NORTH COAST BEEF CATTLE PASTURE AND NUTRITION SYMPOSIUM, CASINO, NOVEMBER 7 & 8, 1967

Arranged by

N.S.W. DEPARTMENT OF AGRICULTURE

NORTH COAST BEEF CATTLE RESEARCH LIAISON COMMITTEE

NORTH COAST BRANCH, GRAZIERS' ASSOCIATION

BEEF CATTLE PASTURE RESEARCH ON THE NORTH COAST

by

D. BROOKS, GRAFTON AGRICULTURAL RESEARCH STATION,

N.S.W. DEPARTMPNT OF AGRICULTURE

It is not generally realized that the North Coast is the most important beef producing area of New South Wales. Moreover, it holds an important place in the national structure of the industry. The North Coast is the only specialist beef breeding area of the state, and in 1966/67, supplied some 60,000 head of store cattle to Victorian and Riverina buyers.

During the recent drought, the North Coast was shown to be a safe breeding area, in that it was the only statistical division in N.S.W. in which cattle numbers did not drop in the two-year period. In fact, the cattle population rose by 10,000 head. This trend is a reflection of agistment rather than an increase from breeding itself, but the fact remains that the country could carry the extra stock during such adverse times. Two important implications can be drawn from this. Firstly, the demand for replacement stock following droughts is high, and the North Coast is a logical source of supply. Secondly, as major pasture improvement schemes begin operating, particularly in northern areas, there will be a greater demand for young stock in compliance with higher carrying capacities. Thus, it can be seen that the North Coast can look forward to a promising future as a major breeding area.

Looking at the local scene more closely, it will be seen that the Shires of Kyogle, Copmanhurst and Nymboida together support the greatest number of beef cattle in the Division. However, the dairy industry is almost as important as beef in the Kyogle Shire. This is a reflection of the much higher carrying capacity of that area, the better calving percentages, and the greater percentage of pasture improvement on an area basis. In other words, the rainfall pattern and soil types of the Kyogle Shire allow for the development of a higher plane of nutrition and a more intensive operation than in the Shires of Copmanhurst and Nymboida. These latter areas, which we shall refer to as the Clarence Valley, can be regarded as problem areas, and as such, are the focal point of beef research on the North Coast.

Despite the fact that the North Coast Division holds such an important place in the State's agriculture, it is relatively undeveloped. In an area only a little larger, the Northern Tablelands uses 800% more superphosphate each year than the North Coast. In the Clarence Valley, 95% of the industry depends on native or naturalized grass dominant pastures. The best of these support a percentage of paspalum, but the majority comprise the tufted native wire and spear grass types, or carpet grass.

All these pastures have serious quantitative and qualitative limitations. Dry matter production is low and poorly distributed throughout the year. Livestock production is hindered by protein, energy and phosphorus restrictions, so that only carrying capacities of the order of 1 beast to 8–12 acres are possible.

These are the reasons that an extensive breeding industry has developed.

Development of Research

Grafton has been the centre for an intensive plant introduction and selection programme that has been conducted for some 10 years. Whilst this programme is set up for the North Coast generally, it concentrates on species with application to the beef grazing system.

In 1962/63, with finance made available by the then Australian Cattle and Beef Research Committee (now reconstituted as the Australian Meat Research Committee), more detailed pasture investigations were commenced. From this beginning, a much-larger multi-disciplinary team approach has been rapidly built up to study the overall problem.

Phosphorus, as you will hear tomorrow, is one of the greatest production limitations at this stage and is receiving a considerable amount of attention, together with other nutritional factors. Detailed investigations are being carried out on species evaluation, establishment, pasture mixtures, and in the near future, management.

Recently, work commenced on livestock husbandry, including the influence of disease and nutrition on reproduction, and on livestock production. Rapid expansion is envisaged in this field.

Special consideration is also being given to the economic aspects of the industry's problems. This work is very closely associated with the pasture and livestock studies and will provide the final analysis of the results from the other fields.

Thus Grafton has rapidly developed as the main centre for beef research for the N.S.W. Department of Agriculture. This is logical for the very reasons I explained earlier. It is just as logical that any future investments made into beef research carried out by the Department be based at this same centre, and not be spread thinly over a number of locations throughout the North Coast, or for that matter, the state. The research that needs to be done will be costly, and will require central facilities, including a well balanced team of professional staff. It will have far-reaching effects, both within the North Coast and beyond.

Research Progress

Before outlining some of the research findings to date, it is as well to point out that a major research programme such as this can only investigate the broad regional problems. It is up to the extension services and the graziers themselves to adjust these findings to their own particular situations.

The native pastures are the subject of very close study. It is important that their limitations and potential be well documented in order that full utilization can be made of them. These pastures are characterised by very slow rates of growth. A maximum growth rate of 15 lb dry matter/acre/day has been measured, whereas growth rates of 60–90 lb D.M./acre/day or more have been attained with exotic grasses. The total production from these swards is low (800–1000 lb D.M./acre) and this is mainly produced in the restricted period of December to March. In terms of quality, the levels of phosphorus and protein to be found in the plant material is unsatisfactory. The pastures are dominantly grasses, are shallow rooted, and show up the vagaries of the weather very quickly.

However, the native pastures can respond to superphosphate application, but their ability to utilize this fertilizer is limited compared to the exotic species. Dry matter responses of the order of 40–50% have been measured to an application of 2 cwt super/acre, and the phosphorus percentage has been raised to a more satisfactory level. In terms of livestock production, however, these responses may not be economic.

The major part of the research programme is concerned with species to modify, or replace the native pastures. The emphasis is being placed on legumes at this stage, and both tropical and temperate species are being considered in detail.

Suitable pasture species have received a lot of attention today, but it is pertinent to make a few additional remarks. In the Clarence Valley, the tropical legumes showing greatest promise are lotononis, Siratro and Townsville lucerne. Lotononis has the greatest production of them all, and it appears to be very useful over a wide range of conditions. Siratro is well adapted to the beef environment and a wide range of soils, but its production is limited by its poor cold tolerance. When the new strains that Dr. Hutton discussed are released, this species will have still greater potential.

It has been said that Townsville lucerne will not grow below a certain latitude, which is to be found in Queensland. Results in the Clarence have given evidence contrary to this. It appears that certain soil types, the climate and the grazing regime in this valley create an ecological niche suitable to Townsville lucerne. The species is best suited to the lighter textured soils, particularly the sandy and gravelly types that are common on the ridge country. In other words, it has its greatest application on areas of low fertility and low carrying capacity. With the current work being carried out on earlier flowering strains and related species, this plant will have an important place in future developments.

Turning now to the temperate species, it is pleasing to note the amount of discussion that has taken place on white clover. I feel that the full potential of this species has not yet been fully realized. White clover has displayed persistence and disease problems in the past, but our research is throwing some light on these. The soil phosphorus levels play an important part in the survival of the clover over the hot summer months. There are big strain differences also. The naturalized strain is early flowering, a heavy seeder and behaves as an annual. Ladino has better heat tolerance and production, but is a shy seeder. A strain introduced from Israel a few years ago has shown much greater summer survival than any other strain, has good seed yields and is capable of good dry matter production. Efforts are being made to increase seed of this strain.

Kenya white clover (*Trifolium semipilosum*) has been mentioned earlier, and our limited research to date indicates that this species has good potential. Subterranean clover may have a place in some situations, and the Woogenellup strain is most promising. Lucerne is giving good results, not only as a forage crop on river or creek alluvials, but also a part of a mixture with say, Siratro and Rhodes grass.

From earlier discussion it has been shown that oats fertilized with nitrogen, and vetch, have economic and management limitations in the beef enterprise at this stage of development.

The species that I have just discussed, when put together, are an attempt to provide better nutrition throughout most of the year. However, at this stage we are not aiming to provide a smooth feed supply curve to fit animal requirements neatly. With the present low gross returns per acre being received, we are immediately concerned with raising the overall level of production, by increasing breeding performance as well as growth rates of young stock. This is being done with grass/legume combinations. When the overall gross returns per acre can be raised to a more satisfactory level, then we will give closer consideration to more intensive techniques.

Future Research

It has been pointed out that there is very little knowledge available on the returns to be expected from pasture improvement for beef production on the North Coast. The stage is now reached where considerable plot data is accumulating, but very little animal data is available. Thus, it is difficult to apply existing knowledge to farm situations.

To overcome this lag, comprehensive grazing trials are being planned. They are being designed to evaluate a range of pasture systems, leading up to a fully developed legume/grass pasture.

