# DEVELOPMENT OF REDUCED TILLAGE SYSTEMS FOR DRYLAND COTTON

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## Introduction

Reduced tillage practices have been developed and widely adopted by many dryland graingrowers on the blacksoil plains and brigalow lands of Northern New South Wales and Southern Queensland over the last fifteen years as a means of protecting the soil and utilising rainfall more efficiently. Many of these farmers now grow some cotton as well because of its greater monetary return. Unfortunately, the introduction of the crop has interfered with the implementation of sustainable farming systems in many instances.

Some of the reasons for this include:

- low levels of stubble produced by cotton
- the necessity of fallowing for 12-18 months
- the extended growth period, making adequate soil moisture storage for double cropping unlikely
- little ground cover early season, especially skip row
- the requirement for cultivation for pupae control after picking removes cover, closes soil cracks
- susceptibity of cotton to phenoxy spray damage lessens fallow options in adjacent fields,farms
- finer seedbed tilth necessary to achieve adequate, even stand when compared with cereal crops

This project sets out to address some of the problems associated with growing dryland cotton using reduced and no-tillage practices, and look for possible solutions which will allow cotton to be integrated into sustainable farming systems for these important production areas.

## Strip Tillage

No-till dryland cotton production has been attempted on some farms in the region. In some instances, it has been successful, while in others, a failure right from planting. Farms with heavy black and grey clay soils have been well represented in the latter category. Cotton is extremely sensitive to soil tilth, depth of planting and presswheel pressure. When planting cereal crops into no-till seedbeds on these particular soils, great liberties are taken with these factors without too many problems arising - the same does not apply with cotton.

Strip tillage techniques have the potential to overcome many of the problems associated with establishing cotton in an untilled seedbed while retaining most of the benefits. The concept of zonal or strip tillage is not new, but has not been investigated to any great extent in Australia. Lindsay

Ward of QDPI used a John Deere Rota-till, which disturbs a narrow band about 5 cm wide as part of the planting operation, achieving greatly improving plant establishment, in early trial work with no-till wheat in Southern Queensland.

In the current investigation, the strip tillage operation was carried out some weeks prior to planting to allow any large clods which were created to break down under wetting and drying. As well, preplant nitrogen was applied, and the herbicide, trifluralin, incorporated during the operation. To manage the limitations with tracking accuracy during planting, and to improve the fertilizing and herbicide application operations, a 30 cm wide strip was tilled for each row to a depth of 8 cm. It was felt that the disturbance of an area of this width in standing stubble would not increase erosion potential or runoff under high intensity storm conditions, especially if laid out across the slope, nor reduce the effectiveness of standing stubble in preventing sand blasting of young seedlings. In a double skip planting configuration, only 15% of the paddock area was tilled.

The trial machine was a two row unit, each tiller being a small PTO driven rotary hoe. Fertizer was dropped from a hopper onto the soil surface immediately in front of the rotary hoe while herbicide was sprayed on immediately behind the hoe, with a narrow four leaf drag harrow for incorporation.

Table 1 gives soil moisture levels at planting, seven weeks after the strip till treatment. Rainfall of 25 mm was measured during this period. It shows slightly higher moisture levels in the seedbed zone of the conventionally prepared and the strip tilled treatments, compared with the no-tilled.

Table 1: Soil moisture (%) in variously prepared seedbeds

| Depth (cm) | Treatment | | |
|---|---|---|---|
| | Strip till | No till | Conventional |
| 0 - 5 | 19.6 | 19.0 | 21.3 |
| 5 - 10 | 34.8 | 30.6 | 35.9 |
| 10 - 15 | 36.8 | 35.6 | 35.2 |

Rainfall of 20 mm, two days after planting, masked any differences in establishment. All treatments had stands of 10.3 - 10.5 plants/m twenty days after planting. A hailstorm in March, 1996 caused considerable damage to the trial, negating any chance for yield comparison from the different seedbed treatments.

