

A summary of grazing trials carried out by CSIRO in northern Australia from 1950–2000: treatments imposed and attributes measured

R.M. JONES

Formerly CSIRO Livestock Industries, Brisbane, Australia

Abstract

The published records of grazing trials that measured pasture and animal production, carried out by CSIRO in northern Australia from the 1950s to 2000, have been collated. They have been grouped into 5 geographical regions: coastal subtropical Queensland, subcoastal subtropical Queensland, tropical Queensland, the Northern Territory and northern Western Australia. The duration of each trial is given plus an indication of whether it included native pastures, oversown native pastures and/or fully improved pastures. The treatments imposed, *e.g.* stocking rates, tree killing, introduction of legumes, use of supplements, fertilisation (N, P, K or lime) and burning, have been tabulated for each trial. This format makes it easy to find all trials that examined the effects of any particular variable.

Many trials measured attributes other than cattle liveweight gain and pasture yield and composition, including: demography, biodiversity, seed contents of faeces, pasture quality, carcase quality and economics, dietary composition, run-off following rainfall and soil fertility. Extra attributes measured in each trial are listed, making it possible to determine which trials have information on any specified attribute. No experimental data are presented; rather this is a record of where experimental data can be found. Similar pasture information is given for a further 12 trials where grazing treatments were imposed but no measurements made of animal production.

Some comments are made about regional differences in the emphasis placed on native pastures as compared with fully improved pastures. It is suggested that inadequate emphasis was

given to burning and to grazing management, other than stocking rates, as variables. In addition, there has been inadequate use of grazing trials as a resource in which to measure how attributes such as biodiversity and soil properties have been affected by the treatments imposed. It is also pointed out that writing up the results of grazing trials for the conventional scientific paper has resulted in the loss of data that could be useful in model development and validation. Some comments are made about attributes which could have been measured, at least in some trials, but were not. Finally, it is stressed that the value of many grazing studies, in terms of measuring changes in botanical composition, has been limited by their short duration.

Reference to web site

Detailed information on the objectives, methods and results is given at (www.tropicalgrasslands.asn.au/downloads).

Introduction and Methods

This paper provides details of CSIRO trials where liveweight gain and/or reproduction of beef cattle and pasture composition were measured under controlled grazing. One trial (Roe and Allen 1993) used sheep. Grazing trials with annual forage crops or trials of less than 2 years duration have been excluded. The paper outlines the treatments imposed and lists the types of data collected. It does not give results, but refers to publications where these data are presented.

All published papers were examined to determine what treatments were imposed, and which attributes were measured.

Results

Location of trials and treatments imposed

Details of the trial sites, including location, rainfall and soil type are listed in Table 1, which is included here as well as on the website. The remaining tables are listed only on the website.

Table 2 gives details of each trial, which is allocated a number. The table lists the site name, duration of the trial in years and the pasture types involved: native pasture, oversown native pasture or fully improved pasture. The table indicates the treatments, with 2 or more levels, which were imposed, listed under the following column headings:

- Stocking rates - the trial included 2 or more stocking rates
- Grazing systems - the trial compared 2 or more grazing systems. Most trials had continuous grazing only.
- Nitrogen - there were 2 or more levels of nitrogen fertilisation
- Phosphorus - there were 2 or more levels of phosphorus fertilisation
- Potassium - there were 2 or more levels of potassium fertilisation

- Calcium - there were 2 or more levels of lime or calcium fertilisation
- Grass - 2 or more grasses were compared as different treatments
- Legumes - 2 or more legumes were compared
- Trees – effects of tree killing were examined
- Hay - 1 treatment included conserving excess feed and feeding this in winter
- Breed comparison - productivity of 2 or more cattle breeds was compared
- Supplements - effects of nutritional supplements such as P and N were examined
- Burning - effects of burning stand-over feed were examined.

A very brief phrase describes each trial, with the key references to that trial. Trials 1–82b all contain some data on animal production, although the level of detail varies widely. Almost all of these trials have some data on pasture yield and botanical composition. Trials 101–112 contain data on yield and composition only. The plot sizes in these trials were adequate to give controlled grazing but not large enough to enable measurement of animal production.

Table 1. Location of experimental sites in northern Australia.

