To minimise establishment failure due to temperature restrictions on growth, leucaena should not be sown in south-east Queensland until mean daily minimum air temperatures are likely to remain above about 15°C. October is the earliest month when this is likely to occur at Gayndah, and meterological records (Anon. 1975) show that a similar planting time may be used at Childers, Gympie and Ipswich. At cooler localities such at Gatton, Kingaroy and Monto, plantings should be delayed until November.

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ANIMAL PRODUCTION IN CENTRAL QUEENSLAND FROM THE AUTUMN-WINTER FORAGE CROPS: LABLAB, MOLOPO BUFFEL GRASS AND ZULU SORGHUM

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ABSTRACT

The liveweight gain of cattle grazing grass pastures in central Queensland declines in autumn as the quality of the pasture deteriorates. The value of autumn grazed forage crops Lablab purpureus *cvv. Highworth and Rongai, and hybrid forage sorghum Zulu (*Sorghum bicolor x S. sudanense*) in improving cattle weights was assessed in two experiments conducted near Theodore in central Queensland. The effect of combining varying proportions of buffel grass (*Cenchrus ciliaris *cv. Molopo) and Highworth areas for grazing was also compared.*

In two out of three years (1973–75), steers grazing lablab at 1.7 steers ha^{-1} gained 50–60 kg liveweight during 86 days grazing (March–June). When buffel pasture was combined with Highworth lablab areas in varying proportions, liveweight gains were directly related to the amount of Highworth available in the Highworth/buffel grass pasture but no significant increase resulted when Highworth exceeded 67%.

In the second experiment, comparing whole cropped areas of Highworth or Zulu, both crops averaged 574 g head^{-1} day^{-1} liveweight gain over 102 days.

Both lablab and Zulu forage sorghum provide valuable autumn forage. Lablab being a leguminous crop, has the added potential of contributing to soil nitrogen fertility.

INTRODUCTION

Beef cattle grazing improved pasture over summer in central Queensland's brigalow country make rapid liveweight gains up until early autumn, March–April (Round 1966). As the quality of the pasture deteriorates through autumn, liveweight gains decline. In southern brigalow areas, steers grazing a late planted forage sorghum crop during autumn-winter can be fattened to a marketable weight 6 to 10 months earlier than those on grass alone (Howard 1961). Alexander (1962) and Arbuckle (1962) also reported valuable liveweight gains for cattle grazing either summer or winter crops.

The leguminous crop lablab (*Lablab purpureus*) has shown potential as a grazing forage (Luck 1965; Anon. 1979; Hendricksen and Minson 1985a). It is a short lived perennial and has outyielded other leguminous crops such as cowpea (*Vigna sinensis*) (Macadam and Swain 1959) and velvet bean (*Stizolobium deeringianum*) (Murtagh and Dougherty 1968). Two cultivars are available in Australia, viz. Rongai (Wilson and Murtagh 1962) and an earlier flowering type, Highworth (Wildin 1974). Detailed studies on growth, animal production and animal grazing behaviour have been reported for Rongai lablab for non-brigalow areas (Hendricksen and Minson 1980, 1985b; Hendricksen and Myles 1980). A late planted forage sorghum crop is an alternative autumn-winter feed in central Queensland where oats production is unreliable because of the variable climate. No information is available for the brigalow region, on the relative grazing value of *L. purpureus* cvv. Highworth and Rongai, and Zulu sorghum as forage crops for fattening steers during autumn-winter.

The aim of the experiments reported herein was to compare animal liveweight gains from Highworth, with Rongai and with hybrid forage sorghum Zulu (*Sorghum bicolor x S. sudanense*) at Theodore in central Queensland. Highworth was grown alone and in varying proportions with buffel grass (*Cenchrus ciliaris* cv. Molopo). The provision of pasture in addition to the area of Highworth was a means of overcoming the problem of slow acceptance and poor initial weight gain which was observed by one author (J.H.W.) when stock first graze Highworth.

MATERIALS AND METHODS

The experiments were conducted at Brigalow Research Station, Theodore (24°50′S, 149°47′E) in central Queensland. Average annual rainfall is about 700 mm with 70% of this falling between November and April.