Very detailed animal performance data will be measured in terms of growth rates, breeding performance, diet selection, intake, digestibility and carcase quality. Not only will responses be measured, but it will be attempted to determine the limitations of each system from the animal's point of view, and to pinpoint the areas for improvement in any one system.

The major overall goal of these projected studies is to develop principles of pasture improvement to fit the physical, social and economic environments of the North Coast beef industry. It is envisaged that from these principles, viable farm plans may be developed.

PASTURE SPECIES AND BEEF PRODUCTION ON THE NORTH COAST OF NEW SOUTH WALES

by

E. M. HUTTON, C.S.I.R.O., DIVISION OF TROPICAL PASTURES, BRISBANE

INTEGRATION OF TROPICAL AND TEMPERATE SPECIES

To increase beef production from pasture it is necessary to increase throughout the year the availability of digestible protein and energy and minerals like phosphorus and calcium to the grazing animal. This can be achieved by making better use of the species which have been with us a long time such as *Paspalum dilatatum,* Kikuyu grass, Rhodes grass, green panic, white clover and lucerne, and intergrating these with the new tropical legumes and grasses. Due to its climate the north coast is a particularly promising area for the integration of temperate and tropical species. From the Macleay River in the south to the Tweed River in the north rainfall is good with the greater percentage being received during the summer growing season from November to April inclusive. For example, at the following sites annual rainfall and the percentage of this received from November to April are — Kyogle 45", 68%; Tabulam 37", 70%; Casino 34", 80%; Lismore 52", 64%; Grafton 36", 65%; Taree 45", 59%. Due to the incidence of winter frosts, particularly away from the coast, it is better to plant the frost sensitive tropical legumes on the well drained hills and the frost resistant white clover, lucerne and *Lotononis bainesii* on the lower alluvial flats.

The important legumes

White clover and lucerne are still two of the most dependable and versatile legumes and every effort should be made to use them more effectively. Due to their frost resistance and high growth potential in winter, spring and early summer they complement the tropical legumes. They can provide valuable protein during what can be the drier part of the year particularly if supplementary irrigation is available. Among the tropicals the most promising include the perennial desmodiums, Siratro, *Glycine javanica, Lotononis bainesii* and the biennials *Dolichos lab lab, Dolichos axillaris* and *Vigna luteola.*

White clover

White clover is the most efficient legume in building up protein and nitrogen in a pasture. Its persistence on the north coast is often affected by Amnemus weevil and root-knot nematode. Also it can be weakened by several virus diseases including white clover mosaic. There is no formula to overcome these difficulties but the introduction of heavy seeding and more annual types like Louisiana will minimize the effects of these parasites by enabling white clover to recolonize pasture areas. Also particular attention needs to be given to the phosphorus, sulphur, and molybdenum status of the soil if white clover is to be kept vigorous and productive and competitive with grasses like *Paspalum dilatatum* and Kikuyu.

At our Samford Pasture Research Station introduction of Ladino white clover and superphosphate and other fertilizer into areas where the small leaved naturalized white clover occurs has resulted in the intercrossing of the two types and the rapid emergence of vigorous, persistent, mainly annual strains better adapted to the more fertile environment. In fact white clover is now spreading over the hills as well as the flats at Samford. It is possible that the same sort of chain reaction could occur on your north coast with white clover given the right ingredients.

Trifolium semipilosum or Kenya white clover is a promising species related to white clover. As well as a stoloniferous habit it has a strong taproot which gives it greater drought resistance than white clover. It has given particularly good winter yields in some areas of southern Queensland and could become more widely used if nodulation and establishment problems could be overcome.

Lucerne

As stated earlier greater use should be made of lucerne. More scientific effort is being devoted to lucerne these days and new strains like African, Hairy Peruvian, and Canberra Creeping are becoming available. The ubiquitous Hunter River still has a lot to offer the grazier.

At the Cunningham Laboratory Dr. R. A. Bray is aiming to breed a vigorous and persistent grazing lucerne for the sub-tropics. He is successfully introducing the creeping-rooted character into new lucerne strains which have the crowns below the soil surface. Persistence under grazing and competitiveness with summer growing species will be assured by the ability to continually replace moribund crowns with new vigorous crowns from buds on the spreading root system.

The desmodiums

Desmodium intortum or greenleaf and *D. uncinatum* or silverleaf have become popular particularly in the better rainfall areas. They are adaptable to a wide range of soils, have a long growing season with good spring and autumn growth and combine well with a range of grasses. Like some of the other tropical legumes they grow and persist best when rotationally grazed at intervals of about a month. A serious problem with the desmodiums in some areas is the weakening and thinning out of stands due to root damage from larvae of the Amnemus weevil.

Greenleaf is tending to replace silverleaf because it is hardier but seed yields for greenleaf are lower and seed prices higher. At the Cunningham Laboratory breeding work is in progress to develop earlier more drought tolerant lines of

D. intortum which set heavy crops of seed before the frosts. The best of these lines will continue vegetative growth in spite of a heavy seed crop. Another character being incorporated in these new lines of *D. intortum* is quicker nodulation than greenleaf which it is hoped will lead to better field establishment. Attention is also being given to field resistance to the virus disease legume little leaf which can become limiting under some conditions. Progress with this aspect is promising. No work is contemplated on resistance to the Amnemus weevil as it is considered that at this stage the problem is an entomological one and research should be concentrated on a study of the ecology and physiology of the Amnemus and associated weevils.

Siratro

Due to its adaptability to a wide range of soil and climatic conditions and its drought resistance the demand for Siratro seed is high and seed tends to be scarce and high priced. The position is aggravated by the relatively low commercial seed yields per acre. In Siratro actual seed yield is quite high but seed is lost due to pod shattering and one of the main aims of the program at the Cunningham Laboratory is to breed lines with pods possessing a high resistance to shattering. Good progress is being made with this character which is being combined with greater stoloniferous development and yield than Siratro and with a longer growing period than Siratro. Some of the new bred lines of Sirarto not yet ready for release continue active growth at Samford until frosting in July whereas active growth of Siratro ceases at the end of April. These lines also commence growth earlier in the spring and it appears that they have a greater tolerance to temperatures below 70°F.

Siratro appears to be the most resistant tropical legume to root knot nematode and has a good level of resistance to Amnemus weevel in Southern Queensland and the north coast of N.S.W. In some areas of North Queensland Siratro and also desmodium and dolichos have been attacked by another type of native weevil. Siratro has good field resistance to legume little leaf but in North Queensland a proportion of plants can be affected where stands have opened up due to drought or overgrazing.

Siratro is compatible with a range of grasses like *Setaria sphacelata*, green panic and Rhodes grass but tends to be crowded out by Kikuyu and Pangola grass. The new lines being bred for ability to grow at lower temperatures appear to preserve a more favourable legume-grass balance as they start active growth at the same time as the grasses in spring.

Glycine javanica

As a result of research at Wollongbar *Glycine javanica* has become the most productive pasture legume on the red and chocolate basaltic soils where it forms a balanced association with Kikuyu and other grasses. It also grows well on fertile scrub soils where it is rivalled by greenleaf desmodium if this is free from Amnemus weevil. *Glycine javanica* although attacked is less susceptilbe to weevil than greenleaf desmodium.

The Clarence strain released by the New South Wales Department of Agriculture has proved to be the most adaptable on the north coast although in Southern Queensland Cooper has proved to be adpatable to a wider range of soil conditions than other strains of glycine. Tinaroo still seems to be the best strain in North Queensland.

Slow establishment is one of the difficulties with glycine and this may be related to slow nodulation. Work is in progress at the Cunningham Laboratory to study pattern of nodulation and growth in a big range of glycine lines with the aim of breeding types with better establishment and early growth. Glycine does not persist on the large areas of poor soils in Queensland and the north coast of N.S.W. represented by the solodics, podsolics and sandy soils. This is puzzling and may be related to low pH and associated aluminium or manganese toxicity or low calcium. Until this is sorted out by work in progress it is difficult to plan a breeding programme aimed at greater adaptability in glycine.

Lotononis bainesii

Miles lotononis unlike most of the other tropical legumes will grow well and persist only when supplied with its specific *Rhizobium.* It is also unusual in being frost resistant and on this basis may not be a true tropical. It has a long growing season from spring to autumn and is well adapted to sandy and shale soils quickly forming a thick mat under the right conditions and combining with grasses like Pangola.

Miles lotononis is quite susceptible to the virus disease legume little leaf particularly in drier areas where the stand tends to be more open. Dense vigorous stands need to be well grazed and managed in summer to prevent thinning out of the stand from fungus attack. It is a very palatable legume and is often grazed selectively. One of the main problems with Miles lotononis is the tendency for it to almost disappear from a pasture after a few years and then thicken up again. The reason for this fluctuation is not known at present.

