REGENERATION OF A DEGRADED BUFFEL GRASS-LUCERNE PASTURE

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ABSTRACT

Early spring (September) renovation and oversowing with lucerne in February increased both yield and density of the Biloela component of a degraded Biloela buffel grass (Cenchrus ciliaris) *Hunter River lucerne* (Medicago sativa) *pasture on a granitic sand in the north Burnett region of south-eastern Queensland. Buffel grass yields in mid winter were further enhanced by the application of a mixed fertilizer. These responses were attributed to the renovation and the nitrogen component of the fertilizer.*

Lucerne was successfully re-established by oversowing the buffel grass pasture after renovation in late summer (February). Although overall herbage yields in mid winter were similar, lucerne contributed 9.5% when pastures were renovated in February and almost nothing in untreated pasture.

INTRODUCTION

Lucerne, *Medicago sativa,* cv. Hunter River, often fails to persist in sown pastures in subcoastal Central Queensland, (Cameron 1968). The decline in lucerne density is associated with a lowering in density and vigour of the sown grass, which is usually accompanied by an invasion of native species and reduced pasture productivity, (Young, Fox and Burns 1963, Young and Daly 1967, Scateni 1970). This paper reports on cultural techniques aimed at regenerating a degraded buffel grass (*Cenchrus ciliaris* cv. *Biloela*) and lucerne pasture.

METHODS

A 1.2 ha experiment was conducted at "Tecoma" 24°56'S, 150°48'E, a property west of the Burnett River on soils derived from the Auburn Granite Massif. The A horizon was a gravelly sandy loam generally deeper than 60 cm and the B horizon a yellow sandy clay of varying depth. The experiment was sited in a 77 ha paddock sown to lucerne and buffel grass in 1961.

Sixteen cultural treatments were arranged in a randomised block with three replications. Plot size was 25 x 9 m². Treatments were:—

Lucerne or lucerne with buffel grass, each sown into either undisturbed pasture, pasture ploughed in September or pasture ploughed in February; lucerne with buffel grass and oats either sown into pasture ploughed in both September and February or pasture ploughed in February only. Each of these treatment combinations were either not fertilized or dressed with 565 kg/ha of mixed fertilizer containing ammonium sulphate, (24% sulphur, 20.5% nitrogen) superphosphate, (9.6% phosphorus, 10% sulphur, 20% calcium) and muriate of potash, (50% potassium) in the proportion of 4:4:1 by weight respectively.

A control plot which received none of these treatments was included.

The first ploughing on September 10, 1968 was to a depth of 10-12 cm using a disc plough in moist soil. The same implement penetrated only 5-6 cm in dry soil at the second ploughing on February 19, 1969. Fertilizer was broadcast after

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ploughing and seed was sown on February 27, 1969. Oats (cv. Saia) and inoculated lucerne seed were broadcast at 25 and 1.9 kg/ha live seed respectively, and harrowed into the surface soil. Buffel grass was then broadcast at 0.5 kg/ha live fasciles and the area rolled.

From the beginning of November until mid December 1968, and from mid January until sowing in 1969, the area was heavily and evenly grazed, but protected from grazing between sowing and the first sampling on June 18, 1969. The area was also grazed for eight weeks between June and the second sampling on October 22, 1969. Herbage yield was determined from five random quadrats of 40 dm^2 and plant density from 20 quadrats of 6 dm^2 positioned on a 4 x 2 m^2 grid, in each plot. At the June sampling buffel grass was separated into old tufts and seedlings; for the October sampling no such separation was made.

RESULTS

TABLE 1

Monthly Rainfall during the trial period

Year	1968				1969								
Month	S	O	N	D	J	F	M	A	M	J	J	A	S	O
Rainfall (mm)	24	0	65	104	16	31	76	8	71	20	10	30	0	72
Wet Days	2	0	1	5	1	1	1	1	7	2	3	3	0	10
Monthly Mean (mm) 1953-1970	20	53	66	104	94	96	80	31	33	37	35	31	20	53

Rainfall totalled 3 mm in the first 60 days after the September ploughing. However, monthly rainfall was average for November and December 1968 (Table 1).