Experiment I

The trial site, an area of predominantly dark cracking clay soil (Ug 5.2) (Webb 1971) originally supported a brigalow (*Acacia harpophylla*)—wilga (*Geijera parviflora*)—sandalwood (*Eremophila mitchellii*) forest, and was cleared in June 1966. The area was cropped with *L. purpureus* before establishing the treatments.

In January 1972, Molopo buffel grass was planted by hand-broadcasting 2.2 kg of seed ha^{-1} behind a disc plough. *L. purpureus* cvv. Highworth and Rongai were planted at 28 kg seed ha^{-1} in 35 rows using a combine planter during the fourth week of January each year (1973–75). Grass establishment in treatments 1 and 4 was poor and on January 22, 1974 the Molopo area in paddock 4 was ploughed and resown to Zulu at 3.5 kg ha^{-1}. The Zulu was replanted again in January, 1975. Treatment 1 (Molopo only) was not available for grazing until the third year (1975) and treatment 4 was grazed in 1974 and 1975 only. Crop dry matter yields at the start of grazing were estimated from quadrats cut 8 to 10 weeks after planting. The yield of crop residue was measured at the completion of grazing in July 1975.

The following pasture/crop combinations were allocated at random without replication to 2.43 ha paddocks:

Treatment	Area (ha) planted to	
	Buffel	Lablab
1	2.43	0
2	2.03	0.40 (16%)* Highworth
3	1.62	0.81 (33%) Highworth
4	1.21 (Zulu)**	1.22 (50%) Highworth
5	0.81	1.62 (67%) Highworth
6	0.40	2.03 (84%) Highworth
7	0	2.43 (100%) Highworth
8	0	2.43 (100%) Rongai

* percentage of grazed areas planted to Lablab.
**buffel grass failed to establish and Zulu sown on January 22, 1974.

Four two-year-old Hereford steers (300–350 kg L.W. range) were allocated by stratified randomization, based on fasted liveweight, to each treatment paddock during March of each year (1973–75). The stocking rate was 1.7 steers ha^{-1}. Fasted (16 hours overnight) liveweights were recorded every 3–4 weeks until steers were dispatched for slaughter. Steers were slaughtered at peak liveweight in one year (1974), to mimic commercial practice.

Experiment II

The trial area of predominantly dark cracking clay (Ug 5.2) with loamy duplex soil (Dd 1.43) (Webb 1971) was planted on January 5–7, 1976 to four replicates of two treatments: (i) Highworth lablab sown at 27 kg seed ha^{-1} and (ii) Zulu forage sorghum at 3.5 kg seed ha^{-1}, arranged in a completely randomised layout.

Grazing at 1.7 steers ha^{-1} commenced on March 12, 1976 when seven two-year-old Hereford steers were allocated by stratified randomization, based on fasted liveweight, to each paddock. Fasted liveweights were recorded every three weeks during the grazing period. Crop dry matter yields were estimated prior to the commencement of grazing by cutting ten 1 m^2 quadrats at random in each paddock.

Statistical analysis

Analysis of variance was used to test the effects of treatments. Means were compared using the protected L.S.D. procedure at the 5% level of significance. The experimental unit in experiment I was the paddock × year cell and in experiment II, it was the paddock.

RESULTS

Seasonal conditions

Throughout the four years of these experiments summer rainfall was mostly above average but the autumn (March–May) rainfall was generally below average except in 1974 when a much above average rainfall of 77 mm fell in April. Mild temperatures were experienced during the winter of 1973 and 1975 but the remaining years were near average.

Experiment I

Forage yield

Forage yields measured at the commencement of grazing are presented in Table 1. Each year, the lablab crops produced between 1720 and 2200 kg dry matter (d.m.) ha^{-1} after eight weeks of growth. Molopo accumulated in excess of 3300 kg d.m. ha^{-1} in 1973 in all paddocks, except treatments 1 and 4 where establishment was poor, and in subsequent years always produced more feed than was eaten. Zulu sorghum yielded 5000 kg d.m. ha^{-1}.