Dolichos and Vigna

Dolichos lablab, Dolichos axillaris, and *Vigna luteola* are biennial legumes which are finding a place under special conditions. Rongai lablab is now used as a preparatory crop for pasture and fills this role very well as it is adaptable and adds significant amounts of nitrogen to the soil. Archer axillaris is drought resistant and grows well in the spring and also holds its leaf well into autumn and early winter; it can be grown on drier hilly areas as a feed reserve and is not particularly palatable until mature.

Dalrymple vigna is a quick growing prostrate legume which is very palatable to stock and which will grow under damp almost swampy conditions. It nodulates freely and adds significant amounts of nitrogen to the soil. It is among the few legumes which tolerate saline conditions.

The Important grasses

The important grasses for the north coast include the paspalums, panicums, setarias, Rhodes grass, Kikuyu and Pangola grass. *Paspalum dilatatum* which is naturalized throughout the area in favourable situations must not be discounted. When oversown with white clover and adequately fertilized with superphosphate and, where needed, with potash and molybdenum the resulting paspalum-legume pasture is highly productive and has a very high nutritive value.

Kikuyu and Pangola are both high quality grasses and when well supplied with the essential nutrients nitrogen, phosphorus, and potassium will give high yields of digestible nutrients and correspondingly high animal production. Kikuyu and Pangola can only be grown on limited areas of the north coast and it is not always easy to grow a legume with them. Wollongbar has been successful in growing glycine with Kikuyu, white clover is grown with Kikuyu on the Maleny tableland of Queensland and at Beerwah Pangola grass and Miles Lotononis with some white clover form a fairly stable mixture.

The panicums and Rhodes grass are more typical of the majority of tropical grasses with their low digestibility which declines rapidly after the young leaf stage. The reason for the low digestibility is not known and cannot be explained solely on the basis of cellulose and lignin percentage. This problem is being investigated at the Cunningham and Cooper Laboratories.

Of the panicums, green panic is well known. More recently Gatton panic has been released and is showing promise, being leafy and vigorous and adapted to a fairly wide area. Some interest is now being taken in the *Panicum coloratum* group but one of the difficulties is their poor seed yields. Panicum kabulabula lines are showing distinct promise as they are high yielding and drought-resistant and have some frost tolerance and grow away rapidly in the spring.

The most promising grass releases of recent years have been Nandi and Kazungula setarias from the *Setaria sphacelata* complex. These grasses establish well and grow quickly and are adapted to a wide range of conditions above about a 30" rainfall. They are also very palatable. The setarias combine well with a range of legumes and seed has been in constant demand. Frost susceptibility reduces their value in winter when there is often a shortage of high quality feed. Mr. R. J. Jones' setaria collecting expedition to East Africa in 1963 gave the setaria breeding program a much needed stimulus by providing material with a high degree of frost resistance. It should not be long before high yielding strains of setaria, with an extended period of growth and frost resistance, will be available.

Nutrient requirements of legumes and grasses

It cannot be stressed enough that production from the soil-pasture-animal system is mainly dependent on whether there is an adequate supply of available soil nutrients. Mr. C. S. Andrew of the Cunningham Laboratory has been investigating for some years the effects of different amounts of the various essential elements on the growth of white clover, lucerne, and a number of tropical legumes. He has determined the lowest or critical percentage of the element which has to be present in the leaves for maximum yield to be obtained in the particular legume. For maximum yield in white clover and the tropical legumes the dried leaves should contain 3 per cent nitrogen, 0.24 per cent phosphorus, and 1 per cent potassium. Thus it is only necessary to take a few leaf samples from the legumes in a pasture and have them analysed for N, P, and K. If any of the percentages obtained are below the critical value the requisite fertilizer needs to be added whereas higher percentages than the critical value indicate that the fertilizer need not be applied. If N is low, in spite of adequate P and K, further molybdenum is needed as this governs the transformation into protein of the N taken up by the *Rhizobium* in the root nodules.

Except in the rich basaltic and more fertile scrub soils phosphorus deficiency, and no doubt the accompanying sulphur and molybdenum deficiencies, are widespread. It is a waste of time the farmer planting legumes and grasses on the less fertile soils unless he is prepared to use adequate quantities of superphosphate and other fertilizer.

The main nutrient required by grasses is nitrogen although for maximum yields fertilizer dressings containing P, K and other nutrients are required. This is often overlooked when the merits of using a system based on nitrogen fertilized grass are discussed. Due to the subsidy and manufacture on a large scale the prices of nitrogenous fertilizer have been reduced by at least a half over the last 10 years. At present nitrogen is 8.3 cents and 6.3 cents per pound on the basis of urea and aqua ammonia respectively. With a high rainfall, an extended growing season and a grass like Pangola, which uses N efficiently to produce high yields of digestible nutrients, nitrogen fertilized grass could be economic. However, careful management is required since a large increase in pasture production from nitrogen does not necessarily mean increased animal production in the same ratio.

Legumes still provide the cheapest source of plant protein for the animal and nitrogen for the associated grass. Also it must not be overlooked that legumes are more digestible than grasses at every stage of growth. Properly fertilized and managed legume-based pastures will always be economic. The constant flow of research findings on legumes in Australia will ensure that their efficiency and utilization will gradually be improved. The "wild" tropical legumes now being used in pastures will eventually be fully "tamed" to give a much higher contribution to the soil-plant-animal system.

Conclusion

There is no doubt that the new knowledge of pastures species and plant nutrition enables you to increase the protein and dry matter available to the animal throughout the year on the north coast of N.S.W. with its equable climate. It is important that wastage of these valuable nutrients is reduced to a minimum and that as high a percentage as possible is converted into beef or milk as the case may be. This calls for management and fodder conservation and other techniques and also challenges the pasture scientist and animal physiologist to find the factors involved in the digestibility and utilization of legumes and grasses by the animal. It is only in this way that the productivity of the cattle industry will be gradually improved.

FILLING PASTURE GAPS

by

R. L. Colman, N.S.W. Dept. of Agriculture, Wollongbar, N.S.W.
Presently: Dept. of Agronomy, University of New England, Armidale, N.S.W.

Successful agricultural enterprise depends primarily on the efficient manipulation of a complex array of factors with the aim of achieving the most economic level of production. Thus, in the beef industry as with other forms of animal production, it is important to maintain the lowest possible costs without restricting unnecessarily the level of production or the time taken for the animals to become a producing unit or reach marketable age. Any increased costs, such as those incurred by the introduction of techniques for supplementing existing pastures, should be more than covered by expected or actual increases in production.

The Ideal Pasture Situation

It has often been stated that to achieve high animal production per acre, a large amount of high quality feed must be grown, the seasonal distribution of which should fit the curve of animal requirements. This situation is rarely if ever achieved under Australian conditions and only rarely in the world (e.g. New Zealand). Dairy cattle in milk require a continuous supply of high quality feed if they are to produce at a high level. Even short term breaks in the feed supply affect total yield during a lactation. In contrast, sheep and beef cattle can tolerate short term breaks in feed supply without much affect on total production. However, long periods of feed stress can have serious effects.

Fluctuations in Feed Supply from Pastures

We are all well aware of the type of fluctuations which occur in the pattern of feed production on North Coast and Northern Tablelands pastures. These fluctuations not only occur in the amount of pasture but also in its nutritive value. Thus, variations in pasture supply can be divided into:

(a) yearly pattern
(b) within-season fluctuations
and (c) week to week or even day to day changes.

Depending on the type of variation being considered so the grazier must make decisions regarding manipulations of his feed supply to best advantage for his animals and his bank account.

Manipulations

In general the grazier manipulates several factors of the environment in order to provide a more even feed supply. This is an extremely complex situation in which a basic knowledge of animal production, some local knowledge of the area and the ability to make a decision on the basis of the information available all play a role. A certain degree of luck may also be involved.

Decisions by the grazier should be based initially on the expected yearly pattern of feed supply and this will provide a basic plan. Once the basic plan is in operation than decisions must be made within seasons and finally from week to week and day to day. The basic plan should include all the components of the system, particularly the number of stock being carried and areas of pasture available.

Some Factors Affecting the Decision to Provide Feed During Periods of Low Pasture Production

Intensity of operation. Under extensive (low stocking rate) conditions it may not pay to provide supplements. The grazier has to contend with fluctuating bodyweights, long periods from birth to marketing and low fertility. As the enterprise becomes more intensive (higher stocking rate, pasture-improvement, sale of fat rather than store cattle) there is an increasing need for and an improvement in the economics of providing supplements to fill pasture gaps.