Dry conditions again prevailed from sowing in February until May 30, 1969. Falls of 76 and 8 mm were registered on the 31st and 46th day after sowing. Although plants emerged after these rains, rapid soil drying probably caused not only seed spoilage but also poor seedling growth and some seedling mortality. Total rainfall from sowing until sampling in June was 175 mm. Total rainfall from September 1, 1968 to August 31, 1969 was low at 454 mm compared to an 18 year average of 679 mm.

The effect of cultivation, oversowing and fertilizer treatment on plant density.

Oversowing without soil disturbance had no effect on buffel grass density (Table 2). The most successful treatment was ploughing in September and oversowing with lucerne or lucerne plus buffel grass in February. This increased seedling density from 1.5 to 119.0 plants/m^2 while the density of old tufts was unaffected. A second ploughing in February and oversowing with lucerne, buffel grass and oats, did not further affect the number of seedlings but significantly reduced the number of old tufts. A single ploughing in February and oversowing increased the number of seedlings in comparison with the control, but significantly reduced the density of old tufts.

Plant counts in October showed a reduction in density in the more successful treatments to between 57-67 plants/m^2.

Ploughing in February and oversowing with lucerne or lucerne and buffel grass was the most effective treatment for increasing density of lucerne but a September ploughing and a February oversowing was also effective (Table 2).

TABLE 2
Effects of Cultivation, Fertilizer and Oversowing on Plant Density

Cultural Treatments	Density* plants/m² 18.VI.69			22.X.69	
	Lucerne	Seedling Buffel Grass	Old Buffel Grass	Lucerne	Buffel Grass
Control	0.3 d†	1.5 c	9.2 a	0.2 d	8.3 b
Lucerne with and without buffel grass in pastures:—					
Undisturbed	5.9 c	1.3 c	10.0 a	3.0 c	10.6 b
Ploughed in Sept.	15.6 b	119.0 a	6.9 a	17.7 b	57.4 a
Ploughed in Feb.	34.0 a	7.2 b	3.3 b	28.8 a	9.6 b
Lucerne buffel grass and oats in pasture:—					
Ploughed Sept. and Feb.	24.6 ab	67.7 a	0.7 c	20.7 ab	66.6 a
Ploughed Feb.	33.4 a	7.7 b	3.0 b	24.1 bc	11.4 b
Co-efficient of Variation	15.4	26.6	25.5	16.3	14.2
Fertilizer					
Nil	18.2 m	13.7 m	4.2 m	14.9 m	19.2 m
Fertilized	16.8 m	13.9 m	4.8 m	12.9 m	21.4 m
Buffel Grass					
Nil	14.1 x	8.5 y	6.5 x	11.5 x	16.2 x
0.5 kg/ha	15.6 x	15.8 x	5.7 x	12.2 x	20.6 x

*Density as equivalent means—antilog of Log_{10} (x + 1) transformations
†Values in a column not followed by the same letter differ $P < 0.05$

Sowing buffel grass in addition to lucerne increased the mean density of buffel grass seedlings (Table 2). This effect was only significant ($P < 0.01$) for sowing buffel grass after a February ploughing when the density increased from 3.6 to 14.3 plants/m² (data not included in Table 2). These differences did not persist until October.

Fertilizer application had no effect on density and persistence of either lucerne or buffel grass.

The effect of cultivation, oversowing, and fertilizer dressings on herbage yields.

Both buffel grass yield and total herbage yield improved with increasing densities of buffel grass and the highest yield was obtained from the September ploughed treatments. June yields of lucerne paralled plant density but were low (Table 3). Herbage yields were increased by the addition of fertilizer the response being significant in all pasture components except lucerne. Within cultivation treatments a significant response was restricted to the September ploughed treatment where application of mixed fertilizer increased the buffel grass yield from 559 to 1368 kg/ha ($P < 0.01$) and the native grass yield from 224 to 440 kg/ha ($P < 0.01$) which together contributed to a total yield increase from 831 to 1877 kg/ha ($P < 0.01$). Sample variation was often high as indicated by the co-efficient of variation in Table 3.

