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EFFECT OF RENOVATION AND NITROGEN FERTILIZATION ON AN OLD STAND OF BUFFEL GRASS (CENCHRUS CILIARIS) IN SUBCOASTAL CENTRAL QUEENSLAND

By B. GROF, D.Econ.Bot., J. COURTICE, Q.D.A., and D. G. CAMERON, B.Sc.Agr.

SUMMARY

The experiment reported was carried out on the alluvial soil of the Callide Valley, Central Queensland. The effect of nitrogen as urea at 1 cwt/ac/application and cultivation with disc harrows was studied, alone and in combination, as a means of restoring vigour to an old buffel grass pasture. Unsuccessful attempts were also made to introduce a fertility building legume, initially *Glycine javanica* L., subsequently *Medicago sativa* L. cv. Hunter River.

Rainfall over the 2 years was below average. Nitrogen with or without discing resulted in major increases in dry-matter yield, mainly at the midsummer samplings. In autumn 1961 dry conditions prior to sampling possibly masked any response, while in autumn 1962 an increase was obtained although it failed to reach a significant level. Discing alone, prior to the dry autumn 1961, resulted in a significant depression in yield. This depression persisted, although not at a significant level, until the end of the trial.

Forage quality was improved by both nitrogen application and discing but total crude protein yield was increased only by nitrogen treatment, which doubled it, and was not influenced by cultivation. Nitrogen recoveries were only of the order of 20%. Possible reasons for this are suggested.

I. INTRODUCTION

Loss of vigour in old grass stands is a widespread and serious problem. Strong sward-forming species such as paspalum (*Paspalum dilatatum* Poir.) and phalaris (*Phalaris tuberosa* L.) frequently become "sodbound" or "rootbound". Loss of vigour also occurs in grasses that do not form a tight sward, and on the alluvial soils of the Callide Valley of Central Queensland such grasses as Rhodes grass (*Chloris gayana* Kunth), green panic (*Panicum maximum* var. *trichoglume* (K. Schum.) Eyles) and buffel grass (*Cenchrus ciliaris* L.) all show lower productivity in the third and subsequent seasons.

Numerous authors—e.g. Whittet (1944), Harper (1948), Fletcher (1950), Theron (1951), Bailey (1952), Dougall (1954) and Stuart (1955)—have indicated that increases in forage or seed production can be obtained by cultural treatment of non-vigorous grass stands with or without the oversowing of suitable legumes. On the other hand, Ahlgren *et al.* (1944), Anderson, Krenzin, and Hide (1946), Hall, Meredith, and Altona (1955, p. 637), Haylett and Theron (1955) and Hegarty (1958) reported responses of degenerate grass stands to the application of various forms of fertilizer nitrogen.

This paper reports work carried out on the Department of Primary Industries Research Station at Biloela in the Callide Valley. The experiment studied the effects of cultural treatment, nitrogen application and legume oversowing on a pure stand of *Cenchrus ciliaris* cv. Biloela.

II. EXPERIMENTAL

The experimental area had been planted in January 1955 to Biloela buffel grass in 42 in. rows. It was used for seed production until April 1958, inter-row cultivation being carried out periodically until late 1957. The area was located on a slight rise above the river flood plain. The soil is poorly structured and inclined to set a hard surface crust. By 1960 the buffel grass showed very poor vigour and was still confined to its original rows, with crowns approximately 12 in. in diameter. The inter-row spaces were ungrassed and had a hard, compacted surface which shed all but low-intensity rains.

The lack of available nitrogen in the soil was suspected as the major reason for the poor vigour of the pasture. It was also possible that poor water penetration was a further factor limiting plant growth.

Early in 1960 a series of treatments were applied to plots $43\frac{1}{2}$ ft x 100 ft arranged in 5 x 4 randomized blocks. These were reapplied to the same plots at intervals during 1960 and 1961. Details are as follows:—

Treatments

A: No treatment.
B: No cultural treatment but 1 cwt urea per acre.
C: Offset disc cultivation.
D: Offset disc cultivation + 1 cwt urea per acre.
E: Offset disc cultivation + legume oversowing.