Type of beef production. This is related to intensity of operation. The type of pasture supplements necessary for a cow-calf operation may be quite different to those required for winter fattening and spring marketing. Timing of the availability of a supplement may also differ depending on the type of production.

Marketing factors. Producing out of season feed can often be highly profitable because it is possible to market animals when prices are high through market scarcity.

Techniques for Providing Supplements

Pasture Improvement. This involves the introduction of exotic species and the use of fertilizers which change the pattern of feed supply and use the environment more efficiently than existing pastures.

Fodder Crops. Oats, vetch, *Dolichos lab lab,* and sorghums grazed in the paddock are suitable. Cost is an important consideration together with reliability and ease of establishment. Sod-seeding may be useful with some species.

Conservation. Excess pasture or specially grown crops may be saved. High costs are involved together with considerable losses of nutrients from the conserved material.

Autumn Saving. This is already used extensively. Problems include large losses of nutrients in the field and declining liveweight over winter.

Concentrates. Coarse grains and protein supplements may be grown or bought.

Urea supplementation. This technique may be useful with the large amounts of low quality roughage available in winter.

Fertilizers. Nitrogen particularly may be useful for modifying the production pattern of grass pastures.

Irrigation. High cost may preclude its use for beef production except under special circumstances, e.g. Mareeba with Pangola grass + N.

WHAT DO WE KNOW ABOUT THE EFFECTS OF SUPPLEMENTS TO PASTURE ON BEEF PRODUCTION?

Let us examine in more detail some experimental evidence of the effects of the more important of the supplements I have mentioned.

Pasture improvement

There is now ample evidence of the large benefits which can be obtained from a programme of pasture development. A classical example of the effect of introducing legumes and fertilizer into a grass dominant summer growing pasture for beef production has been given by Shaw for the spear grass region in Queensland. With the use of Townsville lucerne and fertilizer, beef carrying capacity increased from a beast to 9 acres to a beast to 2 acres and liveweight production from about 30 lb/acre to 240 lb/acre in a good year.

Preliminary economic analyses of the oversowing of Townsville lucerne into natural pastures, shows that substantial returns can be obtained for the resources used. Even in areas where clearing and seedbed preparation is necessary the increased returns exceed the costs involved. Further south in the Wallum country the same story applies.

In the Grafton-Casino and Northern Tablelands areas there is no experimental evidence on the effects of pasture improvement on beef production. However, current research is aimed at the evaluation of species and determination of fertilizer requirements to provide important basic information for pasture development. It is most likely on the basis of evidence obtained elsewhere that pasture development with temperate and tropical legumes and grasses which supplement the existing pastures in this region will also give similar benefits to those obtained elsewhere.

Fodder Crops

In an economic survey of the beef industry in northern N.S.W. (Armidale-Grafton) Duncan found that in the store breeding enterprise the introduction of supplementary feed-supply activities such as vetch growing and buying lucerne hay were far too costly as general purpose feeds. Even as special purpose feed for the breeding herd in the pre- or post-calving period as a means of improving fertility, the extra returns were not favourable to the use of supplements.

Animal production experiments generally indicate that as stocking rate increases so does the benefit from supplements. This suggests that in less intensive situations such as the present beef breeding enterprise, the use of vetch or oats, or conservation does not pay. However, with intensification or the exploitation of seasonal price rises for cattle the growing of fodder crops could be highly profitable. There is probably some local experience on the value of this technique.

Growing oats as a supplement for pasture fed cattle is a common practice in Southern Queensland on fertile soils. The widespread adoption of the practice by beef producers changed the marketing pattern for fat cattle through the year and therefore had a marked effect on price fluctuations. In general the topography and soils of the region are highly suitable for cropping and a BAE survey showed that crop-fattening of cattle could increase nett farm income. Increased income resulted from higher beef gains per acre, lower age of cattle at market, a more even turn-off through winter when prices were higher and more economic use of capital assets such as machinery. In addition because of better winter feed more cattle could be carried on each property and this resulted in better utilization of summer feed.

The use of summer and winter fodder crops as supplements to pasture for beef production on the Tablelands is being investigated at Glen Innes but no detailed results are available.

Conservation

Considerable costs are associated with conservation and feeding out of excess pasture production. There is only limited experimental evidence on the value of conservation and results are generally variable. In a beef production experiment at Samford, S.E. Queensland, Jones found that conservation of excess summer growth of setaria and Rhodes grass increased liveweight gain and maintained increased growth rate in winter when hay was being fed back. The largest benefit was obtained in a year with a wet and frosty winter when feed remaining in the paddock deteriorated rapidly in nutritive value. The value of conservation was also greater at the higher stocking rate (1 beast to ½ acre compared with a beast to 2/3 acre).

Growing of crops specially for conservation can be costly unless high yields of supplementary feed can be produced. On most soils of the beef raising areas of this region large amounts of fertilizer are required to produce a large volume of high quality material for conservation. Unless a very high level of beef production is possible as a result of conservation it is more than likely that the practice will be uneconomic.

Autumn Saving

The value of this technique is very dependent on the pasture species in use and the climatic pattern. Under conditions of a "wet" summer and "dry" winter it is possible to maintain reasonably high levels of nutrients in autumn saved summer pasture, e.g. Townsville lucerne and spear grass. In areas where winter frosts and wet periods occur the nutritive value of autumn saved pasture (both legumes and grasses) declines rapidly. A wet winter under these conditions could mean a loss in bodyweight compared with the maintenance or gain in weight if the winter is dry.

In this region winter rainfall can often be quite high which results in spoilage of standing feed. It is therefore unlikely that autumn saving of pasture will give large and reliable production increases. It would certainly be a risky technique on which to base an increased stocking rate. With extensive beef production in this region non-deliberate autumn saving of excess summer growth provides feed for cattle in winter and early spring if dry conditions prevail. This feed supply is unable to maintain body weight during winter.

Concentrates

Feeding of grain as a supplement to pasture was tested at Yulgilbar with adult cattle during the dry autumn-winter period of 1965. Higher body-weights and better reproductive performances were obtained at low rather than high stocking rates (1 cow to 3 and 1 cow to 4.5 acres). At the low stocking rate 70% of cows became pregnant but only 50% at the high stocking rate. Rate of grain feeding was from 30 to 45 lb per head per week. Total cost per head was $11.20 for supplements from May to September. At the end of the period the cattle receiving supplement were worth $15,480 (172 animals at $90.00 per head). It was estimated that up to 50% of animals on similar pastures without supplement would have died during the period. Thus, the value of the supplement, just on the basis of reduced mortality, was worth approximately $7,500 compared with $2,500 as the cost of grain and its feeding.

An additional advantage in feeding the supplement was the maintenance of a normal breeding cycle in a high proportion of the herd.

Protein supplementation of weaners was also tested at Yulgilbar. Linseed meal fed to the animals at pasture resulted in liveweight increase during winter and spring and 75% pregnancy at 2 years of age compared with liveweight loss and 7% pregnancy in unsupplemented animals. No benefit was obtained from protein or phosphorus supplements to adult cattle.

The development of a coarse grains industry within the Grafton-Casino and Northern Tablelands region could provide a source of cheap concentrates from within the area. Such a development could occur as a part of the development of intensive beef production in the area. However, a careful assessment of the economics of the technique would be necessary based on the cost of grain production and the existing knowledge of the use of high grain rations for beef production.

Urea supplementation

There is now ample evidence of the value of urea as a nitrogen supplement for low quality roughage. In experiments in Western Australia on low quality pastures, urea supplementation was better than barley grain in reducing liveweight loss.

Urea supplementation may be of value for cattle grazing coastal grass dominant pastures during winter and spring but the effect on pastures containing legume may be much less. There is no local information on the use of urea supplements.

Fertilizers

A number of local experiments have demonstrated the value of nitrogen fertilizer for increasing yield, seasonal spread of production and nutritive value of grass pasture. All these effects could be of use in filling periods of feed deficiency in pastures. Application of nitrogen to pastures in autumn and spring for dairy cattle has enabled increased milk production during these periods and it is likely that similar effects on liveweight gain by beef cattle would be obtained. There is no data on the economics of nitrogen use for beef production but some Queensland results suggest that very high levels of beef production can be obtained from nitrogen fertilized grass pastures.