TABLE 1

Experiment 1: Dry matter yields (kg ha^{-1}) of Molopo buffel, Zulu forage sorghum, Highworth and Rongai lablab at the start of autumn-winter grazing (1973–75) and at the finish of grazing (1975 only)

Treatment*		Harvest date and stage of crop growth			
		1973 Mar 16 8 weeks	1974 Apr 4 10 weeks	1975 Mar 25 9 weeks	1975 Jul 26 Residue
T2	Molopo buffel	4200	7400		
	16% Highworth	2200	1700	1326	115
T3	Molopo buffel	4800	6100		
	33% Highworth	2160	2500	2074	209
T4	Zulu sorghum	—	5230		
	50% Highworth	—	3200	2108	482
T5	Molopo buffel	3700	3900		
	67% Highworth	1830	1700	1684	221
T6	Molopo buffel	3300	5680		
	84% Highworth	1940	2150	1870	347
T7	100% Highworth	1820	1900	1984	338
T8	100% Rongai	1720	1800	1428	283

*Treatment 1 (Molopo only) was not available for grazing until 1975 when only the Highworth was sampled.

Animal production

Grazing commenced in the third or fourth week of March each year. Cattle liveweight gains were initially low then increased rapidly to reach maximum gains of 43, 58 and 51 kg head^{-1} at 82 to 86 days (Fig. 1) in 1973, 1974 and 1975 respectively. Liveweight gain was highest in 1974, averaging 620 g head^{-1} day^{-1} compared to 358 and 386 g head^{-1} day^{-1} in 1973 and 1975 (Table 2). During the period of positive weight gain, the average daily gain (ADG) over three years from Highworth (515 g head^{-1} day^{-1}) was similar to that from Rongai (579 g head^{-1} day^{-1}). Planting 84% of the area to lablab was as good as planting 100% Highworth or Rongai (Table 2). Planting less than 67% of the area to Highworth resulted in significantly ($P < 0.05$) lower liveweight gains averaged over three years.

TABLE 2

Experiment I: Comparison of steer liveweight gains from Molopo buffel alone, Molopo buffel with varying proportions of Highworth, and Rongai lablab alone

Grazing Interval (d = days)	Treatment Proportion (%)							Year Means
	Molopo 100	Highworth 16	Highworth 33	Highworth 67	Highworth 84	Highworth 100	Rongai 100	
	Average daily gain (g head^{-1} day^{-1})							
1973 Mar 16–Jun 6 (82 d)	—	91	280	442	527	381	427	358b*
1974 Mar 29–Jun 19 (82 d)	—	457	543	628	683	707	704	620a
1975 Mar 23–Jun 19 (86 d)	91	286	242	255	468	457	605	386b
Treatment Means		278c	355b	442ab	559a	515a	579a	

*Year means or treatment means not followed by a common letter are significantly different (LSD ($P = 0.05$) = 102 or 145 for year or treatment means respectively).

