EFFECT OF GRAZING MANAGEMENT ON AN IRRIGATED PASTURE IN SOUTH-EASTERN QUEENSLAND

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SUMMARY

Various grazing treatments were applied to an irrigated pasture of phalaris, cocksfoot, H1 ryegrass and Irrigation white clover over a period of three years.

Pasture green-weight yields decreased in all treatments. The decrease was greater in treatments with set uniform resting periods than in treatments in which the resting period varied in length. With set uniform resting periods pasture yields fell with frequency of grazing.

Pasture carrying capacity decreased in all treatments. The decrease was greater in treatments with set uniform resting periods than in treatments in which the resting period varied in length. With set uniform resting periods the decrease did not follow the same pattern as that exhibited by pasture green-weight yields.

Serious invasion by foreign species occurred in treatments with set resting periods of 30 days or less. White clover declined in all treatments.

Unevenness in pasture cover quickly developed in treatments grazed every 30 days or more frequently. Treatments that provided a long resting period in late summer and autumn maintained a satisfactory cover.

I. INTRODUCTION

The Queensland Bureau of Investigation of Land and Water Resources opened an Irrigation Research Station at Gatton, in the Lockyer Valley, in 1946. This Station was taken over by the Department of Agriculture and Stock in 1957 and designated the Gatton Regional Experiment Station.

Since the inception of the Station, the emphasis has been on investigations of irrigated pastures. The trial reported here was designed to examine the effects of a number of grazing treatments with dairy cattle on the production, carrying capacity, botanical composition and evenness of cover of a permanent irrigated pasture of temperate grasses and white clover. The trial was carried out from July 1, 1954, to June 30, 1957.

II. MATERIALS AND METHODS

The soil in the trial area was a deep alluvial clay loam of good structure and high inherent fertility. Because of its satisfactory plant food status, fertilizers are not used on this soil type and none was applied to this trial.

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The pasture had been planted 15 months prior to the commencement of the trial and was well developed and vigorous. The species consisted of phalaris (*Phalaris tuberosa*), cocksfoot, H1 ryegrass and Irrigation white clover.

The area available for the trial totalled 4·8 ac and for the purposes of the trial it was subdivided into plots of 0·6 ac to provide for eight treatments. This plot size was considered to be the minimum which would permit the planned grazing management schedules to be satisfactorily applied so as to simulate conditions under normal farming practice with dairy stock. Replication of treatments, by reducing plot size, would have introduced undesirable practical conditions and was therefore not adopted.

When grazing of this type of pasture was first commenced at the Station, only four areas were available and the method adopted was one week's grazing followed by three weeks' rest. A pasture pattern (unevenness of the cover)

Table 1

DETAILS OF TREATMENTS

Treatment	Resting Period (days)	Flexibility in Resting Period (days)*	Grazing Period (days)†	Grazing Management Adopted
A	15	±2	5 days	Overgrazing practice
B	15	± 2	,, ,,	Good grazing practice
C	20	± 5	,, ,,	,,
D	30	± 5	,, ,,	,,
E	40	± 5	,, ,,	,,
F	Summer 20	± 2	,, ,,	,,
	Winter 50	± 5		
G	30	± 5	Average stocking intensity. If more than 5 days' grazing were available a back fence was used after that time to prevent grazing of regrowth	,,
	Rested (grazing deferred) March, April, May, grazed June	± 15		
H	30	± 5	,,	,,
	Rested April, May, June, grazed July	± 15		

* Some flexibility in the resting period was provided to allow easier handling of grazing in unfavourable weather conditions or when grazing of a number of treatments coincided.

† Where the grazing period was fixed at five days, the number of stock used was adjusted accordingly. By April 1955 little grazing was available in some treatments and the length of the grazing period was therefore reduced to suit the circumstances.

quickly developed and grazing efficiency, plant vigour and pasture production decreased; in the period of slow growth in autumn and winter the depreciation rate was serious. When additional areas became available for grazing it was found that allowing the pasture sufficient rest to achieve good growth before grazing resulted in much less depreciation than formerly. The length of spell required increased as weather conditions for pasture growth deteriorated. In working out the grazing treatments to be examined in the trial it was considered desirable to use resting periods of set lengths rather than to graze at various stages of pasture development, as these stages could not be determined with sufficient precision.

