Trap rock boosted by contour chisel ploughing

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Plate 1. Legume plots recover after crash grazing in early May.

Plant cover is arguably the single most important factor in reducing erosion from water runoff.

Where plant cover has been reduced by drought or overgrazing, contour chisel ploughing can help retain water and re-establish pasture. It can also be a useful aid to successful establishment of improved pastures. This article looks at the benefits of contour chisel ploughing on traprock soils shown by early results from a trial set up at cement mills at 'Brooklyn', an hour west of Warwick, near Karara.

Trap rock country (figure 2) is probably best known for its fine wool production. Traprock graziers purchase western Queensland fully grown wethers and keep them for about five years.

Nutritional problems associated with long hard winters are the main limiting factors to sheep breeding enterprises and beef cattle production.

The traprock country has the most reliable rainfall of all the main wool producing areas in Queensland. But the effectiveness of rain, particularly the intense spring storm rain, is limited because of the very slow infiltration, consequently most of the rain runs off.

Plants help because they shelter the soil from the impact of raindrops and allow water to penetrate through their root channels. When plant cover is removed by drought or overgrazing, this access of water is also removed, leaving the soil surface to become dry and crusted.

Management of traprock should therefore be tailored towards keeping adequate plant cover at all times.

Contour chisel ploughing is regarded as a useful management technique to improve the soil infiltration and subsequent pasture regeneration. However, its benefits had not been quantified, which prompted soil Conservation Services Branch to set up the Cement Mills trial.

Because traprock soils soak up water slowly, keeping the water on the soil surface, rather than allowing it to run off, will help infiltration. Chisel ploughing on the contour lets each tyne furrow act as a small dam and allows the water more time to soak into the ground. We estimated that chisel furrows would hold about 30 000 L of water over 1 ha of ground.

Chisel ploughing on traprock is ideally done after rain, as the ground is softer. Spring chisellings are likely to produce the best results. However, if the operation is done in conjunction with seeding of winter legumes, an autumn chiselling would be more appropriate.

Chiselling down to 75 mm is all that is necessary. Any deeper than this can be undesirable as it may bring up subsoil. A minimum tine spacing of 300 mm is recommended to minimise destruction of existing plants.

Results

Runoff

Small plots, both in the chiselled and control areas, were sprinkled with water, at about 60 mm/hour intensity (plate 4). Runoff measurements were taken every 2 minutes until a fairly consistent runoff rate was reached. On average, runoff began after only 4 minutes of rain on the control plots, but not until 10 minutes on the roughened surface of the chisel plots. They reached a constant runoff rate after about 30 minutes, compared to about 15 for the control plots. By then, 40% of the rainfall was still infiltrating the chiselled soil, but only 10% was infiltrating the control plots.

Total infiltration was calculated for each plot after 20 mm of rainfall. The chiselled plots contained twice as much water.

All the plots had a 70% covering of clipped grass, so the results apply to well-grassed country. Other tests show infiltration to be lower without grass cover.

Projection of runoff were calculated for the chiselled and control plots using daily rainfall figures for 1987 and 1988. The USOA curve number equation was used to estimate runoff:

$$R = \frac{(P - .2\,S)^2}{(P + .8\,S)}$$

where R is total runoff and P is total rainfall. For our purposes, rainfall was accumulated until there were more than 5 dry days between rain days. This accumulated rain was then used in the equation to calculate runoff from each rain period in those two years.

The factor S was calculated by subtituting total runoff and total rainfall from the rainfall simulator plots into the above equation. The values of S were 39.5 and 11.7 for the furrowed and control plots respectively.

Evaporation was not considered and furrows were assumed to remain all year. One millimetre was subtracted from each rainfall event as surface storage on the control plots, while 5 mms were subtracted from the furrowed plots. 1987 was taken to represent a dry year in the traprock and 1986 represented a very wet year.

Figure 2 shows the hypothetical runoff from chiselled and unchiselled sites. In chiselled sites, in 1987, runoff only occurred 11 times with 31% runoff. In unchiselled plots, runoff occurred 17 times, with about 68% lost as runoff. Runoff for 1988 was 49% and 76% respectively, mostly from record rains in April, when 235 mm fell in the traprock area. Of this, about 188 mm would have runoff form chiselled sites, and 220 mm for unchiselled sites.

