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EFFECTS OF GRAZING LUCERNE SUPPLEMENTATION AND STOCKING RATE ON SHEEP AND NATIVE PASTURE PRODUCTIVITY IN THE QUEENSLAND TRAPROCK REGION: PROGRESS REPORT 1962-1965

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SUMMARY

The first three year's results of a grazing experiment on native pastures dominated by *Bothriochloa decipiens* and *Dichanthium humilius* are presented.

Total native pasture and green material availability were consistently greater on areas grazed at 2 ac/sheep without lucerne and at 1 ac/sheep with lucerne than on those grazed at 1 ac/sheep without lucerne and at 0·67 ac/sheep with lucerne. The area of lucerne provided was one-sixth of the total grazing area. In the July-October periods, the 1 ac/sheep with lucerne treatment produced best body-weight performance, but compensatory weight gains were evident subsequently in the other treatments, except in the dry 1964-65 summer.

The provision of supplementary lucerne grazing increased greasy wool yield by 1·5 lb/head at the 1 ac/sheep grazing rate. The treatment 0·67 ac/sheep with lucerne also produced heavier fleeces than native pastures alone at 1 ac/sheep, and it gave the highest wool production per acre.

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I. INTRODUCTION

In southern Queensland the traprock soils cover an area of some 2,000 square miles within the Shires of Rosenthal, Inglewood and Stanthorpe. The northern portion of this area has been delineated and briefly described by P. J. Skerman and G. H. Allen (1952) and traprock country on the Northern Tablelands of New South Wales by Roe (1947). Parent material consists mainly of palaezoic metamorphic rocks such as hornfels, indurated slates and shales, quartzites, tuffs and jaspers. These have given rise to grey to grey-brown soils of texture varying from stony clay loam to stony clay.

The annual rainfall of the area is of the order of 25 in., with a marked summer incidence, two-thirds being received in the six summer months October to March. Summer temperatures are hot (average mean maximum for various centres 80-90°F) and winter temperatures low (average mean minimum for various centres 35-42°F), with a high incidence of severe frosts.

The tree vegetation is dominated by species of *Eucalyptus,* although cypress pine (species of *Callitris*) communities are common in some localities.

The native pastures are used extensively for grazing sheep for wool production and cattle raising. These pastures are essentially graminaceous and throughout the winter period are incapable of maintaining body-weights even at light stocking rates; consequently severe restrictions are placed on the breeding and growing of young stock. In severe winters, stock losses may occur. With the introduction of improved pastures to the area these inadequacies have been offset to some extent. Of the improved pasture species investigated, lucerne planted as a grazing stand has offered the best prospects for improvement (Lee 1961). Successful establishment has been associated only with a full seed-bed preparation and this fact alone has restricted the areas planted to cultivable country. For the most part these areas are small, owing to the undulating to steeply hilly topography of the region.

This experiment was designed to investigate the utilization and overall effects on both stock and pastures of a proportion of lucerne grazed in conjunction with a much larger proportion of unimproved native pasture and of stocking rate.

II. MATERIALS AND METHODS

The experiment was located near Texas, Queensland, on "Kelso", a property owned by Mr. I. A. F. Murray. It occupied an area of 98·1 ac of gently sloping land having a westerly aspect and bordered on the east by a range of traprock hills. *Bothriochloa decipiens* (Hack.) C. E. Hubbard and *Dichanthium humilius* J. M. Black comprised almost one-half of the native pasture sward and were relatively uniform throughout the experimental area. The graminaceous nature of the pasture and the paucity of native legumes are indicated from the inital botanical survey in January 1962 shown in Table 1.