Previous experience had indicated that resting periods that did not permit sufficient development of pasture between grazings could cause rapid and serious deterioration. It was considered that a trial period of three years would provide sufficient information on the effects of the treatments to be employed.

The treatments used were as shown in Table 1.

Following each grazing period, manure on the pasture was spread with a "Dillon" pasture harrow, care being taken to avoid any cultivation effect or any damage to the pasture components.

Pasture yield was assessed by quadrat cuts (51·3 in. x 24 in.) at the rate of one per bay (5 per acre).

Botanical composition was measured by hand sorting of representative samples derived from the bulked quadrat material.

Evenness of cover was assessed on August 28, 1956, and July 1, 1957, on a scale ranging from 0 (evenly mixed pasture cover of uniform growth) to 10 (pasture cover most uneven).

A record was kept of cow-grazing-days.

The stock used were six Jersey cows and six Australian Illawarra Shorthorn cows, all in milk.

Surface irrigation was applied to provide maximum pasture production. It was timed to fit in with the grazing schedule. Details of irrigation and rainfall are shown in Table 2.

Table 2

IRRIGATION AND RAINFALL

Month	1.vii.54–30.vi.55								
	Irrigation applied in inches								Rainfall
	A	B	C	D	E	F	G	H	
July ..	..	..	..	..	..	..	..	..	5·56
Aug. ..	..	..	..	..	..	..	..	..	2·77
Sept. ..	3·9	3·9	3·9	6·3	2·4	2·4	2·4	2·4	2·25
Oct. ..	2·2	2·2	2·2	2·2	2·6	2·6	2·6	2·6	4·99
Nov. ..	2·4	2·4	2·4	2·4	..	..	..	..	3·32
Dec. ..	..	4·2	5·1	3·0	9·5	8·8	8·8	8·8	2·71
Jan. ..	2·4	2·4	5·5	5·5	5·8	5·8	..	5·8	5·24
Feb. ..	..	..	..	..	3·8	3·8	3·8	3·8	2·21
March ..	4·3	4·3	5·2	6·0	6·1	6·1	6·1	3·4	10·00
April ..	5·0	5·0	5·0	5·0	4·8	4·8	2·2	2·4	5·25
May ..	2·5	2·5	2·5	..	2·7	..	..	..	4·14
June ..	2·5	2·5	2·5	2·5	2·4	2·4	2·4	2·4	·82
Total ..	25·2	29·4	34·3	32·9	40·1	36·7	28·3	31·6	49·26

IRRIGATION AND RAINFALL—*continued*

Month	1.vii.55–30.vi.56								
	Irrigation applied in inches								Rainfall
	A	B	C	D	E	F	G	H	
July ..	1·7	1·7	1·7	1·7	2·4	2·4	2·4	2·4	1·91
Aug. ..	3·6	3·6	3·6	5·2	4·9	4·9	4·4	5·2	·48
Sept. ..	5·6	5·6	5·6	5·6	5·9	5·9	5·9	5·9	2·59
Oct. ..	4·5	4·5	4·5	4·5	6·2	6·2	6·2	6·2	3·08
Nov. ..	4·7	4·7	4·7	4·7	5·3	5·3	5·3	5·3	·97
Dec. ..	3·5	3·5	3·5	6·8	5·5	2·9	2·9	5·2	4·10
Jan. ..	9·0	6·1	6·1	6·7	8·9	8·9	8·9	8·6	3·91
Feb. ..	..	..	..	..	..	..	..	..	11·05
March ..	..	..	..	..	..	..	..	..	3·86
April ..	3·0	3·0	3·0	3·0	3·3	3·3	3·3	3·3	4·94
May ..	2·5	2·5	2·4	2·4	2·2	2·2	2·2	2·2	4·57
June ..	2·4	2·4	2·4	3·8	2·8	2·8	2·8	2·8	3·01
Total ..	40·5	37·6	37·5	44·4	47·4	44·8	44·3	47·1	44·47

