Trial Summary Report

Protecting our Productive Soils

2019

Demonstration of in-paddock techniques to manage hillslope erosion

Forthside Vegetable Research Station

Cradle Coast NRM

Cradle Coast Authority

Australian Government

National Landcare Program

Introduction

The rate of soil erosion is determined by the climate, soil topography, plant/ground cover and land use. Best practice management principles to manage erosion need to either reduce the erosivity of water or reduce the erodibility of soil. To reduce the erosivity of water, the run-off volume of water needs to be reduced or the velocity of run-off and flow need to be reduced.

This trial is intended to demonstrate how some level of protection can be given to bare soil during the phase of vegetable crop establishment on an intensively cropped sloping paddock of red Ferrosol soil, and demonstrate how effective four different treatments are at reducing the erosive potential of water. The erosive potential of water is reduced to varying degrees (by three of the treatments) by providing an avenue for water moving down the slope to enter the soil profile hence limiting downhill water movement and surface runoff. The paddock is a commercial cropping paddock, of nearly 6 hectares in size, with the length of the slope varying between 265-280 metres.

Project partners:

tia TASMANIAN INSTITUTE OF AGRICULTURE

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TIA is a joint venture of the University of Tasmania and the Tasmanian Government

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Aim

To visually demonstrate the relative efficacy of different in-paddock erosion control techniques at reducing the in-paddock movement of soil.

Materials and methods

Four different erosion control treatment were established in a 5.8-hectare paddock of beans during early November immediately following sowing. The slope angle (inclination) of the paddock varied between 13-17°, and the four treatments are described briefly below:

(1) Ripper-mulch lines (or straw drains)

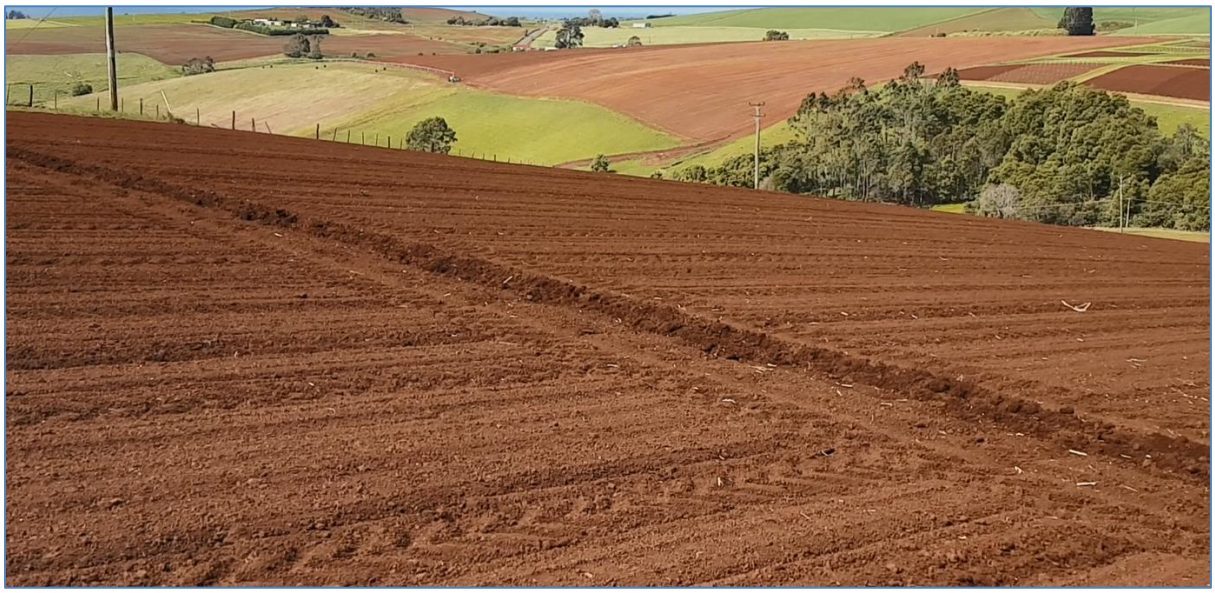
The ripper mulcher is a tractor towed implement which rips a single line across the contour of a paddock which is then filled with straw and firmly pushed down with a press wheel. The implement was designed by renowned Tasmanian soil scientist Dr Bill Cotching, and was fabricated at Dobmac Agricultural Machinery in Ulverstone, Tasmania.