TABLE 1

BASAL COVER AND BOTANICAL COMPOSITION, JANUARY 1962

Species	Mean Percentage Basal Cover	Mean Percentage Composition
Bothriochloa decipiens (Hack.) C. E. Hubbard*	6·29	45·8
Dichanthium humilius J. M. Black*	..	..
Sporobolus elongatus R. Br.*	1·08	7·6
Aristida spp.	1·05	7·2
Chloris spp.	1·55	11·5
Enneapogon gracilis (R. Br.) Beauv.	0·15	1·2
Tripogon loliiformis (F. Muell.) C. E. Hubbard	0·86	6·2
Panicum spp.	0·35	2·6
Paspalidium spp.	0·07	0·5
Chrysopogon fallax S. T. Blake	0·31	2·2
Eragrostis spp.	0·24	1·8
Tragus australianus S. T. Blake	0·11	0·8
Arundinella nepalensis Trin.	0·03	0·1
Cynodon dactylon (L.) Pers.	0·01	0·1
Digitaria brownei (R. & S.) Hughes	0·17	1·2
Stipa setacea R. Br.	0·02	0·1
Dichondra repens R. Br.	0·71	4·7
Cheilanthes sieberi Kze.	0·10	0·7
Sida subspicata F. Muell. ex Benth.	0·02	0·1
Cyperus gracilis R. Br.	0·34	2·3
Cyperus spp.	0·27	2·0
Euphorbia drummondii Boiss	0·07	0·4
Glycine tabacina Benth.	0·03	0·2
Boerhavia diffusa L.	0·01	0·1
Alternanthera repens (L.) Link.	0·01	0·1
Other species	0·07	0·5
Totals	13·92	100·0

* These species were not separated in the initial botanical survey

Three replications of each of the following treatments were arranged in a randomized block design:—

(1) 0·67 ac per sheep, in which one-sixth of the area was planted with lucerne—(H/Luc treatment)

(2) 1·0 ac per sheep, in which one-sixth of the area was planted with lucerne—(M/Luc treatment)

(3) 1·0 ac per sheep, native pasture only—(M treatment)

(4) 2·0 ac per sheep, native pasture only—(L treatment)

The lucerne plots were drill-sown at 4 lb inoculated seed per acre with 2 cwt. superphosphate per acre into a fully prepared seedbed. These lucerne plots were each subdivided into six paddocks and sheep given access on the basis of 1 week's grazing and 5 weeks' deferment. The native pastures in all treatments were continuously grazed. Seven 18-month-old Merino x Corriedale wethers were introduced to each treatment paddock on April 3, 1962.

The following measurements were made:—

(a) *Pastures*.—Available total native pasture was measured every 6 weeks by cutting to ground level with a rotary-type motor mower six quadrats 2·75 ft x 34·9 ft in each of the 12 paddocks. Following the discarding of extraneous material such as stones and sticks, the cut forage was separated into green and dead material, then dried and weighed. The nitrogen content of the total native pasture available was determined for all harvests carried out during 1963 and 1964, the analyses being made on material bulked from each treatment.

At 6-weekly intervals throughout the periods during which lucerne was available for grazing, the amount on offer was determined by hand-clipping to ground level the lucerne contained in three 25 sq. lk quadrats from the subplots to be grazed next.

Botanical composition and basal cover was determined annually, using a point quadrat and examining 2,000 points in each of the 12 paddocks. The quadrat consisted of five points with 4-in. spacings and was a slight modification of the method described by Brown (1954).

(b) *Sheep*.—The liveweight of all animals was recorded at 6-weekly intervals and coincident with the 6-weekly pasture measurements. Sheep were shorn in February of each year and the individual greasy fleece weight of each sheep was recorded. In 1964 and 1965 the following fleece measurements were made on mid-side samples collected from each animal at shearing:—clean scoured fleece weight, staple length, fibre diameter and crimps per inch as outlined by Moule and Miller (1956).

Faecal samples were collected at 6-weekly intervals from the rectum of four randomly selected sheep from each paddock and worm egg burden determined by

