C.S.I.R.O. RESEARCH AT THE NARAYEN RESEARCH STATION NEAR MUNDUBBERA, QUEENSLAND

FIELD MEETING OF THE BURNETT SECTION: 10 FEBRUARY, 1970

THE NARAYEN RESEARCH STATION

by

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The Narayen Research Station was acquired in August 1966 to undertake research on land development in speargrass and brigalow country typical of southern sub-coastal Queensland.

The overall objective of the station was described by Shaw (Tropical Grasslands, 1967, Vol. 1, pp. 43-47). The station covers 22,500 acres of which 6000 acres are Eucalyptus forest on granite and 4000 acres are brigalow, of which 2500 acres are cleared. The long term average rainfall is 28 inches with a high variability, most of which falls in the summer months; frosts are common.

The first concern was to develop the station by building internal roads, fences, accommodation for married and single staff, an office-laboratory, machinery sheds and a small primary school.

Nevertheless, the first small plot experiments were started in January 1967 and in 1968 two large scale experiments were started, one on the brigalow and one on the speargrass side of the station. These together with small scale experiments cover about 1000 acres.

The main avenues of research at present are beef production and pasture management, plant breeding and plant introduction on both types of country, cropping investigations on the brigalow and woody regrowth studies on the *Eucalyptus* forest country.

Two breeds of cattle are being run on Narayen, namely Herefords and Belmont Reds. The latter were developed by the C.S.I.R.O. Division of Animal Genetics at "Belmont", near Rockhampton. They are essentially ½ Africander, ¼ Hereford, ¼ Shorthorn. Research at "Belmont" has shown these animals to be valuable with respect to fertility, growth rate, and tick resistance and one objective in running them at Narayen is to increase numbers so that the breed can be made available to the grazing industry. In addition, further comparisons of overall performance will be made between Belmont Reds and Herefords. At present the total herd comprises 500 breeders with 900 head of grown stock and 350 calves. The size of our herd will, of course, increase as development continues.

BEEF PRODUCTION FROM IMPROVED PASTURES ON GRANITIC SOILS AT NARAYEN

by

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INTRODUCTION

Soon after the acquisition of the property in late 1966 we commenced work on fertilizer requirements and suitable grass and legume species for improved pastures on soils of granitic origin.

Of commercially available grasses Biloela and Nunbank buffel (*Cenchrus ciliaris*) and green panic (*Panicum maximum* var. *trichoglume*) were outstanding and of the legumes siratro (*Phaseolus atropurpureus*) and Hunter River lucerne

(*Medicago sativa*) were the best. Other grass and legume species have shown promise, but more work over a longer period under grazing is required to establish their value.

Fertilizer experiments have indicated that the granitic soil is deficient in nitrogen, phosphorus, sulphur and molybdenum. Potassium will give a small increase in yield but good yields and high potassium levels in the plant are obtained without the addition of potassium.

BEEF PRODUCTION

Treatments

Towards the end of 1967 the area for a 320 acre experiment was cleared of *Eucalyptus* forest, mainly narrow-leaf ironbark (*E. crebra*). Between January and March 1968 the following pastures were established:

1) Biloela buffel grass
2) Biloela buffel grass with Hunter River lucerne
3) Biloela buffel grass with Hunter River lucerne and siratro
4) Biloela buffel grass with 150 lb N/ac/year as urea in three dressings
5) Native pasture species were left to recover after clearing operation.

The sowing rates were: buffel grass 3 lb/ac, Hunter River lucerne, and siratro 4 lb/ac each. Both legumes were inoculated and lucerne seed lime pelleted. All pastures were fertilized with 4 cwt/ac of Mo-superphosphate and 1 cwt/ac muriate of potash at planting and in November 1968 an additional 2 cwt/ac of superphosphate was applied.

The pastures established well and would have been ready for grazing two months after planting, but due to unavoidable delays in fencing and the provision of shade and watering facilities grazing was not started until November 1968.

For the first year of grazing the buffel grass with legumes and with nitrogen were grazed at three stocking rates, viz 3, 4.5 and 6 acres per beast and buffel grass alone and native pasture at 4.5 acres per beast only. Grazing was commenced with 14 months' old Hereford steers, which were slaughtered in June 1969 and replaced by 9 months' old Hereford steers.

Grazing of all pastures is on a four weeks on four weeks off basis. There are four replicates of each of the pasture x stocking rate treatments, two of which are grazed while the other two are ungrazed.