DISCUSSION

Ploughing in September and oversowing with lucerne or buffel grass in February was the best renovation treatment for improving the buffel grass component of the pasture. By the following June this treatment resulted in an eleven fold increase in density which was accompanied by an increased yield of buffel

TABLE 3
Effects of Cultivation, Fertilizer and Oversowing on Herbage Production

Cultural Treatments	Herbage Yield kg/ha					
	Lucerne	Buffel Grass	Native Grass	Weeds	Oats	Total
Control	0 b†	203 b	268 ab	8 b		479 c
Lucerne with and without buffel grass grass in pasture						
Undisturbed	4 b	287 b	386 a	22 b		699 bc
Ploughed in Sept.	17 b	964 a	332 a	41 ab		1354 a
Ploughed in Feb.	53 a	218 b	196 b	91 a		558 c
Lucerne buffel grass and oats in pasture						
Ploughed Sept. and Feb.	41 a	395 b	366 a	26 ab	206	1034 ab
Ploughed Feb.	47 a	214 b	171 b	35 ab	183	650 bc
Co-efficient of Variation	69.8	89.6	45.7	146.4		40.6
Fertilizer						
Nil	28 m	319 n	222 n	25 n		632 n
Fertilized	31 m	567 m	370 m	67 m		1095 m
Buffel Grass						
Nil	24 x	507 x	47 x	272 x		850 x
0.5 kg/ha	24 x	472 x	52 x	338 x		891 x

†Values in a column not followed by the same letter differ $P < 0.05$

grass compared to untreated pasture. As sowing additional seed in February did not increase buffel grass density a high proportion of the seedlings evident in June resulted from either seed present in the soil at ploughing or from seed produced from old tufts during the summer after ploughing. Lucerne was most successfully re-established after February ploughing and oversowing. After a September ploughing, lucerne produced 1.2% of the total herbage yield of the pasture but 9.5% was obtained when ploughing was conducted just prior to sowing in February. However this treatment reduced both total herbage yield and the yield of buffel grass to levels similar to untreated pasture.

Improved herbage production after renovation of rhizomatous or stoloniferous grass, with or without legume oversowing, is commonly reported in literature; for example—Harper (1948), Fletcher (1950), Bailey (1952), Dougall (1954) and Whyte, Moir and Cooper (1959). This is usually attributed to improved water penetration and/or nitrogen mineralization. Both factors probably caused the response in buffel grass to September ploughing and oversowing reported in this experiment. When a mixed fertilizer was applied in February, the stand was relatively dense and well grown and the resulting response was greater than in other cultivation treatments. Low density of buffel grass and a short dry growing season probably limited the response to February ploughing. Similarly, Grof, Courtice and Cameron (1969), did not report improved production from a buffel grass pasture disced on March 3, 1960, February 24, 1961, and December 1, 1962. It appears that early spring renovation is more likely to improve production from a degraded buffel grass pasture than a summer or autumn renovation.

Oversowing after February ploughing seems to be an effective method of re-establishing Hunter River lucerne where it has failed to persist in Biloela buffel grass lucerne pastures. The frequency of this operation necessary to maintain a

satisfactory legume population will vary with the rate of its decline. Sowing in early summer, a time usually considered suboptimal for lucerne (Norton and Cull 1966; Cameron 1968) is a possible reason for the failure by Grof, Courtice and Cameron (1969), to introduce it into Biloela buffel grass after renovation.

Plant response to the mixed fertilizer were probably due to its nitrogen component as soil available phosphorus values exceeded 100 p.p.m. and replaceable potassium ranged from 20-38 m-equiv. percent to a depth of 60 cm and total nitrogen ranged from 0.07% in the surface 8 cm to 0.03% in the remainder. On a similar soil on the same property, Parkinson (personal communication) detailed the fertilizer requirements. He obtained a marked response in buffel grass to applied nitrogen but little response to superphosphate application.

ACKNOWLEDGEMENTS

Generous assistance extended by the Pownall Grazing Company, "Tecoma" is gratefully acknowledged. Mr. N. F. Fox gave advice, Mr. G. H. Malcomson assisted with sampling, and Miss E. Goward conducted statistical analysis. Funds were supplied by the Australian Meat Board.

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[Accepted for publication November 22, 1971]