Conditioning

This involves holding carcases at about 15°C for the period that it takes for rigor to develop. Unfortunately this temperature favours the growth of bacteria. To control this a very dry atmosphere is needed which means a high degree of shrink is inevitable. Nevertheless the process is in use in New Zealand.

Vacuum packaging

Cuts are vacuum sealed in special plastic bags and held for "ageing" to allow tenderness to develop. The speed of this development depends on the temperature the meat is held at in the bag. The bag allows the build up of carbon dioxide within itself which vastly reduces bacterial growth with a consequent vast increase in shelf life.

Usually two to three weeks ageing are regarded as necessary. This plus the expense of the process adds to costs. High pH beef is unsuitable for bagging and beef which has been severely shortened will not improve in the bag.

Problems which I personally feel are occurring in the trade in "bagged" beef are:

1. No consumer education (in the bag muscle looks black, fat greyish and the normal bloody liquid is off putting).
2. Little butcher education. Whilst processors are aware of the needs of this process retail butchers generally are not. I have observed this situation: beef bagged today, delivered to butcher shop tomorrow and sold the next day. Bags have been seen in butcher shop windows with price tickets piercing the bag, yet once the seal is broken shelf life is very short.

Electrical stimulation

This involves the passage of a current through the body within an hour of death. The result is the acceleration of the rigor process to completion in about two hours. Shortening is thus reduced because of the temperature effect.

Whilst this is still experimental Meat Research personnel in C.S.I.R.O. believe it is very close to being practical. A problem still to be solved is modifying slaughter chains to allow it to be done. Even if adopted there will still be a place for tender-stretch.

Most importantly electrical stimulation raises the very real possibility of hot boning without substantial loss in tenderness, drip, etc. This has the potential of substantial savings in chiller cost in processing.

FIELD MEETING IN THE BOONAH DISTRICT, MAY 13, 1977
LOW COST PASTURE ESTABLISHMENT ON STEEP ROCKY HILLSIDES

Many properties have at least some country which is steep, difficult of access and often unproductive. This land is often too steep to go over by tractor and is frequently left undeveloped. However because of its elevation it may not be frosted and so is well suited to tropical legumes.

Two pastures of this type were inspected in the Boonah district, the first pasture had only been sown eighteen months previously while the second pasture was sown seven years ago. The field day was organized in conjunction with the Boonah Dairy Development Committee.

AN INTRODUCTION TO THE BOONAH AND FASSIFERN DISTRICT

K. F. Lowe*

The Boonah Shire, of which the Fassifern Valley is a part, has an area of 148,000 ha. In fact the use of the term Fassifern Valley for the general Boonah area is a misnomer as it really is the area of the Parish of Fassifern which surrounds Kalbar.

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Industries

The major industries in the area are horticulture, agriculture, grazing and dairying. Horticultural crops, which include carrots, beetroot, peas, beans, sweet corn and cabbages, are grown on the better alluvial soils and irrigated from surface water sources. Agricultural crops include potatoes, pumpkins, soybeans, maize, sorghum, barley and lucerne. Generally these are grown on similar soils to horticultural crops but also on better class scrub country. Again much of the production is irrigated from streams but farm water storages are also used.

Beef and dairy production are generally restricted to the scrub and forest country but some dairying is still conducted on alluvial soils, especially in the Harrisville and Maroon areas. There are approximately 160 dairy farms in this general area, all supplying the Q.F.C.A. Factory in Booval. Some would still be supplying cream, although the majority would be supplying bulk milk for manufacturing. Many would have a small quota for supplying fresh milk.

Soils

There is a central area of scrub soils which is surrounded by areas of forest country, both areas being intersected by the alluvial soils of the major drainage lines of the Reynolds, Warrill and Teviot Creeks and Bremer River. These alluvial soils are mainly dark, medium to deep cracking clay soils (prairie soils and black earths). The scrub soils can be divided into two distinct types, the brown neutral structured earths to the north and the dark, neutral and alkaline structured earths to the south. The forest soils to the east of the Boonah-Ipswich Road are acid yellow or grey duplex soils while those to the north, south and east of the central scrub area are acid or neutral mottled, bleached duplex soils. The foothills of the Great Dividing Range and the Macpherson Ranges contain a wide range of soils, including shallow non-cracking clay soils with areas of prairie soils, podzolic soils and kraznozems.

Climate

Average annual rainfall at Boonah is 880 mm but within the area it varies from 760 mm in the north to 1300 mm in the south. Seventy-two percent falls in the period October to March. Frosts occur in the area during the months June-August but the number and intensity depends on location, aspect, elevation etc. Evaporation recorded at Moogerah Dam is 1860 mm per year.

