A STUDY OF THREE IMPORTANT PASTURE MIXTURES IN THE QUEENSLAND SUBTROPICS

PROGRESS REPORT, 1955–1958.

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SUMMARY.

The first four years' results of a grazing trial of three pasture mixtures are presented. The mixtures were Rhodes grass, green panic and Gayndah strain buffel grass, each sown with Hunter River lucerne and phasey bean.

All mixtures carried beef cattle at a heavy rate through a severe drought, and during seasons of good rainfall uninterrupted liveweight increases through the winter occurred. Animal weight gains on the Rhodes grass-legume mixture were inferior to those on the other mixtures.

The liveweight increases per acre on sown pastures were more than three times as great as those on native pasture grazed continuously at the rate normal for the district, which was half the stocking intensity of the sown pastures.

The buffel grass-legume pasture produced the highest yields of dry matter and of crude protein. Consistent differences occurred in the crude protein status of the grass components in each mixture, the order being green panic, buffel grass and Rhodes grass.

The value of Hunter River lucerne in all mixtures was demonstrated and its ability to persist under rotational grazing confirmed.

Seasonal pasture productivity trends and liveweight changes are discussed. Of the pasture indices considered, the legume crude protein yield bore the closest relationship to liveweight changes.

I. INTRODUCTION.

Rhodes grass (*Chloris gayana*), green panic (*Panicum maximum* var. *trichoglume*) and Gayndah strain buffel grass (*Cenchrus ciliaris*) are widely used sown pasture species in subtropical Queensland. Extensive monospecific sowings of all three grasses have been made in country which originally carried a canopy of closed softwood or brigalow (*Acacia harpophylla*) scrub associations. Buffel grass has also been sown extensively in the cleared gidyea (*A. cambagei*) scrubs of central-western Queensland. Relatively small areas have been developed in the extensively ringbarked eucalypt forest country, which is still largely under native pasture. Little information exists on the relative merits of the three species when sown in association with legumes on a prepared seedbed on the one soil type.

Marked seasonal fluctuations in the protein status of grasses occur throughout the Queensland subtropics. When soil moisture is not a limiting factor, the yield and the protein content of the pasture grasses during the spring, summer and autumn are sufficient for weight gains in beef cattle. Frosts cause a cessation of pasture growth and result in a general decline of protein to a level barely adequate for maintenance. In years of low rainfall, the bulk of pasture available to stock may also be insufficient. However, a period of low protein levels which is independent of rainfall generally exists during at least the three winter months.

Christian and Shaw (1952) showed the benefits derived by two experimental Rhodes grass pastures from the association of lucerne, but the persistence of this legume in a grazed pasture on eucalypt forest soils in the Burnett region had not been demonstrated. The subtropical phasey bean (*Phaseolus lathyroides*) had also given promise as a pasture legume in south-eastern Queensland, but its value as a component of pasture was unknown.

A grazing trial of grass-legume mixtures was laid down on "Brian Pastures" Pasture Research Station, Gayndah, which is owned by the Australian Meat Board and operated by the Department of Agriculture and Stock. The object of the trial was to compare the productivity of three grass-legume mixtures. The grasses used were commercial Rhodes grass, commercial green panic and Gayndah strain buffel grass, and each was sown with lucerne and phasey bean. The assessment was made in terms of liveweight gains of beef cattle and of pasture growth, protein status and persistence.

II. EXPERIMENTAL PROCEDURE

(1) Design.

The three treatments were sown with commercial seed at the following rates.—Rhodes grass 6 lb. per acre; commercial green panic and Gayndah strain buffel grass, each 5 lb. per acre; Hunter River lucerne 1 lb. per acre; and phasey bean 0.5 lb. per acre.

R.	B.	G. P.	B.	G. P.	R.
G. P.	B.	R.	G. P.	R.	B.
			R.	G. P.	B.

G. P.—Green panic treatment

R.—Rhodes grass treatment

B.—Buffel grass treatment

Fig. 1.

Diagram of Design.

A split plot design was employed. Five sub-plots, each of four acres, were sown to each treatment, the sub-plots being arranged at random in five blocks each containing three sub-plots (Fig. 1). All blocks were grazed rotationally on the basis of 2 weeks' grazing and 8 weeks' spell.

The trial was established on heavy-textured, basalt-derived, brown clay soils of good fertility carrying native pasture, the predominant species being bunch spear grass (*Heteropogon contortus*), forest blue grass (*Bothriochloa intermedia*) and other blue grasses (*Dichanthium* spp.).

(2) Establishment of the Pasture.

All plots were sown in January–February 1954, on land which had been prepared by ploughing and harrowing. Initial establishment was best in the Rhodes grass treatment. Two sub-plots of both buffel grass and green panic which failed to establish satisfactorily were resown in January 1956.

(3) Management.

Experimental grazing commenced in January 1955 with five 2-year-old steers of 600 lb. liveweight per treatment. From September 1956, eight weaner steers per treatment were employed. All cattle were matched into approximately equal groups by a random selection based on previous liveweights.

Up to the end of 1958 six groups had been depastured on the trial, as listed in Table 1.

Table 1.

STOCKING SEQUENCES.

Group.	Date of Commencement of Grazing.	Duration of Trial. (Weeks.)	Description.
1.	Jan. 7, 1955	54	5 2-year-old Hereford steers, initial average liveweight 605 lb., per treatment of 20 acres
2.	Jan. 20, 1956	18	5 forward store Hereford steers aged 34 months, initial average liveweight 903 lb., per treatment of 20 acres
3.	May 11, 1956	20	5 forward store Hereford steers aged 30 months, initial average liveweight 888 lb., per treatment of 20 acres
4.	Sept. 14, 1956	64	8 weaner Hereford steers aged 9–10 months, initial average liveweight 421 lb., per treatment of 20 acres
5.	Nov. 22, 1957	40	8 weaner Hereford steers aged 12 months, initial average liveweight 363 lb., per treatment of 20 acres
6.	Aug. 15, 1958	..	8 weaner Hereford steers aged 9 months, initial average liveweight 411 lb., per treatment of 20 acres

At the commencement of the trial with Group 1, a shortened rotation of 2 weeks' grazing, 4 weeks' spell, using only three blocks, was adopted, as two blocks were not considered ready for grazing. This shortened cycle was again used in January–March 1956, when two blocks were withdrawn from grazing and the buffel grass and green panic sub-plots oversown.