IRRIGATION AND RAINFALL—*continued*

Month	1.vii.56–30.vi.57								
	Irrigation applied in inches								Rainfall
	A	B	C	D	E	F	G	H	
July ..	..	..	..	..	..	..	..	..	1·01
Aug. ..	5·8	5·8	5·8	5·8	4·4	4·4	4·4	4·4	·06
Sept. ..	3·0	3·0	3·0	3·0	6·9	6·5	6·5	6·9	·14
Oct. ..	7·1	7·1	7·1	7·1	8·6	8·6	7·7	8·6	·78
Nov. ..	6·4	6·4	6·4	8·0	10·2	10·2	10·9	10·2	·35
Dec. ..	..	3·5	3·5	3·5	3·0	3·0	3·0	..	8·39
Jan. ..	5·6	5·6	5·6	5·6	7·0	7·0	7·0	7·0	1·99
Feb. ..	8·4	8·4	8·4	8·4	8·4	8·4	8·4	8·4	2·70
March ..	3·7	3·7	4·0	4·0	4·5	4·5	4·5	4·5	2·84
April ..	6·9	6·9	6·9	4·9	8·9	8·9	8·9	8·9	·67
May ..	6·9	6·9	6·9	4·8	5·9	5·9	5·9	5·9	..
June ..	2·6	2·6	2·6	2·6	2·4	2·4	2·4	2·4	·85
Total ..	56·4	59·9	60·2	57·7	70·2	69·8	65·6	67·2	19·78

Application rates are all calculated from the amounts actually pumped and have no regard for losses by seepage from head ditches or run-off from bays from excessive application.

III. RESULTS

(a) Pasture Yields

Green yields were recorded at each time of grazing. These provide a comparison of annual yields and growth rates within treatments and show the effect of treatment over three years.

The pasture green yields are shown in Table 3 and Figure 1. Production was high in all treatments in the first year, but declined in the second year in all treatments. The decline ranged from 1·2 per cent. in Treatment B to 17·5 per cent. in Treatment E. The mean annual production in the second year for all treatments was 11·1 per cent. less than in the first year.

The decrease was accelerated in practically every treatment in the third year, and as a result the mean annual production for all treatments was 22·0 per cent. less than in the second year. Only Treatment H failed to show a decline.

The average reduction in pasture green yields for all treatments from first year to third year was 30·6 per cent. The reduction in Treatments A, B and C was serious at 39 per cent., 41 per cent., and 40 per cent. respectively. Treatment H showed the small decline of only 5 per cent.

Treatments providing set uniform resting periods throughout the year (A, B, C, D, E) showed greater decline in production than treatments where the length of spelling varied (F, G, H). The mean reduction for the two groups was 37·4 per cent. and 19·1 per cent. respectively.

Table 3

PASTURE GREEN YIELDS

Treatment	1.vii.54–30.vi.55		1.vii.55–30.vi.56		1.vii.56–30.vi.57		Means		Reduction in Yield, 1st Year to 3rd Year
	Total Green Yield (tons/ac)	Average Weekly Growth Rate (tons/ac)	Total Green Yield (tons/ac)	Average Weekly Growth Rate (tons/ac)	Total Green Yield (tons/ac)	Average Weekly Growth Rate (tons/ac)	Total Green Yield (tons/ac)	Weekly Growth Rate (tons/ac)	(%)
A	45·09	·86	42·52	·81	27·44	·53	38·35	·73	39·1
B	44·34	·85	43·80	·83	25·97	·50	38·04	·73	41·4
C	45·43	·87	38·08	·73	27·10	·52	36·87	·71	40·3
D	46·70	·89	42·19	·81	29·15	·55	39·35	·75	37·6
E	42·01	·81	34·66	·66	30·22	·58	35·63	·68	28·1
F	45·00	·86	37·70	·72	33·00	·63	38·57	·74	26·7
G	44·37	·85	41·21	·79	33·17	·64	39·58	·76	25·2
H	43·62	·84	36·94	·71	41·41	·79	40·66	·78	5·1
Mean ..	44·57	·85	39·64	·76	30·93	·59	38·38	·73	30·4