Irrigation

Irrigation is expensive to operate and must be used in conjunction with high producing pastures. Unless beef production is very intensive it is unlikely that the use of irrigation would be economic. However, it can be very significant in maintaining dairy production.

CONCLUSIONS

(1) Under extensive beef production situations the economic value of supplements to the existing pasture is generally questionable. An exception may be feeding for survival during sustained drought.

(2) The largest and most lasting benefits will be derived from a planned programme of pasture improvement based on the introduction of suitable species, the use of necessary fertilizers and an increase in stocking rate.

(3) When basic pasture improvement has occurred and stock numbers have been raised it may be economic to introduce to the system some of the techniques of supplementation mentioned above. The technique should be selected on the basis of cost, the availability of the extra feed, the chance of carrying more stock and the effect of the extra feed on the time that animals will be ready for market.

(4) As a general rule the provision of extra feed as a supplement should be coupled with an increase in stocking rate.

(5) The economic value of supplements increases as the intensity of production increases.

(6) On most beef holdings where labour is usually a major limiting factor it is possible to have both an extensive and an intensive enterprise, e.g. a store breeding enterprise with an intensive fattening unit based on a high level of improvement on a relatively small part of the farm. Supplements will be important on the intensive unit.

PLANT NUTRITION RESEARCH — BEEF CATTLE PASTURES OF NORTHERN NEW SOUTH WALES

by

E. J. HAVILAH and P. T. MEARS,

AGRICULTURAL RESEARCH STATION, N.S.W. DEPARTMENT OF AGRICULTURE, GRAFTON and WOLLONGBAR respectively.

Pasture plant production on the North Coast of New South Wales is generally low because of lack of established improved species and the essential nutrients for growth. The climate is favourable for plant growth and the region has a potential for a high sustained level of pasture productivity when species and fertilizer are introduced. The factors, species and fertilizers are under the graziers control and together with animals, capital, and knowledge can be manipulated to vastly improve farm production and income. Plant nutrition research aims to determine what nutrients are required to be applied as fertilizers to obtain productive pastures.

Research into the plant nutrient requirements for pastures for beef cattle in Northern New South Wales is being conducted from two centres. The fertility status of soils of the Clarence region is being investigated from the Grafton Agricultural Research Station, using species suitable for beef cattle grazing. Investigations from the Wollongbar Agricultural Research Station are being conducted into the nutritional requirements of the soils of the Richmond-Tweed region. This work is concentrated mainly on species adapted to fertile soils and grazed by dairy cattle. The results should be directly applicable if the same pastures are to be grazed by beef cattle.

The aim of these talks is to discuss the results obtained from this work, and to comment on fertilizer practices for beef pastures of the region.

SOIL TYPES OF NORTH COAST OF NORTHERN NEW SOUTH WALES

The distribution of the various soil types in Northern New South Wales can be closely related to the basic geology of the area. McElroy (1962) made a study of the geology of the Clarence-Moreton Basin. The area covered in the survey also delineates the area where plant nutrition research is being conducted in Northern New South Wales.

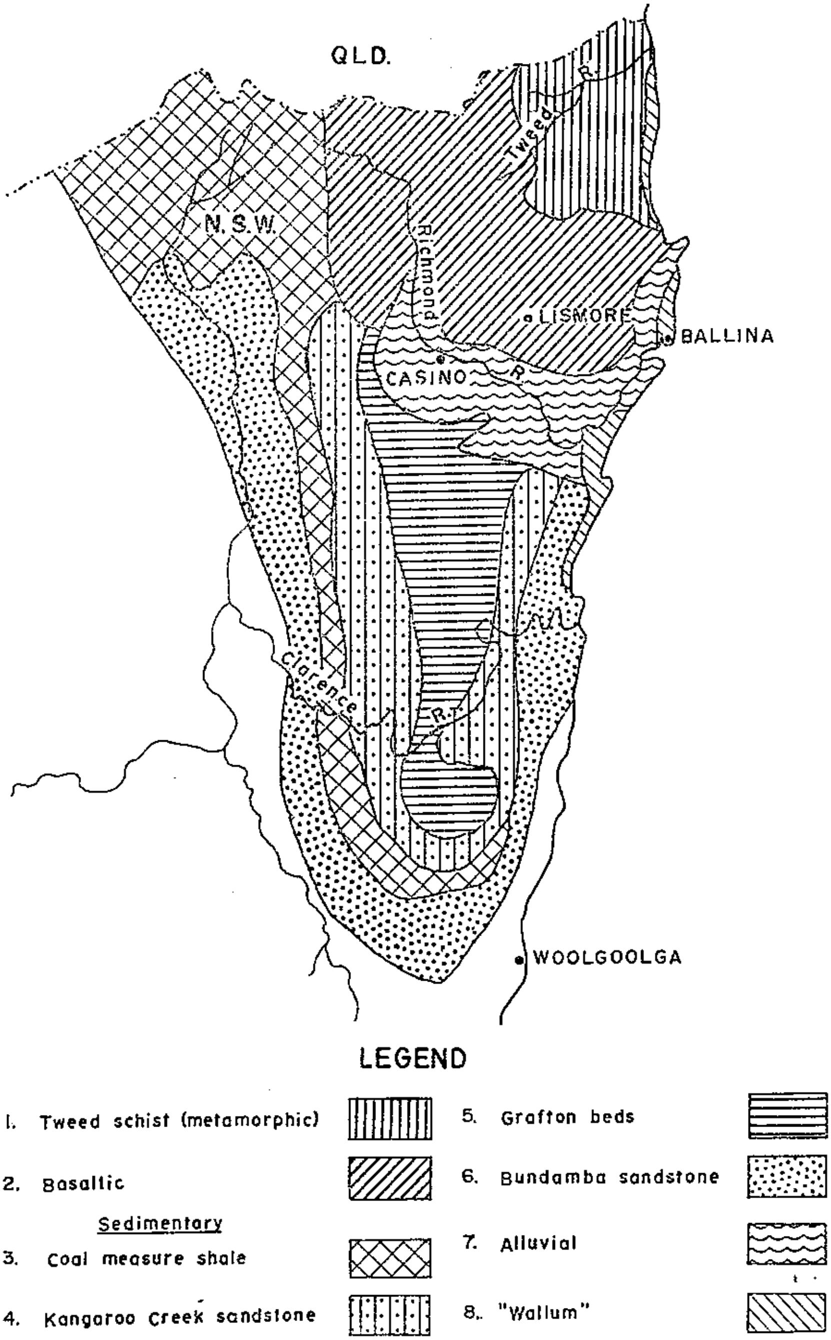
The main features of the geology of the area are:

1. Sedimentary series of the Clarence-Moreton Basin:

This series is a fresh water, sedimentary one in which beds of sandstone and shale have been laid down on the basement rock of marine origin. The sandstone/shale series is divided into the following groups:

- (a) The Grafton beds: These beds are shale in their axis and grade to coarse sandstone on the outer edges
- (b) The Kangaroo Creek sandstone series
- (c) The coal measure shale series
- (d) The coarse sandstones of the Bundamba and Marburg Series

SKETCH MAP OF SOILS OF RICHMOND-CLARENCE-TWEED REGIONS



The beds of the various series described above, outcrop along both sides of the axis which lies in a line between Casino and Grafton.

2. The Igneous Intrusion of Granite and Serpentine:

On the western edge of the sedimentary basin, intrusions of granite have led to scattered areas of soils produced from the granite rock type.

Associated with the igneous intrusion of granite, later in geological time, there have been further intrusions of the basic rock "Serpentine".

3. Metamorphic Slates and Phyllites West of the Clarence River:

The basement rock dates from the silurian age, and is derived from marine sediments.

4. The Basalt Flows of the Richmond/Tweed:

Basalt flows produced from Mt. Warning and other areas, resulted in the inundation of the sedimentary basin in the Northern areas by a cap of basalt. This basalt is the parent material for the basaltic series of the Richmond/Tweed.

5. Metamorphic Slates and Phyllites of Tweed Regions (Schist).

CHARACTERISTICS OF SOILS DERIVED FROM THE VARIOUS PARENT MATERIALS

The soils derived from sedimentary rocks, the sandstones and shales, are of lower fertility. These soils form the basis for the production of beef cattle on a high percentage of the Clarence River catchment. They are mainly podzolic or podzolic-like, and are recognized by a bleached A2 horizon, and a sharp texture change between the A and B horizons. The texture change is from a sandy loam, or sandy clay loam, in the A horizon to a medium or heavy clay in the B horizon. All soils have a deficient nitrogen and phosphorus status, low cation exchange capacity and, poor organic matter content. Drainage is also impeded. The shale soils with a higher clay content in the A horizon have a superior moisture holding capacity to the sandstone soils.

