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EFFECTS OF GRAZING LUCERNE SUPPLEMENTATION AND STOCKING RATE ON SHEEP AND NATIVE PASTURE PRODUCTIVITY IN THE QUEENSLAND TRAPROCK REGION: Final Report

By G. J. CASSIDY, M.Agr.Sc., G. R. LEE, B.Sc.Agr., and J. G. NATION

SUMMARY

Results are presented for the second 3 years of a 6-year grazing experiment with sheep. The effects of stocking rate and supplementary grazing lucerne on wool production and sheep liveweight are presented and overall implications of the 6 years' results discussed.

Greasy wool yield increased from 36 to 65 kg/ha over the 6 years when stocking rate on native pasture was doubled to 0.4 ha/sheep. Grazing lucerne as a supplement on one-sixth of the total area increased yield to 72.5 kg/ha at the 0.4 ha/sheep stocking rate. Increasing stocking rate to 0.27 ha/sheep, with lucerne, raised greasy wool yield to 100 kg/ha. Sheep in the lastmentioned treatment and those on native pasture at 0.4 ha/sheep had to be hand-fed for survival during the 1965-66 drought. Those at 0.4 ha/sheep with lucerne and those on native pasture at 0.8 ha/sheep accumulated sufficient body reserves to survive the drought without hand-feeding.

Highest wool yield per head was produced in the lightest stocked treatment in the drought year, but from 0.4 ha/sheep when adequate lucerne was available in 1967.

Treatment effects on native pasture yield are presented. From the results of this experiment it is concluded that very small areas of lucerne for periodic supplementation of wool-growing wethers is not economical in the traprock country.

I. INTRODUCTION

Grazing for wool production in the traprock country of southern Queensland, an area of some 5 million ha west of the Stanthorpe–Wallangarra granite belt, is based on native pastures dominated by the summer-growing perennial grasses *Bothriochloa decipiens, Dichanthium humilius,* species of *Chloris,* and *Sporobolus elongatus.* Year-long carrying capacity is largely restricted by that of winter and early spring. Pasture quality is then at a minimum, summer species are dormant and standing feed deteriorates rapidly with heavy dews, rain and frosts.

In July the overall nitrogen content of the standing forage reaches a minimum of about 0·6% (4% crude protein), stressing the necessity for sheep to select material with a much higher nitrogen content to maintain nitrogen balance. For subtropical pasture species in south-eastern Queensland, a crude protein level of 7·2% in the forage consumed is necessary to ensure zero nitrogen balance (Milford and Haydock 1964).

Soils are mostly shallow and skeletal, akin to the podsolised and solodised Red Brown Earth Associations (Hallsworth and Gibbons 1951; Dr 3·42 of Northcote 1966). Mean annual rainfall ranges from 550 to 650 mm, with 65% occurring between October and March. Annual evaporation is 1800 mm and mean monthly maximum and minimum screen temperatures range from 32°C and 20°C for January to 18°C and 6°C for July respectively.

This experiment, conducted for 6 years, was designed to examine the effects of stocking rate and supplementary grazing lucerne on liveweight and wool production of sheep grazing native pasture and to monitor productivity, botanical composition and ground cover of the native pastures.

The results for the first 3 years, to March 1965, were presented by Lee and Rothwell (1966). They found that the provision of supplementary lucerne grazing increased greasy wool yield by 0·68 kg/head at the 0·4 ha/sheep stocking rate. The treatment 0·27 ha/sheep with lucerne also produced heavier fleeces than native pasture alone at 0·4 ha/sheep and it gave the highest wool production per ha. Greatest liveweight gains during this initial 3-year period were made by sheep stocked at 0·4 ha/sheep with lucerne.

The present paper covers the final triennium to February 1968.

II. MATERIALS AND METHODS

Treatments.—The following treatments were arranged in a randomized block with three replications:

(1) 0·27 ha/sheep with one-sixth of the area lucerne (H/Luc).
(2) 0·4 ha/sheep with one-sixth of the area lucerne (M/Luc).
(3) 0·4 ha/sheep native pasture only (M/Pas).
(4) 0·8 ha/sheep native pasture only (L/Pas).

Each paddock was stocked with seven 18-month-old Merino/Corriedale wethers in March 1962 and these were removed on March 29, 1966. The area remained unstocked until May 10, 1966, when a second flock of 18-month-old wethers, similar to the original sheep, was introduced. These remained until February 1968.

The lucerne areas of 0·3 and 0·47 ha respectively for H/Luc and M/Luc were subdivided into six paddocks to permit a rotational system of 1 week's grazing and 5 weeks' deferment during periods of lucerne availability (Figure 1).

