

On-farm demonstrations of low-input methods for establishing legumes in central Queensland.

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Abstract

In 2010 a three year Meat and Livestock Australia funded Producer Demonstration Site (PDS) was established to demonstrate low-input sowing strategies for achieving legume establishment in buffel grass (*Pennisetum ciliare*) pastures in central Queensland. Butterfly pea (*Clitoria ternatea*), burgundy bean (*Macroptillium bracteatum*) and siratro (*Macroptillium atropurpureum* cv. *siratro* and cv. *Aztec atro*) were sown by broadcast, direct drill and crocodile seeder methods. Intensive herd impact applied immediately post sowing was trialled to determine if seed germination and establishment would benefit from animal induced soil disturbance. Treatments with soil disturbance at sowing (direct drill and crocodile seeder) recorded higher first year legume numbers than broadcasting. Despite excellent rainfall in the first two years of the trial, strong population declines across all treatments were recorded in subsequent years, with similar plant populations per hectare recorded between treatments at the conclusion of the trial. The results from the application of herd impact were inconclusive. Siratro was the only species to persist within the buffel grass dominated pastures. This trial demonstrated that low-input sowing methods with little or no removal of grass competition achieved poor plant populations. Industry needs to adopt longer fallow management for moisture storage and control of grass when establishing legumes into existing grass pastures.

Keywords

Nitrogen, fixation, agronomy, grazing, buffel grass, yield

Introduction

Declining sown pasture productivity as a result of reductions in plant available soil nitrogen is an ongoing constraint to grazing production across the brigalow bioregion of central and southern Queensland (Peck *et al.* 2011). Research suggests that legume establishment offers the most cost effective long-term remediation strategy for improving pasture quality and yield (Peck *et al.* 2011). In 2010, a three year Meat and Livestock Australia funded Producer Demonstration Site (PDS) was established to demonstrate low-input sowing strategies for achieving legume establishment in buffel grass pastures in central Queensland.

Methods

Two uniform and adjacent 50 hectare paddocks consisting of buffel grass dominated brigalow clay soils were selected on a beef cattle property in the Arcadia Valley, central Queensland. Within each paddock, five treatments were randomly allotted a ten hectare strip (Table 1). There were no dividing fences to distinguish the boundaries of the five treatments within each paddock.

The five treatments included:

1. Control: no treatment.
2. Broadcast: Seed applied using an air-driven, back-mounted pellet applicator.
3. Broadcast near water: Ten hectare buffer zone to eliminate potential effects of higher utilisation. Seed applied using an air-driven, back mounted pellet applicator.
4. Direct drill: Seed sown using converted chisel plough with narrow points spaced at 1.1m intervals.
5. Crocodile seeder: A pulled implement consisting of two partially offset drums, each with multiple metal feet that cut into the soil surface, leaving a scalloped hole. Seed was deposited from the drums into each hole.

Table 1: Paddock and treatment layout of the trial. The northern boundary is located adjacent to the watering point (▼)

Paddock 1 (50 ha) (herd impact applied at sowing)					Paddock 2 (50ha) (no herd impact applied at sowing)				
Direct Drill Seeder (10ha)	Crocodile Seeder (10ha)	Control (10 ha)	Broadcast (10 ha)	Broadcast Near Water (10 ha)	Broadcast Near Water (10 ha)	Control (10 ha)	Direct Drill Seeder (10 ha)	Broadcast (10 ha)	Crocodile Seeder (10 ha)

Three legume species consisting of butterfly pea (*Clitoria ternatea*), burgundy bean (*Macroptillium bracteatum*) and siratro (*Macroptillium atropurpureum cv sirarto and cv Aztec atro*) were sown as a combined mix in a single pass across the treatments (except control) in mid to late 2010. Seed sowing rates and viability are summarised in Table 2. All seeds were treated with the recommended rhizobial inoculants at time of sowing. Immediately prior to sowing, both paddocks were grazed down beyond regular end of dry season levels in an attempt to reduce the competitive effects of the existing buffel grass on seed germination and seedling growth. Paddock 1 had intensive herd impact applied by stocking 200 head of cattle (average weight 450kg) per hectare for 12 hours immediately following sowing. This was applied with the aim of improving soil-seed contact and further minimising pasture competition. Following the initial high density herd impact, each paddock was grazed using the same management regime for the remaining duration of the trial.

