

BEEF PRODUCTION FROM FORAGE CROPS IN THE BRIGALOW REGION OF CENTRAL QUEENSLAND I. FORAGE SORGHUMS

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ABSTRACT

Three forage sorghums, *Sorghum alnum* cv. Crooble, *S. bicolor* cv. Sugardrip and *Sorghum* spp. hybrid cv. Zulu, were grown on a predominantly uniform textured, cracking-clay, brigalow soil and grazed at 3 stocking rates, 1.5, 3.0 and 4.5 beasts/ha, for 3 grazing seasons, 1968, 1970 and 1971. Drought prevented grazing of the 1969 crop and interfered with productivity in other years.

At the lowest stocking rate, 98 to 133 days grazing were recorded, with average daily gains from 0.41 to 0.85 kg/head/day. Sugardrip gave the highest total liveweight gains. At the intermediate stocking rate, the crops were grazed for 57 to 89 days with average daily gains from 0.34 to 1.15 kg/head/day. At the heaviest stocking rates available forage was rapidly utilized and there was little effective regrowth, especially from Sugardrip.

RESUMEN

Tres especies de sorgo forrajero (*Sorghum alnum* cv. Crooble, *S. bicolor* cv. Sugardrip y *Sorghum* spp. híbrido cv. Zulu) se cultivaron en un suelo brigalow, de textura predominantemente uniforme de arcilla quebradiza y pastoreado con tres cargas animales, 1.5, 3.0 y 4.5 cabezas/ha, durante 3 temporadas de pastoreo (1968, 1970 and 1971). Las sequías impidieron el pastoreo en 1969 e interfirieron con la productividad en otros años.

En la carga animal más baja, se registraron de 98 a 133 días de pastoreo, con promedios diarios de ganancia de peso de 0.41 a 0.85 kg/cabeza/día. El cv. Sugardrip dio las ganancias de peso vivo más altas. En la tasa de carga intermedia, los cultivos fueron pastoreados durante 57 a 89 días con un promedio de ganancia diaria de 0.34 a 1.15 kg/cabeza/día. En las cargas más altas, el forraje disponible fue utilizado rápidamente y hubo muy poco rebrote efectivo, especialmente del cv. Sugardrip.

INTRODUCTION

The value of forage sorghums for beef production has been demonstrated by a number of workers. In Queensland, Yates *et al.* (1964) and Coaldrake *et al.* (1969) recorded liveweight gains of 0.51 to 0.55 kg/head/day from year-round grazing of *Sorghum alnum* whilst in the USA, Gangstad (1959) obtained 0.70 to 1.01 kg/head/day from sudan grass (*Sorghum sudanense*) grazed for shorter periods.

With the introduction of hybrid forage sorghums (*Sorghum* spp. hybrids) into Australia, cutting trials were used to compare the hybrids with sweet sorghum (*Sorghum bicolor*) and sudan grass types. At Tamworth, N.S.W., yields at the first harvest of cvv. Sudax, and Sugardrip, and *Sorghum alnum* cv. Crooble, were comparable. The yields of the hybrid types were superior when cut a number of times (Boyle and McDonald 1964). However, cv. Sugardrip did not recover. Imrie (1966) concluded from cutting trials that various sudan grass × *Sorghum bicolor* hybrids were probably capable of producing higher yields than sudan grass or sweet sorghum under continuous summer grazing.

Brigalow (*Acacia harpophylla*) regrowth is effectively controlled by ploughing (Johnston 1966), and the resultant seed-bed can be used to grow forage crops for

finishing cattle for market. Our work was carried out to measure the liveweight gains possible from 3 forage sorghums grazed at 3 stocking rates in the brigalow region of central Queensland.

MATERIALS AND METHODS

The site was 48 ha of predominantly uniform textured, cracking-clay soil (μg 5.2; Northcote 1971) with small areas of associated texture contrast (Dd 1.43, Dy 2.43 and Db 1.43) soils (Webb 1971) on the Brigalow Research Station, 50 km north-west of Theodore. The area has a mean annual rainfall of 700 mm, with two thirds falling from November to March. The original vegetation of brigalow and wilga (*Geijera parviflora*) with associated Dawson gum (*Eucalyptus cambageana*) and false sandalwood (*Eremophila mitchellii*) had been cleared from the site 3 years previously, and graded banks were erected for erosion control.