The granite soils have a higher sand content, but their chemical characteristics are similar to soils from the sedimentary series. On the other hand, soils on the Serpentine, a rock which is high in magnesium and other base elements, vary from red earths to narrow bands of black earths. These soils have different chemical properties to the soils from the sedimentary series. The areas of Serpentine are minor and no research has been conducted on them at this stage.

The red basaltic, chocolate basaltic and meadow soils differ widely in morphology, genesis, water table characteristics, fertility and topography. The red basaltic soils were developed under high rainfall, have a typical "kraznozem" profile, are acid, low in exchangeable bases, and contain a large proportion of sesquioxides, resulting in a high proportion of kaolinite. The chocolate basaltic soil type developed under a lower rainfall with less intense leaching. The soil is shallower and is slightly acid to neutral in reaction, has a high base status and clay minerals are predominantly of montmorillonite. The topography of the two respective soil types ranges from undulating to steeply broken country. A range of meadow type soils exists on the flood plains of the Richmond River. Periodic flooding, a clay profile with restricted permeability and a seasonal high water table are the main characteristics of this soil type. Selected chemical data from these soils are shown in Table 1.

PROGRESS IN PLANT NUTRITION FOR THE CLARENCE REGION

The research into the nutrient requirements of the soils of lower fertility aims to diagnose nutrient deficiencies, and to devise fertilizer programmes to correct these deficiencies.

TABLE 1.
Chemical properties of selected soils of the Clarence and Richmond-Tweed areas.

Soil Type	Texture of Top-Soils 0–6″	pH	Total N%	Phosphorus Total	Phosphorus Available*	Exchangeable Cations Milliequivalent per 100 gms Soil			
				%P	p.p.m. P	Ca	Mg	K	Total Exchange Capacity
1. Soils derived from Sedimentary parent material:									
a. Grafton Series	Sandy Loam	5.3	0.18	0.18	2.0	1.8	0.7	0.11	—
b. Kangaroo Creek coarse sandstone series	Sandy Loam	5.5	—	0.053	2.0	0.63	0.21	0.23	1.59
c. Coal-measure shale series	Sandy Clay Loam	5.1	0.18	0.025	2.0	5.98	2.51	0.51	9.58
d. Bundamba-Marburg coarse sandstone series	Sandy Loam	5.4	0.13	0.019	2.0	2.63	1.44	0.43	4.64
2. Soils derived from intrusive parent material:									
a. Granitic Soils	Sandy Loam	5.0	0.10	0.016	3.0	1.78	0.65	0.32	5.21
b. Serpentine Soils	Clay Loam	—	—	—	—	3.63	1.44	0.45	6.14
3. Metamorphic Slates and Phyllites west of the Clarence River:		4.9	0.33	0.042	4.5	6.0	1.5	0.60	—
4. Soils derived from basalt:									
a. Red basaltic soil	Clay Loam	5.0	0.447	0.33	10.9	3.70	2.87	0.37	39.7
b. Chocolate basaltic soil	Clay Loam	5.0	0.295	0.16	—	12.30	4.52	0.72	21.8
c. Alluvial soil	Clay	6.2	0.327	0.38	—	34.70	18.30	1.10	70.9

*Bray No. I Extraction

The importance of providing adequate nutrition, to allow the vigorous growth of legumes, is emphasised in a broad acre form of production such as beef raising as practiced on the Clarence. The soils being studied are very low in both nitrogen and phosphorus. At this stage of our development, the cheapest way to adjust the resulting, low levels of protein (nitrogen) and phosphorus in the animal's diet is to place a strong reliance on adequately fertilized nitrogen-fixing legumes as a basis for improved pastures.

The research programme is divided into two distinct sections. In the first section, the phosphate requirement of the soil and plant is being studied. The importance of the very low phosphate status of the soil is recognized in this programme. Basal dressings of all other essential nutrients are applied to field trials.

The second section is aimed at diagnosing other possible nutrient deficiencies. In these studies, basal dressings of phosphate are applied. The response to application of nine essential nutrients is being measured. These studies are conducted as a survey, where the range of soil types upon which beef grazing is conducted will be assessed. This work is done initially with pot studies in the glasshouse, but will eventually be taken to the field, where the fertilizer requirements of different improved species will be assessed in rate trials with responsive nutrients. The interaction between nutrients has also to be evaluated.

The phosphate research programme

The phosphate research project is a co-operative project between the Chemistry Branch and the Division of Plant Industry of the New South Wales Department of Agriculture. Mr. J. Bradley of the Chemistry Branch is responsible for the chemical analysis of both soil and plant samples, whilst one of the authors of this paper, (E. J. H.) is responsible for the field work. The programme is financed from funds made available by the Australian Meat Research Committee. Research has been conducted on the Upper Clarence for the last three years.

These investigations test the response of two plants, *Lotononis bainesii* and white clover, to varying establishment and maintenance levels of superphosphate application. Twenty-seven trials have been sown at nine sites. The establishment rates of fertilizer used are 0,2,4, and 6 hundredweight of superphosphate per acre whilst the maintenance rates are 0, 75, 150 and 225 lb of superphosphate per acre. Pasture plant yield, soil level of phosphorus, plant level of phosphorus and protein content have been measured over three seasons.

TABLE 2

Response of Ladino white clover to initial rates of superphosphate (mean yield legume dry matter lb/acre)

Parent Rock	Soil Type	Superphosphate Rate (cwt/acre)			
		0	2	4	6
Coarse Sandstone (Bundamba/ Marburg Series)	Sandy Loam	337	1447	2557	3272
Granite	Sandy Loam	141	1672	2290	2661
Fine Sandstone-Shale Coal Measures	Sandy Clay Loam	207	1411	3133	3559

The levels of available soil phosphorus are assessed on 0–3" samples using the Bray No. 1 extraction technique. On all soil types, the levels have been extremely low, ranging from 2–8 parts per million. On adequately fertilized plots, the levels reach 25–30 parts per million available phosphorus.

TABLE 3

Response of *Lotononis bainesii* to initial rates of superphosphate (mean yield of legume dry matter lb/acre)

Parent Rock	Soil Type	Superphosphate Rate (cwt/acre)			
		0	2	4	6
Coarse Sandstone (Bundamba/ Marburg series)	Sandy Loam	283	1287	1647	2550
Granite	Sandy Loam	1943	6516	8029	7786
Fine Sandstone Coal Measure	Sandy Clay Loam	588	2161	2694	3281
Fine Sandstone Coal Measure	Sandy Clay Loam	506	1518	2588	2977

Tables 2 and 3 show the response in Ladino white clover and *Lotononis bainesii* production to increasing rates of superphosphate. The dry matter yields obtained represent a marked improvement in productivity above that of the native pasture. The total yield of the native pasture measured over the same period and in the same area, was only 1400 lb of dry matter per acre. (Brooks, unpublished).

The phosphorus content of the plant changes markedly with increasing superphosphate additions. Without superphosphate, the phosphorus content of leaf material of white clover is approximately 0.10%. At higher levels, the phosphorus content of leaf material increases to 0.23% and above.

TABLE 4

The effect of rate of superphosphate application on the phosphorus content of *Lotononis bainesii* and Ladino white clover on a granite soil

Initial superphosphate Rate: cwt/acre	Phosphorus content	
	Ladino white clover % D.W.	*Lotononis bainesii* % D.W.
0	0.13	0.07
2	0.19	0.12
4	0.24	0.15
6	0.30	0.17

The trials show that the annual maintenance rate of superphosphate required to continue maximum white clover growth under cutting has been 2 cwt per acre per annum. This rate applies particularly when 2 and 4 cwt of superphosphate per acre are used as initial dressings. Lower rates may be satisfactory with 6 cwt of superphosphate per acre initial dressing. These results have been obtained over three years. It is possible that the maintenance fertilizer requirement could be lower in subsequent years. The problem of maintenance rates of superphosphate requires further research.

Diagnosis and investigation of other nutrient deficiencies

The survey of requirements of other nutrients on these soil types is only in the early stage. Preliminary work suggests that the largest initial response in legume growth will come from an adequate supply of superphosphate. The persistance of pastures may be affected by other major or trace elements deficiencies. Results are not available as yet to make firm recommendations, although preliminary trials have shown that molybdenum is likely to be important on some soil types. Interactions have been recorded between phosphorus and sulphur on some soils. Follow-up investigations are required, but it is suggested that the sulphur requirement of the low fertility podzolic soils could be met with adequate rates of superphosphate.