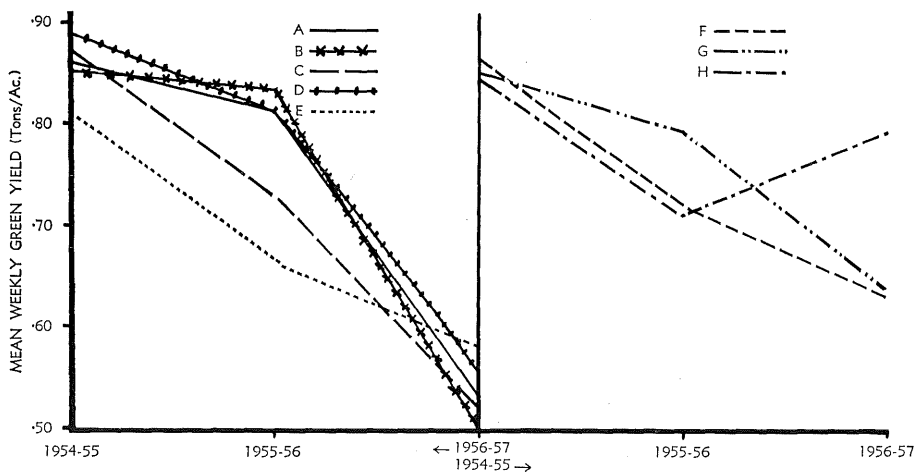

Fig. 1.—Mean weekly green weight yield of pasture.

In treatments giving set uniform spells, production fell with frequency of grazing.

As it may be assumed that the moisture content of the pasture was higher in treatments with short resting periods than in those with long spells, it is evident that Treatments H and G maintained better production rates than A, B, C, D and F, while E cannot be compared.

The only treatment in which there was any apparent loss of quality or attractiveness to stock was Treatment E, in which cocksfoot was not well accepted in late spring and summer, and an ungrazed residue remained when stock were removed.

(b) Carrying Capacity

Grazing data, expressed as full-time days of grazing, are given in Table 4 and Figure 2.

Table 4

PASTURE GRAZING YIELDS

Treatment	1.vii.54–30.vi.55		1.vii.55–30.vi.56		1.vii.56–30.vi.57		Means		Reduction in Grazing Yield 1st Year to 3rd Year (%)
	Total Cow Days	Carrying Rate/Acre	Total Cow Days	Carrying Rate/Acre	Total Cow Days	Carrying Rate/Acre	Cow Days	Carrying Rate/Acre	
A	549	2·51	450	2·05	202	·92	400·3	1·83	63·2
B	453	2·07	414	1·89	183·5	·84	350·2	1·60	59·5
C	510	2·33	400	1·82	285	1·30	398·3	1·82	44·1
D	456	2·08	435	1·98	253·5	1·16	381·5	1·74	44·4
E	456	2·08	399·4	1·82	210·4	·96	355·3	1·62	53·9
F	405	1·85	400	1·82	292·5	1·34	365·8	1·67	27·8
G	410	1·87	450	2·05	291	1·33	383·7	1·75	29·0
H	454	2·07	420	1·91	331	1·51	401·7	1·83	27·1
Mean ..	461·6	2·11	421·0	1·92	256·1	1·17	379·6	1·73	43·6

Grazing yield is expressed as full-time cow-days of grazing per plot.

Calculated carrying rate is expressed as number of cows carried per acre (365 cow-days per acre per annum=1 cow per acre).