Three 8 ha and six 4 ha paddocks, randomly located between the graded banks, were used in the following factorial design.

| | | | | |
|--|---|----------|---|--|
| <i>Sorghum</i> spp. hybrid cv. Zulu (Hybrid forage sorghum) <i>Sorghum alnum</i> cv. Crooble (Colombus grass) <i>Sorghum bicolor</i> cv. Sugardrip (Sweet sorghum) | } | \times | { | 4.5 beast/ha 3.0 beast/ha 1.5 beast/ha |
|--|---|----------|---|--|

One 8 ha and two 4 ha paddocks were planted to each of 3 forage sorghums in each of the 4 years from December 1967. A fully prepared seedbed was used, with a planting rate of 6.7 kg/ha (5 kg/ha in 1970) in 30 cm rows. The same crop was planted in each paddock throughout the experiment, and grazing commenced when the crop was well established.

Planting dates, times of commencement of grazing, and rainfall received over the crop periods are shown in Table 1.

TABLE 1

Dates of planting each crop and commencement of grazing, together with monthly rainfalls (mm) over the crop season each year

| Year | Planting Date | Grazing Commenced | Monthly Rainfall | | | | | | | | |
|------|---|-------------------|------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| | | | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug |
| 1968 | December 11-14, 1967 | February 2, 1968 | 87 | 137 | 108 | 66 | 119 | 52 | 0 | 56 | 31 |
| 1969 | February 11-13, 1969 | Not grazed | 106 | 33 | 73 | 60 | 7 | 48 | 21 | 6 | 10 |
| 1970 | December 21-30, 1969 (interrupted by rain) | February 5, 1970 | 84 | 123 | 36 | 23 | 12 | 0 | 22 | 0 | 11 |
| 1971 | February 1-18, 1971 (interrupted by rain) | March 31, 1971 | 156 | 144 | 297 | 3 | 17 | 19 | 2 | 8 | 82 |
| Mean | (1968-82) | | 113 | 109 | 117 | 40 | 26 | 39 | 26 | 31 | 27 |

At the commencement of grazing, plant populations were estimated by counting plants in five 1.8 m² quadrats per hectare. At the same time, one quadrat per 0.8 ha was cut to ground level to estimate forage yields. In 1968 forage on offer was also estimated at each of the first 2 monthly weighings, and nitrogen concentrations of whole plant samples were determined by Kjeldahl distribution.

The steers used for grazing had mean initial liveweights (\pm SD) of 351 \pm 26.5 kg (1968), 213 \pm 32.8 kg (1970) and 293 \pm 46.8 kg (1971) and were allocated treatments by stratified randomisation. On each forage type the desired stocking rates were achieved by allocating 12 beasts to the 8 ha paddock (1.5 beasts/ha) and either 12 or 18 to the 4 ha paddocks (3.0 and 4.5 beasts/ha respectively).

The steers were weighed monthly after an overnight fast, and at more frequent intervals as forage availability declined. Grazing continued until the available forage was exhausted.

Forage yields at commencement of grazing were analysed by one-way analysis of variance to compare the 3 cultivars. Liveweight gains per grazing day in the 9 paddocks were compared by analysis of variance, using animal-to-animal variation within paddocks to estimate experimental error. Pairwise testing of means was done using the LSD procedure.

RESULTS

Crop details

Plant populations varied considerably from year to year (Table 2) and from the target populations of *c.* 150,000 plants per hectare. Populations were very low in 1968, with only 25,500 plants/ha in the heavily stocked Sugardrip treatment, but were better in succeeding years with up to 395,000 plants/ha in 1971 (Table 2).