An operator on the ripper mulcher feeds square bales of straw into the intake tray as the implement is towed across the contours of the paddock, installing "straw drains" as it progresses at between 1-3 kilometres per hour. Approximately 15 bales of straw per hectare were used in this treatment plot.

The ripper mulcher sitting idle in the farmyard and in service in the paddock

(2) Single rip lines

A single rip line was installed across the contours of this treatment plot. This treatment is essentially the same as using the ripper mulcher implement without straw, and was demonstrated as the availability of clean (seed free) straw can vary. The single rip line has a swath width of approximately 0.5 metres.



A single rip line along a paddock contour after installation

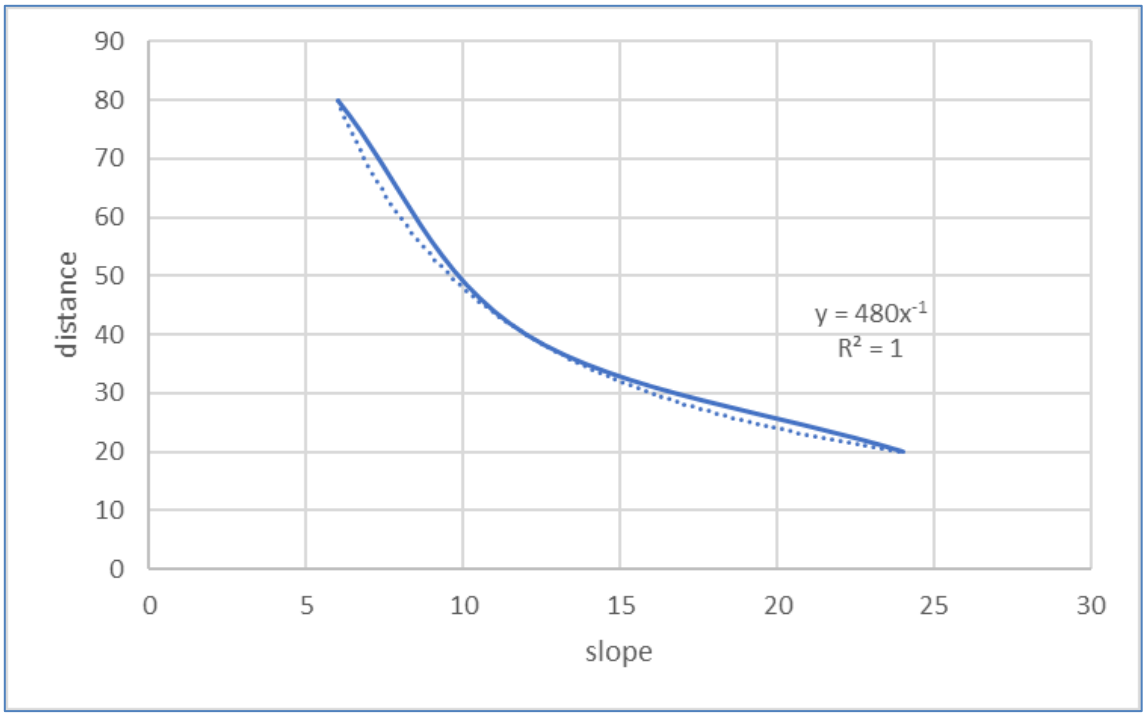
(3) Nontreated (No erosion control treatments were applied to this treatment plot)

(4) Agro plough rip lines (7 offset tynes following wheels)

A seven-tyne Agro plough was used to install rip lines across the contours of the slope in this treatment. Agro ploughs are common farm implements found on most farms and rip a swath of approximately 2.2 metres.