From mid-December 1956 to mid-February 1957, all blocks were mown to remove a large bulk of dead material accumulated from the previous season's growth. Hay of low quality was conserved from mowings which were made immediately after stock had been removed from each block. This hay was fed back to appropriate sub-groups at 12 lb. per head per day for five months of the 1957 drought.

(4) Records.

(a) Pasture Yields.

Forty 5 link x 5 link quadrats were cut at ground level in each sub-plot immediately prior to grazing. The pasture components were separated into sown grass, lucerne, phasey bean, and other species, dried and weighed. Yields of forage, percentage moisture and crude protein were determined from the sub-samples.

From July 1956 the sampling intensity was reduced to 30 quadrats per sub-plot, but an additional sampling was made immediately after grazing to provide estimates of consumption during the grazing period and the growth in excess of deterioration of the various species during the protected phase.

(b) Cattle Weights.

Cattle weights were recorded fortnightly following 16 hours' fasting immediately before each grazing period. A group of steers of similar age and of comparable weight were depastured in the Station bullock paddock adjacent to the trial area. These cattle were weighed monthly with other Station cattle, and indicated the growth pattern to be expected of steers of similar age on native pasture under normal Station management (continuous grazing and annual burning).

III. SEASONAL CONDITIONS.

The climate is subtropical, with a mean annual rainfall of 30 in. of predominantly summer incidence. Some 9 in. are recorded in the six winter months. Daily maximum temperatures greater than 95 deg. F. occur quite frequently. The mean January and July temperatures are 78·0 and 56·5 deg. F. respectively.

The main growing period of the sown grasses is usually January–March, but when soil moisture is adequate good growth occurs from October and may continue till early May if temperatures permit. Light frosts can occur from mid-April. Heavy frosts are experienced in late June–July with grass recordings as low as 20 deg. F., resulting in cessation of growth and frosting of the summer-growing grasses.

Abnormal fluctuations in rainfall have occurred since the commencement of the trial, as shown in Table 2.

Table 2.

MONTHLY RAINFALL (INCHES) AT "BRIAN PASTURES" FROM JANUARY 1954 TO AUGUST 1958, AND MEAN VALUES FOR GAYNDAH, 1870–1956.

Month.	"Brian Pastures."					Gayndah. Mean, 1870–1956.
	1954.	1955.	1956.	1957.	1958.	
January	Nil	·75	3·14	1·18	3·36	4·70
February	9·51	3·43	8·29	·31	8·15	4·20
March	·37	9·65	10·15	·46	2·78	3·10
April	·40	4·17	1·57	·05	1·39	1·46
May	·25	4·56	2·42	·00	·11	1·55
June	·70	·50	2·35	·73	5·99	1·82
July	9·21	1·84	2·14	1·96	·17	1·47
August	2·22	·12	·33	1·04	1·57	1·12
September	1·56	2·43	·23	·00	1·51	1·47
October	2·30	2·11	2·50	·89	—	2·37
November	4·21	1·26	1·77	1·37	—	2·97
December	1·33	5·29	9·93	1·17	—	4·21
Total	32·06	36·06	44·85	9·16		30·44

IV. RESULTS.

(1) Pasture Yields.

(a) Total Dry Matter.

Marked seasonal changes in the amount of available forage present before grazing occurred in all treatments, as shown in Fig. 2. These curves were calculated from the moving means of five successive samplings. The actual growth of the pasture was even more seasonal, and for five months from early May in 1955 production during the 8-weeks' protected phase failed to satisfy the appetites of the stock which were dependent for at least a portion of their diet on standing feed produced during the previous summer–autumn.

For the first 14 months the Rhodes grass mixture produced more total dry matter than the other treatments, but by the end of the second summer the green panic and buffel grass mixtures were both outyielding the Rhodes grass mixture. The deterioration of Rhodes grass during the winter and spring of the second year was slower than that of the other grasses and Rhodes grass yielded more forage, but this was of very low quality.

Peak yields of fodder available before grazing occurred in the autumn of the second year, when 3,200, 3,400 and 4,000 lb. dry matter per acre were present in the green panic, Rhodes grass and buffel grass plots respectively.

Mowing drastically reduced available forage during February–May 1957, and steers grazing Rhodes grass had a slight advantage in total feed. With no effective rainfall in this period a steady decline in pasture yields occurred into midwinter, and the low quality hay from the December–February cut was fed back during this period, adding to the bulk consumed but making little contribution to the digestible protein intake.

Two inches of rain in July and a further inch in August produced a rapid though short-lived response in both green panic and buffel grass; Rhodes grass remained quiescent. At the end of the drought, samplings at ground level showed the total amount of forage available to be of the order of 80–120 lb. dry matter per acre present before grazing.

The recovery of buffel grass and green panic from drought was excellent. Three weeks after rain fell in mid-January 1958 these species had produced fresh growth in excess of appetite requirements. This effect is illustrated in Fig. 2. Rhodes grass had a high degree of mortality, and the few surviving crowns made poor regrowth. Data to illustrate this response are presented in Table 3.

Table 3.

GROWTH RATE OF GRASS COMPONENTS.

Expressed as Pounds of Air-dry Matter per Acre.