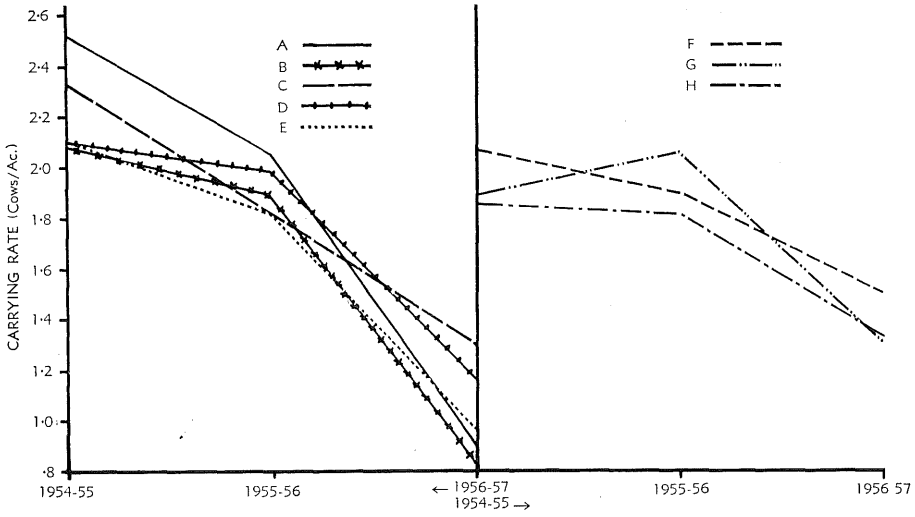

Fig. 2.—Carrying rate of pasture.

Due to pasture depreciation there were times when no grazing was available at the scheduled dates in some treatments. In 1956, there was no grazing available in Treatments A, B and C between July 24 and September 12. In 1957, Treatments A and B could not be grazed between May 21 and July 11, and

Treatments C and D between May 5 and July 12 and May 27 and July 12 respectively. For this year, pasture growth and grazing were allotted to June 30 on a *pro rata* basis from figures determined at subsequent grazings.

It is evident from the data that the overall grazing return declined from year to year. The decline in the second year (mean reduction for all treatments 8·8 per cent.) was not great, but the mean return dropped sharply in the third year, when it was 39·2 per cent. less than in the second year.

The average reduction in pasture grazing yields for all treatments from first year to third year was 43·6 per cent.

Treatments providing set uniform resting periods throughout the year (A, B, C, D, E) showed greater decline in grazing yield than treatments where the length of spelling varied (F, G, H). The mean reduction for the groups was 53·2 per cent. and 27·9 per cent. respectively.

Decrease in grazing yields did not follow the same pattern as decrease in pasture yields. The percentage decrease in grazing yields was greater than the percentage decrease in pasture yields. The average decline in the grazing yield from the first year to the third year was 43·6 per cent., while the corresponding decline in pasture yield was 30·4 per cent. This resulted from reduced grazing efficiency caused by the severity of the grazing pattern aggravated by unpalatability (poor acceptance by stock) in late spring and summer of cocksfoot in Treatment E and invaders in Treatment D.

(c) Botanical Composition

A summary of the analyses of botanical composition is given in Table 5.

Figures 3–5, based on the data in Table 5, show the effects of various treatments on the botanical composition.

The percentage of sown grasses increased in the first half of the trial and declined thereafter.

It will be noted that the amount of grass and its proportion to white clover were particularly high in Treatment E, the treatment with the longest set uniform resting period and the least number of grazings per year. This was due to the neglect by stock during late spring and summer of cocksfoot, which developed big stools, and for this reason was able to persist well and to control invaders, at the same time overlaying and reducing the white clover.

Invasion by foreign species was high in Treatments A, B, C and D. The plants mainly involved were paspalum (*Paspalum dilatatum*), nut-grass (*Cyperus rotundus*) and wild millet (*Echinochloa crus-galli*). Their development was favoured in summer in the selectively overgrazed areas.

Table 5

BOTANICAL COMPOSITION*

Treatment	Year	Botanical Composition		
		Sown Species		Invading Species (%)
		White Clover (%)	Grasses (%)	
A	1954–55	63·9	18·5	17·7
	1955–56	56·1	19·0	24·9
	1956–57	41·3	12·5	46·2
B	1954–55	67·3	13·9	18·8
	1955–56	53·2	21·1	25·7
	1956–57	41·3	14·8	43·9
C	1954–55	72·9	14·0	13·1
	1955–56	50·9	21·6	27·5
	1956–57	38·5	12·8	48·7
D	1954–55	68·6	15·7	15·7
	1955–56	50·8	23·9	25·3
	1956–57	37·1	9·0	53·9
E	1954–55	60·3	32·6	7·1
	1955–56	41·2	48·8	10·0
	1956–57	35·8	44·4	19·8
F	1954–55	63·1	27·6	9·2
	1955–56	53·5	29·2	17·3
	1956–57	58·9	14·5	26·6
G	1954–55	61·9	32·1	6·0
	1955–56	49·5	38·2	12·3
	1956–57	49·7	20·1	30·2
H	1954–55	55·7	30·7	13·6
	1955–56	44·4	47·7	7·9
	1956–57	51·6	35·5	13·1

* Average annual composition derived from individual analyses at grazing periods.