Water Supply

Most of the area is 'headwaters' country and as such has a large number of small to medium drainage lines. Major drainage lines are Warrill, Reynolds and Burnett Creeks, Teviot Brook and Bremer River.

Moogerah and Maroon Dams store water from the Reynolds and Burnett Creeks respectively and were constructed specifically for irrigation.

Underground water supplies associated with alluvial flats are used in the area, but those associated with scrub soils are usually saline and unsuitable for irrigation and stock purposes.

Vegetation

The vegetation can be divided into two main classes dependent on topography.

(a) On the flats, hills, and lower slopes of the ranges.

1. Queensland Blue gum open forests—mainly on the flats.
2. Gum-topped box open forests—on flat or gently undulating land.
3. Ironbark open forest—on poor soils of low slopes and foothills.
4. Spotted gum—narrow leafed ironbark open forest—on poor soils of the low slopes of ranges and on low ridges and hills.
5. Brigalow softwood open forest—on the more fertile soils of hilly to undulating country.

(b) On the mountain peaks, and the mid and high slopes of the ranges.

1. Open forests of ironbark—stringybark, flooded gum, brush box.
2. Closed forests of rainforests and scrubs, antarctic beech, etc.

General

Fully improved tropical pastures have done extremely well in this area on both scrub and forest country. A problem exists on newly cleared Brigalow scrub soils with the establishment of tropical pastures. Legume persistence appears to be affected by the excessive growth of grasses associated with high nitrogen levels.

There is approximately 40,000 ha of country in the Boonah Shire which is suitable for low cost pasture establishment. Most of this country, for a variety of reasons, is not able to be cultivated. The practical examples of the two farms seen today show what this type of pasture development can do for this steep country.

FARM VISIT—"EL NIDO" PASTORAL CO., CHARLWOOD

Introduction

The property and pasture development program were described by Mr. Harley Adams. The holding comprises 138 ha, sloping from the top of Mt. Edwards down to a creek frontage. The land had been logged and commercially useful timber removed prior to development. The block then had a carrying capacity of less than one beast to seven hectares and was still dominated by light to moderate density eucalypt forest, with a thin cover of native grasses. The few open areas were often dominated by blady grass.

Pasture development

Approximately 60 ha were manually treated with Tordon between September 1975 and April 1976. Overall the kill was good, although spotted gum treated under less favourable conditions 'bled' badly and was much slower to brown out. Cost of timber treatment chemicals was high as limited labour was available and the Tordon was applied at above recommended concentrations to insure success. The total cost of timber treatment was estimated as follows:

Tordon	\$825
Labour (120 man hours at \$4 per hour)	\$480
	\$1305 (\$21.70 ha^{-1})

Fifty ha of the treated area were aerially fertilized and sown during November 1975, while timber treatment was in progress. Establishment was satisfactory regardless of whether timber was treated before or after sowing.

The sowing rates used and seed costs were as follows:

Siratro (1.5 kg ha^{-1})	\$230
Green panic (3 kg ha^{-1})	\$250
Mo super (250 kg ha^{-1})	\$800
Application	\$200
	\$1480

Thus development costs were \$29.60 ha^{-1} for seed and fertilizer application and \$51.30 for the full treatment. The whole block was stocked with 40 head just before sowing and was carrying 60 head when inspected.

There had been a good establishment of the oversown species, Siratro in particular having a good density of vigorous plants although plants were small as a result of the grazing pressure imposed. The density of green panic was probably adequate although the individual plants were still small and unproductive. The green panic is not expected to yield well until there is a build up of soil nitrogen from the sown legume. The general feeling of members was that grazing pressure would have to be appreciably lightened for this legume build up to occur.

FARM VISIT—PROPERTIES OF MESSRS L. & K. CHALK, CARNEY'S CREEK

Introduction

The properties and the history of pasture improvement were described by Mr Keith Chalk. The two farms owned by the Messrs Chalk are on the foothills of the McPherson Range with an annual rainfall of approximately 1250 mm. The farms, run independently, both have a dairy herd of approximately 80 cows and, in addition, beef cattle which are grazed further away from the farmhouses. Sward lucerne, grown on alluvial flats, was formerly the major source of feed for the dairy herd. However with the pasture development program described below the dairy herd is now fed on native pasture oversown with tropical legumes. The alluvial flats are now used for other purposes including cash crops such as potatoes. The pasture inspected on the field day was that used for the dairy herd, but similar development has occurred on areas used for the beef herd.