8-weeks Period Ending.	Rhodes Grass.			Green Panic.			Buffel Grass.		
	Sub-plot.	Growth per Day.	Available Feed.	Sub-plot.	Growth per Day.	Available Feed.	Sub-plot.	Growth per Day.	Available Feed.
3–1–58 ..	11	3·5	351	10	—0·6	26	12	3·2	373
17–1–58 ..	13	—0·8	332	14	—0·02	21	15	1·4	239
31–1–58 ..	1	—0·02	194	3	—2·5	189	2	4·7	474
14–2–58 ..	6	—2·8	2	5	8·8	561	4	16·4	1,059
28–2–58 ..	9	—0·8	46	7	8·9	504	8	16·7	981
14–3–58* ..	11	3·1	374	10	9·3	532	12	25·9	1,540
14–3–58* ..	13	3·9	301	14	9·9	417	15	20·1	1,157
28–3–58 ..	1	0·8	67	3	24·7	1,154	2	39·4	2,116
11–4–58 ..	6	2·8	132	5	41·9	2,157	4	46·1	2,691
25–4–58 ..	9	3·4	215	7	11·2	1,016	8	31·3	2,341

* One block mown for hay.

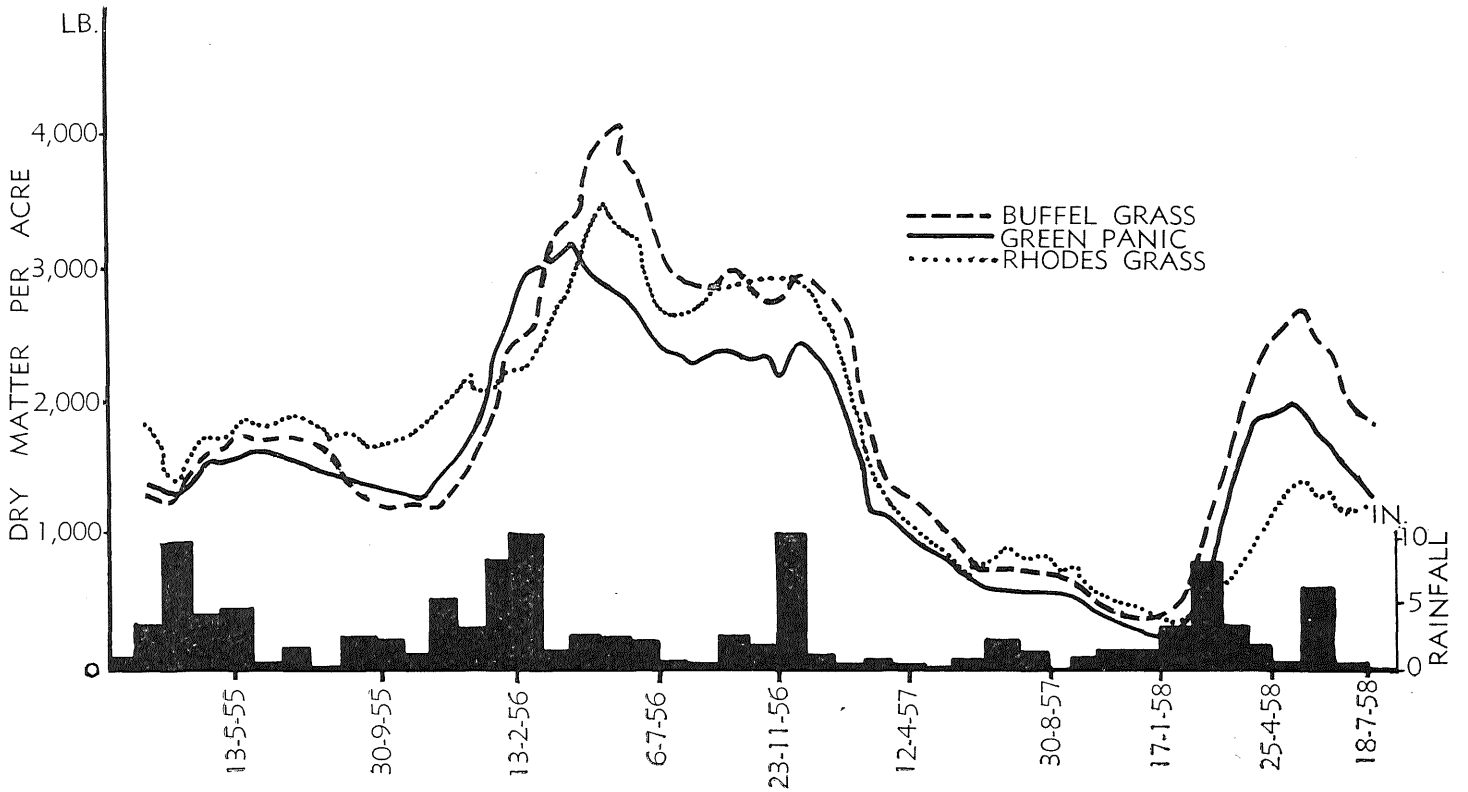

Fig. 2.

Total Dry Matter Yield of Pasture Mixtures at Sampling Before Grazing. Rainfall records are given in histogram form.

(b) Lucerne.

The effect of initial competition from Rhodes grass on the density of lucerne was evident until the spring of 1957. Lucerne yields increased under rotational grazing to a peak in the late spring of 1956 of the order of buffel grass 450, green panic 380 and Rhodes grass 220 lb. dry matter per acre present before grazing (Fig. 3). In years of adequate rainfall, lucerne made most rapid growth during September–October, the lucerne : grass ratio always increasing at this time. The 8-weeks' protected phase permitted seasonal seeding, and natural regeneration occurred.

