Managing weeds under reduced tillage

Findings from the "Sustainable dairy farm systems for profit" project

M5 Project Information Series - Studies on Mutdapilly Research Station and subtropical dairy farms 2001 to 2005

Rob CHATAWAY, Warren ORR and John COOPER

edited by ***Anne CHAMBERLAIN***

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Overview

BECAUSE of the proven long and short-term benefits of reduced-tillage, staff working on the environmental aspects of the M5 farming systems project are encouraging the widespread adoption of this farming practice on subtropical dairy farms.

Controlling weeds in reduced or zero-till farming systems is a juggling act between achieving the benefits of less soil cultivation, and managing weeds well.

However, it is possible to successfully control weeds in reduced-tillage farming systems, through careful planning and strategically using a range of chemical and non-chemical weed management tools.

Photo 1. Zero-till planting offers cost savings and environmental benefits over planting techniques that are reliant on a tilled seedbed.

Industry background

REPLACING mechanical tillage (partly or wholly) with herbicides results in a reduced rate of soil organic matter breakdown, increased soil surface cover, improved water storage (under certain circumstances), a reduced risk of soil compaction, and reduced fuel, labour and machinery costs.

However, weed-populations change in response to different levels of tillage, and over-reliance on herbicides can lead to hard-to-control species becoming dominant. Some weeds have also developed resistance to herbicides.

Photo 2. A surface germinator, sow thistle is a weed that is well adapted to zero or minimal tillage.

Lessons from the M5 farming systems project

Mutdapilly Research Station M5 farmlets

THE M5 farming systems project aimed to implement best-management practices on all five farmlets.

This included reduced-tillage to establish both winter and summer raingrown crops. Typically, glyphosate-based herbicides were used to control weeds until 6 to 8 weeks before planting, when one or two tillage operations were used to prepare a seedbed suitable for a conventional planter. Compared with conventional tillage, this resulted in higher levels of surface cover over the cropping cycle, and reduced risk of soil compaction and farm energy demands. Both winter and summer crops grown using these techniques were highly productive.

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Minimising soil erosion & structure

Cover of less than 30% is associated with greatly increased loss of soil through erosion.

The farmlets' use of herbicides instead of cultivation early in the fallow period reinforced its value as a management tool to extend the period of adequate soil cover. Ideally, tillage would be avoided altogether to maintain higher levels of soil cover until planting. It was noted in the farmlets that surface cover dropped significantly when the first tillage operation was introduced.

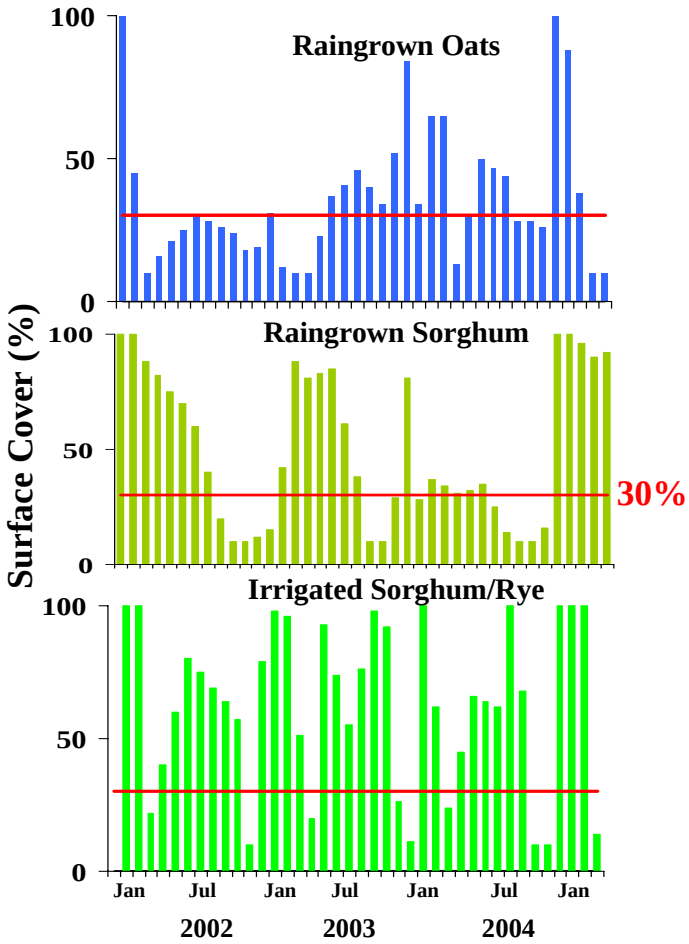
With heavy emphasis on annual crops, the M3 limited-irrigation cropping system is most vulnerable to soil erosion and soil-structure decline when conventional tillage practices are used. An emphasis on summer cropping and zero tillage would reduce these adverse outcomes.

PHOTO 3. A LOW level of stubble cover (<10%) on a fallowed forage oat paddock in mid-Summer 2005.

PHOTO 4. A LABLAB crop planted with wide row spacing and inter-row cultivation provides a low level of soil cover during establishment.