The grasses persisted quite well in Treatments H and G and exercised some control over the invasion of paspalum and nut-grass. Grazing regularly until the end of March and then deferring grazing for three months (Treatment H) gave better control of invaders than where deferment was commenced at the end of February (Treatment G).

In Treatments A, B, C, D and F the decline of the sown grasses was very serious and the individual plants had become small and lost most of their vigour at the end of the trial.

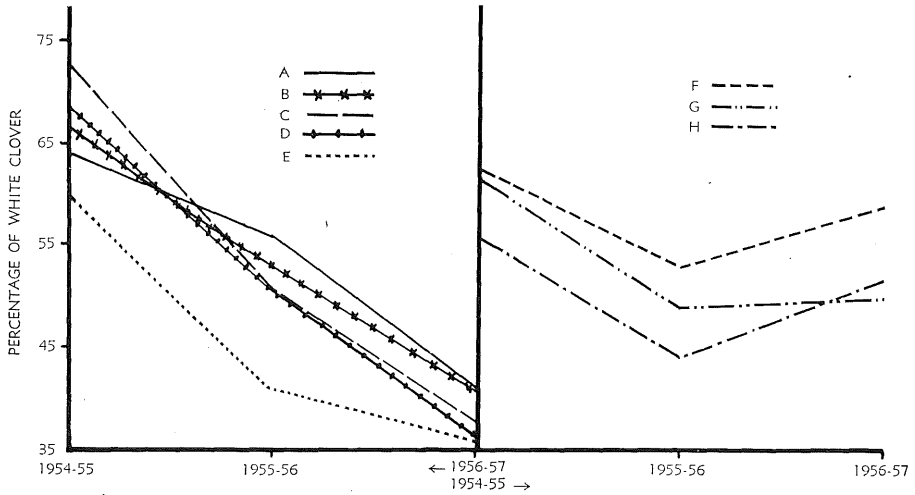

Fig. 3.—White clover content of pasture.

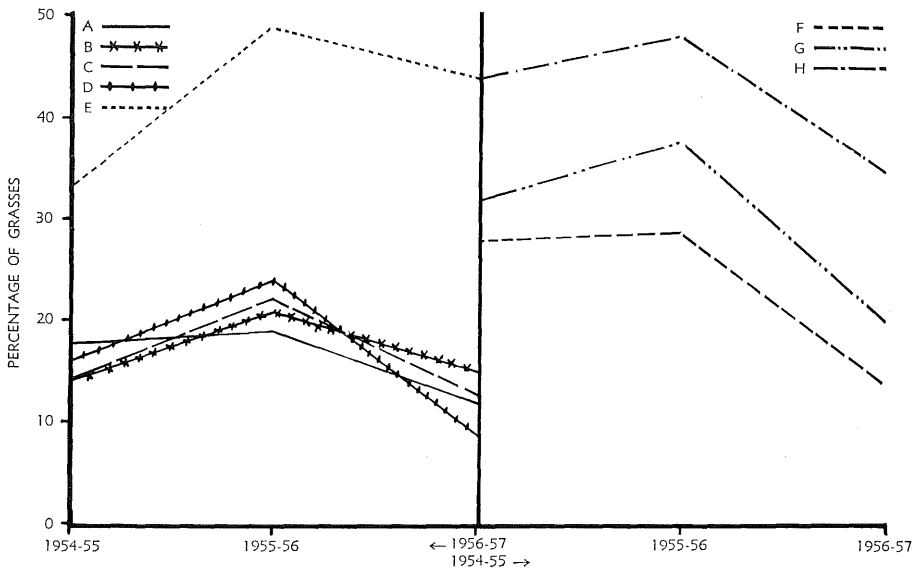

Fig. 4.—Grass content of pasture.