Results

Drought prevailed during the first year of grazing, with only 8 inches of rain being received between October 1, 1968 and October 1, 1969.

In October 1969 5½ inches of rain fell thus relieving the extreme drought conditions. Despite this drought, which was second only to that in 1902/03, live weight gains were recorded as is shown in the table on the next page.

These live weight gains could be achieved because the buffel grass pastures on these granitic soils were able to respond markedly to small falls of rain of the order of 50 points, of which several occurred during the drought, and because the winter of 1969 was very mild with only a few frosts. A flush of growth occurred after each small fall of rain, providing the animals with a green pick of high quality feed. These results were obtained without supplementary feed, while on unimproved pastures in the district animals were in poor condition and many died unless they were hand-fed.

Accumulative live weight gains between December 1968 and November 1969 (325 days)

Pasture	Stocking rate (acres/beast) 3 lb/head	3 lb/ac	4.5 lb/head	4.5 lb/ac	6 lb/head	6 lb/ac
Native			247	55		
Buffel			329	73		
Buffel + lucerne	280	93	392	87	468	78
Buffel + lucerne + siratro	261	87	386	86	429	71
Buffel + 150 lb N	353	117	457	102	490	82

Of the 66 animals slaughtered in June 1969, 44 were graded first quality and only 8 as third quality carcases, 6 of which came from the native pasture treatment.

All pasture species survived the drought and the siratro content has increased, but the lucerne content has decreased slightly.

During the summer of 1969/1970 stocking rates were increased except for native pasture. The present stocking rates are for buffel with legumes 2.25, 3.38 and 4.50 acres per beast, for buffel with 150 lb N/ac/year 1.50, 2.25 and 3.00 acres per beast and for buffel alone 3.38 acres per beast.

Actual figures of costs and returns cannot as yet be given with confidence, although results to date indicate that buffel grass with legume pastures at high stocking rate are the most profitable of the alternatives discussed here.

CONCLUSION

After three years work on the granitic soils at Narayen and taking into account the results and experience in other areas of speargrass country as well as that of graziers it appears that beef production from speargrass country in this district can be increased appreciably by pasture improvement techniques based on buffel grass with legumes and fertilizers. It is likely that the lucerne will disappear from these pastures within about 5 years after planting, but the buffel grass and siratro can be regarded as permanent.

The results described here were obtained during the second most severe drought on record and better results can be expected in more favourable years.

It appears that pasture improvement on these light sandy soils is a good means of avoiding drought losses. Even at a stocking rate of 1 steer to 3 acres good live weight gains were obtained without the need to use supplementary feed in a year of about one third normal rainfall.

PASTURE AND CROP ROTATION EXPERIMENT ON BRIGALOW LAND

by

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This experiment is designed to study plant and animal production in relation to soil fertility trends on cleared brigalow land that has been under pure grass pasture for over 20 years. Treatments are based on the three main systems of land use that will apply over the brigalow region in the foreseeable future, viz. continuous pasture, continuous cropping, and crop-pasture rotation.

The experiment commenced with sowings in the summer of 1967-68. It covers a total area of 308 acres divided into 92 paddocks of different sizes.

The design of each segment, and some comments on progress are set out below. But it must be realised that this is a long-term experiment in its very early stages, so that the results mentioned here do little more than prove that the experiment is satisfactorily established.

(*a*) *Continuous pasture*

There are 4 pastures x 3 stocking rates x 3 replications.

Pastures: I. Grass alone—Rhodes, (*Chloris gayana*), green panic (*Panicum maximum* var. *trichoglume*)

II. Grass/legume—Rhodes, green panic, Hunter River lucerne (*Medicago sativa*), siratro (*Phaseolus atropurpureus*), Cooper glycine (*Glycine wightii*)

III. Grass alone + 1½ cwt super-phosphate and 2 cwt ammonium sulphate per acre per year.

IV. Grass/legume + 1½ cwt super per acre per year.

Stocking Rates: These were initially 1.4, 2.0, and 2.8 acres per cow, but they have now been reduced to 1.9, 2.7, and 3.8 acres per cow. Herd size was initially 8 per treatment, but is now 6.

Grazing: By breeding cows (Hereford) which are mated on the experiment to calve in September-October. Calves are weaned at about 6 months. There is one herd of cows for each of the 12 pasture x stocking rate treatments and these graze in rotation through the three replicates so that each paddock is grazed for two weeks and then rested for four weeks.