Pasture improvement

The first pasture improvement on non-arable land was undertaken in 1969 when 26 ha were aerially sown on both properties with Siratro, Louisiana white clover and Ladino white clover, each sown at one kg ha^{-1}, with 500 kg ha^{-1} of molybdenised superphosphate. There was some timber treatment with Tordon before sowing and small amounts of follow-up treatment since.

The seed was sown in March and the paddocks stocked until the end of August; this was believed to assist in pushing the oversown seed into the soil surface. There was good emergence and establishment of the sown species following spring burning. Mr. Chalk has continued with March sowing, which is partly controlled by March being a suitable time for small planes to operate in the valley. Flying in winter and early spring is restricted by windy conditions. An additional problem is that paddocks are often burnt inadvertently in spring and seeding of native pasture straight after burning can result in exposed seeds failing to germinate and establish well in hot drying spells which often follow spring thunderstorms.

Another 26 ha was sown on both farms in 1970, using 0.5 kg of Siratro and 1.0 kg of Tinaroo glycine, fertilized with 250 kg ha^{-1} of molybdenized superphosphate and 250 kg of standard superphosphate. Glycine was slower to develop than Siratro but with time has resulted in a better pasture, although Cooper glycine is now preferred to Tinaroo. This pattern of development has been continued. Over half of the total area of both properties has now been improved, 320 ha out of 608 ha.

Results of pasture improvement

Mr. Chalk explained how using tropical legume based pastures has eliminated the time and trouble associated with controlling the grazing of dairy cows on sward lucerne. The 80 ha pasture inspected by the Society is grazed throughout the year at one cow per hectare and provides the basic feed supply for the dairy herd throughout the year. The pasture is subdivided into three paddocks of equal size and the two paddocks closest to the dairy building are used mainly for night grazing. White clover provides quality feed in the cooler months when there is little growth from tropical species. The main period of pasture deficiency occurs between August and November when some supplementary grain feed is used.

Mr. Chalk described how the botanical composition of the oversown pastures has changed with time. By three years after sowing the pastures were legume dominant, the native wire grass and naturalised blady grass being largely eliminated. With the build up of nitrogen and mulch there was some invasion of weeds and thistles, but these seem to be decreasing as 'high fertility' grasses such as Rhodes grass, couch grass, Kazungula setaria and paspalum are invading. There may be scope for assisting this invasion by oversowing grasses such as green panic, Nandi setaria and Narok setaria. This has already been carried out on a small scale by sowing after a burn, as pastures in this area are regularly burnt, accidentally or otherwise. A burn every three years is preferred to a burn after six years when there is a greater build up of fuel and the fire may be too hot. Mr Chalk and Mr Steenstma of the Soil Conservation Branch both emphasised how the vigorous dense cover of the oversown pasture prevented surface wash erosion and landslips.

The pasture is now stocked at one cow per hectare and Mr Chalk considered that further subdivision could enable better distribution of grazing and assist in raising the stocking rate further. There has been some evidence of a slight response to sulphur top dressing and at present different forms of sulphur suitable for top dressing are being considered and their costs assessed. However there has been no maintenance fertilizer application to date, although the oldest pastures are now seven years old.

The farm was an impressive example of how low cost tropical legume based pastures can be successfully maintained and used for dairying. In proposing a vote of thanks to both Mr Adams and Mr Chalk, Dr P. C. Whiteman pointed out how the two field visits demonstrated that tropical legumes could be successfully oversown into native pastures and gave members the opportunity to examine both newly oversown and well established pastures. Readers interested in following this topic further are referred to review papers in the preceding issue of *Tropical Grasslands* (Vol. 11, No. 1) which deal with establishment of Siratro (pp. 41-8) stability of Siratro pastures (pp. 55-68) and animal production from Siratro-based pastures (pp. 79-86).

MAINTENANCE FERTILIZERS FOR SIRATRO PASTURES

G. E. Rayment

Introduction

When it is considered that Siratro (*Macroptilium atropurpureum* cv. Siratro) based pastures have been established on soils with widely ranging physical and chemical properties and that these pastures are subjected to varying grazing pressures and environmental influences, it is reasonable to expect that their specific requirements for maintenance fertilizers could vary considerably.

Local district maintenance fertilizer recommendations, usually based on expectation rather than direct experimental evidence, clearly have limitations and in the present and likely future economic climates, a more rational basis for determining fertilizer needs is desirable.

To be more precise it is necessary to know firstly when a useful increase in productivity could be expected, following the application of one or more nutrients; and secondly, when a need is recognized, how much, in what form, when and how should the nutrients be applied.