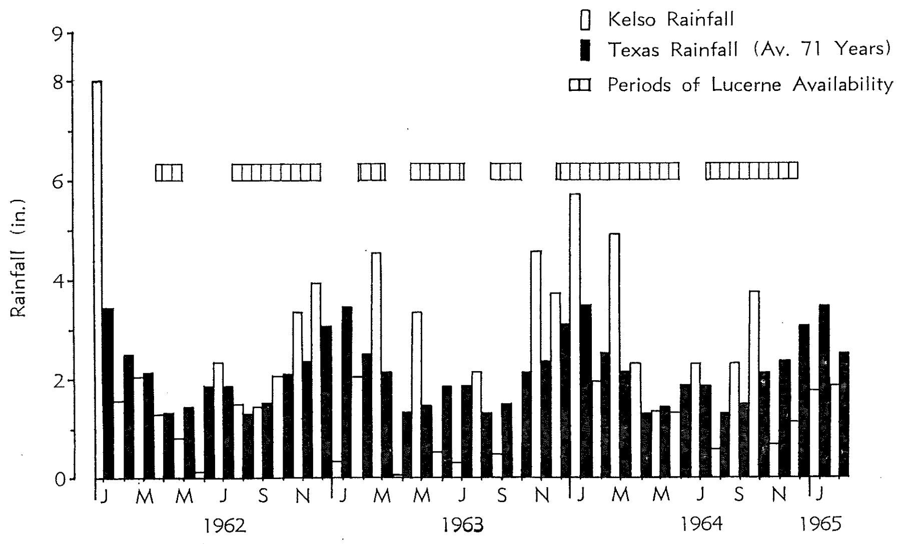

Fig. 1.—Rainfall recorded at the experimental site.

the McMaster dilution salt flotation method (Gordon and Whitlock 1939). Each sheep received a 6-weekly dose of a commercial thiabendazole preparation appropriate to current body-weight.

(c) *Seasonal conditions.*—The monthly rainfall recorded at the experimental site, together with the 71-year monthly mean recorded at the Texas Post Office, is presented in Figure 1. From January 1962 to February 1965 there were 148 wet days and on 97 of these occasions the registration was 0·50 in. or less. During the first 3 years of this experiment there were no prolonged periods of either very dry or very wet weather. Below-average registrations from November 1964 to February 1965 placed severe restrictions on pasture growth.

III. RESULTS

(a) Total Native Pasture and Green Material

In Figure 1 the available native pasture and green material for the first 3 years of the trial are expressed as the means of the three 6-weekly harvests conducted during each of the following 4-monthly periods of the year—March–June, July–October, and November–February. No marked seasonal fluctuations in total forage were apparent, but there was a gradual decline of the amount on offer throughout this period. The considerably higher levels of forage and green material available in the period March–June 1962 resulted from the above-average rainfall in January 1962, coupled with the fact that stock were excluded from the trial area during the preceding summer. The low feed levels recorded in the period November 1964–February 1965 reflected the unfavourable growing conditions during that time.

Significant treatment differences in total native pasture were obtained for eight of the nine periods examined and in green material for seven of the periods. Almost without exception the amount of total native pasture and green material on offer was greatest in the L and the M/Luc treatments, the latter having more pasture available than the M treatment.

The highest level of total pasture recorded during the periods examined was 865 lb dry matter per acre in the L treatment at the commencement of the trial. In the November 1964–February 1965 period the level of total forage in this treatment had dropped to 207 lb/ac.

The amount of green material available fluctuated markedly with seasonal conditions. Some green material was usually available by September of each year, the amount being dependent upon the incidence of late winter and early spring rain. Green material was available throughout the summer months but showed a marked decline as the pastures matured during the autumn. With the onset of frosts, very low levels of green material were recorded, and individual samplings conducted in June and July indicated that no green grass was available during these months. Treatments had little effect on the amount of green material available during the July–October period.

The highest level of green material recorded was 496 lb dry matter per acre and the lowest level 9 lb/ac.

(b) **Nitrogen Content of Native Pasture**

The nitrogen content of the total native pasture showed only minor variations throughout the year (Figure 2). There was a tendency for the highest levels to be recorded during the summer months, corresponding with the peak of green material production, while the frosted pasture in the winter months dropped to as low as 0·59% nitrogen. Nitrogen levels were lower also during short hot, dry periods in the summer months when the pastures dried out rapidly. This was the case particularly in December 1964 and January 1965. Subsequent pasture regrowth resulted in higher nitrogen levels. There were no consistent treatment effects on the nitrogen content of the total pasture.