In 1957 a prolific lucerne germination occurred in August–September during the drought following late winter rain. A greater amount of surface trash in all Rhodes grass plots, coupled with much stronger competition from the grasses in the other two treatments, resulted in marked differences in lucerne seedling survival. Many seedlings in the Rhodes grass plots survived, while the majority in the other two treatments succumbed. With an accompanying general decline of the older established lucerne in both buffel grass and green panic as the drought progressed, the greatest lucerne yields in 1958 were recorded in the Rhodes grass treatment.

While an overall decline in yield was recorded, the performance of lucerne throughout the driest year on record was outstanding. All forage produced was consumed to ground level at each grazing period, the small regrowth produced during each spell being eagerly sought by stock. Valuable though short-lived responses occurred to rains falling during the drought period. The surviving crowns responded vigorously after drought-breaking rain but the regrowth was almost defoliated by jassids, black spot, anthracnose and stem and leaf rusts. However, subsequent winter and spring growth was good, and yields varied from 70 to 100 lb. dry matter per acre in the spring of 1958. With a basal cover of 0·5 per cent., lucerne yielded sufficiently well to provide for the total appetite requirements of all stock for the grazing periods occurring during the flush spring growth periods. In spite of this, no symptoms of bloat were recorded.

(c) Phasey Bean.

Establishment of this legume was satisfactory and density increased to provide yields in excess of 4 cwt. dry matter per acre in the autumn of the second year (1956). Stock deferred grazing until after seed had been set, young plants seeming less palatable. In the first two years the plant provided high-protein fodder in late autumn, but regeneration during December 1956 was poor in spite of good soil moisture. Phasey bean provided negligible winter grazing in all years, being almost completely defoliated by frost.

(d) Intrusion of Native Species.

The greater proportion of native species, principally *Dichanthium* spp., present in the green panic and buffel grass treatments was largely due to the poorer initial establishment and the tussocky habit of these sown species.

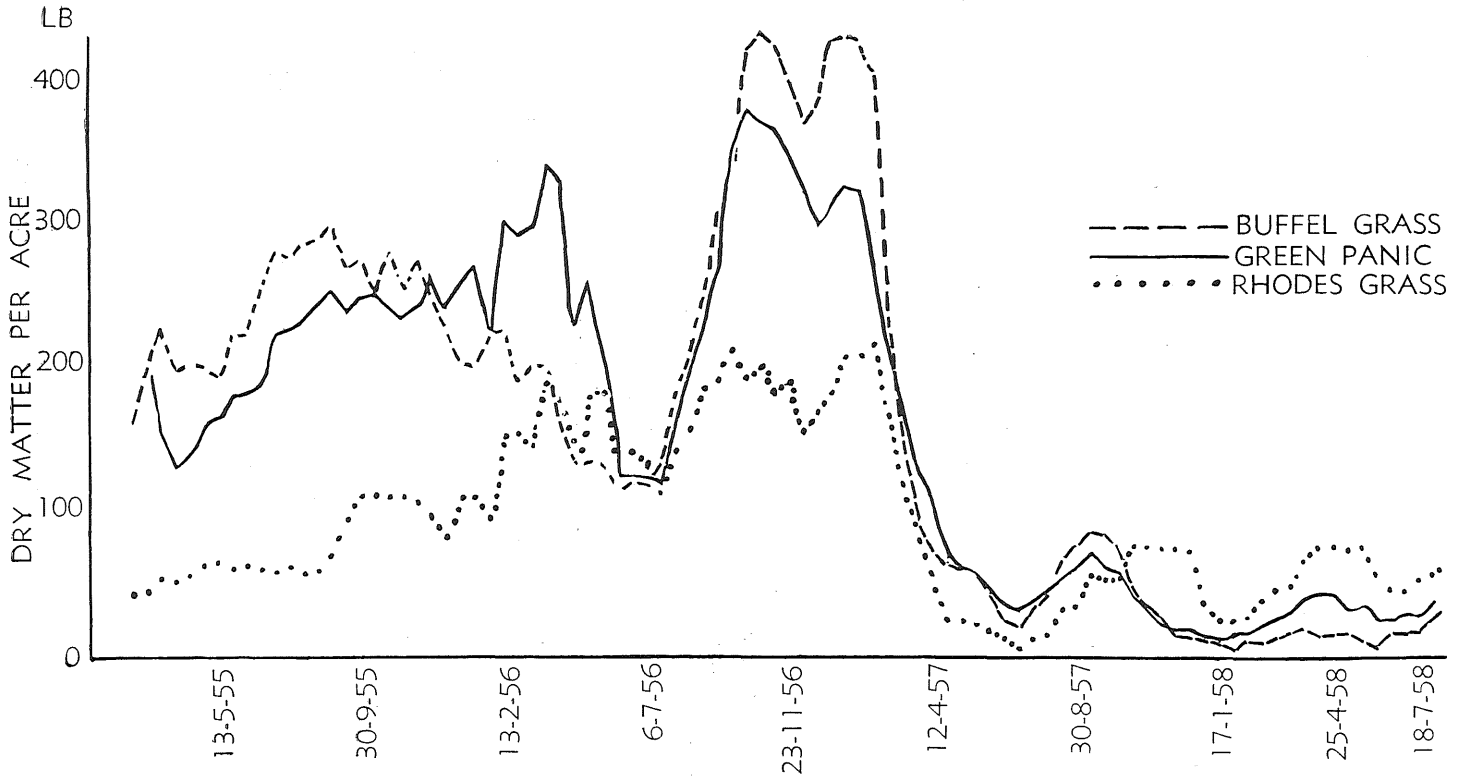

Fig. 3.

Dry Matter Yield of Lucerne in Pasture Mixtures. Moving means are plotted.

To measure the effect of the severe drought of 1957 on persistence, botanical surveys were conducted to estimate percentage basal cover. The point quadrat method was employed and surveys were conducted during January 1958, when all plots were under peak drought stress, and in September 1958, some eight months after the drought had broken.