Dates of Application

3.iii.60: Initial treatment, E received 4 lb *Glycine javanica* L. per acre.
21.x.60: Urea 1 cwt/ac reapplied to B and D.
23.xi.60: Glycine resown on E.
24.ii.61: Discing and fertilizer reapplied to B, C and D.
1.xii.61: Discing and fertilizer reapplied to B, C and D. E disced and oversown with Hunter River lucerne (*Medicago sativa* L. cv. Hunter River).

Rainfall for the duration of the experiment was below the Biloela average of 27·86 in., being 24·95 in. in 1960 (of which 11·40 in. fell in January and February), 24·79 in. in 1961 (with 9·87 in. in January and February and 7·46 in. in November-December), and 26·11 in. in 1962 (with 7·25 in. in January-February).

Yields were measured by cutting strips across each plot. In 1961 these were 6 ft x 16 ft and were cut with a 6 ft mower. In 1962 an Autoscythe was used and 3 ft x 16 ft strips were cut. Green weights were obtained in the field and a subsample of 500–1000g returned in plastic bags to the laboratory for drying at 90°C in a forced-draught oven. Single bulk samples of oven-dry matter from each treatment were used for determination of protein.

After each sampling the area was bulk grazed and then cut with a rotary slasher close to the ground to remove residues from the previous growing period.

III. RESULTS

Seasonal conditions in autumn 1960 did not provide adequate growth for measurement of the effects of the initial treatments. The first sampling possible was in January 1961. In all treatments yields were measured on four occasions and are shown in Table 1.

TABLE 1

MEAN YIELDS OF OVEN-DRY MATTER (LB/AC)

Treatment	20.i.61	21.iv.61	30.i.62	30.iv.62	Total
D. Disc + N ..	2,606	753	2,378	1,982	7,719
B. N alone	1,461	829	1,966	2,233	6,488
A. Control	548	742	1,344	1,516	4,148
C. Disc alone ..	705	378	925	1,250	3,257
E. Disc + Legume	619	476	882	947	2,925
L.S.D. 5%		241	918	982	1,815
L.S.D. 1%		338	1,286	1,397	2,544
Significance	D≫≫B, C, E, A B≫≫C, E, A	B≫≫E, C D, A≫≫C D, A≫E	D≫≫C, E D≫A B≫C, E	B≫C, E D≫E	D≫≫A, C, E B≫≫C, E B A

Throughout, no legume establishment was achieved and the oversowing treatment was thus a repetition of the discing alone.

The two treatments incorporating nitrogen gave higher dry-matter yields than other treatments.

The mean percentage crude protein contents of the bulked samples for each treatment are shown in Table 2, and Table 3 gives actual yields of crude protein per acre over the 2-year period.

All treatments resulted in a lift in mean percentage crude protein, while the two nitrogen treatments doubled crude protein yield over control or discing alone.

TABLE 2

Crude Protein Percentages (Water-free Basis)

Treatment	20.i.61	21.iv.61	30.i.62	30.iv.62	Mean
D. Disc + N	6·1	6·1	6·0	7·7	6·5
B. N alone	10·0	7·4	5·7	7·9	7·6
A. Control	6·4	4·1	4·2	9·8	5·8
C. Disc alone	5·7	4·4	6·2	8·1	7·0
E. Disc + Legume . .	. .	. .	5·3	7·9	. .

TABLE 3

Crude Protein Yields (lb/ac), 1961–62

Treatment	20.i.61	21.iv.61	30.i.62	30.iv.62	Total
D. Disc + N	159·0	45·9	142·7	152·6	500·2
B. N alone	146·1	61·3	112·1	176·4	495·9
A. Control	35·1	30·4	56·4	118·2	240·3
C. Disc alone	40·2	16·6	57·3	101·2	215·4
E. Disc + Legume . .	. .	. .	46·7	74·8	. .

IV. DISCUSSION

Possibly the most suitable implement for cultivating degenerate grass stands in the present environment is a chisel plough, but as one was not available a set of offset disc harrows was used. These gave a more complete cultivation than was desired. It would not, however, have been as severe as the complete mouldboard ploughings used by Whittet (1944) or Fletcher (1950).