The lucerne died out during the 1965 drought and was successfully resown in June 1966. Native pastures were continuously grazed.

Drought-feeding of sheep.—In 1965 hand-feeding for survival was necessary in the H/Luc and M/Pas treatments, sheep in individual paddocks being fed when the average liveweight per head dropped to 34·4 kg (25% below average maximum weight). The ration of lucerne hay and compressed pellets of grain, meatmeal and lucerne meal was fed at a rate to provide up to 1·8 kg starch equivalent per head per week (Briggs, Franklin and McClymont 1957). Hand-feeding in one paddock of the H/Luc treatment commenced on March 30, 1965, another on June 30 and the third on November 3.

Sheep on two of the three M/Pas paddocks were fed commencing on July 13. Feeding ceased on November 30 when limited paddock feed became available (Table 3). During this period two sheep died from starvation in each of the H/Luc and M/Pas treatments and were not replaced until restocking with the new flock. Following introduction of the new flock, hand-feeding to maintain initial liveweight was necessary in H/Luc paddocks from July 12 to September 2, 1966 (Figure 1).

Analysis of variance for sheep liveweight changes and wool parameters has ignored the fact that stock in some treatments were hand-fed. Missing values have been included in the analysis, where applicable, for sheep deaths.

Measurements.—Native pasture on offer was assessed at 6-weekly intervals in 1965, 8- to 12-weekly intervals in 1966 and twice in 1967 using Lee and Rothwell's (1966) techniques. One forage yield was also taken in 1969, twelve months after destocking. Green native pasture forage was manually separated and weighed when present in the pasture. Lucerne yields were not measured in the second triennium. The 6-weekly sheep weighing schedule was maintained and shearing took place in February each year. Concurrently, mid side fleece samples were measured for clean scoured fleece weight, staple length, fibre diameter and crimp frequency (Moule and Miller 1956).

Botanical composition and ground cover were assessed in 1966, 1967 and finally in March/April 1968. Results will be reported in a subsequent publication.

Worm egg burdens were determined (Gordon and Whitlock 1939) from faecal samples collected at each weighing, and sheep were drenched regularly with an anthelmintic.

Seasonal conditions.—A severe drought lasted from January to November 1965, only 212 mm being registered in that period. In December, 248 mm brought some relief but moisture stress redeveloped progressively until August 1966 when further heavy rain occurred. Rainfall for the remainder of 1966, throughout 1967 and to conclusion of the trial in February 1968 was favourable (Figure 1).

III. RESULTS

Sheep weights.—Mean daily liveweight changes per head, inclusive of wool, were calculated for three periods of the year designated autumn-winter (March–June), winter-spring (July–October) and summer (November–February) (Figure 1). These conformed to the previous pattern of highest gains in spring/summer with low gains and in some cases weight losses in winter.

TABLE 1

SHEEP LIVEWEIGHT CHANGES (kg) 1965–1968

Exclusive of wool

Treatment	Total Gain ii.65–ii.66	Live-weight ii.66	Total Gain v.66–i.67	Live-weight i.67	Total Gain i.67–ii.68	Live-weight ii.68
H/Luc	3·2	48·0	15·4	42·8	5·9	48·8
M/Luc	−3·9	55·9	16·9	44·4	14·2	58·5
M/Pas	3·5	51·7	14·1	41·6	8·6	50·1
L/Pas	2·0	56·8	15·2	42·6	10·9	53·3
Necessary differences for significance 5%	1·1	2·7	1·5	1·6	1·6	2·5
Necessary differences for significance 1%	1·5	3·5	2·0	2·1	2·2	3·4