Total basal cover declined from 8·8 to 4·9, 8·2 to 6·8 and 6·6 to 6·2 per cent. in the Rhodes grass, buffel grass, and green panic treatments respectively. All sown grasses declined in basal cover, Rhodes grass the most severely. The following changes in basal cover of the grasses were recorded:— Rhodes grass from 6·5 to 1·4 per cent., buffel grass from 5·3 to 3·7 per cent., and green panic from 3·3 to 2·6 per cent. Some increases were registered in native species but much of this increment was due to ephemeral herbage, such as *Coronopus didymus, Plantago varia* and *Calotis cuneata.* Native species of *Dichanthium* declined slightly in cover over the period, and their regrowth following drought-breaking rains was inferior to that of the sown species.

(2) Protein Content.

Seasonal changes in the crude protein content of the pasture available before grazing are shown in Fig. 4. The percentage of protein was closely related to the lucerne contribution, which reached spring peaks of 70–80 lb. crude protein per acre in the green panic and buffel grass mixtures and 40 lb. crude protein per acre in the Rhodes grass mixture. Consistent differences occurred in the crude protein content of the grass components, green panic being superior to buffel grass, which was superior to Rhodes grass. The lower yield of lucerne in the Rhodes grass plots further reduced the crude protein content of the mixture until the break of the drought, when the rise in the lucerne-grass balance increased pasture quality in this treatment.

The total crude protein yield per acre (Fig. 5), being a function of percentage crude protein and total dry matter, showed seasonal fluctuations. The Rhodes grass mixture, with consistently less protein from the grass component, though initially considerably outyielding the other two treatments in total dry matter had less crude protein per acre available. The buffel grass mixture produced the greatest crude protein yield, this being a reflection of its greater bulk, and the percentage crude protein of the mixed pasture was initially superior to that of the green panic mixture. However, the protein status of the green panic mixture was slightly superior after the autumn of 1956, in spite of higher lucerne yields in the buffel mixture.

(3) Animal Liveweight Changes.

Animal growth curves for the good rainfall year of 1955 and the drought year of 1956–57 are presented in Figs. 6 and 7. These curves are drawn from fitted values derived from fifth degree polynomials. Growth curves for the periods 20-1-56–11-5-56 and 11-5-56–14-9-56 are presented in Figs. 8 and 9 respectively. Being of short duration, both these curves are plotted as actual values.

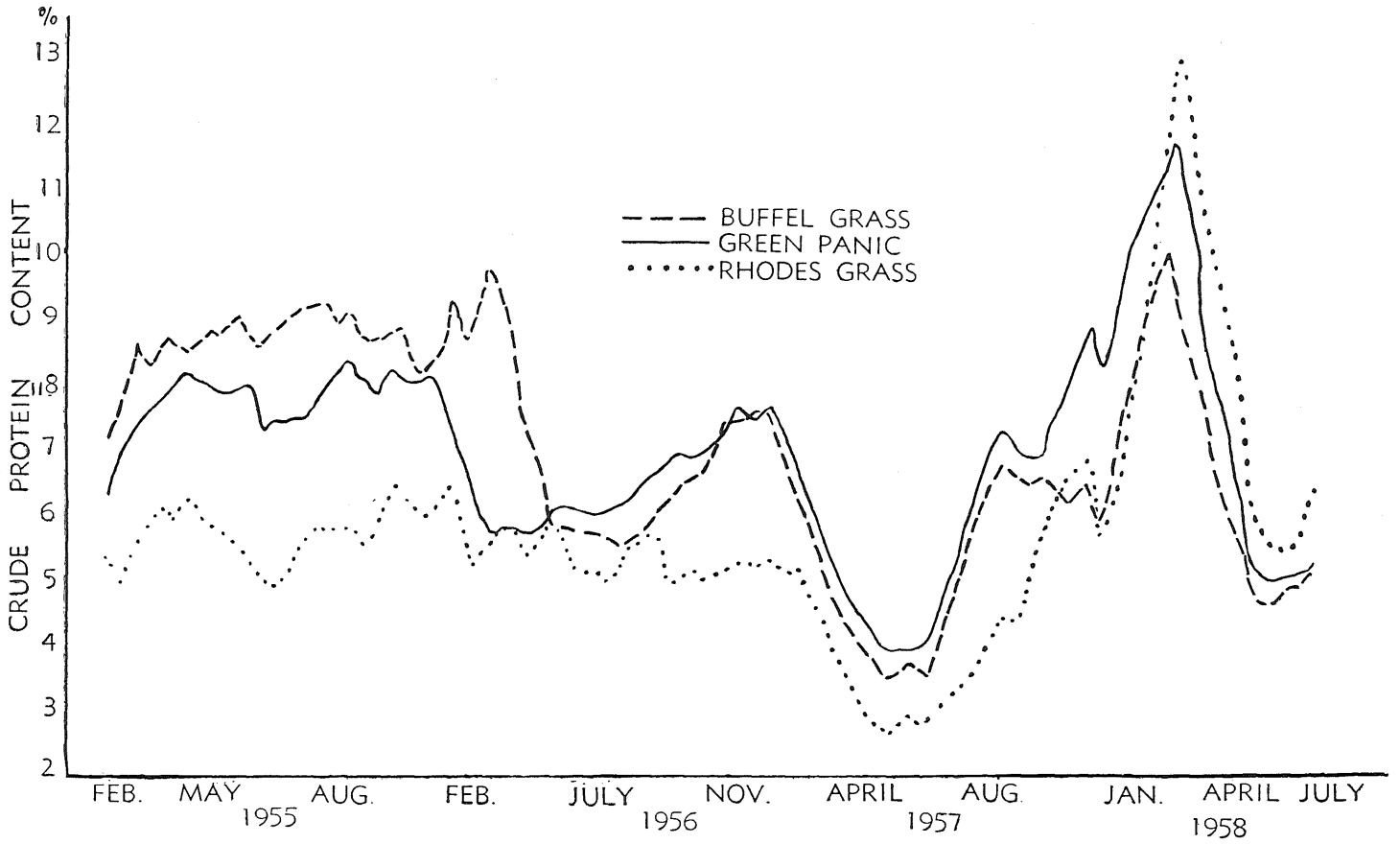

Fig. 4.