The agro plough sitting idle in the farmyard and in service in the paddock

The three treatments installed across the contours of the paddock (ripper mulcher, single tyne and Agro plough) were spaced at approximately 5 metre drops in elevation. With the slope varying between 13-17° in this particular paddock the treatments installed along the contours were at intervals of between 30-40 metres moving down the slope. This appears to be close to the optimum spacing for erosion controls to be implemented *(Dr Bill Cotching, Personal communication)* and is summarised in the graph below.



Graph and equation denoting distance between erosion control measures

After the treatment plots were installed in the paddock, they were visually quite impressive and noticeable from Forthside Road over 400 metres away (see images below). From left to right in the image below, the treatments are:

- Ripper mulcher (about ¾ of the paddock)
- Single rip lines
- Nontreated
- Agro plough rip lines

In-paddock erosion control techniques demonstration paddock

In-paddock erosion control techniques demonstration trial layout

Results and discussion

Two months after implementing the trial, measurements were taken to record:

(1) The number of rills uphill and downhill from the treatments, to estimate the relative efficacy of the various treatments at reducing the erosivity of water and moving down hill
(2) The length, width and depth of all rills in the treatment areas assessed, to allow an estimation to be made of the volume metres^3) and/or tonnes of soil eroded from each treatment plot.

Only rills were measured in the assessment of this demonstration trial, as sheet erosion which occurs prior to rill erosion proved too difficult and time consuming to record. An irrigation blowout which occurred in the nontreated plot was excluded from the analysis, as this would have biased the data.

<u>Number of rills</u>

Numerous quadrats above and below the treatments installed across the contour lines assessed. The number of rills immediately uphill and downhill from each of the treatment plots were recorded. This gave a sense of the relative efficacy of the

various treatments at reducing the erosive potential of water moving downhill compared to the nontreated or control plot. The ripper mulcher and agro plough implements showed the best performance, resulting in a 5% reduction in the number of rills downhill from both of these treatments. The single rip line reported no difference in the number of rills immediately uphill and downhill from the treatment, while in the nontreated plot a 167% increase in the number of rills was observed on the downhill side of the treatment compared to uphill (see table 1: Number of rills observed in treatment plots).

Treatment	No. rills uphill from treatment (per hectare)	No. rills downhill from treatment (per hectare)	Variation in No. of rills downhill from treatment (per hectare)
Ripper mulcher	100	50	50% decrease
Single rip line	100	100	no change
Nontreated	150	400	**167% increase**
Agro plough rip lines	100	50	50% decrease

Table 1: Number of rills observed in treatment plots

Volume of soil eroded from rills

The length, depth and width of all rills observed was recorded, allowing an estimation of the volume of soil eroded in the treatment plots to be estimated (See Table 2: Soil eroded through rill erosion). Inherent variation resulted in differing numbers of rills forming above the different treatment plots, so the effect of the various treatments were described as percentage change in tonnes of soil per treatment. An estimated 134.26 tonnes of soil per hectare was eroded above the ripped mulch lines, while 11.25 tonnes per hectare of soil was eroded downhill from this treatment. This resulted in an 87% decrease in erosion from the ripper mulcher treatment. The agro plough treatment reported a 75% decrease in soil eroded immediately downhill from the treatment (8.89 tonnes per hectare) compared to uphill from the treatment (36.90 tonnes per hectare). An estimated 41.73 tonnes per hectare of soil was eroded from rills immediately uphill from the single rip line treatment, while 32.29 tonnes per hectare of soil was eroded from rills immediately downhill from this treatment plot. The single rip line therefore reported a 23% decrease in eroded soil as a result of this treatment. The nontreated plot, in the absence of any erosion control measures, reported an increase in soil eroded immediately downhill from the paddock contour of 142.88 tonnes per hectare in comparison to uphill from the contour (136.91 tonnes per hectare). The ripper mulcher treatment therefore provided the best means of reducing hillslope erosion (87% of eroded soil retained by control measure), followed by the agro plough (75% of eroded soil retained by control measure). The single rip line provided the least benefit, reducing hillslope erosion by 23% compared to the nontreated plot.