Legume plant populations were recorded annually at the end of each growing season. A minimum of forty (40) quadrats (0.25m²) were assessed at approximately equal distances along two random transects between the northern and southern boundaries of each treatment. Due to the demonstrative nature of the trial and design, labour and cost constraints, results were not statistically analysed.

Table 2: Seeding rates applied within the trial and viability information (viability information provided by seed supplier).

	Butterfly Pea (<i>Clitoria ternatea</i>)	Burgundy Bean (<i>Macroptillium bracteatum</i>)	Siratro (<i>Macroptillium atropurpureum</i>)
Standard indicative seeds/kg	23,000	160,000	80,000
Measured viable seeds/kg	23,286	140,365	80,268
% Viable Seed	101	88	100
Sowing rate (kg/ha)	1.7	2	1.15

Results and discussion

Rainfall

Rainfall received in the first summer growing season of the trial was exceptional (Figure 1). Rainfall in the second summer was above average, while the final growing season recorded below average falls.

Total legumes

Observationally, in the first year, the direct drill and crocodile seeder treatments resulted in higher total legume emergence (Figure 2). This is likely to have been due to these treatments having increased levels of soil disturbance and soil-seed contact at sowing. By 2012, all treatments demonstrated a decline in legume populations, with the direct drill and crocodile seeder treatments maintaining higher legume numbers per hectare than both broadcast treatments. During the final year (2013), legume population levels declined even further from 2012 with little differences in final legume counts recorded between all treatments.

The rapid decline in plant population counts was expected given the competitive conditions of established pastures and the sowing methods employed (Miller *et al.* 1993). In comparison to more intensive seedbed preparation methods such as full cultivation and/or herbicide control, all of the Producer Demonstration Site sowing methods were relatively low-input and resulted in little or no removal of grass competition. The direct drill and crocodile seeder approaches, while providing better soil-seed contact did not reduce grass

competition. Broadcasting is inherently low-input and does nothing to aid in the optimal placement of seed within the soil, relying heavily on favourable seasonal conditions for any prospect of establishment success.

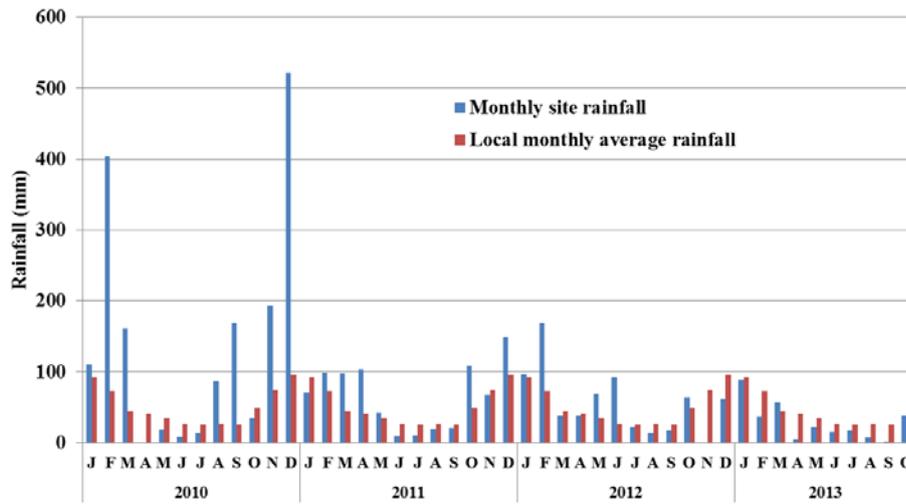


Figure 1: Monthly site rainfall for the duration of trial (mm). Rainfall in the first two summer growing seasons of the trial was well above average, while the third wet season was below average.