Seasonal Changes in Percentage Crude Protein Content of Pasture Mixtures

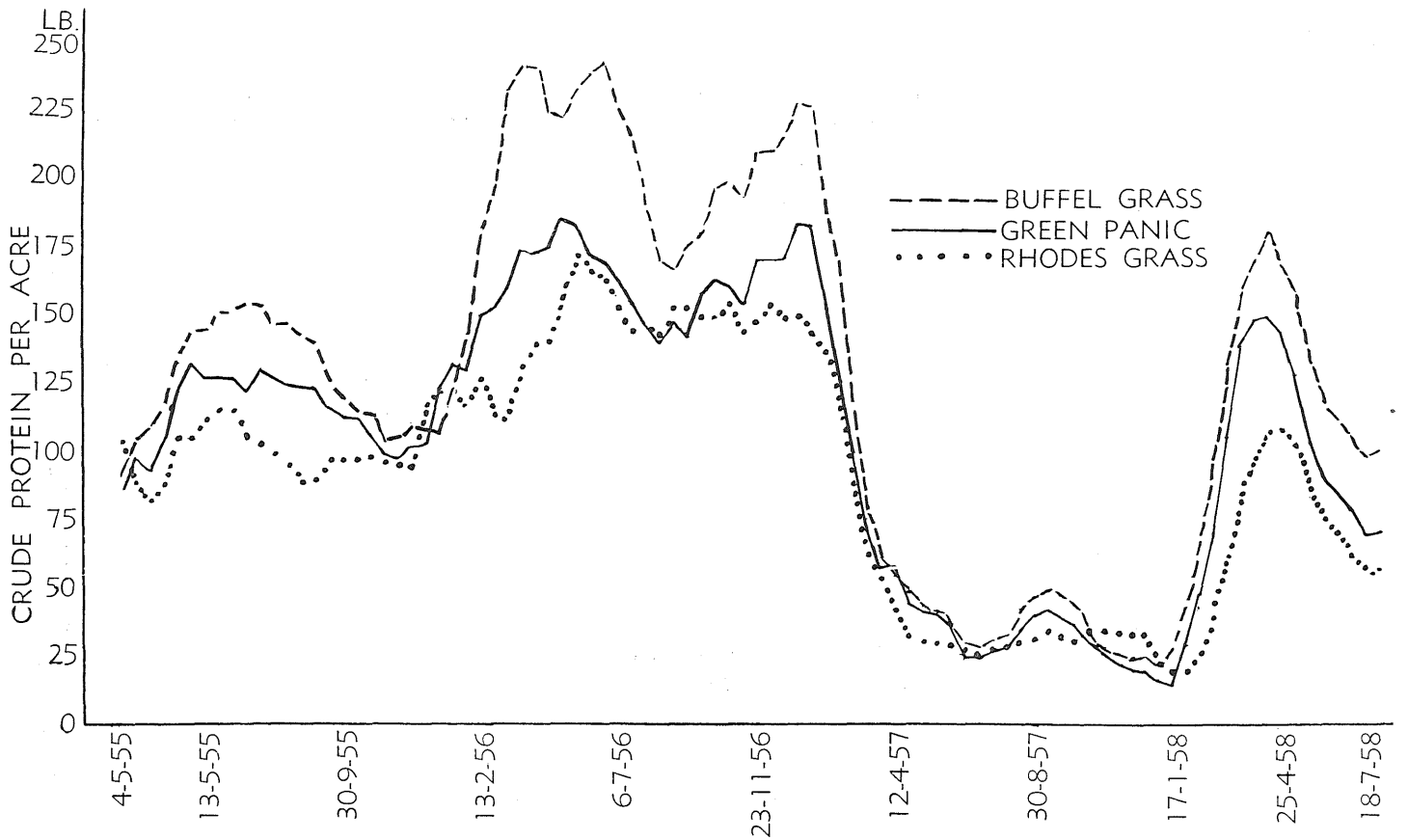

Fig. 5.

Crude Protein Yield of Pasture Mixtures. Moving means are plotted.