Generally, authors reporting increases in forage and seed production as a result of cultural treatment of old grass stands attribute these to increases in the level of available nitrogen. Harper (1948), however, referred to increased water penetration following shallow cultivation on the contour with a lister contributing to a threefold increase in yield of buffalo grass (*Buchloe dactyloides* (Nutt.) Englem.) over a 5-year period at Spur, Texas. In the present trial, however, discing, while effectively breaking up the old grass rows and giving an even if somewhat sparse stand, had no major benefits. There may have been some benefit from extra moisture penetration at the first sampling where nitrogen was applied. Here dry-matter yield was significantly increased while crude protein percentage was markedly reduced, suggesting greater moisture availability. This was not the case at subsequent samplings, possibly because the treatments applied on February 24, 1961, were followed by a long period of dry weather, only 3·04 in. of rain being recorded in the following 4 months. Discing alone caused a highly significant depression in grass yield at the subsequent sampling. This depression persisted, although not at a significant level, to the end of the trial. In the presence of added nitrogen, however, there was no apparent or permanent damage to the stand.

Besides causing severe damage to the stand when followed by dry conditions, cultural treatments increase the danger of weed invasion. Anderson, Krenzin, and Hide (1946) considered that tillage of brome grass (*Bromus inermis* Leyss) seed stands in Kansas increased the danger of invasion of seed areas by weeds and in the present case invasion of the area by the inferior Rhodes grass has been noted.

In 1961 there was a three- to five-fold increase in dry matter from the application of nitrogen, which unfortunately was obtained only at the height of the growing season and not in autumn, possibly because of the very dry conditions. In 1962 the midsummer increases were less spectacular but they did carry on, although not significantly, to the autumn sampling. There is also an indication in 1962 that the initial response to nitrogen was greater with discing, but application of nitrogen alone gave a more sustained response.

The lifts in protein level obtained by the application of nitrogen or by discing were not great. Sampling, however, was carried out towards maturity each time, so protein levels were tending towards a common base. Even so, the increases obtained may be of considerable practical value. Assuming that a crude protein level of less than 8% in an animal's diet is inadequate for the maintenance of good health and allowing a 2% improvement in the level of ingested food as a result of selectivity of feed by the animal, the mean of control figures of 5·8% crude protein + 2% is still below the required protein intake level. On the other hand, 6·5% + 2% could be considered as giving an adequate if not ideal protein intake level, so that both nitrogen application and discing lifted the quality of the forage sufficiently to be of possible value. With discing alone, however, there was a tendency for reduced total dry matter production.

The total crude protein yield gives a better gauge of the value of the treatments because of the greater quantity of dry matter present on the fertilized plots. The quantity of crude protein available was doubled overall by nitrogen application with or without discing, while discing alone gave no increase.

In terms of nitrogen recovery the trial was not efficient. A total of 206 lb of nitrogen per acre was applied, with recovery of only 41·6 lb nitrogen more from the disc + N treatment than from the control and 41·0 lb nitrogen more from the N alone plots. This represents 20·2% and 19·9% recovery in the tops respectively. Henzell (1962, p. 161) quoted recoveries of 50–75% as very satisfactory, with a range of values for subtropical and tropical areas of from below 10% to as high as 88%. Walker (1956) gave a recovery figure of 60% in the aboveground portions of temperate pastures in New Zealand as a desirable level.

In the present instance there are several factors which may have contributed to the low recoveries. Firstly, the initial application was made on March 3, 1960, but the first sampling was not carried out until January 20, 1961, by which time a further application of nitrogen had been made (on October 21, 1960). The application made on February 24, 1961, was followed by a long dry spell and response was only mediocre. A further factor is that the final response to the fertilizer applied was not measured. Visual responses were still apparent by as late as December 1962, by which time the area was being utilized for other purposes and could not be sampled. These visual differences had, however, disappeared by March 1963. Efforts were made to minimize any possible losses of nitrogen from the urea due to volatilization by making the applications immediately before an approaching storm, but the expected rain did not always eventuate. The use of bulk grazing over the area for the 3 years could also have tended to even out differences between treatments as the trial progressed.

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B. Grof and D. G. Cameron are officers of Agriculture Branch, Queensland Department of Primary Industries, and are stationed at South Johnstone and Biloela respectively. J. Courtice was previously an officer of the Branch.