The concept of banding the residual herbicide trifluralin is attractive should a planting opportunity for cotton not arise. An alternative crop can be established adjacent to the banded rows without fear of damage. Banding herbicide preplant also ensures that some degree of weed control will

be achieved along the row, in the event of banded herbicide applied at planting not receiving rainfall early enough to activate it, a common scenario in dryland cotton.

The single pass with the light harrow appears to have given a satisfactory level of incorporation. A new formulation of trifluralin, Treflan CR, supplied by Nufarm, was included for evaluation purposes, to see if its performance was superior to the standard product under minimal incorporation conditions. At planting, average weed counts per square metre of 28.7 in untreated, 5.4 in Treflan CR and 3.7 in standard trifluralin treatments were obtained. There was no statistical difference in the level of weed control provided by the two formulations, both being very satisfactory for the incorporation technique being used.

**Deep Tillage**

One of the problems of dryland cotton production is wetting up the soil profile after the crop. Double cropping a winter cereal back into cotton ground is one way of getting some cover back on the ground, to improve the chances of refilling the soil. If the opportunity for this doesn't arise, one alternative is to use surface roughness as a substitute for ground cover and soil cracking, to improve infiltration and slow surface runoff during the summer fallow.

A trial was set up to look at the effectiveness of different fallow practices in storing summer rainfall. A dryland cotton field was ripped in early Spring to a depth of 40 cm, using a 9 tine Austquip ripper, tines spaced at 55 cm. The operation was carried out at a rate of approximately 2 ha per hour. Tramlines were left undisturbed to allow passage of a ground rig for weed control during the summer fallow. Other treatments were conventional cultivation, and a no till treatment, which in this instance still contained remnant cereal stubble from the fallow prior to the cotton crop.

Figure 1: Comparative soil moisture in different tillage treatments after a series of high intensity storms

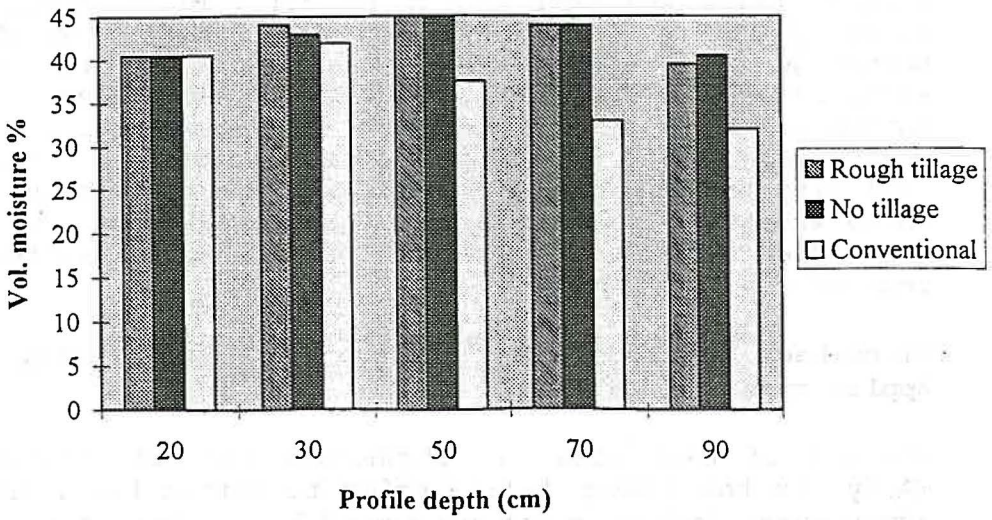

Figure 1 shows the soil moisture profiles after a series of mid-summer high intensity storms. The deep ripped and no-till fallows were significantly wetter than the conventionally cultivated. As the fallow progressed, a period of significant low intensity rainfall events resulted in all treatments moving towards similar soil moisture levels.