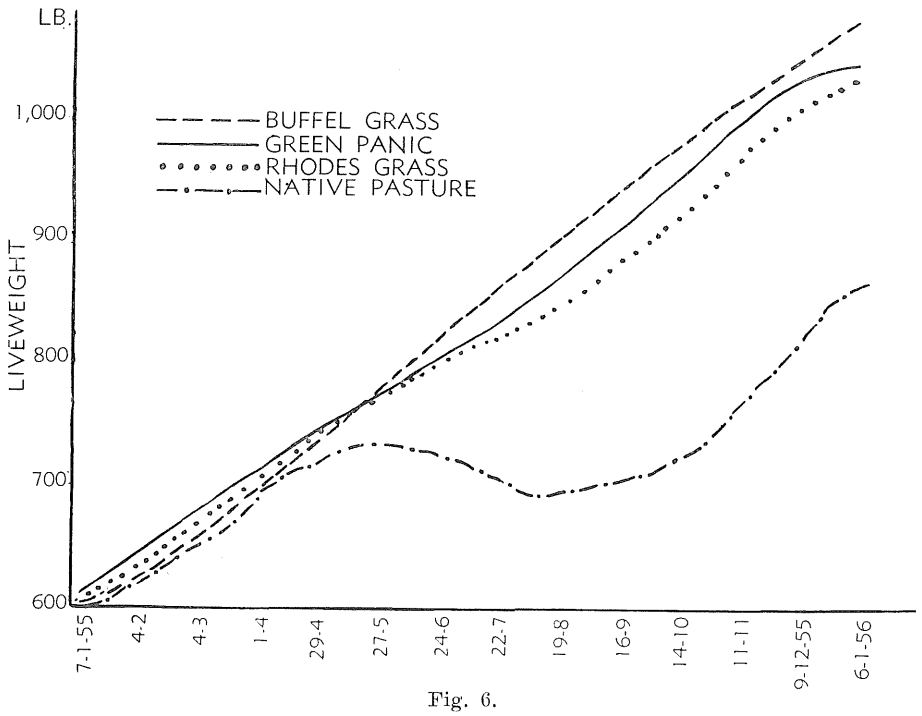

Fig. 6.

Liveweight Changes During 1955, A Year of Good Rainfall.

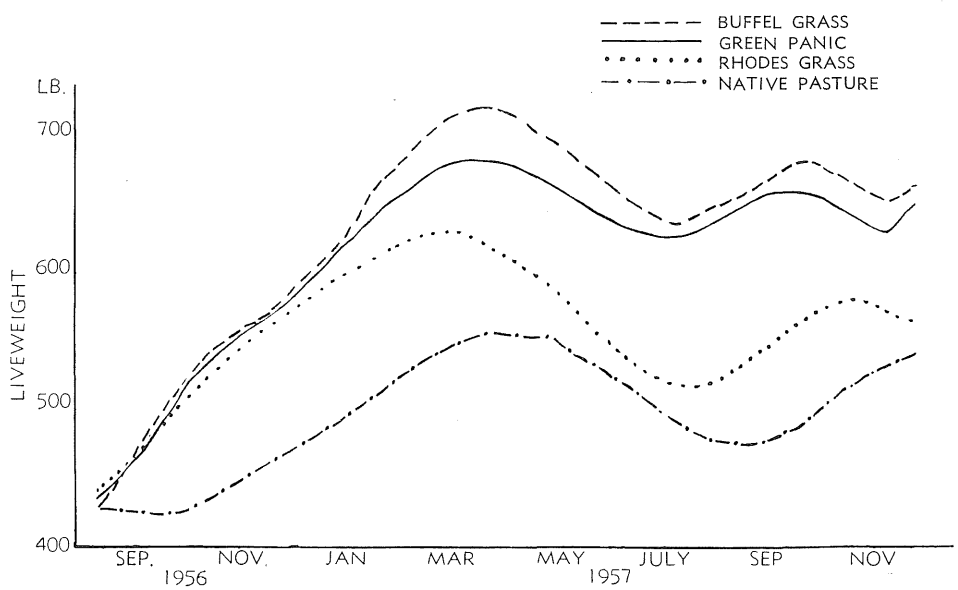

Fig. 7.

Liveweight Changes from Sept. 14, 1956 to Nov. 22, 1957, a Period of Low Rainfall.

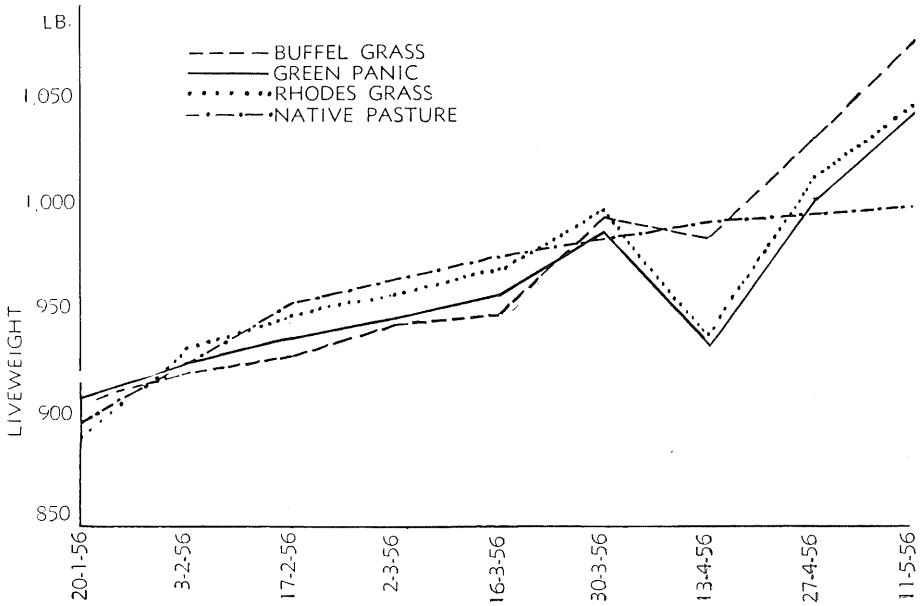

Fig. 8.

Liveweight Changes in the Summer-Autumn of 1956 and 1957.