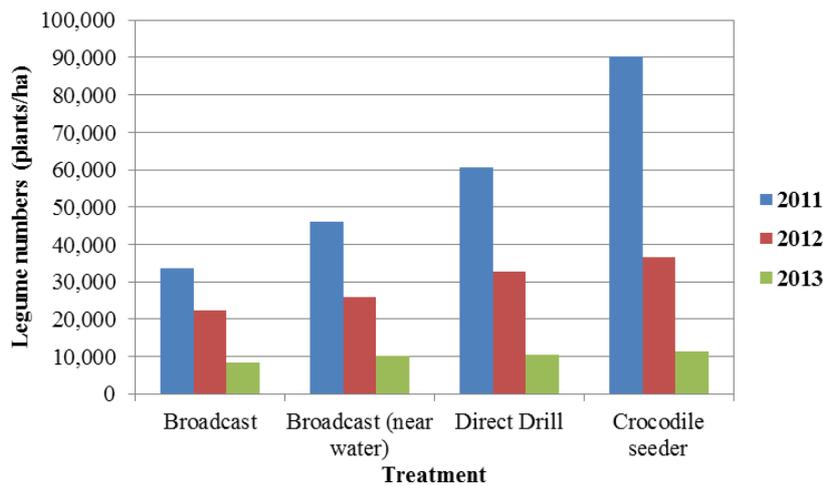


Figure 2: Average combined annual legume population counts for all species (plants per hectare) for each of the four treatments within the trial.

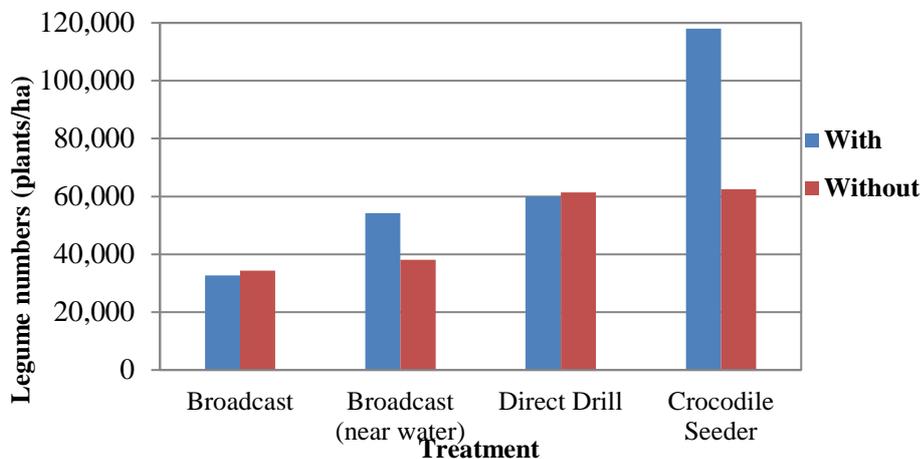


Figure 3: Average combined legume population counts for all species (plants per hectare) in April 2011 following 'with' and 'without' herd impact at sowing for each of the four treatments within the trial.

Individual legume species

Across all treatments, siratro was the most dominant and persistent legume species. Initial plant counts for burgundy bean and butterfly pea were on average lower than siratro for all treatments. Treatments with higher levels of soil disturbance did result in higher plant germination and establishment levels for siratro and burgundy bean. Butterfly pea recorded similar plant populations for 2011 for both the broadcast treatments. From 2011 to 2012, plant attrition rates were severe for both burgundy bean and butterfly pea despite above average rainfall. In contrast, siratro demonstrated a smaller decline across all treatments. By 2013, both siratro and butterfly pea recorded little to no difference between treatments for each individual species with burgundy bean virtually non-existent at the conclusion of the trial.

Grazing and herd impact

The initial total legume population counts at the conclusion of the growing season in 2011 showed that the 'with' herd impact at sowing resulted in higher plant numbers for the broadcast near water and crocodile seeder treatments (Figure 3). The higher numbers in the crocodile seeder treatment appeared to have been influenced by several quadrats that recorded higher legume counts than the average quadrat figures for the treatment plot. When averaged across all treatments, the 'with' herd impact resulted in higher plant populations at the conclusion of the first growing season (Figure 3). There appeared to be no herd impact effect on the broadcast or direct drill treatments. No herd impact benefit was observed in subsequent years.

Conclusion and recommendations

Practices with greater soil disturbance and soil-seed contact at the time of sowing demonstrated increased first year legume counts when compared with broadcasting. Through significant rates of legume plant attrition recorded across all treatments, these gains however were lost within the subsequent two years of the trial despite above average rainfall. This rapid decline in legume plant populations was partly expected given the competitive conditions of established grass pasture and the low-input sowing methods employed. Siratro was the only species to persist within the buffel grass dominated pastures. There was an observed but inconclusive benefit from adopting intensive herd impact on legume emergence in the first growing season of the trial, but this was not observed in subsequent years. The trial demonstrated that low-input sowing methods with little or no removal of grass competition achieved poor plant populations. Industry needs to adopt longer fallow management for moisture storage and control of grass when establishing legumes into existing grass pastures.

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