TABLE 2

Mean plant populations ('000 plants/ha) achieved each year measured at the commencement of grazing in each paddock of the forage sorghum grazing trial

| Crop | Stocking rate (beast/ha) | 1968 | 1970 | 1971 |
|---|-----------------------------|------------------|-------|-------|
| | | ('000 plants/ha) | | |
| <i>Sorghum alnum</i> cv. Crooble | 1.5 | 57.6 | — | 271.8 |
| | 3.0 | 65.0 | — | 205.1 |
| | 4.5 | 43.0 | — | 210.0 |
| | Mean | 54.4 | 111.2 | 229.8 |
| <i>Sorghum bicolor</i> cv. Sugardrip | 1.5 | 52.1 | — | 395.3 |
| | 3.0 | 40.8 | — | 271.8 |
| | 4.5 | 25.5 | — | 321.2 |
| | Mean | 46.0 | 74.0 | 329.0 |
| <i>Sorghum</i> spp hybrid cv. Zulu | 1.5 | 52.1 | — | 247.1 |
| | 3.0 | 43.0 | — | 173.0 |
| | 4.5 | 44.7 | — | 173.0 |
| | Mean | 46.9 | 86.5 | 198.0 |

Dry matter yields at the commencement of grazing also varied between years, but were reasonably even within years, except for the 1968 high stocking rate Sugardrip paddock (Table 3). In 1968, forage continued to accumulate throughout the grazing period at the low stocking rate especially for Crooble and Zulu, but at the medium stocking rate the amount of forage decreased after about a month. At the heavy stocking rate, forage was rapidly depleted from the commencement of grazing (Table 3).

TABLE 3

Mean DM yields of forage on offer (kg/ha) at the commencement of grazing each year and at the first 2 monthly weighings in 1968, together with mean nitrogen concentrations in the material at each harvest in 1968

| Crop | Stocking rate (beast/ha) | Forage on offer | | | | | Nitrogen 1968 | | |
|------------------------------|-----------------------------|-------------------|-----------------|---------|-------|-------|---------------|-------|-------|
| | | 1968 | | | 1970 | 1971 | 1968 | | |
| | | Feb 1 | Mar 4 | Apr 2 | | | Feb 1 | Mar 4 | Apr 2 |
| Crooble | | | | (kg/ha) | | | | (%) | |
| | 1.5 | 1580 ¹ | 4590 | 5580 | 3070 | 2210 | 1.97 | 1.26 | 0.91 |
| | 3.0 | 2480 | 3250 | 2480 | 2090 | 2040 | 2.10 | 1.49 | 1.02 |
| | 4.5 | 1330 | 2300 | 710 | 1810 | 1590 | 2.21 | 1.17 | 0.75 |
| | Mean | 1740a | | | 2510a | 2010a | | | |
| Sugardrip | 1.5 | 1440 | 3790 | 2410 | 3940 | 5080 | 2.14 | 1.39 | 1.25 |
| | 3.0 | 1500 | 1740 | 1080 | 3890 | 4070 | 2.37 | 1.68 | 1.33 |
| | 4.5 | 540 | — | — | 3500 | 4290 | 2.21 | — | — |
| | Mean | 1230a | | | 3820b | 4630b | | | |
| Zulu | 1.5 | 2020 | 4330 | 3890 | 5220 | 3850 | 2.26 | 1.39 | 1.23 |
| | 3.0 | 1920 | 1930 | 980 | 4990 | 1970 | 1.89 | 1.38 | 1.09 |
| | 4.5 | 1760 | 1320 | 740 | 4960 | 1880 | 2.30 | 1.73 | 1.01 |
| | Mean | 1930a | | | 5100c | 2880a | | | |
| SE | | 250 | | | 250 | 450 | | | |
| LSD of Crop means (P = 0.05) | | 850 | NA ² | NA | 860 | 1550 | NA | NA | NA |

¹ Within columns means with a letter in common do not differ significantly (P > 0.05)

² NA = Not analysed statistically

In 1968, nitrogen concentrations in the whole plant were around 2.0% but declined rapidly and after 2 months of grazing, were less than 1.2%. (Table 3).

Duration of grazing

At the low stocking rate, all crops had sufficient dry matter for 98 to 133 days of grazing, but this period became less as stocking rates increased (Table 4). At the highest stocking rate all 3 crops could be grazed for no more than 28 days, with Sugardrip giving least grazing in 2 of the years.