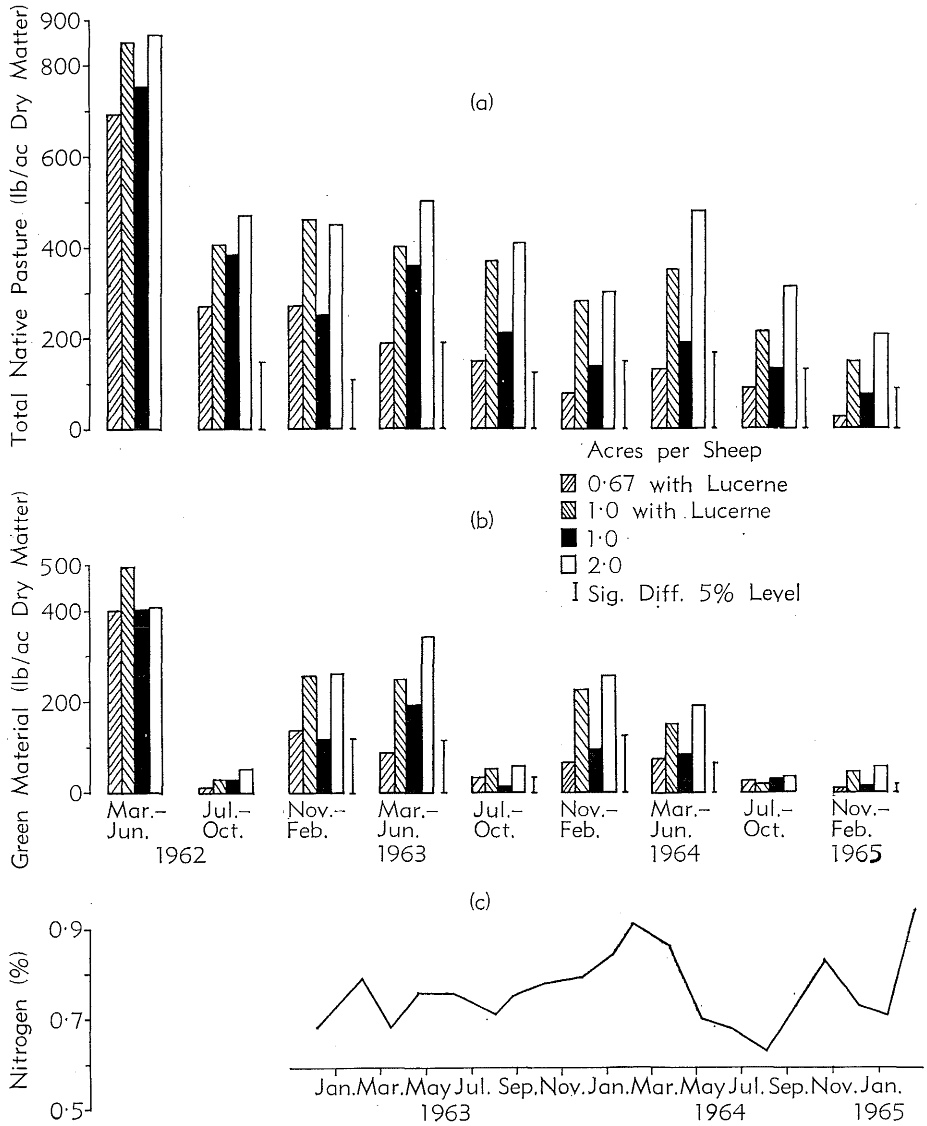

Fig. 2.—Yield and nitrogen content of the total native pasture. (a) Dry weight of total native pasture available. (b) Dry weight of green material. (c) Percentage nitrogen of total native pasture (mean of all treatments).

(c) Lucerne Availability

The periods during which lucerne was available for grazing are shown in Figure 1. The amounts available at the commencement of each of these periods and subsequently at 6-weekly intervals during the time of availability are shown in Table 2.