Some answers to these questions have come from research programs conducted in south eastern Queensland over recent years. In at least two of these, the requirements for fertilizer by Siratro or Siratro based pastures have been linked to some measurable quantity or management practice.

I have been intimately associated with one of these programs—relating the response to components in Siratro based pastures to applications of phosphorus, potassium and sulphur fertilizers and linking the responses obtained to soil tests and plant analyses. In another program the responsiveness of Siratro to molybdenum and the residual value of molybdenum to Siratro over a period of years has been studied. This work with molybdenum has been a joint CSIRO-DPI program co-ordinated by CSIRO.

Particular attention has been given to phosphorus, potassium, sulphur, and molybdenum in these studies for a very good reason; all are key elements for consideration in maintenance fertilizer programs for legume based pastures generally. For simplicity in this discussion, I propose to discuss the apparent responsiveness and needs of Siratro based pastures for each of these nutrients in turn, as determined from the research programs mentioned.

Phosphorus

In a recent paper (*Tropical Grasslands*, Vol. 11, No. 1, pp. 67-78) my co-authors and I detailed the responsiveness of established Siratro pastures to phosphorus and linked the response of the Siratro component to the two 'available' phosphorus soil tests commonly used in Queensland. Using the bicarbonate test on soil samples of 0–10 cm depth, responses are likely below 10 ppm, unlikely above 14 ppm and uncertain in the range from 10 to 14 ppm. By acid extraction (0.01 N H_2SO_4) equivalent values are 13, 22 and 13 to 22.

These are relatively low values by soil testing standards, suggesting that established Siratro plants have a low phosphorus requirement, are efficient at extracting phosphorus from the soil, or are unable to obtain sufficient phosphorus from surface applied fertilizer to respond, due to competition from associated grasses and/or phosphorus fixation by the soil.

In any case a soil test can now indicate with a good degree of confidence which Siratro based pastures are likely to respond to maintenance phosphorus fertilizers. On the other hand, plant phosphorus levels did not provide a reliable guide to the prediction of phosphorus response but they may indicate some situations where phosphorus is in luxury supply.

How much phosphorus to apply to a responsive site is more difficult to determine with accuracy as it is influenced by such things as soil type, environment and the dry matter production required. Preliminary estimation from our data of the "best rate" of phosphorus for the 18 Siratro experiments studied, suggests a rate of 30 kg P ha^{-1} (375 kg superphosphate) below 10 ppm bicarbonate extractable phosphorus and 20 kg P ha^{-1} (250 kg superphosphate) from 10 to 14 ppm P for 90% of maximum Siratro yield. For 70% of maximum yield, 10 kg P ha^{-1} (125 kg superphosphate) would appear to suffice. It should be noted however that low rates of phosphorus (10 kg ha^{-1}) tended to give inconsistent responses.

These rates apply to broadcast application of mono calcium phosphate ($CaH_4(PO_4)_2H_2O$), the form of phosphorus found in single and high analysis superphosphates. At present we have no information on how long after the year of application this fertilizer remains effective.

Potassium

Significant responses ($P < 0.05$) to potassium applied as muriate of potash equivalent to 50 kg K ha^{-1} were recorded at three of the 18 sites examined. At one site a response occurred in both grass and Siratro components, at another it occurred only in the Siratro component while at the third site the response was in the grass component but at no time were any of these responses dramatic.

Exchangeable potassium analyses on surface 0–10 cm soil samples from all sites indicate that no response to potassium in either the Siratro or grass components, growing in the presence of an adequate supply of all other nutrients, would be expected when the level exceeds about 0.2 m equiv per cent or 80 ppm. Below this level a response is possible but not certain since an equal number of responsive and non-responsive sites were in this grouping. In this uncertain zone, at least until other soil tests for potassium are evaluated, the decision whether or not to apply potassium must rest on other considerations such as the presence of leaf symptoms, foliar analyses or test stripping. When laying down test strips or treating the entire area, application rates of from 25 to 50 kg K ha^{-1} in the form of muriate of potash should be suited to most soil types but it should be noted that the best "rate" to use cannot be determined from the work conducted to date.

Sulphur

The response of both Siratro and grass components to sulphate–sulphur in the presence of adequate phosphorus and other nutrients was also examined. Of the 18 sites studied only one showed a significant ($P < 0.05$) response in the Siratro component and no positive responses were recorded in the grass components. However the sulphur treatment depressed the grass yield at two sites and at one of these sites the effect carried over into the total yield of the pasture which was also depressed. An application rate of 25 kg S ha^{-1} as gypsum was used at all eites.