TABLE 4
Average daily liveweight gain (kg/head/day) and the number of days grazing achieved each year when grazing the various forage sorghums at different stocking rates

| Crop | Stocking rate (beast/ha) | Average daily gain (kg/ha/day) | | | Days grazing (days) | | |
|-----------|-----------------------------|-----------------------------------|--------|--------|------------------------|------|------|
| | | 1968 | 1970 | 1971 | 1968 | 1970 | 1971 |
| Crooble | 1.5 | 0.57ab ¹ | 0.85a | 0.41ab | 116 | 112 | 98 |
| | 3.0 | 0.44c | 0.91ab | 0.34a | 89 | 63 | 63 |
| | 4.5 | 0.31d | 1.08cd | 0.43ab | 81 | 48 | 28 |
| Sugardrip | 1.5 | 0.73e | 0.81a | 0.60bc | 116 | 112 | 133 |
| | 3.0 | 0.64ae | 1.15c | 0.53ac | 89 | 63 | 57 |
| | 4.5 | | | 0.37a | 19 | 28 | 35 |
| Zulu | 1.5 | 0.68ae | 0.85a | 0.53ac | 116 | 112 | 133 |
| | 3.0 | 0.50bc | 0.99bd | 0.39ab | 81 | 63 | 85 |
| | 4.5 | 0.41cd | 0.99bd | 0.62c | 81 | 48 | 28 |
| | SD | 0.16 | 0.16 | 0.27 | | | |

¹ Means within a column with a letter in common do not differ significantly ($P > 0.05$)

Liveweight gain

In all years the lowest stocking rate gave the highest LWG per head for each crop and LWG declined rapidly as stocking rates increased, particularly for Sugardrip. Sugardrip grazed at 1.5 beast/ha gave greatest liveweight gains in 1968 and 1971, and was similar to Crooble and Zulu in 1970 despite a large liveweight loss in mid season. Crooble gave the lowest overall liveweight gains (Figure 1).

Average daily gains (ADG) ranged from 0.41 to 0.85 kg/head/day at the low stocking rate but exceeded 1.14 kg/head/day for shorter periods at the medium stocking rate (Table 4).

DISCUSSION

Summer forage crops, mainly forage sorghums, are widely grown in central Queensland for cattle fattening. Although results are less variable than with winter crops (Rudder 1977), they are still not completely reliable. Our trial was carried out in a series of unusual seasons; we had no grazing from the 1969 crop and a poor crop in 1971. In both 1970 and 1971 there was insufficient rain after grazing commenced, reducing regrowth drastically and cattle at the heavier stocking rates, especially 4.5 beasts/ha and often 3 beasts/ha, soon exhausted the forage available. At lighter stocking rates Sugardrip performed best but its regrowth was slow. It was rapidly eaten out at the higher stocking rate. Only the low rate gave a grazing period greater than 100 days.

This unreliability is not unusual. Coaldrake *et al.* (1969) and Yates *et al.* (1964), who both used *Sorghum almum* as a perennial pasture grass, experienced problems with continuity of feed. Coaldrake *et al.* (1969) lost their stands at Goondiwindi part way through the second year due to drought. Their Pioneer Rhodes grass (*Chloris gayana*) stands also died that year. While Yates *et al.* (1964) obtained 2 full years' grazing from their plantings at Lawes, they still had to destock 2 replications of the unfertilized treatment at the highest stocking rate after 14 months of grazing.

