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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 contribute 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 predominantly 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 3 soil types on a degraded creek frontage in the Burdekin River catchment of north Queensland over the 2011/12 summer. These bare patches occur widely across the 2 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 pasture on these bare patches. This will assist landholders in returning unproductive land to useful grazing pastures and will provide benefits to the wider community by improving quality of water 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 3 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 plowing to 20 cm deep at 20 cm tyne spacing; deep ripping to 50 cm deep at 1 m spacing; crocodile seeder (a rotating seed-containing large drum with shovel-like tools attached); and grass hay mulch to 20 cm deep after surface disturbance and levelling with a grader blade, were compared with an undisturbed control. The mechanical treatments were applied to dry soil in October 2011, and a seed mix of tropical pasture grass and legume was broadcast over all treatments, including the control. This was followed by 100 mm of rainfall within a week in mid-October 2011 and a total of 775 mm 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

The rainfall following seeding produced germination of pasture seed over the trial site, and all seedlings died during one month of heat-wave conditions to 40 °C, eliminating some soft-seeded species. These false germination starts are a threat to pasture rehabilitation in spring in this area. There was a second germination event in mid-December 2011, following 96 mm of rainfall. This germination was predominantly Indian bluegrass (*Bothriochloa pertusa*), butterfly pea cv. Milgarra (*Clitoria ternatea*) and desmanthus cv. Progardes (*Desmanthus* spp.). Establishment success varied with soil type. Cover (to 90%) and yields (>3,400 kg/ha) were highest on the vertosol and sodosol soil

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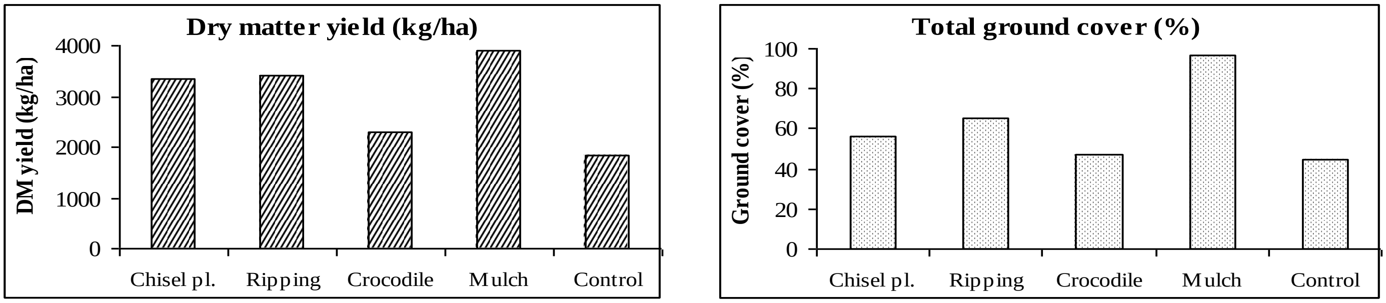

Figure 1. Pasture dry matter yield and cover for various mechanical treatments (April 2012).

types and lowest on the sodic dermosol soil (cover <20% from annual native *Sporobolus* and *Portulaca* spp.).

The hay mulch cover treatment produced the highest total dry matter yield (3,910 kg/ha), including 55% Rhodes grass (*Chloris gayana*), and cover (97%), while results were similar from the deep ripping and chisel plowing treatments (3,400 kg DM/ha and 60% cover) over the first growing season (Figure 1). Crocodile seeding produced a lower yield than other disturbance methods, only marginally higher than the control, and cover similar to the control (mean all soil types 45%). Pasture basal area was highest in the deep ripping and chisel plowing treatments (1.8%) and lowest in the control (1%).

Dry matter yields of pasture species groups (Table 1) showed the hay mulch layer produced the highest yields of both perennial (predominantly Rhodes grass) and annual grasses. Chisel plowing and deep ripping treatments produced similar yields (predominantly Indian bluegrass), and the highest legume yields. The crocodile seeder treatment was inferior to the more intensive surface disturbance treatments and only marginally superior to the undisturbed control.

Table 1. Mean pasture dry matter yield in rehabilitation treatments over the first summer.

Plant group	Pasture yield (kg/ha)				
	Chisel plow	Ripping	Crocodile	Hay mulch	Control
Perennial grasses	2,110	1,820	2,060	3,040	1,420
Annual grasses	190	100	60	460	210
Legumes	1,030	1,430	170	300	200
Forbs	30	70	20	110	30
Total DM yield	3,360	3,420	2,310	3,910	1,860

Conclusions

Mechanical rehabilitation on degraded D-condition bare areas in tropical north Queensland in spring, when the following rainfall conditions over summer are favorable for pasture establishment, can produce sufficient pasture cover to limit erosion within the first year. Selecting suitable soil types and the most adapted pasture species offers the greatest chance of success. False germination events could lead to failure in the first year, as the two 100 mm rainfall germination events in early summer in this study were not an annual occurrence in this environment. In an above average rainfall summer, soil type had the most influence on establishment success, production and cover in the first year.

While pasture seeding with grass hay mulch cover on disturbed vertosol and sodosol soils produced the highest herbage yields and ground cover in the first season, deep ripping and chisel plowing are much more practical options and produced a greater legume percentage in the pasture. These methods are recommended for pasture establishment on these soils. The resulting pasture is sufficient to limit soil sediment and nutrient losses from bare areas in these grasslands.

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. Additional research is needed to identify appropriate methods for developing sustainable pasture cover on the sodic dermosol soils.

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