Plant nutrition research for the Richmond-Tweed region

A new research programme has been started. The aims of the programme are as follows:

(i) Definition of nutrient deficiencies on various soils.
(ii) Determining form and rate of fertilizer required for pasture establishment.
(iii) Determining fertilizer input for maintenance of pasture under grazing.
(iv) Assessment of nutrient status of species by plant and soil analysis.
(v) Determination of nutrient requirement of grass as with applied nitrogen.

Definition of Nutrient Deficiencies

Additive, factorial pot trials have been conducted growing Clarence glycine and silverleaf desmodium in the glasshouse on basaltic derived soils. The mean response to various nutrients are given in Table 5.

TABLE 5

Mean response of test plants on various soils (g/pot)

NUTRIENTS	Clarence glycine Red Basaltic (cultivated)	Clarence glycine Chocolate Basalt (virgin)		Silverleaf desmodium Riverbank Alluvial (cultivated)	Silverleaf desmodium Heavy Clay Alluvial (virgin)
	Cut 1	Cut 1	Cut 2	Sum 3 Cuts	Sum 3 Cuts
Phosphorus	basal	1.74*	0.36	0.22	1.83*
Potassium	–0.08	–0.36	–0.59	1.24*	0.31
Sulphur	1.16*	0.17	10.20*	1.41*	0.52
Calcium	5.98*	3.18*	3.12*	0.30*	2.18*
Molybdenum	2.48*	3.99*	0.69	–0.12	1.13*
Copper	0.02	–0.02	0.69	0.41	–0.18
Zinc	0.11	–0.22	0.39	–0.21	0.67
Boron + Magnesium	–0.64	—	—	—	—
Mean Yield of Experiment g/pot	11.90	19.50	17.33	19.50	9.98

*Significant Response

It is of interest that sulphur and molybdenum were deficient in three out of four soils. Significant negative interactions between calcium and molybdenum were obtained, indicating a release of molybdenum through heavy liming. The responses to phosphorus, which were measured on chocolate basalt soil and heavy clay alluvial soil, were not as great as the response to molybdenum or sulphur application.

On many of the basaltic soils, it would appear that sulphur and molybdenum are the two more important nutrient deficiencies. The two elements are required for the formation of protein in legumes. Under grazing and high rainfall, sulphur is more rapidly leached from the soil than phosphorus and annual applications will be necessary. The use of sulphur fortified superphosphate at lower rates is the most effective way to adjust the sulphur-phosphorus ratio of the maintenance fertilizer.

The red basaltic soils, which are acid and contain a high percentage of ferric iron oxide, are known to strongly absorb available molybdenum. Response to higher rates than the normal 1 oz. per acre rate have been obtained with Clarence glycine (Mears, unpublished). Further research is being done to determine optimum rates and frequency of application of molybdenum.

Use of nitrogen on grass pasture

The role of nitrogen fertilizer in the development of a pasture programme in the beef industry is a problem which has still to be thoroughly investigated by research workers. The use of nitrogen fertilizer can greatly increase the cost of pasture production if applied over a large proportion of a property, but if applied strategically to special purpose pasture can supply valuable supplementary feed.

The role of nitrogen will probably vary between soils of high and low fertility. In the low fertility soils, economic returns can be obtained from use of legumes and superphosphate, whilst nitrogen fertilizer could be of real value on an intensive fattening property with higher soil fertility.

The use of nitrogen fertilizer requires a high level of management skill from the grazier. It takes skill to plan the most effective way to use nitrogen fertilizer. It also takes skill to effectively utilize the pastures produced from the use of nitrogen fertilizer to the best advantage.

The questions which should be asked when bagged nitrogen is contemplated are:

(i) Under what conditions does nitrogen deficiency restrict growth?
(ii) What is the response in terms of increased dry matter or nitrogen yield per lb of nitrogen applied?
(iii) What forms of nitrogen should be used?
(iv) Will the pasture grown with applied nitrogen be of sufficient quality?
(v) Will the extra pasture be efficiently converted to animal products?
(vi) Is the use of applied nitrogen economic?

Currently, the Department of Agriculture, C.S.I.R.O., and Fertilizer Companies are engaged in research on aspects of these questions. Several principles on the use of nitrogen on grasses are emerging.

(a) Nitrogen can be used effectively to increase out-of-season pasture production, e.g. rye or oats fertilized with nitrogen for winter feed, or applied nitrogen to Kikuyu or setaria pasture in spring.
(b) Greater managerial skill will be required to efficiently utilize the extra feed at a young stage of growth.
(c) Tropical grasses such as Kikuyu, setaria, Pangola and Rhodes grass require heavy dressings of nitrogen to produce their maximum yield in this environment and to maintain a satisfactory level of nitrogen in their tissues.

CONCLUSIONS

Nitrogen and phosphorus deficiencies are the major limiting nutrients for beef cattle pastures on the North Coast of New South Wales. Sulphur and molybdenum are two other nutrients likely to be deficient in the region. Legumes, fertilized with superphosphate and other nutrients depending on soil type, can substantially increase pasture growth and quality cheaply over a large proportion of the farm. Bagged nitrogen can be used for intensive pasture production at certain times of the year.

In the development of new areas after clearing of timber, the aim should be to:

(i) Correct phosphate deficiency with the required amount of superphosphate. This is particularly important on the poor quality sandy soils of the region. Graziers must be prepared to fertilize with heavy rates of superphosphate up to 4 and even 6 hundredweight per acre may be necessary. On basaltic soils 1–2 hundredweight will be required with sulphur as an important nutrient constituent. A suitable legume should be sown to take maximum advantage of the applied superphosphate.

(ii) At the same time correct all trace element deficiencies with a suitable dressing. This will depend on an adequate definition of the nutrients required and the rates to be applied. Nutrient deficiencies such as molybdenum can prevent pasture establishment.

Graziers will be growing temperate and tropical species in their farm development programmes. The same fertilizer principles apply to both groups of species, although there may be differences between species in degree of response to fertilizers.

REFERENCES

McElroy, C. T. (1962). — The Geology of the Clarence-Moreton Basin, Memoirs of the Geological Survey of New South Wales, No. 9.

ANIMAL NUTRITION

by

D. J. Minson, Division of Tropical Pastures, C.S.I.R.O.,

Lawes, Queensland.

I understand that low calving percentages are a major problem in this area of the Upper Clarence River. This may be caused by disease but level of nutrition is probably an important factor.

The American publication "Nutrient Requirements of Beef Cattle" states "With pregnant mature cows, of the dominant beef breeds, a weight of not less than about 1050 lbs before calving is usually necessary to support consistently regular rebreeding and sufficient lactation to produce heavy calf weaning weights". How many of your breeding cows reach this weight?

The importance of body condition was recently shown in experiments conducted by the C.S.I.R.O. Division of Animal Physiology at Yulgilbar, using over 2,000 cows studied for three years. Cows with calves at foot had a pregnancy rate of 69% if in fat condition but only 35% if in store condition. The corresponding figures for dry cows was 84% and 53%.

It is clear that if calving percentages are to be increased then the cows must be in better condition at calving time. From nutrition studies we know that the key factor controlling whether an animal gains or loses weight is the quantity of dry matter absorbed from the digestive tract. This is illustrated by the following example for an 800 lb animal:

Dry matter absorbed lbs/day	Liveweight gain lbs/day
3	−0.8
6	0.1
9	1.0
12	1.9

The quantity of dry matter absorbed from the digestive tract will depend on two things — the quantity of feed being eaten and secondly the quantity of unabsorbed feed excreted in the faeces. We usually consider these two as separate figures:

1. Quantity eaten
2. Digestibility % of the feed

What we mean by digestibility is best illustrated by two examples. An animal eating 10 lbs grain a day may lose in the faeces only 2 lbs i.e. the digestibility is 80%. However, if 10 lbs of mature grass were eaten 5 lbs might be lost in the faeces — a digestibility of 50%. These two examples illustrate how the value of feeds can vary and digestibility figures (also T.D.N. and Starch Equivalents) are very helpful when purchasing feed.

The digestibility of pastures vary considerably according to both the botanical composition of the pasture and how long it has grown since last grazed. It has been generally found with both temperate and tropical species that the digestibility falls as the time interval between grazings is increased. This fall is associated with a general increase in the quantity of fibre present as the proportion of leaf declines and seed heads develop. The obvious conclusion is that pastures should be grazed as frequently as possible and certainly not left to grow for more than two months if reasonable animal performance is to be obtained. The second conclusion (now widely recognised in the Northern Hemisphere) is that if good quality hay is required it must be cut early. No haymaking technique has yet increased digestibility and this applies to the most expensive artificial drying equipment.