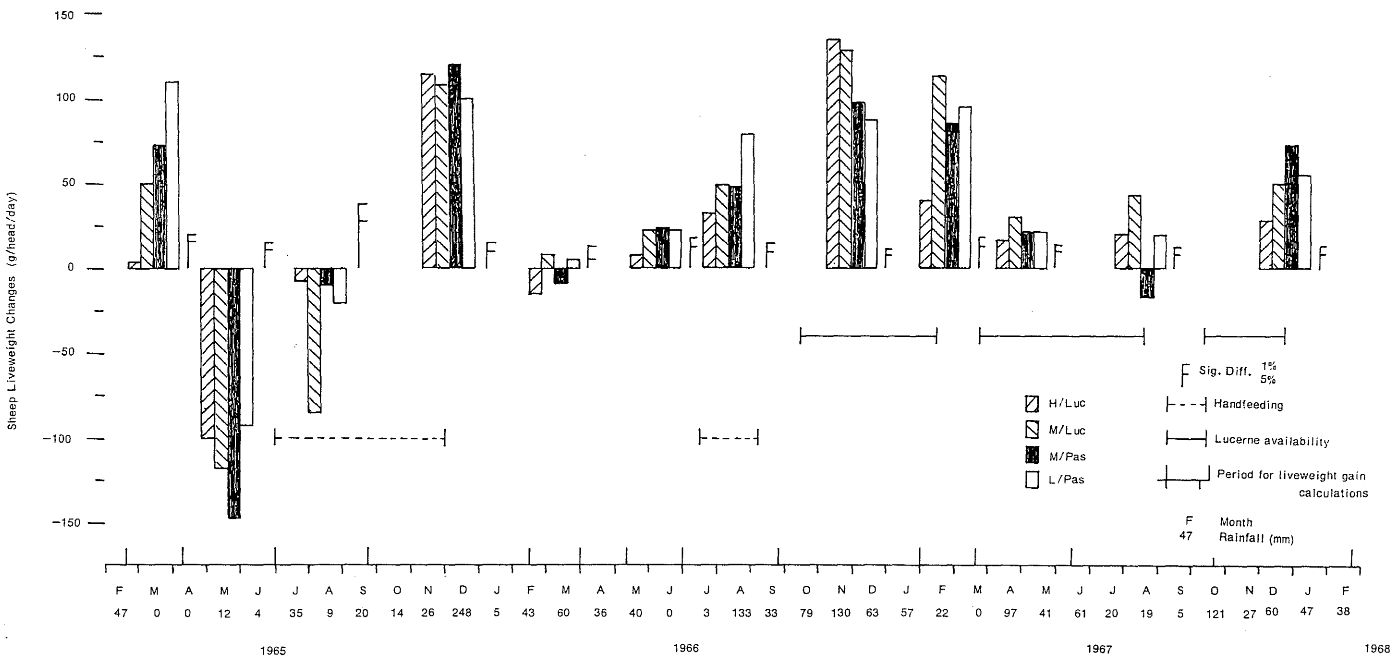

Fig. 1.—Sheep liveweight changes, periods of hand-feeding, lucerne availability and monthly rainfall.

Treatment effects were masked in 1965 by hand-feeding. The fed groups lost less weight and subsequently made higher gains until feeding ceased. Supplementary lucerne improved liveweight gains, particularly in M/Luc in 1966 and 1967. Gains on L/Pas rarely exceeded those on M/Pas during this period. Liveweight gains per sheep in 1965-66, omitting wool, were greatest in the H/Luc and M/Pas treatments. Conversely M/Luc and L/Pas sheep in February 1966 were heaviest. Liveweight gains of the new flock from May 1966 to February 1968 were greatest in the M/Luc treatment.

TABLE 2

WOOL YIELDS AND FLEECE MEASUREMENTS

Parameter	Treatment				Av. Sig. Diff.	
	H/Luc 1	M/Luc 2	M/Pas 3	L/Pas 4	5%	1%
Greasy wool (kg/head)						
1966 shearing	3·65	3·66	3·58	4·42	0·29	0·39
1967 shearing	4·67	4·84	4·78	4·93	NS	..
1968 shearing	5·47	6·43	5·45	5·71	0·51	0·68
Clean wool (kg/head)						
1966 shearing	2·10	2·20	2·12	2·77	0·18	0·24
1967 shearing	2·82	2·87	3·03	3·15	0·24	0·32
1968 shearing	3·66	4·16	3·57	3·89	0·36	0·49
Greasy wool (kg/ha)						
1966 shearing	13·45	9·03	8·84	5·46	1≫2,3≫4	
1967 shearing	17·32	11·97	11·81	6·09	1≫2,3≫4	
1968 shearing	20·26	15·71	13·47	7·06	1≫2≫3≫4	
Percentage yield						
1966 shearing	57·89	60·30	59·58	62·71	2·77	3·67
1967 shearing	60·22	59·22	63·56	64·09	2·13	2·82
1968 shearing	66·97	64·60	65·56	67·93	2·40	3·19
Average fibre diam. (μ)						
1966 shearing	23·64	22·45	25·30	26·11	2·02	2·69
1967 shearing	26·03	26·51	26·19	26·58	NS	..
1968 shearing	25·08	26·62	26·16	26·79	NS	..
Staple length (mm)						
1966 shearing	85	85	90	100	6	8
1967 shearing	115	115	120	125	7	10
1968 shearing	115	120	115	125	NS	..
Crimp/25 mm						
1966 shearing	8·25	8·62	8·40	7·71	NS	..
1967 shearing	7·29	7·48	7·52	6·98	NS	..
1968 shearing	8·07	8·23	7·81	6·69	NS	..