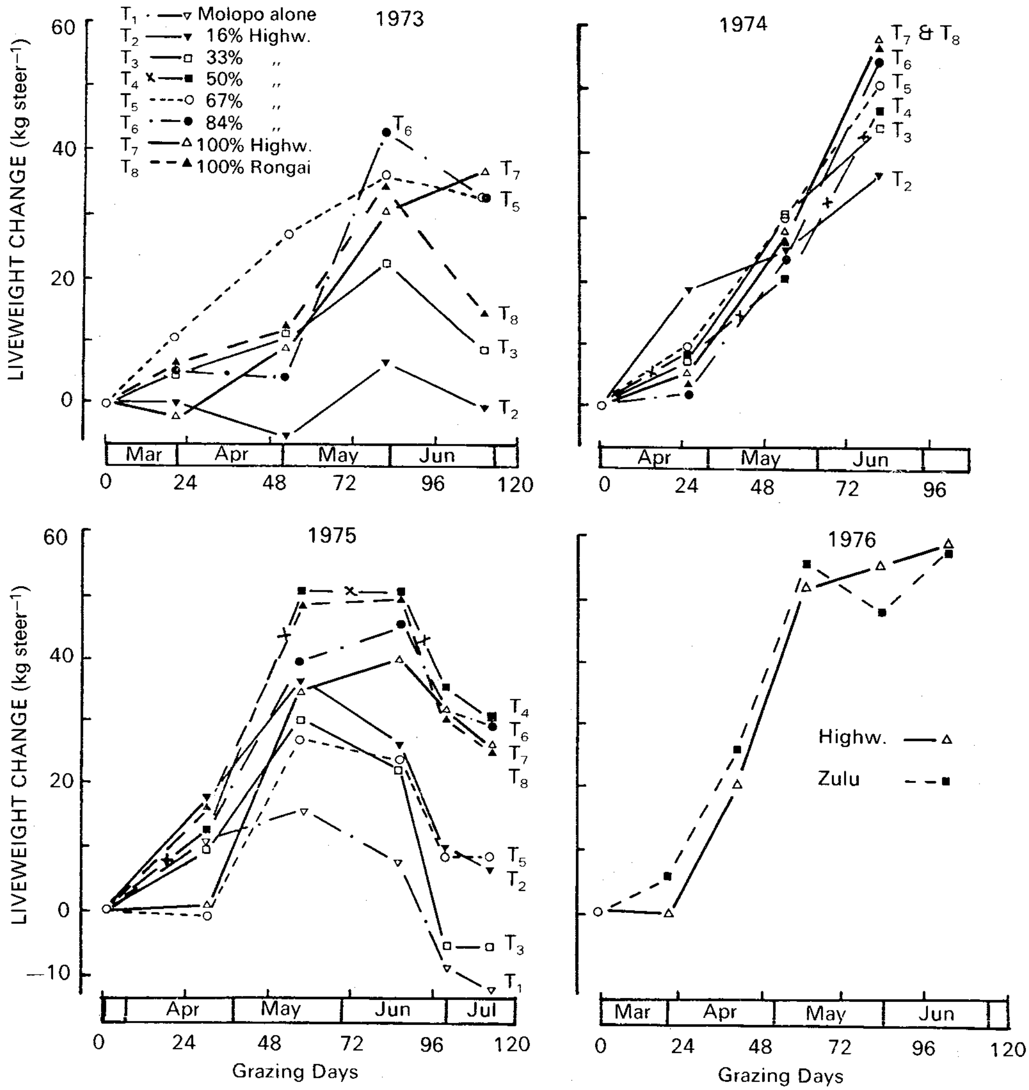

FIGURE 1

The mean liveweight change (kg head^{-1}) of steers grazing Molopo buffel alone and with varying proportions of Highworth, Rongai lablab, and Zulu forage sorghum in 1973, 1974 and 1975 (Experiment I); and Highworth and Zulu forage sorghum crops during 1976 (Experiment II).

The relationship between ADG of steers (y) (Table 2) and the proportion (%) of land planted to Highworth (x) was defined for each year by the following linear regression equations:

1973, $y = 106 + 4.0x$; $r^2 = 0.83$

1974, $y = 428 + 2.9x$; $r^2 = 0.99$

1975, $y = 192 + 2.5x$; $r^2 = 0.78$

The slopes of these equations were not significantly different ($P > 0.05$), so the three year's data were used to fit common slopes equations of the form $y = a + 3.1x$ ($r^2 =$

0.70**) where y and x are as above and the a values reflect the year differences: being 156, 416 and 154 g $head^{-1}$ day^{-1} for 1973, 1974 and 1975 respectively. Steers grazing treatment 4 (Zulu and Highworth) made similar weight gains to those predicted from the buffel-Highworth relationship for 1974 but better weight gains than buffel-Highworth in 1975 (Fig. 1).

Experiment II

Forage yield

Forage yields of both crops were variable, particularly Highworth which was stunted and pale green to yellow in patches. At the commencement of grazing, Zulu had produced the most forage and replicate yields ranged from 4120 to 6780 kg d.m. ha^{-1}. Yields of Highworth varied from 540 to 1270 kg d.m. ha^{-1}.

Animal production

Grazing commenced on March 12, 1976, after nine weeks of crop growth and continued for 102 days up to June 22, 1976. Low ADG's of 14 and 114 g $head^{-1}$ day^{-1} were recorded over the first 20 days grazing (Fig. 1). However, subsequent weight gains to day 60 were 861 and 936 g $head^{-1}$ day^{-1} from Highworth and Zulu respectively (LSD ($P = 0.05$) = 195). The average for both crops was 899 $\pm$ 28 g $head^{-1}$ day^{-1} over the first 60 days. Steers on both crops made little further weight gains between days 60 to 102. Overall there were no significant differences between crops, which averaged 578 and 570 g $head^{-1}$ day^{-1} over 102 days from Highworth and Zulu, respectively.