Native pasture production

For contour chisel ploughing to be viable, the extra water conserved has to be turned into extra grass production. Increases in production of up to 100% were shown (mainly on Queensland blue grass (*Dicanthium sericeum*) and pitted blue grass (*Bothriochloa decipiens*)). Areas that were completely bare before chiselling also regenerated well compared with non-chiselled sites.

Plate 2. Setting up for the rainfall simulator—the hard soil conditions make a jackhammer necessary.

Plate 3. Operating the simulator.

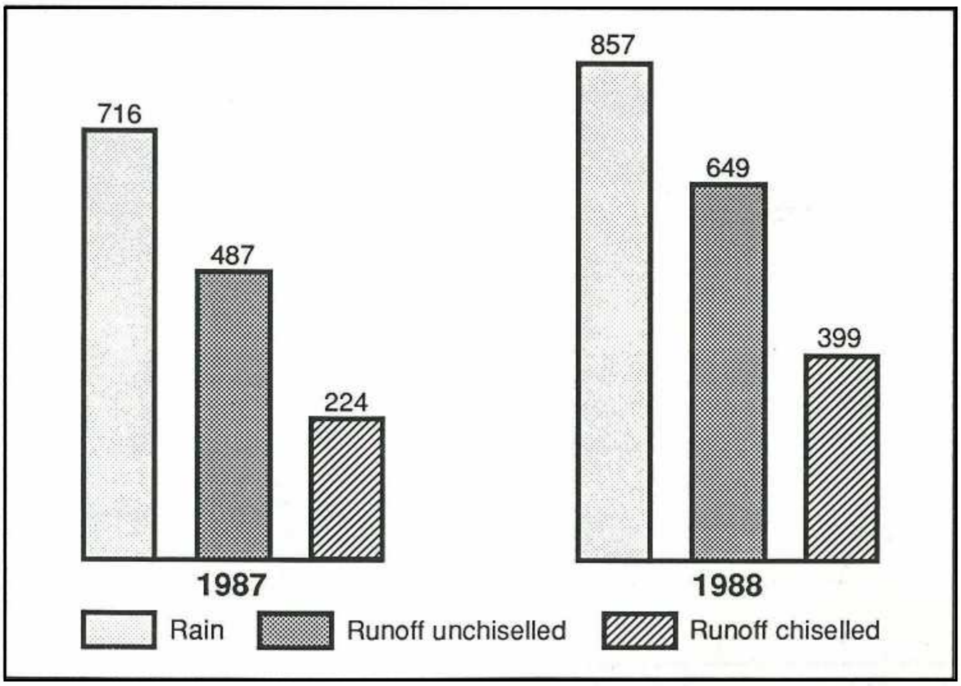

Figure 1. Rainfall and runoff from chisel furrows.

Pasture improvement

Native pasture in cleared country carries on average 2 dry sheep equivalents/ha. It is good summer grazing, but its dormancy in winter produces a major feed gap. Improved pastures are essential supplements to winter grazing, but are generally very difficult to establish using low cost techniques. Attempts at surface seeding into undisturbed ground have generally failed.

Contour chisel ploughing can give plants a better chance of germination. The chisel furrow protects seedlings from the sun and wind, and traps water providing moisture for longer periods. Chiselled sites sown with a mixture of clovers, medics and lucerne and 250 kg/ha Mo 200 superphosphate germinated very well. Seedling survival rates were also high, especially in the chisel furrow (plate 5).

Dry matter production on these sites was also impressive (table 2). Production in the crucial winter feed gap period was five times greater than the control plots. Pasture quality was also better with legumes making up between 30 and 60% of the pasture sampled.

A useful, low-cost method of pasture establishment can be achieved by mounting a planter box on a chisel plough. Seeding and contour chiselling can then be done in one cheap operation.

Reduced erosion

Traprock, like most grazing lands, has a thin layer of top soil. Top soil is the main source of nutrients and seeds for pasture regeneration so it is important that this layer is maintained.