Wool yields and fleece measurements.—Both greasy and clean fleeces at the 1966 shearing and clean fleeces at the 1967 shearing were heaviest in the lightest stocked treatment, L/Pas. M/Luc produced the heaviest fleeces at the 1968 shearing. Wool per hectare over the 3 years increased with increasing stocking rate. Differences in percentage yield of clean wool occurred at all shearings, such differences favouring the lightest stocked treatment, L/Pas. Fibre diameter differed for the 1966 shearing only, while staple length differed in the 1966 and 1967 shearings. Crimp frequency was insensitive to the treatments imposed.

Worm burden.—The regular drenching programme maintained the worm egg burden at the very low level of less than 200 eggs/g of faeces in all treatments.

Pasture yields.—Native pasture on offer was exceptionally low throughout 1965 and up to the end of 1966, when improved seasonal conditions resulted in yield increases which continued in 1967. The highest amounts of pasture on offer in 1965 were in the L/Pas treatment (Table 3). Forage in M/Luc was of a similar order to that in L/Pas in 1966 up to the September harvest, both being greater than the H/Luc and M/Pas treatments. This pattern continued into 1967. By August L/Pas significantly (5%) outyielded the other three treatments.

TABLE 3

NATIVE PASTURE PRESENTATION YIELDS (kg/ha)

Date	H/Luc	M/Luc	M/Pas	L/Pas	Sig. Diff.	
					5%	1%
*18.xii.64–17.ii.65	26 (10)	167 (47)	86 (17)	232 (65)	99 (21)	149 (32)
17.ii.65 ..	17 (6)	165 (47)	55 (12)	198 (61)	81 (21)	123 (32)
6.iv.65 ..	20	76	49	183 (38)	72	110
17.v.65 ..	19	85	49	126	76	116
30.vi.65 ..	12	37	27	120	NA	..
10.viii.65 ..	7	39	20	122	NA	..
3.xi.65 ..	Nil	37	Nil	141	NA	..
26.i.66 ..	24 (24)	102 (102)	22 (22)	224 (224)	80 (80)	122 (122)
29.iii.66 ..	21 (19)	157 (123)	19 (17)	117 (69)	NS (NS)	..
12.vii.66 ..	36 (10)	75 (16)	157 (45)	114 (24)	NS (NS)	..
26.ix.66 ..	21 (9)	57 (6)	26 (3)	94 (11)	69 (NA)	104
17.xi.66 ..	67 (67)	212 (212)	189 (189)	343 (343)	163 (163)	246 (246)
27.iv.67 ..	280 (140)	858 (429)	346 (173)	982 (491)	201 (101)	307 (153)
17.viii.67 ..	277 (138)	549 (275)	271 (136)	809 (405)	269 (134)	407 (203)
4.iii.69† ..	200	858	409	699	247	374

* From Lee and Rothwell (1966).

NA = Not analysed.

NS = Not significant.

(9) Green material contained in the total forage.

† Yield after destocking for 12 months except in L/Pas, which was grazed at 0·4 ha/ram from 5.vi.68 to 19.ix.68 and 0·13 ha/ram from 19.ix.68 to 15.xii.68.

Small amounts of green native pasture were available in all treatments in February 1965. However, by April only L/Pas contained a measurable amount. No green material was available in any treatment for the remainder of 1965. Green material was available at all harvests in 1966 but only in January and November were significant treatment differences demonstrated. At both harvests in 1967 it amounted to 50% of the total native pasture forage.

IV. DISCUSSION

Serious drought in 1965 caused very low native pasture forage yields and complete absence of green material after April. Analysis of variance of forage yields on several occasions was either not calculated or if calculated failed to show significance due to the zero yields or inability to harvest any material in some paddocks of the heavily stocked treatments. It was the only year in which serious liveweight losses occurred (Figure 1). All treatments exhibited a close association between sheep liveweight gains and the availability of fresh green feed as demonstrated by Roe, Southcott and Turner (1959) on the northern tablelands of New South Wales. Low gains and in two treatments liveweight losses in February/March 1966 were again associated with a decrease and subsequent disappearance of green feed which followed December 1965 rain. The better performance of sheep on H/Luc and M/Pas in late winter and spring 1965 was a reflection of hand-feeding and possibly also reduced stocking rates, as dead sheep were not replaced. Although aggregate weight losses were greater and more protracted on M/Luc and L/Pas, the body-weight reserves accumulated during the previous 3 years (Lee and Rothwell 1966) enabled these sheep to survive the drought without hand-feeding (Table 1).

