker", Emerald 98-99

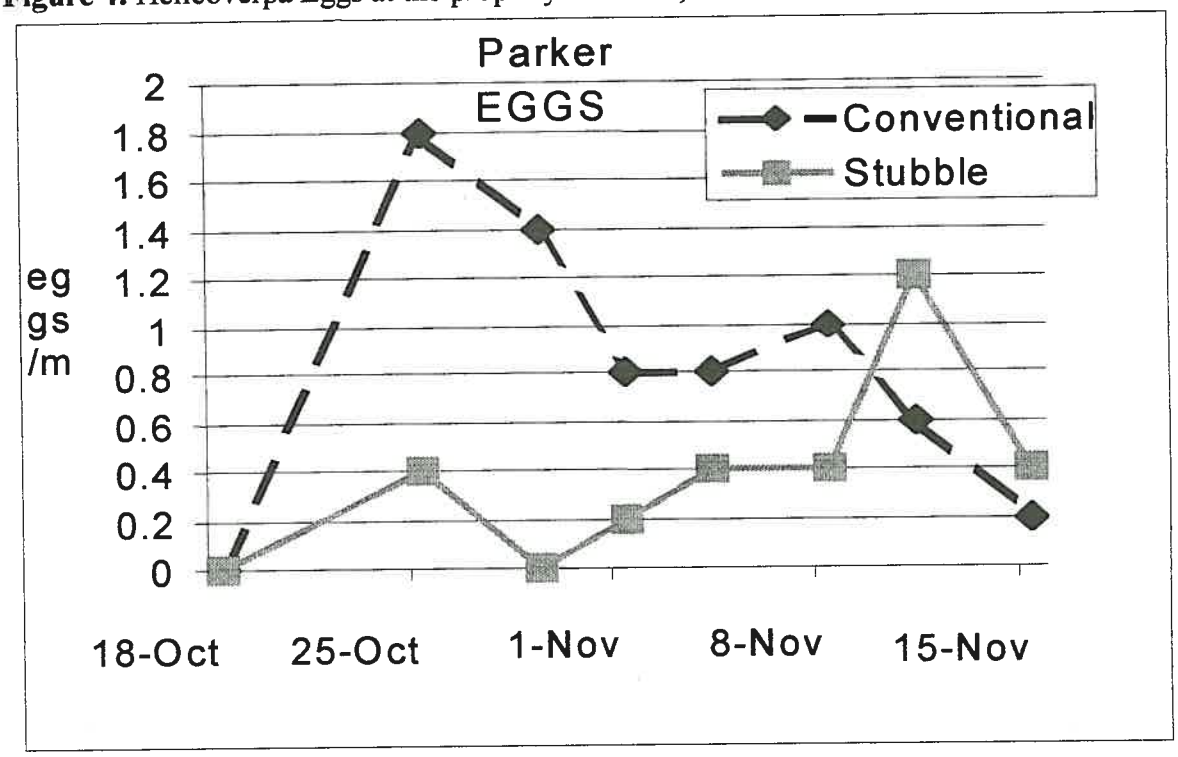
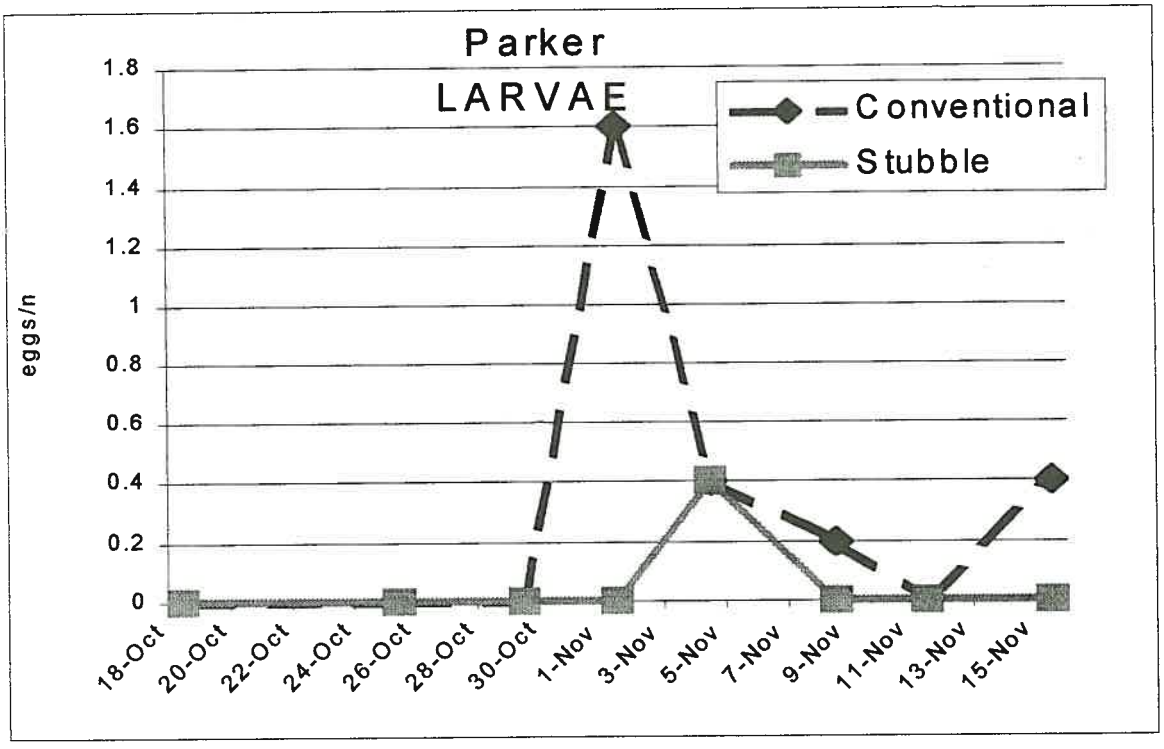