The pastures were sown in January 1968 and good rainfall until June 1968 led to an excellent establishment of all the sown grasses and legumes as determined by plant counts in November 1968. Grazing commenced in June 1968 with pregnant Hereford cows. Thereafter, the experiment endured a drought that has only been exceeded once before in this area (1901-02) in the period covered by records. From May 1968 to September 1969 total rainfall at this site was 16 inches compared with the long-term average of 34 inches over the same period of 17 months.

Under these conditions treatments were unstocked individually as feed became exhausted in the period February-April 1969. The grass plus legume treatments had to be unstocked first, while the pastures of grass plus nitrogen and phosphorus fertilizer lasted the longest. Six inches of rain in October-November 1969 enabled restocking of all pastures early in December 1969.

The cows were mated on the pastures in November-December 1968 at a time when major differences had developed in the amount of feed available on different

treatments. As a result conception rates ranged from 60 to 90% for animals at heavy stocking rates to a uniform 100% for all animals at the lightest stocking rate. Despite the drought calves on the pastures at the lightest stocking rate gained 2 lb per day from November 1968 to February 1969. In 1969 the gains have ranged from 2 to 3 lb per day per head.

As yet the pastures show no significant responses to fertilizer, possibly because of continued shortage of moisture. Plant counts in November 1969 showed that green panic and lucerne both recovered strongly after the drought broke, whereas Rhodes grass has been slow to regenerate from seed. The populations of both siratro and glycine were seriously reduced on these clay soils.

(*b*) *Continuous cropping.*

Crops: grain sorghum or wheat on separate areas.

Fertilizers: a factorial combination of the following—

N_0 — nil P_0 — nil

N_1 — 23 lb N/ac for wheat P_1 — ¾ cwt super/ac
— 46 lb N/ac for sorghum

N_2 — 46 lb N/ac for wheat P_2 — 1½ cwt super/ac
— 92 lb N/ac for sorghum

(N applied as anhydrous ammonia)

Design: Randomised block with four replications and with main plots split for fertilizers.

The initial crop of grain sorghum yielded from 30 to 36 bushels per acre with no significant differences between fertilizer treatments. The second crop (in 1969) did not head. Yields of wheat in 1968 were greatly affected by low rainfall and some damage by mice, and were quite variable. The yield ranged from 8 to 21 bushels per acre and mean yield over all plots was 14.3 bushels per acre. The drought caused extremely low yields in 1969 with a mean yield of only 2.9 bushels but responses to phosphorus as superphosphate were recorded on certain soils.

Crop yields and responses to fertilizer, at least in the initial years are likely to be influenced by the high soil fertility of the brigalow soils in this experiment which had never been previously cultivated. Soil analyses showed a high initial soil nitrogen content.

(*c*) *Crop-pasture rotations.*

There are 3 rotations, all based on a length of 4 years, and all based on wheat as the grain crop.

Rotation A: 2 years wheat, 2 years pasture with "winter legume", started under oats.

Rotation B: 1 year wheat, 3 years pasture with "winter legume" started under oats.

Rotation C: 2 years wheat, ½ year grazing oats, 1½ years "summer legume" pasture.

"Winter legume" = lucerne, barrel medic 173, Cyprus medic, snail medic, plus *Sorghum almum.*

"Summer legume" = *Dolichos lablab* plus *Sorghum almum.*

All treatments receive 1½ cwt super/ac/year.

Design: All phases of each rotation are included each year giving 12 treatments. These 12 treatments are arranged in a randomised block with 4 replications.

Grazing: Pastures and oat crops are grazed by steers, and herds rotate through the replicates of the relevant treatments—2 weeks on, 6 weeks off.

Good establishment of oats and oats-pasture in 1968 was followed by grazing with mixed herds of Hereford and Africander x Hereford (Belmont Red) weaners at 2 weaners per acre. Weight gains were in the range of 1.6 to 2.0 lb per head per day with no significant differences in performances of the two breeds.

While establishment of these treatments in 1969 was satisfactory, subsequent growth was severely reduced by the drought and the returns from grazing were reduced accordingly. Wheat yields in 1968 ranged from 0.01 to 15.6 bushels per acre, the variation being due to a combination of spring drought and some damage by mice. Yields of wheat in 1969 were greatly affected by the severe drought and ranged from none to 4.5 bushels/ac.