Treatment	Tonnes of soil eroded per hectare uphill from treatment	Tonnes of soil eroded per hectare downhill from treatment	% increase or decrease in eroded soil volume downhill from treatments	Estimated value of nutrient loss with soil per hectare	Cost of treatment to implement per hectare
Ripper mulcher	134.26	11.25	87% decrease	$ 247.50	$ 175.00
Single rip line	41.73	32.29	23% decrease	$ 710.33	$ 50.00
Nontreated	136.91	142.88	**5% increase**	**$ 3,143.25**	$ -
Agro plough rip lines	36.90	8.89	75% decrease	$ 195.53	$ 50.00

Table 2: Soil eroded through rill erosion

Cost of nutrients eroded and adoptability of treatments

In the absence of any means to manage hillslope erosion in the paddock, the nontreated plot resulted in an estimated $3,143 worth of nutrients (Potassium, Phosphorus and Sulphur) being eroded per hectare. The agro plough reported the lowest estimated value of soil nutrients eroded of $195 per hectare, however inherent variation of where rills happened to form may bias this result in comparison to the ripper mulcher treatment as more soil was eroded uphill from the ripper mulcher treatment compared to the agro plough treatment plot. The main point here to consider is that without erosion control measure, upwards of $3,000 worth of nutrients per hectare can be washed away, and that the ripper mulcher reduced erosion by 87% while the agro plough reduced erosion by 75%.

The ripper mulcher cost an estimated $175 per hectare to install straw drains, which includes the cost per bale of straw (10 bales per hectare at $5 at bale) and cost and time of a tractor driver and implement operator. The agro plough and the single rip line were both estimated to cost $50 per hectare to implement, both being single-operator implements and requiring no straw.

While the ripper mulcher provided the greatest reduction in soil eroded compared to no treatment, the agro plough is likely to be a management change more readily adoptable by a larger number of farmers. The ripper mulcher proved the most effective treatment at reducing soil erosion and the use of them should be encouraged and supported, but only within a practical distance of where they are located by experienced operators who have planned ahead and have a supply of clean straw. The agro plough is approximately 80% as effective at reducing hillslope erosion compared to the ripper mulcher, is cheaper and easier to implement and therefore more widely adoptable.

Adoptability - pros and cons of the ripper mulcher compared to an agro plough

- There are only a small number of ripper mulchers in service (3), while every farm has an agro plough or two
- A supply of good quality clean straw needs to be on hand to utilise the ripper mulcher to install straw drains
- The ripper mulcher requires an implement operator to feed straw bales into the intake tray in addition to the tractor driver
- The ripper mulcher must be used in daylight as it would be unsafe to use at night, while agro ploughs are often used at night if that is the window of time available to install erosion control measures
- There comes a point where the gradient of a slope becomes too steep to tow a ripper mulcher with an operator across the contour of a paddock, while an agro plough can be utilised to manage erosion on steeper slopes

Rill erosion in the agro plough treatment plot

Demonstration facilitating the adoption of improved erosion management practices

As a part of this demonstration of erosion control techniques, two riper mulcher implements in a state of disrepair have been located on commercial farms in the

region. One was found after a Burnie farmer contacted the Cradle Coast Authority NRM team following the publication of a newspaper article in the local paper written by Cradle Coast NRM which talked about hillslope erosion. The second was located through the wide reach of the farmer networks developed over time by the Cradle Coast Authority NRM team. Both of these implements have been transported to their place of manufacture, Dobmac Agricultural Machinery (Ulverstone) where they will be repaired and put back into service for farmers to utilise to better manage hillslope erosion on their farms see image below). One ripper mulcher will be rehomed at the Tasmanian Institute of Agriculture's Forthside Vegetable Research and Demonstration Station, where this demonstration trial took place. The second will be housed on TasTAFE's Freer Farm campus on the outskirts of Burnie, and be available to farmers in surrounding districts. It is anticipated these implements will repaired and back on the ground by Autumn of 2020.

Two ripper mulcher implements awaiting repair

Acknowledgements

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