Liveweight gains in the new flock from May 1966 onwards closely reflect treatments and conform in general with the overall pattern of maximum gains in summer and minimum gains or even losses in winter previously recorded by Lee and Rothwell (1966). Once seasonal conditions and pasture growth improved, animal performance on M/Pas and L/Pas proved similar in terms of body-weight and wool production despite a twofold increase in stocking rate. However, the absence of any safety margin is evident in the June/October 1967 period when sheep in M/Pas lost weight during a period of feed shortage in that treatment. (Figure 1 and Table 3).

The significant effect of supplementary lucerne on liveweight is clear when M/Luc and M/Pas are compared (Figure 1 and Table 1). The benefit was consistent during the periods of lucerne availability and in terms of body-weight (without wool) amounted to an advantage of 8·4 kg by February 1968. In the November 1967/February 1968 period a compensatory weight gain in M/Pas resulted in that treatment gaining at a greater rate than its lucerne-fed counterpart M/Luc.

The native pasture stocking rate in M/Luc was 7 sheep on 2·3 ha. While this would have been the case throughout 1965, when lucerne was unavailable, it appears that grazing pressure could have been considerably lower during the periods of lucerne availability. This would explain the rapid pasture recovery between November 1966 and the April 1967 assessment, when available forage on M/Luc equalled that on L/Pas and was double that on M/Pas. This suggests that little use was made of the native pasture when lucerne was available. It was used as a high quality substitute rather than as a supplement.

The consistent heavy stocking of native pastures in the H/Luc and M/Pas treatments temporarily suppressed regrowth. At commencement of the trial in April 1962, presentation forage yields in all treatments were approximately 1200 kg/ha. Twelve months after destocking, regrowth on H/Luc was only 16·67% of this and that on M/Luc 33·34%. The recovery of the M/Luc and L/Pas paddocks is apparent from Table 3, this effect commencing from early 1967.

A positive effect of lucerne on greasy wool production per head occurred only at the 1968 shearing when the advantage due to lucerne at the 0·4 ha/sheep stocking rate was 0·98 kg/head. In this triennium 1967 was the only year when it was possible to maintain a reasonably continuous supply of lucerne. Inability to supply lucerne throughout 1965 and for the first 9½ months of 1966 has obviously seriously detracted from evaluation of its role as a supplement for native pastures.

Practical implications.—Consideration of the first 3 years' results (Lee and Rothwell 1966) in conjunction with those presented in this paper provides a comparison of treatments over 6 consecutive years, which included one serious drought year. When stocking rate on native pasture was doubled from the "drought safe" level of 0·8 ha/sheep to 0·4 ha/sheep, the yield of greasy wool was increased by 81%, from 36 kg/ha to 65 kg/ha. The allocation of one-sixth of the area to lucerne, grazed when available, resulted in a further small increase to 72·5 kg/ha (significant differences occurred between M/Luc and M/Pas in 4 of the 6 years). By increasing stocking rate further to 0·27 ha/sheep, including lucerne, total greasy wool increased to 100 kg/ha. At the medium stocking rate (M/Luc) the major effect of lucerne was to improve sheep body-weight, especially during the first 3 years. This resulted in those animals accumulating sufficient body-weight reserves to survive the 1965 drought without hand-feeding. At the same stocking rate on native pasture only, sheep in two of the replications had to be fed a survival ration for 20 weeks. It is doubtful if the benefits derived from lucerne, which had to be planted twice, justified the cost of fencing, cultivation, seed and fertilizer.

The economic ability of rotationally grazed lucerne to increase production per hectare in terms of meat and wool through increased stocking rates has been demonstrated in central western New South Wales (Robards and Peart 1967; Clinton 1968; Peart 1968). However, the topography and rocky nature of the traprock country in south-eastern Queensland permit cultivation, a necessary procedure for lucerne establishment, in limited areas only, and Lee (1961) has outlined possible uses for such areas and the type of production which can be achieved. The concept of using the restricted areas for specialist enterprises such as lambing ewes or fattening sheep for sale when uninterrupted access is necessary during strategic periods appears to offer best prospects.

It appears as if the greatest restriction in this experiment has been the limited amount of lucerne that was available and consequent inability to maintain continuous access to the lucerne subplots.

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Mr. Cassidy is an officer of Agriculture Branch, Queensland Department of Primary Industries, stationed at Gympie. Mr. Lee is an officer of the Branch stationed at Brisbane. Mr. Nation is an officer of Sheep and Wool Branch, Queensland Department of Primary Industries, stationed at Warwick.