Not all sulphate–sulphur soil analyses were available for examination so an indication of the value of the soil sulphur test for predicting response to sulphur cannot be given at this time. It may be worthy of note that of the values so far obtained, the responsive site had the lowest level at 1.4 ppm sulphur in the 0–10 cm portion of the profile. An increase in sulphate–sulphur status with increasing soil depth would also be expected in those soils with an acidic profile trend and lower phosphorus status at depth.

From our work it does appear that sulphur deficiency in established Siratro based pastures in south eastern Queensland is not prevalent, especially when growing in soils which are acidic at depth and which have received applications of superphosphate or sulphur during the establishment phase. More caution would be required where soils are neutral to alkaline at depth and/or have a high phosphorus status throughout the profile, since under these conditions sulphate–sulphur can readily leach through the soil.

The "best rate" of sulphur to apply cannot be determined from our work since only one sulphur rate was used. Almost certainly lower rates than this would suffice, especially in marginally sulphur deficient areas. When phosphate is also required, the sulphur contained in superphosphate should be adequate.

Molybdenum

Following several years joint CSIRO-DPI work, a clearer picture on the molybdenum requirements for Siratro has emerged. On most soil types, especially those with an acidic profile and which have an ability to adsorb phosphorus, molybdenum will be required from time to time to ensure the good growth of the Siratro component in the pasture.

For most soils growing Siratro, a rate of 100 g Mo ha^{-1} every three to four years would ensure an adequate supply. When phosphorus is also required by the pasture, molybdenum fortified superphosphate applied at the appropriate rate to supply the necessary quantity of molybdenum would be the preferred method of application. When phosphorus is not required a spray application preferably following heavy grazing or slashing should prove equally effective if the same quantity of molybdenum is supplied.

At the present time there are no direct soil or plant tests for molybdenum of diagnostic value.

Summing up

Not all established Siratro based pastures respond to maintenance fertilizer in the year of its application. In the case of phosphorus a response in the Siratro compon-

TABLE 1

A Guide to the Assessment of Need, Application Rates, Suitable Fertilizer Forms and Timing for Maintenance Fertilizers on Siratro Based Pastures in South Eastern Queensland

Nutrient	Method of Assessing Need	Critical Values or Times and Nutrient Application Rates for Most Soils					Suitable Fertilizers	Timing of Application
P	Acid (0.01N H_2SO_4) *or*— Bicarbonate P soil tests on 0–10 cm samples	Response*	Soil P Test (ppm P)		P Application Rates* (kg ha^{-1})		Single or high analysis superphosphate	Top dress prior to active growth period
			Acid	Bicarbonate	90% Max Yield	70% Max Yield		
		Likely	<13	<10	30	10–15		
		Uncertain	13–22	10–14	20	Up to 10		
		Unlikely	>22	>14	Nil	Nil		
		*Responses and application rates apply only to the Siratro component						
K	Exchangeable K soil test on 0–10 cm samples (Best indicates when a response should NOT occur) Appearance of leaf symptoms	Response*	Soil K Test m.equiv %	ppm	Tentative K application rate kg ha^{-1}		Muriate of Potash (KCl)	As above
		Uncertain	<0.2	<80	Test Strip 25 to 50			
		Unlikely	>0.2	>80	Nil			
		*Response applied to both Siratro and Grass components						
S	Soil sulphur test still being evaluated. Experiments suggest S deficiency not common at present, possibly due to accumulations of SO_4–S at depth in many acidic soils	One response in Siratro component recorded at 1.4 ppm SO_4–S Tentative Application Rate — 10 to 25 kg ha^{-1}					● Single superphosphate ● Gypsum ● Elemental Sulphur	As above
Mo	Consider past Mo history and soil properties	Apply Mo at 100 g Mo ha^{-1} every 3 to 4 years especially on soils which fix phosphorus strongly					● Mo Superphosphate ● Molybdenum Trioxide as a seed treatment ● Sodium molybdate when applying as a spray	As above in year of application

ent can now be predicted with some confidence from soil phosphorus tests commonly used in Queensland, while exchangeable potassium tests appear to best define when a response should not occur. Soil sulphur tests are still being evaluated but sulphur deficiency in Siratro pastures found in south eastern Queensland does not appear to be widespread at present. Molybdenum applied at 100 g Mo ha^{-1} every three to four years should satisfy the molybdenum requirements of this legume on almost all soils. This information has been summarised in Table 1.

The best phosphorus rate varies with the yield expectancy and ranges from about 30 to 10 kg P ha^{-1} although low rates of phosphorus generally gave unreliable yield responses. Best results should occur when this is applied just prior to the active growing period of the pasture.