Rehabilitating degraded frontage soils in tropical north Queensland

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Introduction

The extensive tropical grasslands of north Queensland are grazed by beef cattle and provide a significant proportion of the water flowing into the Great Barrier Reef (GBR) lagoon. Soil sediments and nutrients eroding from the grazing lands of the Burdekin and Fitzroy catchments in north-east Queensland contributes to reduced water quality in the GBR lagoon. Degraded and eroded D-condition bare areas and eroding gullies in grazing lands provide a disproportionate amount of soil and nutrient losses from predominately native pasture grasslands used for cattle grazing. Rehabilitating these degraded areas will help improve water quality flowing onto the reef.

Rehabilitation methods were evaluated on three soil types on a degraded creek frontage in the Burdekin River catchment of north Queensland over the 2011-2012 summer. These bare patches occur widely across the two catchments and consistently degraded sites have been identified by 24 years of satellite imagery. The objectives of this study were to identify mechanical methods and management practices for regenerating these bare patches. This will assist landholders in returning unproductive land into useful grazing pastures and will provide benefits to the wider community by improving water quality from grazing lands that enters the GBR lagoon.

Methods

Site

Long-term, bare D-condition areas were identified by the Bare Ground Index from satellite imagery over 1988-2011, and surveyed by ground truthing to locate a 10 ha research site in the mid-Burdekin catchment of tropical north Queensland. The site was a periodically inundated creek flat with up to 50 cm of topsoil eroded, in undulating narrow leaved ironbark (*Eucalyptus crebra*) and Reid River grey box (*E. brownii*) flats west of the Burdekin River (GPS 19.337^{o}S, 145.814^{o}E). There were three soil types: a deep grey sodosol (Dy3.13), a crusty deep black vertosol (Ug5.15), and a sodic brown dermosol (Uf6.41).

Treatments and measurements

Four unreplicated mechanical soil disturbance treatments of 1-2 ha size: chisel ploughing to 20 cm deep at 20 cm tyne spacing, deep ripping to 50 cm deep at 1 m spacing, crocodile seeder, and grass hay mulch to 20 cm deep after surface disturbance and levelling with a grader blade, were compared with an undisturbed control. A tropical pasture grass and legume seed mix was broad-cast over all treatments including the control. The mechanical treatments, applied to dry soil in October 2011, were followed by 775 mm of rainfall, in an above average rainfall wet season. Pasture measurements were: establishment, species yield and ground cover, which were monitored after the first summer season in April 2012. Cattle grazing was excluded.

Results and Discussion

Mechanical rehabilitation on dry soils in spring when the following rainfall conditions over summer are favourable for pasture establishment can produce sufficient pasture cover to limit erosion within the first year. However, pasture rehabilitation in spring can suffer from false germination events. There was 100 mm of rainfall within a week of sowing in mid-October 2011 which produced pasture seedling germination over the trial site. These seedlings all died in over one month of heat-wave conditions to 40^{0}C, eliminating some soft seeded species. There was a second germination event in mid-December 2011 on 96 mm of rainfall. This germination was predominantly Indian bluegrass (*Bothriochloa pertusa*), cv. Milgarra butterfly pea (*Clitoria ternatea*) and cv. Progardes desmanthus (*Desmanthus* spp.). There were soil type differences in establishment success. Cover (to 90%) and yields (>3400 kg/ha) were highest on the vertosol and sodosol soil type and lowest on the sodic dermosol soil type (cover <20% from annual native *Sporobolus* and *Portulaca* species).

The hay mulch cover treatment produced the highest total dry matter yield (3910 kg/ha), 55% Rhodes grass (*Chloris gayana*), and cover (97%), with results similar from the deep ripping and chisel ploughing treatments (3400 kg/ha DM yield and 60% cover) over the first growing season (Fig. 1). The crocodile seeding produced a lower yield than other disturbance methods, only marginally higher than the control. Cover was similar between the crocodile and the control treatments (mean all soil types 45%). Pasture basal area was highest in the deep ripping and chisel ploughing treatments (1.8%) and lowest in the control (1%).

The dry matter yield of the treatments in pasture species groups (Table 1) shows the hay mulch layer produced the highest yield of both perennial

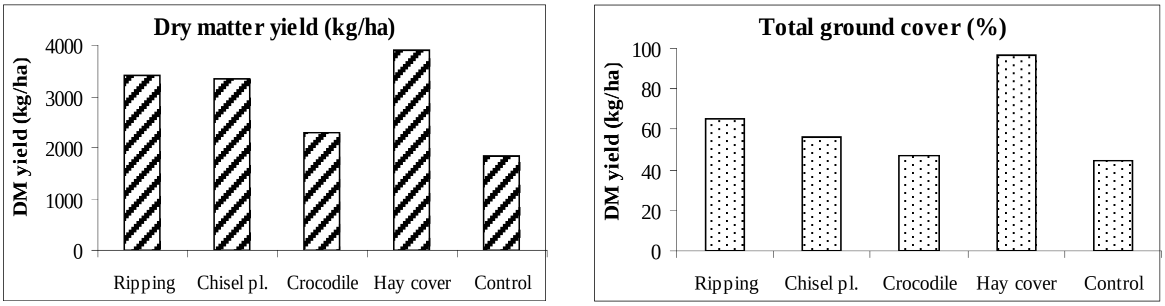

Figure 1. Pasture dry matter yield (kg/ha) and cover (%) in mechanical treatments (April 2012).

(predominantly Rhodes grass) and annual grasses. There were similar yields from the chisel ploughing and deep ripping treatments (predominantly Indian bluegrass), which both produced the highest legume yields. The crocodile seeder treatment was inferior to the two more intensive surface disturbance treatments and marginally superior to the undisturbed control.

Conclusions

Selecting suitable soil types and the most adapted pasture species offers the greatest chance of success in rehabilitating degraded D-condition bare areas in tropical north Queensland. In an above average rainfall summer, the soil type had the most influence on establishment success, production and cover in the first year. Establishment was most successful on the vertosol soil and failed on the sodic dermosol. False germination events could lead to failure in the first year. In this trial there were two 100 mm rainfall germination events in early summer, which is not an annual occurrence in this environment.

Pasture seeding with grass hay mulch cover, deep ripping and chisel ploughing on disturbed vertosol soil produced the highest herbage yields and ground cover in the first season. This pasture is sufficient to limit soil sediment and nutrient losses from bare areas in these grasslands. The latter two treatments, which had the highest legume yields improving the grazing value of the new pasture, are recommended for the vertosol and sodosol soil types. Pasture survival and cover levels in following years will determine if these methods of rehabilitation of D-condition bare areas provide a permanent solution to improving land productivity and reducing sediment and nutrient losses from these grasslands. The sodic dermosol soils require additional research to develop sustainable pasture cover.

Table 1. Mean pasture dry matter yield (kg/ha) in rehabilitation treatments over the first summer.

Species Groups	Rehabilitation treatments (kg/ha)				
	Ripping	Chisel plough	Crocodile	Hay cover	Control
Perennial grasses	1820	2110	2060	3040	1420
Annual grasses	100	190	60	460	210
Legumes	1430	1030	170	300	200
Forbs	70	30	20	110	30
Total DM yield	3420	3350	2300	3910	1850