Two types of erosion are common on traprock country, gully and sheet. Both are caused by too much water runoff (plate 6). Sheet erosion usually occurs at such a low rate it is unnoticed. But its long-term effect, particularly when occurring on shallow topsoil, will be pasture degradation.

Contour chisel ploughing will reduce total runoff and sheet erosion, particularly in overgrazed pasture. The speed in which gullies cut back will also be slowed and the chance of them regenerating through simple techniques

Plate 4. Chisel furrows holding runoff after simulated rainfall.

Table 1. Native pasture production.

Treatment	Oct–May	May–Oct	Total
	(Dry matter kg/ha for 1988-89)		
Control (no chiselling)	513	46	559
Chisel furrows (1 year old)	1118	68	1186
Chisel furrows (2 years old)	951	70	1020
Chisel furrows (3 years old)	*	*	*

* Data not available yet

Table 2. Improved pasture production.

Treatment	Oct–May	May–Oct	Total
	(Dry matter kg/ha for 1988-89)		
Chiselled plus legume seed and Superphosphate (1 year old)	1204	248	1452
Chiselled plus legume seed and Superphosphate (2 years old)	*	*	*

* Data not available yet

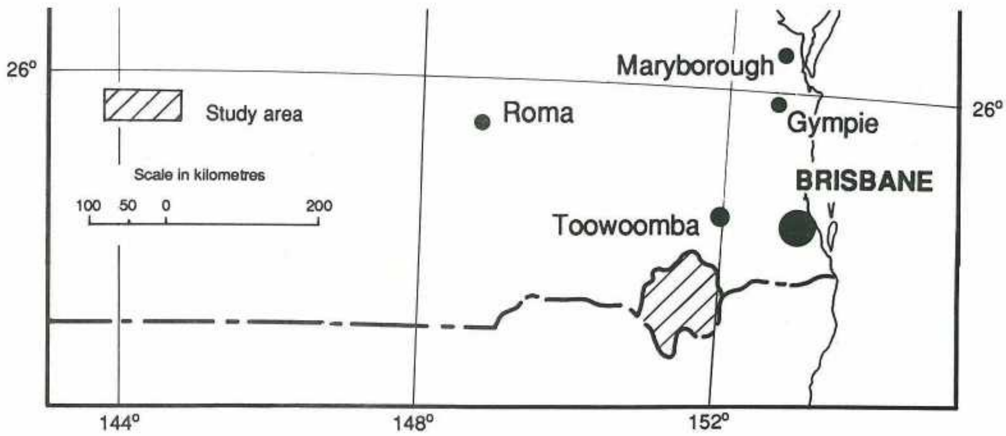

Figure 2. Location map: trap rock country.

such as destocking will be much improved.

Economics

It costs about $10/ha to chisel plough. But the returns in terms of improved wool production are not easy to measure. However, by being able to establish improved pastures that provide good quality feed through winter, financial benefits are obvious.

Method

Treatments

An even slope was selected for the trial site. Five plots were replicated six times to remove any bias. Plot treatments follow.

1 Contour chiselling in the first year

2 Contour chiselling in the second year

3 Contour chiselling in the third year

4 No chisel ploughing (control group)

5 Contour chiselling, followed by 250 kg/ha MO 200 superphosphate with 0.5 kg/ha 581 lucerne and 0.5 hg/ha trifecta lucerne, 0.5 kg/ha Parragio and Gemalong medic, 1 kg/ha cluster clover and 0.5 kg/ha Haifa Clover.

The reason chiselling is to be done over three years is to compare chiselled plots done in the first year of the trial with those in the second and third. This will then give an idea as to how long the benefits of chiselling will last.

Measurements

Dry matter (kg/ha), depth of soil wetting (cm), % soil moisture, runoff (m) and species composition were measured on each plot.

Dry matter was measured by clipping the plots at the end of each growing season. Runoff was measured using a rainfall simulator (plate 3). Depth of infiltration and the amount of soil moisture were measured after simulator runs and after natural rainfall events.