Location	Latitude	Longitude	Rainfall	Soils
	(S)	(E)	(mm)	
Coastal subtropical Queensland				
Samford Research Station (RS)	27° 22'	152° 53'	1105	duplex, some alluvial
Beerwah RS	26° 50'	153° 02'	1609	light textured
Gatton RS	27° 34'	152° 30'	781	clays
Rodds Bay	24° 00'	151° 30'	812	duplex
Subcoastal subtropical Queensland				
Westwood	23° 39'	150° 07'	720	red earth/prairie
Goondiwindi	28° 11'	150° 09'	623	clay
Kogan	27° 02'	150° 55'	616	solodic duplex
Narayan RS speargrass (sg)	25° 41'	150° 52'	715	podsolics (speargrass)
Narayan RS brigalow (br)	25° 41'	150° 52'	715	clays (brigalow)
South-west Queensland				
Cunnamulla	28° 04'	145° 41'	366	heavy loam/clay loam
North Queensland				
Lansdown RS	19° 40'	146° 51'	861	solodics
Weipa	11° 07'	142° 04'	1674	yellow earth
Wrotham Park	16° 40'	144° 00'	937	yellow earth/podsol
Kangaroo Hills	18° 56'	145° 40'	634	solodic duplex
Cardigan	21° 11'	146° 43'	670	neutral red duplex
Hillgrove	19° 40'	145° 45'	535	euchrozem
Lakeview	20° 18'	145° 54'		red earth
Northern Territory				
Katherine RS	14° 28'	132° 18'	955	loams
Katherine Scotts Ck	14° 08'	131° 08'	950	kandosol
Manbulloo	14° 47'	131° 57'	940	loamy red earth
Western Australia				
Kununurra RS	15° 39'	132° 18'	773	clays

Attributes measured

Table 3 lists attributes *other than* liveweight gain, pasture yield and botanical composition data that have been measured in these trials, listed under the following column headings:

- Soil fertility - includes attributes such as pH, available P, total N, total C
- Run-off - includes measurements of run-off and soil loss
- Demography - includes plant survival, seed-set, seed banks, seedling recruitment
- Faecal seed - seed levels in cattle faeces
- Biodiversity - plant biodiversity or species richness
- Economics - economic analyses were carried out comparing different treatments
- Pasture quality – includes measurements such as N%, P% and digestibility
- Carcase grade - carcase grades of animals from different treatments
- Animal measurements - includes P in blood and bone, thyroxine in blood
- Dietary composition - from oesophageal fistula or analyses of C isotopes of faeces
- Grass - includes measurements of grass leaf/stem and green/dry components, etc.
- Reproduction - includes pregnancy %, calving %, calf growth rates, semen quality
- Pests - includes ratings of insect damage.

Further details of any pasture quality and animal measurements taken in each trial are given in Table 4. Twelve columns describe what elements (N to Mn) were measured in at least some of the samples and 9 columns relate to measurements of animal bone P, blood, faeces or saliva. Appropriate references, giving the results of the above measurements, are listed.

Discussion

The main objective of this paper is to assist readers to find if any of the 200+ references listed are relevant to their needs.

The following section summarises some other points discussed in more detail on the web site.

There is an interesting difference between the pasture types used for experimentation in southern Queensland, north Queensland and the Northern Territory. In southern Queensland, most

experiments studied fully sown pastures. In contrast to southern Queensland, experiments in northern tropical Australia, with the exception of those under irrigation at Kununurra in Western Australia, focussed on undisturbed or oversown native pasture. Reasons for this are discussed. Comments are also made on the small amount of research on burning and tree clearing.

Very few trials have looked at grazing management other than set-stocked year-long grazing. Many of the treatments imposed have resulted in overgrazed pastures at the heaviest stocking rate, yet little effort has been made to investigate how to restore these overgrazed pastures. References are given of instances where this was done.

A considerable amount of information has been collected on nutrient concentrations in forage to provide data to enable better interpretation of results of animal growth. The value of most of these measurements is questioned.

Comparatively few studies have taken extra measurements of other variables such as species diversity and soil fertility that can be measured in grazing trials. The advantage of taking such measurements is that they can be placed in the context of controlled variables such as fertiliser and stocking rate and known rainfall and pasture composition. Similarly, there has been very little use of exclusion cages to measure how applied grazing treatments have affected true pasture growth and decay. Such measurements are particularly useful in pasture modelling.

Valuable information on pastures has been obtained by using small paddocks that enabled different stocking rates to be imposed, yet were not large enough to measure animal production. Some comments are made about this type of experimentation.

In many trials, vast amounts of data on pastures and animal liveweight changes were collected at regular 4–8 weekly intervals. These data could be of considerable use in model development and validation, but with 2 exceptions were not published. As published data on long-term trials are often presented on an annual basis, or even as the mean of a number of years, this detailed information is lost unless it is specially presented in another form.

Finally, it is pointed out that short-term trials may be misleading in that they give no indication of long-term botanical change.