TABLE 2

LUCERNE AVAILABILITY TO SHEEP AND YIELDS BEFORE GRAZING

Period of Availability	Sampling Date	Yield (lb/ac dry-matter)	
		H/Luc	M/Luc
3.iv.62–15.v.62 . .	3.iv.62	793	661
8.viii.62–11.xii.62 . .	8.viii.62	242	206
	18.ix.62	280	340
	31.x.62	182	176
8.ii.63–22.iii.63 . .	13.ii.63	317	277
23.iv.63–16.vii.63 . .	23.iv.63	424	429
	11.vi.63	248	361
5.ix.63–17.x.63 . .	5.ix.63	154	228
10.xii.63–16.vi.64 . .	20.xii.63	629	770
	6.ii.64	334	325
	24.iii.64	452	696
	7.v.64	152	222
21.vii.64–8.xii.64 . .	30.vii.64	68	225
	16.ix.64	128	256
	27.x.64	386	705

(d) Sheep Liveweight

Sheep liveweight changes are presented in Figure 3 for the three periods. Rapid body-weight increases commenced in August or early September and continued until January. From February to late May growth rates were considerably reduced. In June and July large body-weight losses occurred. (This point is not clearly illustrated in Figure 3, since in this diagram weight changes were arranged for 4-month periods.) Weight losses during the winter were offset by large gains during the following spring and summer. The winter weight losses were associated with a reasonable level of total forage but a very low level of green material.

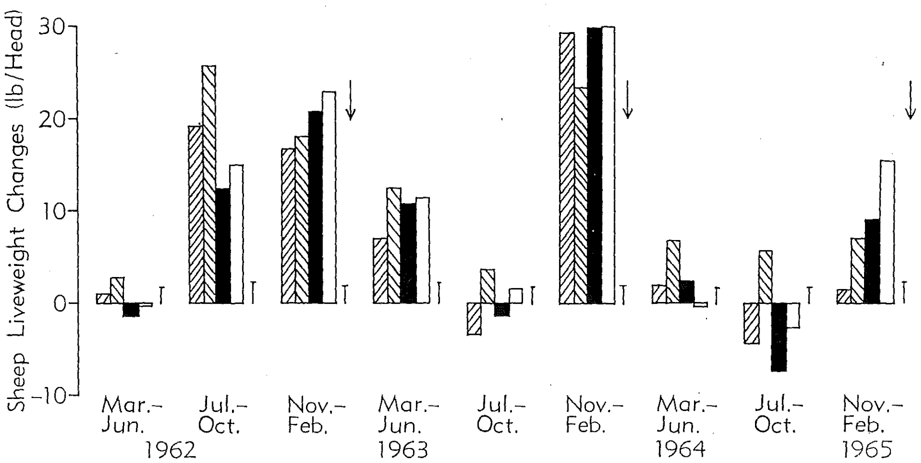

Fig. 3.—Sheep liveweight changes. (Legend as for Fig. 2).

Significant treatment differences were demonstrated in each of the nine periods examined. During the July–October period in each of the 3 years, body-weight was better maintained by the sheep on the M/Luc treatment. In the November–February periods of the first 2 years, compensatory weight gains were evident. The sheep growing most poorly in the preceding periods grew more rapidly than those of other treatments during the November–February periods. This trend was not consistent in the summer of 1964–65, when the feed supply was much less adequate.

The overall total gains during the three years are shown in Table 3.

TABLE 3

TOTAL BODY-WEIGHT GAIN, 1962–1965

Treatment	Gain (lb/head)
H/Luc	68·8
M/Luc	105·5
M	74·9
L	93·0

(e) Wool Yields and Fleece Measurements

Wool yields and fleece measurements are shown in Table 4.

TABLE 4

WOOL YIELDS AND FLEECE MEASUREMENTS

Parameter	Treatment				Necessary Differences for Significance	
	H/Luc	M/Luc	M	L	5%	1%
Greasy wool (lb/head)—						
1963	7·96	8·52	6·85	7·68	0·42	0·55
1964	10·73	11·73	10·83	12·00	0·74	1·11
1965	10·45	11·72	9·91	11·28	0·72	0·96
Clean wool (lb/head)—						
1964	6·54	7·34	6·68	7·50	0·61	0·91
1965	6·50	7·36	6·24	7·13	0·46	0·61
Clean wool (lb/ac)—						
1964	9·8	7·4	6·7	3·7	0·63	..
1965	9·75	7·36	6·24	3·56	0·48	0·63
Fibre diameter (μ)—						
Base						
1964	26·9	27·1	27·0	27·9	N.S.	..
1965	26·2	27·5	25·7	27·9	1·39	1·84
Middle						
1964	20·5	22·3	20·8	22·1	1·56	2·37
Tip						
1964	26·1	26·9	26·5	27·5	N.S.	..
Staple length (in.)—						
1964	4·21	4·37	4·38	4·49	0·24	0·36
1965	4·00	4·15	4·17	4·19	N.S.	..