Even at the young stage of growth, there are large differences between pastures according to their botanical composition. Temperate species like rye-grass, white clover and oats have maximum dry matter digestibilities around 80% while tropical species range between 60 and 70%. The obvious conclusion is that the maximum use should be made of temperate species particularly white clover wherever they will grow.

By now you may be fully convinced that digestibility is the only factor controlling how fast an animal grows and the likely calving percentage. However, we must not forget the quantity of feed eaten. Imagine a pasture overstocked in the spring — high digestibility but low intake due to low availability. The most important aspect of the pasture improvement programs recommended at this meeting is that they are mainly aimed at overcoming a straight feed shortage.

A lack of feed is not the only factor which will affect the quantity eaten. Animals can starve in the midst of plenty. If the pasture consists of old grass the protein content will be low and this protein deficiency will reduce feed consumption. This deficiency can be overcome in three ways:

1. Feeding urea/molasses.
2. Increasing soil nitrogen with urea
3. Legume supplements

It should be noted however, that these supplements increase production by increasing feed intake. The urea will obviously be of no value as a supplement if there is no extra grass to be eaten.

Phosphorus deficiency can be overcome by feeding bone meal, a method used by many graziers in this area. However, the more satisfactory method is to increase the phosphorus content of the grass by applying superphosphate. This in time will increase legume growth, overcoming any protein deficiency.

The following conclusions may be drawn:

1. Calving percentage can be increased by better feeding.
2. Prevent feed shortage by using improved pastures.
3. Eliminate phosphorus deficiency by using superphosphate.
4. Eliminate protein deficiency by growing legumes.

PASTURE IMPROVEMENT AS AN INVESTMENT

by

R. C. DUNCAN, N.S.W. DEPARTMENT OF AGRICULTURE,
AGRICULTURAL RESEARCH STATION, GRAFTON.

A farm is a collection of resources grouped into the following categories — land, labour, capital and management. All of these in combination generate income, but their income-generating powers can depreciate. The depreciation of capital improvements is visible and obvious. The depreciation of land and management is not so visible. Seeing that the depreciation of capital is obvious it is more likely to be made good.

I only raise this point to demonstrate that some expenditure on pasture improvement should rightly be regarded as maintenance expenditure rather than as new investment. The resources of land and management can be improved and this school is evidence of your desire to improve your managerial ability and ultimately the income-generating power of your land.

If the farm is to grow and productivity to increase then pasture improvement often seems to be the best way to achieve this goal. I must emphasise that pasture improvement is only another investment and all other possible avenues of new investment should be compared before making the decision to invest in pasture improvement.

Having said this, it is now my purpose tonight to examine the characteristics of pasture improvement as an investment and to look at the prospects for investment in pasture improvement in the beef cattle industry.

Two points should be noted. First of all, almost the whole of the pasture improvement developments in the post-war period have taken place in the areas of relatively reliable rainfall of the wheat-sheep zone and high-rainfall areas of the sheep zone. Secondly, there has been relatively little economic evaluation of any kind of pasture improvement.

What are the main features of investment in pasture improvement?

(1) The project generally requires inputs of investment over a number of years, e.g. fertilizer for pasture to reach full potential. (You should distinguish here between maintenance expenditure and investment.)

(2) Investment in pasture improvement almost automatically means other investment in fixed and working capital so that the full benefits of the investment in pasture improvement can be achieved.

The fixed capital expenditure, e.g. fences, watering facilities, is often quite substantial and generally has to be made in the first few years of the project. The investment in working capital, especially increased stock numbers, can be spread out over a number of years. However, experience has proved that this is often the neglected factor in the planning and implementation of the project.

(3) The returns from pasture improvement gradually build up over a number of years. Here the rate of establishment of species and the establishment techniques are important variables.

Let's have a look now at some of the results which have come out of economic studies of pasture improvement programmes in the sheep areas.

(1) Large variations in returns on investment have been evident from on-farm studies. I would guess that this is due in large part to the variations in the management factor.

(2) There is a long period of years before total returns exceed total costs. A combination of factors is involved here:
(a) rate of establishment; (b) size of outlay on complementary investment; (c) type of establishment technique — buying versus hiring; (d) cost/price squeeze.

(3) A limiting factor has been the availability of finance 3–7 years after commencement of the programme. This raises two points: (a) Types of bank lending available: Lenders must realise that pasture improvement investment is spread out over a number of years and expenditure, especially on fertilizer, must be maintained.
(b) Seeing it is such a long-term form of investment, somewhere along the line the investor must expect to run into adverse seasons.

(4) The optimum method of improvement is likely to depend on the level of capital available. It appears that if little savings are available and money has to be borrowed then less intensive methods of improvement are best. If capital is not limiting then intensive methods seem to be the best.

The economic analyses which the Bureau of Agricultural Economics have carried out on pasture improvement in Queensland in the brigalow and speargrass zone show that these general conclusions will probably hold under a beef cattle regime. Under realistic price assumptions for beef, returns on investment in pasture improvements have been budgeted out to 20%. The work by the B.A.E. to date points up the importance of price, especially in the high-risk intensive improvement programmes. For example, an 8% variation in expected prices results in an extension of the debt repayment period by up to 13 years.

What are the prospects for investment in pasture improvement in the beef cattle industry?

The beef cattle industry has not been subjected to the cost/price squeeze which the wool industry has been facing, especially in the 1960's. Since 1961 prices for beef have probably been rising as fast as or faster than costs. However, we can expect that costs will keep rising, with little effort towards restraint under the present tariff policies. Therefore the point which comes foremost to mind is the prospect for beef, both here in N.S.W. and overseas.

The consumption per head of beef and veal in Australia is presently below 100 lb. A lot of currency has been given lately to the fall in meat consumption per head since the war and the inroads which poultry has made. I do think the fall in meat consumption per head should be discounted but quite substantially it results from the change in population distribution since the war.

The population of N.S.W. at the 1966 census was 4.2 million. If population growth continues at the rate of 1.5 to 2.0% annually, and if beef consumption continues at the present level, then the annual increase in domestic consumption of beef and veal in N.S.W. will be around 2,900 tons or approximately 14,500 carcasses (i.e., about 1% of total production). In 1965 beef and veal production in N.S.W. reached a peak of 303,400 tons, a rise of 28% over the average of the years 1955 to 1959. This rise represents a yearly increase of over 4%. It seems therefore, that N.S.W. will be relying increasingly on the export market for beef if the industry is to go forward at a good pace.

Given the current U.S. legislation on beef imports, little growth can be expected in that market. It should, however, continue to provide a useful long-term outlet for culled cows and such and therefore help towards raising the general quality of the herds.

A developing market for Australian beef in Japan is being widely mooted. It is expected that with its rising standard of living and increasing consumption of meats that Japan will be importing larger quantities of lean meat. However, N.S.W. producers should not be over-greatly encouraged by this prospect as northern Australian producers have a significant comparative advantage in the production of lean meat.

The developing countries, especially in Asia, are also being regarded as potential markets for Australian meat. However, long range forecasts by the F.A.O. and by the Faculty of Agricultural Economics, Monash University, predict that mutton, because of its relative cheapness, will be the most attractive meat product to consumers with rising incomes in the less developed countries.

At present, distance and technical obstacles prevent effective marketing of high quality meats overseas. It seems that lean meats have the brightest future in the export markets for some time to come.

If Northern Australia has a competitive advantage in lean meat production, it seems that N.S.W. will have to rely heavily on exports to the highly competitive markets for beef and veal in Europe. Trends in the home market are also towards the younger, high quality beef products. So it seems that most of the State's production must be channelled along these lines. In view of the United Kingdom's intention to enter the European Economic Community the following statement by Dr. R. Patterson, M.H.R. is pertinent.

> "History reveals that export markets have rarely provided a constant and satisfactory margin of profit to the Australian producer and, except for short periods of time, one buyer, the U.K., has been largely responsible for the determination of the level of prices for beef on the principal markets of the world".

The beef industry must be prepared to accept periods of low prices on export markets. Export markets cannot be secured for indefinite periods (instance the U.K.) and therefore the industry has to be able to compete effectively on the world market. This means that costs of production have to be kept as low as possible.

All of this points to the fact that efficiency of production has to improve. In other words management has to improve. The part which management, and by this I mean mainly economic decision making, plays in all forms of business, including farming, is only being realized. This symposium is directed mainly towards the technical side of the management factor. I hope you don't neglect the economic side.