Figure 5: Helicoverpa Larvae at the property "Parker", Emerald 98-99



New trial results from the 1999-2000 season in Emerald showed little response in insect numbers to the stubble treatments. This is probably the case because the insect pressure in Emerald early in the season was exceptionally low.

Stephen Kimber, Environmental Scientist for NSW Agriculture in Wollongbar found at his trial site at Darling Farms in Bourke (99-00 season) slightly different results. Whilst his trial did no show any difference in egg numbers, the increased number of predatory insects and spiders must have been the reason for the significant difference in larval numbers. The stubble treatment received four early season insecticide sprays less than the bare field.

Because the cover crop was sprayed out too early at the Namoi site (wheat was at the jointing stage), the benefits in regards to Helicoverpa numbers could not be achieved. It is now perceived that the optimal time to spray out the cover crop is at early flowering of the cover crop. The remaining stubble should then be strong enough to keep standing until the cotton crop outgrows it.

Robert Mensah, Entomologist at the Australian Cotton Research Institute observed in his work that standing wheat stubble might disturb the flight pattern of Helicoverpa moths. He suggests that this disturbance contributes to the change of the oviposition pattern of Helicoverpa moths.

All the facts mentioned above have generally lead **to a saving of one to four early season insecticide sprays**. It is suggested that the combination of stubble plantings with nearby trap crops (e.g. chickpeas or sorghum) could improve this result even more.

Growers Experiences with Stubble Plantings

Following is a summary of the interviews we did with seventeen cotton growers that have planted cotton into wheat stubble.

Observed Benefits of Stubble Plantings
➢ Less crusting ➔ better plant stands
➢ Less sand blasting
➢ Higher soil temperature and better microclimate ➔ better early vigor
➢ Higher infiltration rate ➔ improved soil moisture holding capacity
➢ Less erosion, pesticide and nutrient movement off the field
➢ Decreased pest pressure and/or increased beneficial insects ➔ less early sprays
➢ Increased cash flow if wheat can be harvested (Emerald only)
➢ Good water use efficiency if wheat is harvested
➢ Mostly same or better yields (plus 0.5 to 0.75 b/ha)
➢ Decreased weed pressure in dryland situations and some irrigation farms
Potential Problems with Stubble Plantings
➢ Trash handling at planting ➔ variable plant stands
➢ Potential for "Kinze-slot"
➢ Expensive herbicides and chipping
➢ Increased water logging on heavier soils due to slowing water down
➢ Decreased water use efficiency if cover crop can't be harvested
➢ Cost of sacrificial cover crop

Some "doe's and don'ts"

Wheat:

- Use wheat varieties with tough stubble (Hartog and Janz have been mentioned)
- Too high stubble can lead to rank cotton plants
- Wheat planting rates used were between 45 and 70 kg/ha. It is important to get good soil coverage to achieve the erosion benefits
- Spray sacrificial wheat out as it comes to head, no earlier, to keep it standing
- Aim for even distribution of wheat stubble behind header, using choppers and spreaders

Cotton:

- Estimated N-uptake of cover crop and increase fertilizer need for cotton accordingly
- Sample for wire worm before cotton planting
- Beneficial planter modifications: - trash whippers necessary
  - 3rd press wheel over the planting slot
- Increase planting rate to compensate for reduced emergence rate
- Avoid water logging on heavy soils by:
  - cleaning center of furrows after wheat planting
  - clean trash out of furrows at cotton planting
- If available, alternative irrigation systems (center pivot, lateral, drip) are better suited to stubble plantings than furrow irrigation (water does not have to travel through furrows)
- Fertilizer application should have minimal effect on stubble cover. Water run fertilizers are well suited. Use minimum disturbance tines when incorporating fertilizers
- Use sap samples to monitor N requirements during the season
- Mentioned was also the importance to apply 15-20kgN/ha as a starter fertilizer
- Round-up Ready cotton is obviously suited very well if available
- Typical Herbicide program: - Diuron & Cotogard at planting (1kg + 1kg, 100%)
  - Verdict and/or Staple if necessary
  - Glyphosate with shielded sprayer at 8 nodes or more

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Special thanks go to the growers and researchers that have willingly provided us with their experiences and trial results.