The heaviest fleeces were produced from the M/Luc and L treatments but the H/Luc treatment produced considerably more wool per acre than any other treatment. Differences in staple length were recorded only in 1964, when the staple length was greater in the L treatment than in the H/Luc. The average fibre diameter at the base of the staple in both the L and the M/Luc treatments was greater than in the H/Luc and M treatments in 1965 only. In 1964 the fibre diameter at the middle of the staple was greater in the M/Luc and L treatments than in H/Luc.

There were no significant differences in the percentage yield of clean scoured wool, which varied from 61 to 64. In 1964 the average crimp frequency was 7·68 crimps/in. at the base of the staple, 9·27 at the middle and 8·11 at the tip. In 1965 the figure was 8·83 at the base of the staple. In neither year did any significant treatment difference occur in these parameters.

(f) **Worm Burden**

The regular 6-weekly drenching programme maintained the worm egg burden at the low level of less than 200 eggs per gram of faeces. This was independent of grazing treatment.

IV. DISCUSSION

One of the major restrictions on animal production on native pastures in the traprock country of south-eastern Queensland is the sub-maintenance value of the forage during the winter months. The critical period is in June, July and early August, when there is practically no production of green material and the pastures consist of low-protein, unpalatable roughage representing the matured residue of the previous season's growth.

In this progress report it is not proposed to examine critically relationships between stock production and green material availability. However, the importance of the green portion of pastures has been stressed by various workers. In the Australian Capital Territory, Willoughby (1959) showed that liveweight gain by sheep on *Phalaris tuberosa*—subterranean clover pasture increased until a level of 1,400 lb dry matter per acre in the green material was available. This figure is well in excess of the highest level of green material (496 lb dry matter per acre) recorded in this experiment. In a grazing experiment conducted by Roe, Southcott, and Turner (1959) on the Northern Tablelands of New South Wales, it was found that sheep liveweight and also wool fibre diameter were related to the amount of green forage in the pasture.

The stocking rate of the native pastures is largely determined by their ability to support stock, though in a declining condition, during the winter months. In this experiment, increasing the stocking rate from 2 ac per sheep (L) to 1 ac per sheep (M) resulted in lowered body-weight and fleece weight but increased wool yield per acre. Fleeces were an average of 1·2 lb lighter, and at the end of the first 3 years sheep in the M treatment were 18·1 lb per head lighter than those in the L treatment. However, the greasy wool yield per acre from the M treatment showed an increase of 77%. This effect is consistent with the results of Mott (1960), who described the effects of stocking rate on both product per animal and product per acre.

The addition of a small area of grazing lucerne as a supplement to the native pastures allowed a further increase in stocking rate without undue detriment to sheep liveweight. In a direct comparison between the M/Luc and M treatments, the inclusion of the lucerne supplement was responsible over the 3-year period for a 15·9% increase in wool yield and a final body-weight advantage of 30·6 lb per head. The wool yield per acre from the H/Luc treatment was 2·8 times that from the L treatment.

Native pasture supplementation with grazing lucerne has also been responsible for increased liveweight of cattle at "Brian Pastures" Pasture Research Station in south-eastern Queensland (Anon. 1963 p. 14). Cattle with access to a lucerne area which represented one-sixth of the total grazing area available to them gained 158 lb per head per annum more than those grazing native pasture only.

The significant effects of grazing treatment on pasture production, fleece weight and sheep body-weight are in contrast to the results of Roe, Southcott, and Turner (1959) on the Northern Tablelands of New South Wales. They showed no consistent significant differences between grazing treatments in their effects on the pasture, sheep liveweight and wool per head, but levels of forage availability were considerably higher than in the Texas study.

The applicability of these results to commercial practice can only be finally assessed when long-term changes in botanical composition and effects on sheep production have been measured.

However, at this stage of the investigation the use of supplementary grazing lucerne offers a promising means of extending the benefits from a small area of improved forage to land generally unsuitable for cultivation.

V. ACKNOWLEDGEMENTS

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