White clover declined in all treatments, and in all except F, G and H had declined to such extent as to provide very little grazing.

At the end of the trial the pastures in Treatments A, B, C, D and F had lost their identity as mixtures of temperate species and were virtually mixtures of summer grasses and white clover.

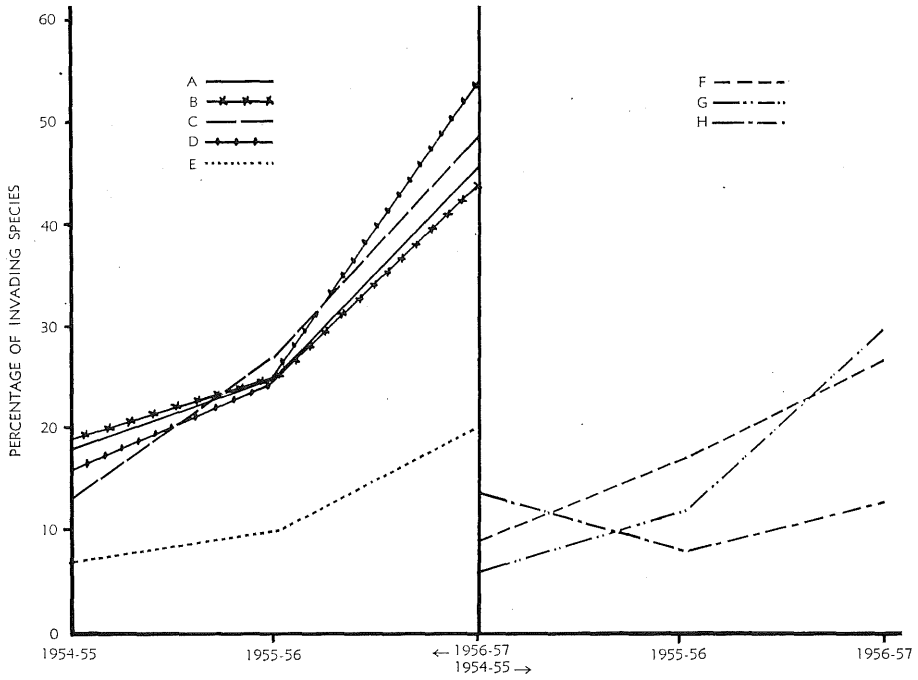

Fig. 5.—Invading species content of pasture.

(d) Evenness of Cover

The ratings for evenness of cover on the recording dates were as follows:—

Treatment	28.viii.56	1.vii.57
A	10	10
B	9·5	10
C	9	10
D	8	10
E	7	7
F	5	5
G	4	4
H	3	3

In some of the treatments, as a result of the grazing habits of stock, marked pattern effects were evident before the end of the first year and had become very pronounced by the end of the second year. At the conclusion of the trial,

Treatments A, B, C and D had a most uneven pasture cover and the pasture had reached a condition where it could no longer be maintained in first-class condition. At the same time, the treatments that provided a long rest in late summer/autumn, and 30-day spells during the rest of the year (H and G), maintained a satisfactory evenness of cover.

IV. DISCUSSION

In all the treatments in which the resting period was uniform throughout the year, pasture deterioration was serious. This was shown by slower growth rate of the pasture, lower stock carrying capacity, and deterioration of the botanical composition. Selective grazing quickly developed. Some of the effects of this were unevenness in the pasture cover, overgrazing of selected patches, reduction of vigour and low production of various species, heavy invasion by volunteer species, and a drop in annual production. Invasion was particularly heavy in treatments in which the resting period was 15, 20 or 30 days.

The treatment which provided for resting periods of 20 days in summer and 50 days in winter resulted in less depreciation than those providing uniform lengths of spell.

A long resting period before winter was of great benefit to the pasture. It did much to remedy selective grazing and to increase the vigour of weakened plants—the best treatment was that in which the pasture was ungrazed in April, May and June.

The trial indicates that maintenance of even pasture cover at all times is of paramount importance, and that the pasture cover is a good indication of the efficiency of the grazing practices employed.

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