This is the section of the experiment in which differences in treatment effects will necessarily be slow to appear.

MEASURES TAKEN TO PREVENT DROUGHT LOSSES AT THE NARAYEN RESEARCH STATION

by

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Although the 1969 drought was the second worst in the history of the Hawkwood district since records began in the 1880's, there were no stock losses from drought at Narayen. There are various ways in which drought losses can be prevented or avoided and those taken at Narayen were as follows:

(1) Early weaning of calves, followed by hand feeding of weaners.

(2) Pregnancy testing of cows and the selling of empty and faulty cows.

(3) Control of stock and grazing pressure with long term preparation for hand feeding of breeders.

(4) Supply of high energy, high protein supplement to cattle on dry feed.

(5) Hand feeding of breeders as necessary.

(1) *Early weaning of calves and hand feeding of weaners.*

No effective falls of rain had been received by the end of February 1969 and with pastures low in both quality and quantity, it was obvious that some action would have to be taken if stock losses were to be avoided during the coming winter. Immediate action was taken by weaning all 340 calves early in March at an average age of 5½ months. These weaners were hand fed in the stockyards on a survival ration of 3-4 lb cracked grain and 1 lb poor quality hay per head per day, so that all standing feed on the property would be available for the breeding herd. By July, the number of weaners being hand-fed was reduced to about 140, the other 200 having been allocated to grazing trials at Beerwah, Lawes and Narayen. Hand-feeding of the remaining 140 weaners continued till after good rains were received in October.

(2) *Pregnancy testing and selling of empty and faulty cows.*

When calves were weaned in early March the majority of the breeders were pregnancy tested. Empty cows and faulty cows were set aside for immediate sale to avoid carrying unproductive "passengers" through the coming winter and spring. This policy of pregnancy testing and the culling of empty and faulty cows at weaning time is, however, a routine managerial procedure at Narayen and is carried out irrespective of the seasonal conditions.

(3) *Control of stock and grazing pressure and long term preparation for hand feeding of breeders.*

In contrast to the principle of "opening all gates and letting the cattle look after themselves" in times of drought, I believe in the strict control of stock and pastures during a drought. Cattle should be distributed in such a way that the best use is made of standing feed and so that hand feeding programs can be initiated with a minimum of difficulty if and when it becomes necessary. At Narayen, paddock and watering facilities on the western (brigalow) side of the property were such that the implementation of a hand feeding program would be comparatively easy while the opposite situation occurred on the eastern (speargrass on granitic soils) side. Therefore, an assessment of the overall paddock feed situation was made at the end of March and the lighter eastern country was stocked at a level at which cattle would survive through the winter and spring without any need for hand feeding. There was a big temptation to add more stock to this country, especially after a good flush of feed resulted from 1½ inches of rain in late March. The rest of the breeding herd was run on the heavier western country where hand feeding could be started when necessary.

(4) *Supply of high energy and protein supplement to cattle on native pasture.*

Throughout 1969 up till mid-October cattle were provided with an adequate supply of a home made high energy and protein supplement, which contained grain, urea, molasses, calphos, meatmeal and salt. Breeding cows consumed an average of 1½-2 lb per head per day of this supplement. It was impossible to determine what role the supplement played in the maintenance and survival of the breeding herd but without any concrete evidence to support my statement, I believe that it played a major part in preventing drought losses.

(5) *Hand feeding of breeders as necessary.*

By mid August, the state of the paddock feed and the condition of some of the breeders on the western side had deteriorated to such an extent that it became necessary to commence hand feeding. Initially, about 30 breeders were hand fed on a ration of 7 lb crushed oats and 8 lb clover hay per head per day and were fed three times a week. Cows were brought straight on to the full ration because there was very little risk of grain poisoning. The choice of feed was determined by the availability of the various classes of stock fodder.

Calving commenced at the end of August and early in September another 70 breeders with calves at foot had to be hand fed. By the beginning of October well over half the cows had calved and it looked as though all the breeders on the western side would have to be hand fed. Fortunately, however, good rains were received at the beginning of October and, although the country was slow to respond, all hand feeding was discontinued by the middle of the month.

The total cost of feeding cattle during the drought, including the costs of supplements, and making an allowance for labour and freight was calculated to be about $8000. Without supplementation and hand feeding losses would have far exceeded this figure in value.