The trial showed the importance of this type of treatment being carried out on the contour. In this instance, the tramtracks became mini-rivers because of the roughness and elevation of the surrounding ripped area. Provided good weed control is obtained, it should not be necessary to disturb a ripped field until a couple of months before planting, by which time the soil will have melted down to allow easy seedbed preparation.

**Control of Regrowth Cotton**

Being such a vigorous weed, regrowth cotton demands careful attention during a fallow. In many areas, cultivation is the only option because of drift concerns with many herbicides during spring and summer. One option is to use herbicides on regrowth cotton soon after picking, a time of the year when there are generally few susceptible crops about. Previous trial work showed that Tillmaster was the superior herbicide for killing cotton at this stage, when 2.5 L/ha gave 80% mortality while most other herbicide options gave very low levels of control.

In 1995, one trial was laid down at Warra to assess the level of regrowth necessary to take up sufficient Tillmaster to give plant mortality. A rating system was developed, involving the degree of nodal shoots and mature upper leaves at the time of herbicide application. Three rates of herbicide were applied. In this instance, herbicide rate and degree of regrowth did not have any influence in the result. The very dry winter appears to have made the plants very susceptible, with the result that a final assessment in September showed almost 100% plant mortality.

Another trial was carried out at Billa Billa using various rates of Tillmaster and Tillmaster + Pulse. Soon after the herbicide applications, wheat was direct drilled into the standing cotton stubble. At final assessment in late November, there was no regrowth, the competition from the wheat crop having killed the plants across all treatments, including the unsprayed. In contrast, in an adjacent paddock where wheat was planted a month later, and never tillered to the same extent, 95% of cotton plants exhibited basal regrowth in late November.

**Plant-back Periods for Cotton following Ally Fallow Application**

The use of tank mixes of glyphosate and metsulfuron-methyl (Ally) in the summer fallow prior to cotton has a number of advantages, including enhanced weed kill, short term residual and reduced drift concerns.

However,the current recommendation of a 18 month plant-back period for cotton following summer application of Ally restricts its use, although local experience does not agree. As part of the project, research is being conducted on representative dryland cropping soils to determine the safety of re-cropping to cotton after using Ally during the summer.

The approach being used is to measure the seedling and yield response in cotton sown 3-10 months following Ally application at various sites, and to compare the cotton seedling response with a measured herbicide concentration in the soil at sowing, to determine the critical level below which it is safe to plant. Ally was applied to trial plots on three soil types at a rate of 5 g/ha, on three occasions between December and May. The soil types were a black earth (Waco) at Pittsworth, a grey clay (Cecilvale) at Dalby and a grey-brown clay (Brigalow) at Warra.

Table 2 outlines the effect of residual Ally on cotton seedling biomass at the three sites. With a 9-10 month plantback, there was no effect at any site. At Dalby and Pittsworth, a 8 month plantback had no effect on seedling biomass, but a 7 month plantback caused a 33% reduction at Warra. With shorter plant-backs, biomass reduction varied from 23 to 67%. Yield measurements were conducted at the Warra site. There was no significant difference in yield between any of the times of application, despite the difference in early seedling vigour. However, seasonal conditions including severe waterlogging events, and insect damage at the site may have masked any effects.

Table 2: Cotton seedling biomass reduction (% of untreated) from Ally fallow application. Ally concentration at sowing (ng/g)in 0-10 cm depth shown in brackets

| Plant back (months) | Location | | |
|---|---|---|---|
| | Dalby | Pittsworth | Warra |
| 9 - 10 | 3 (0.25) | 0 (0.86) | 2 (0.31) |
| 7 - 8 | 3 (0.48) | 0 (0.75) | 33 (0.47) |
| 5 - 6 | 0 (0.62) | 42 (1.54) | 46 (1.32) |

**Pupae Control in Dryland Cotton**

This project has also been evaluating the effectiveness of various cultivation techniques in achieving pupae control in dryland cotton fields. Details of these findings have been outlined in Australian Cottongrower (March 1995, May 1996) and also is covered in a poster at this Conference.