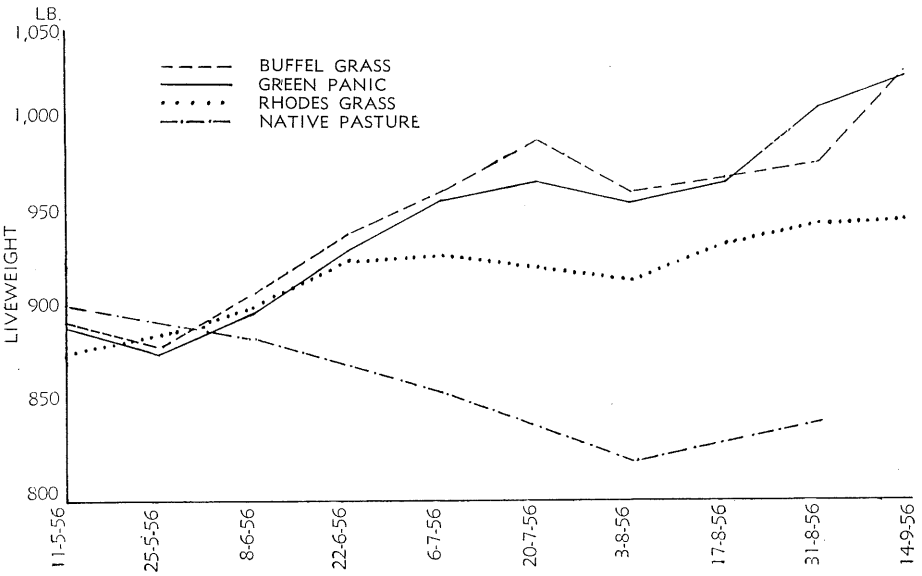

Fig. 9.

Liveweight Changes in the Winter of 1956.

The liveweight data from the first six groups of animals are summarised in Table 4.

Table 4.

WEIGHT CHANGES FOR FIVE GROUPS TURNED OFF THE TRIAL.

Expressed as Pounds Liveweight per Acre.

Group.	Period.	Rhodes Grass Mixture.	Green Panic Mixture.	Buffel Grass Mixture.	Native Pasture.
1.	7–1–55 to 20–1–56	112	116	122	36·5
2.	20–1–56 to 11–5–56	40	34	43	13
3.	11–5–56 to 14–9–56	23	33	34	—7·7
4.	14–9–56 to 22–11–57	51	93	83	25
5.	22–11–57 to 15–8–58	50	65	74	41
	Total..	276	341	356	108

The first groups of 15 steers turned off the trial had an average liveweight of 1,077 lb. at 34 months of age. These cattle dressed with a mean of 58·4 per cent. and graded 8 baby beef and 7 first grade.

One group of forward stores (Group 3) was finished over the period May–September 1956, gaining an average of 120 lb. liveweight during a period when stock on native pasture were losing weight.

From the time of commencement (September 1956), weaner steers made uninterrupted weight gains approximating 1·4 lb. per day during the spring. Rain in December (Fig. 2) enabled this trend to be maintained until April 1957, by which time drought was markedly reducing pasture yield and quality. From this period a general weight loss was recorded until late November, when the next group of weaner steers was depastured. However, all groups recorded a short period of weight gain during the drought, this being a direct reflection of the pasture reaction to July–August rains when both buffel grass and green panic made short growth responses. Early spring growth of lucerne in the Rhodes grass plots provided sufficient high quality forage to enable a slight weight recovery of the steers in this treatment. While these stock were in poor store condition at the time of change, it was possible to maintain the increased stocking rate for the duration of the drought without stock dying.

Cattle responded quickly after drought-breaking rains. Little scouring occurred while they were grazing the lush growth, and weight gains of approximately 2·1 lb. per day were recorded for the first six weeks after rain.

Despite the increased stocking rate, no difficulties with ectoparasites or endoparasites were experienced. Cattle generally carried a low tick burden; this may be a reflection of the rotational management.

In the second half of the period under review the liveweight gain from the Rhodes grass mixture was markedly inferior.

The liveweight changes over the whole period were examined in relation to pasture data, which included changes in the available total dry matter, lucerne dry matter, total protein, lucerne protein, legume protein, percentage crude protein of the pasture, percentage crude protein of grass, and the ratios legume dry matter: total dry matter and lucerne dry matter: total dry matter. Legume crude protein yield bore the closest relationship to liveweight changes.

VI. DISCUSSION.

Despite the inferior overall performance of Rhodes grass, its ease of establishment and early vigour merit attention. Initial establishment of green panic and buffel grass seems critical. Where establishment in the initial year was poor they have not demonstrated ability to colonise fresh areas by successful competition with native grasses. However, both green panic and buffel grass have persisted well, and where early establishment was satisfactory native species have not intruded to any extent.

Rhodes grass seems more frost-tolerant and its autumn growth is superior, but neither the protein yield nor the liveweight gains reflected this. Green panic responded rapidly to rain following moisture stress and to brief warm periods during winter. Its early spring growth was good and surpassed that of buffel grass and Rhodes grass. Buffel grass made its most rapid growth during the hot months of midsummer. The slightly different growth rhythm of green panic and buffel grass suggests that the establishment of separate areas of these two species might be advantageous.

However, the critical factor in animal production was lucerne yield. The wider use of this legume is strongly advocated. Its adaptability to a wide range of climatic and soil conditions is proven and its contribution in increasing the quality of forage has been demonstrated widely. With rotational grazing it has persisted well. Although some decline in lucerne density occurred in the buffel grass and green panic pastures, this followed fairly heavy stocking throughout a bad drought. Observations in 1955 and 1956 showed that seedling regeneration could be expected in years of good rainfall. Sufficient plants were present in the spring of 1958 and further regeneration from seed set in 1958 can be expected. In any event, oversowing is practicable and inexpensive. Lucerne will persist in any of these pastures if some scheme of deferred grazing similar to that reported is practised.

The sown pastures increased productivity, gave good weight gains with young animals, and could ameliorate the seasonal nature of beef turn-off. The question of their best utilisation is important. As stock make adequate live-weight increases on native pasture for five to six months of the year, sown pastures may be better reserved for bridging the nutritional gap of winter and early spring, although this programme may have to be allied with summer conservation.

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REFERENCE.

CHRISTIAN, C. S., and SHAW, N. H. 1952. A study of two strains of Rhodes grass (*Chloris gayana* Kunth.) and of lucerne (*Medicago sativa* L.) as components of a mixed pasture at Lawes in south-east Queensland. Aust. J. Agric. Res. 3: 277-299.

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