DISCUSSION

Steers grazing forage crops of either lablab or Zulu sorghum in autumn-winter at a stocking rate of 1.7 steers ha^{-1} reached peak liveweight gains in 80 to 100 days depending on seasonal conditions. In two of the four years, cumulative liveweight gain reached 58 kg by late June-early July. Steers grazing sown grass pasture at a lighter stocking rate during March-June would normally make little or no weight gain (Graham *et al.* 1983), and in this experiment the steers on Molopo buffel alone lost 12 kg in 1975 (Fig. 1).

Liveweight gain was linearly related to the proportion of lablab available in the lablab-buffel grass pasture. The pooled slopes equation which accounted for 70% of the variation in ADG indicated an increase of 3.13 g $head^{-1}$ day^{-1} for each per cent increase in the availability of Highworth lablab. Norman (1970) reported a linear response in steer liveweight gain to increasing availability of Townsville stylo (*Stylosanthes humilis*) in situations where steers grazing poor quality pasture responded to higher protein intake. Both these experiments demonstrate the importance of protein shortage in limiting liveweight gain during autumn-winter and also suggest that increasing legume availability by planting only portions of the paddock either in strips or blocks would be beneficial.

The ADG up to peak liveweight, of steers grazing lablab ranged from 400 to 700 g $head^{-1}$ day^{-1}. These liveweight gains were higher than those reported by Hendricksen and Myles (1980) because stocking rates in this experiment were lower and grazing commenced earlier. When compared directly with forage sorghum in 1976, steers on either Highworth or Zulu averaged 574 g $head^{-1}$ day^{-1} over 102 days. Our results compare favourably with other work on summer forage crops. Yates *et al.* (1964) showed that two-year-old Hereford steers grazing *Sorghum almum* at about 1.7 steers ha^{-1} during February-May made gains which ranged between 400 and 560 g $head^{-1}$ day^{-1}. At Katherine, Norman and Begg (1968) reported that Shorthorn steers grazing Bulrush millet (*Pennisetum typhoides*) from late March onwards made positive weight gains for 87 days at a rate of 510 g $head^{-1}$ day^{-1}.

Norman and Begg (1968) found that extending the grazing period beyond 87 days resulted in weight loss. A similar result occurred in these experiments with lablab and this effect was more pronounced when the proportion of lablab was low. After 80 days grazing, there was a trend towards lower ADG's and pronounced weight loss as the proportion of lablab was reduced below 84%. There was less wastage of the forage crop when the proportion of lablab to buffel grass was low.

Good weight gains were recorded from steers grazing lablab even when yields were low. For example, in experiment II, Highworth yield of 1100–1200 kg d.m. ha^{-1} was only one-fifth that of Zulu (5700–6800 kg d.m. ha^{-1}) yet both crops gave similar weight gains. The lablab yields in these experiments were similar to those of Murtagh and Doherty (1968) but lower than the yields of about 2800 kg d.m. ha^{-1} at eight weeks of age reported by Hendricksen and Minson (1985).

There appears to be a palatability problem with Highworth lablab in the first two to three weeks of grazing. Access to buffel grass in experiment I (1973 and 1975) gave steers sustenance during the first 24 days of grazing and improved liveweight gain in this period. A narrow border area of forage sorghum with a lablab forage crop may also be of benefit during the early grazing.

These experiments show that steers grazing crops of *L. purpureus* cvv. Highworth and Rongai or Zulu forage sorghum are capable of good liveweight gains of up to 600 g head^{-1} day^{-1} for nearly three months during autumn-winter. While steers grazing forage sorghum crops may make positive weight gains for longer periods (up to 120 days) (V. French, *personal communication*), the added advantage of growing lablab is that it is a legume and has the potential for maintaining or improving soil nitrogen status. Forage sorghums, on the other hand, use nitrogen released from soil reserves, and removal of crop and animal products from the paddocks can lead to losses of soil nitrogen.

In central Queensland, balanced farming systems are required to conserve soil resources and build soil nitrogen levels. Lablab is one crop that, as well as providing valuable grazing, could be useful in this role.

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