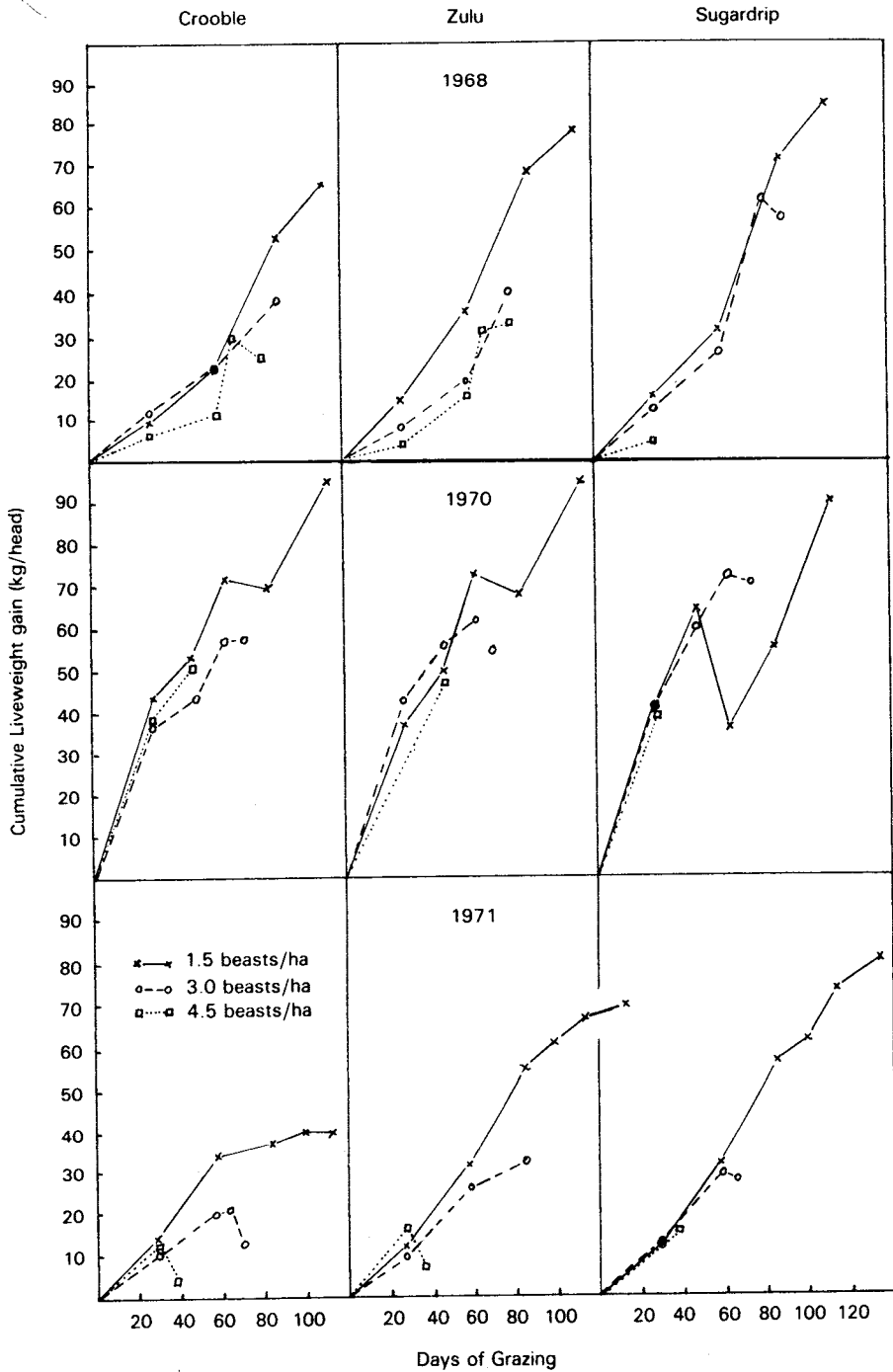


FIGURE 1

Cumulative liveweight gain (kg/head) of animals grazing 3 forage sorghums at 3 stocking rates in 1968, 1970 and 1971.

In our study, despite treating the *Sorghum alnum* as a forage crop and planting annually onto a fallow in which some soil moisture storage could have occurred, we could only achieve an adequate grazing period at the lowest stocking rate. Yates *et al.* (1964) considered that their intermediate stocking rate at (2.5 beasts/ha) was their optimum rate. Our intermediate rate at 3.0 beasts/ha was slightly heavier but it is doubtful that this was sufficient to cause the lower performance, and the failure of any crop to provide more than 89 days grazing in any year.

In our study Crooble *Sorghum alnum* gave similar liveweight gains (LWG) to Zulu in 1970, despite having less feed on offer at the commencement of grazing. In 1968 Zulu was grazed for a week longer but there was no significant difference ($P > 0.05$) between Crooble and Zulu in ADG. The only time that Zulu exceeded Crooble was in 1971 and then only at the lightest stocking rate; as well 35 days extra grazing was obtained from Zulu. At this stocking rate Sugardrip was able to match or exceed these figures.

In 1968 bovine ephemeral fever affected most animals in the trial, but it does not appear to have seriously affected the results. In 1970 two animals grazing Sugardrip at the light stocking rate died and were replaced. The cause of death was not positively identified but was thought to be grain poisoning. More grain was developing on the lighter, than heavier, grazed crops.

The maximum liveweight gain of 95 kg/head was satisfactory but was achieved only in 1970 at a low stocking rate. At the more generally acceptable stocking rate of 3 beast/ha, LWG exceeded 60 kg/head only in 1970, possibly due to the unusually dry conditions.

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