The forage system used in the M5 'no-graze' feedlot farmlet, - double cropped maize-barley and lucerne - provided good year-round ground cover, and posed minimal risk of nutrient and water loss below the crop root zone.

FIGURE 1. SOIL surface cover for selected feedbases, January 2002 to May 2005.



By regular assessment of surface cover, the M5 farmlet project showed that even minimal till (only tilling in the late fallow) was not able to maintain adequate soil cover (>30% ground cover) over the late spring/early summer storm period - a period of moderate to high erosion risk. This finding supports other work done in the subtropical grain belt (Freebairn and Wockner, 1986) where dairy farming is practiced. It means that on lands vulnerable to water erosion, crop stubble needs to be maintained over the whole fallow period - using a combination of zero tillage and cropping sequences that don't leave soil bare. If this cannot be done, crops should be replaced with perennial pastures, such as a lucerne/grass mix.

PHOTO 5. WINTER fallow following sorghum forage crop. The use of herbicides rather than tillage to manage fallow periods increases soil cover and reduces energy and labour inputs.

Weed Control

The M5 farming systems project looked at strategies to manage weeds in each of the five farming systems, plus their long-term sustainability from a reduced-till and weed management perspective.

M5 Companion farmer experiences

COMPANION farmers raised the issue of weed control as a very important part of their land management.

Measurements on commercial farms - M3 and M4 style - also reinforced the difficulty in maintaining adequate levels of soil cover when tillage is used to prepare seedbeds and control weeds.

The project established that using herbicides rather than tillage to control weeds in the early fallow period was successful in maintaining overall higher levels of surface cover and reducing time and fuel costs. Conventional planting equipment could still be used in this farming system.

However, to maintain surface stubble right up to planting requires a move to more robust planting equipment that is suitable for zero tillage operations. This change in machinery and practices should be considered by all farmers where soil erosion poses a significant risk to the sustainability of the farming operation.

Other Studies

DEPARTMENT of Primary Industries & Fisheries weeds agronomist Dr Steven Walker suggests a strategic approach to weed control, using the principles of integrated weed management. The aim is to economically and sustainably gain maximum control of problem weeds by reducing weed density and minimising seed-set.

Dr Walker recommends using a mixture of agronomic, chemical, biological and mechanical weed-control methods for profitable and environmentally-sustainable dairy farming in the region.

Agronomic tools

- Monitoring the effectiveness of the farm's weed management program, and using the records for future planning. Records need to include species and density of weeds, herbicide and application rate, other weed management techniques used, and the level of control achieved.
- Choosing species of crops and pastures carefully, as they will determine the control options available for that season.
- Using good establishment techniques and sowing at higher rates and in narrow rows will improve competition against weeds. Keeping the crop or pasture healthy - paying attention to crop nutrition, disease and pest management - will enable the crop to compete with weeds for water and nutrients, and will reduce weed vigour and seed production.

PHOTO 6. A WELL-ESTABLISHED oat crop in Farmlet M3 at Mutdapilly. Well-grown crops and pastures compete vigorously with weeds for nutrients and water.

Chemical tools

- Rotating herbicides. Continual use of the same herbicide - or herbicides with the same mode of action - will change the weed population over time. More difficult-to-control weed species can become dominant and herbicide-resistant weeds may develop. So rotate the different herbicide groups (which are now clearly marked on all labels). Using herbicide mixtures will also help avoid these potential problems.
- Adjusting herbicide application rates (within the range on the herbicide label) to account for weed size and density, and spraying conditions. Weeds under stress are harder to kill than healthy weeds, and generally require a higher rate of herbicide.
- Ensuring that weed control is not affected by water quality. High levels of dissolved salts, suspended clay and organic matter can reduce herbicide effectiveness.

Biological tools

- A healthy soil will encourage good crop growth, and a range of soil organisms will be available to eat weed seeds and reduce the future potential weed burden.
- Weeds can be accidentally imported into paddocks by purchasing crop or pasture seed, or fodder that is contaminated with weed seeds. Equipment that has been working in 'dirty' paddocks and not cleaned properly can also spread weeds onto other parts of the farm.
- Grazing plays a role in controlling weeds – but be careful not to spread weed seeds around the farm via grazing stock.

Mechanical tools

- Retaining heavy stubble cover will retard weed growth.
- Burning stubble can kill some weed seeds on the soil surface - but can lead to soil erosion, so should only be used in extreme situations.
- Even in reduced tillage systems, consider strategic cultivation at certain times - to prevent the development of herbicide-resistant weeds, and for dealing with hard-to-control and stressed weeds.

Contact

Rob Chataway, Mutdapilly Research Station

Ph (07) 5464 8745

Email: robert.chataway@dpi.qld.gov.au

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The *Sustainable dairy farm systems for profit* project at Mutdapilly Research Station and on associated commercial farms investigated the potential impact of intensification of five subtropical dairy farming systems on business productivity, on the social well being of farming families and on the farm environment.