FIELD VISIT TO GRAFTON, NORTHERN NEW SOUTH WALES, APRIL 21–22, 1978

PASTURE AND ANIMAL RESEARCH AT GRAFTON AGRICULTURAL RESEARCH STATION

The two day field meeting was held at Grafton Agricultural Research Station in conjunction with the North Coast Beef Research Liaison Committee. The field meeting ended at "Amarina", Casino, where many of the principles outlined at the Research Station had been applied in practice. The topics covered a wide range of interests including species evaluation, grazing management, fertilizer requirements, animal production and economic evaluation. The meeting was opened by Dr P. D. Mears, Supervisor of Research at the Station, and concluded with a vote of thanks by Mr R. Pechy, vice-president of the Tropical Grassland Society. All presentations were made by officers of the New South Wales Department of Agriculture, Grafton.

ENVIRONMENT OF THE NORTH COAST REGION

A. D. O'Brien

The North Coast Region of New South Wales extends from the Tweed river catchment, latitude 28° 30'S, to the Manning river catchment, 32° S. Research interest extends west to the Northern Tablelands, but the relevance of the research extends beyond the Regional boundaries.

Climate

The climate of the Region is basically subtropical and warm temperate. Over most of the region north of Coffs Harbour the mean temperature of the hottest month exceeds 24°C and the mean temperature of the coldest month is within the range 13–19°C. Over most of the region south of Coffs Harbour the mean temperature of the hottest months exceeds 22°C and that of the coolest month is within the range 8–13°C. The coldest areas are the Dorrigo and Comboyne basaltic plateaux.

The plateaux and much of the Tweed river catchment have the highest rainfall (1375–1875 mm median rainfall). Almost all of the remainder falls within two divisions. Wollongbar Agricultural Research Centre is located in the higher 1125–1375 mm median rainfall division and Grafton Agricultural Research Station is located in the lower 875–1125 mm median rainfall zone. The rainfall and temperature regimes for Grafton are similar to those for Gympie, in south-eastern Queensland.

Geology and soils

The parent materials for the soils of the major portion of the region are metamorphics and shales of varying ages. The podsolic and earthic soils derived from these are of poor to medium fertility, with the metamorphics generally better than the shales.

In the extensive area of "Clarence beef country", sandstones and granites form half the parent materials. The sandy podsolics and podsols formed from these are poorer than the other Clarence soils derived from shales and metamorphics. The basalt areas of the Richmond Valley and the coastal plateaux are the only areas of fertile soils.

Topography

Thirteen percent of the region is relatively flat, less than 5% slope. The larger areas are in the Clarence and Richmond valleys. With attention to both surface and internal drainage, these areas are suitable for cropping. The most intensive pasture improvement, mostly for dairying, is found in this category.

Eleven percent is undulating, 5–15% slope. With attention to erosion control and internal drainage most of this category is suitable for cropping, particularly with zero tillage. Pasture improvement is generally low cost, extensive rather than intensive.

Twenty-two percent of the region is hilly, 15–30% slope. Natural timber stands are important. Pasture improvement should be limited to species reinforcement by oversowing. Fifty-four percent is rugged, with greater than 30% slope. It is minimum development, multiple use, timber-beef country. There is scope for pasture reinforcement by oversowing.

Pastures

Natural pastures are the basis of the beef industry and forest grazing is an important part of this. Most natural pastures are unstable and soil fertility is declining, erosion is common and species composition is deteriorating.

Pasture improvement for beef production, involving replacement pastures and oversown legumes, has gone through several cycles of interest. Of recent years there has been a halt; however, this year there is renewed interest. A strong case can be argued for more integration of beef and cropping, and beef and timber, to increase diversification and stability of income.

Conclusion

Temperature, rainfall, geology and topography have major patterns of variation, which, when combined, form a complex of variable environments. All these components interact with each other and with other environmental influences, such as soil type, run-off, drainage, watertable, fertility, aspect and frost; plus the man controlled variables of burning, fertilizer usage and grazing management.

The interactions of these environmental variables is reflected in changes in the natural vegetation, both timber species and native and naturalized pasture species; and also influence where improved crop, horticulture, timber or pasture species will grow.

With such environmental diversity there is plenty of scope for many minor crops and the need for wide tolerances in the major crops. A wide choice of pasture species is necessary to improve productivity because of this diversity and because of the varying needs of different sections of the livestock industries.

SPECIES INTRODUCTION AND THE ROLE OF NATIVE LEGUMES

G. P. M. Wilson

Species introduction

The plant introduction program was initiated in 1954. Initially the plants sought included both tropical and temperate grasses and legumes adapted to the spectrum of soils, climate and management of the North Coast region. This is illustrated by the diversity of the nine cultivars released from the Station and others which are recommended. These plants virtually selected themselves in that they survived after exposure to a range of environments and grazing by cattle. Two groups of legumes emerged:

Productive species—requiring relatively high inputs of fertilizer and or management for survival (e.g. Siratro, Lotononis, *Glycine wightii*, white clover, Kenya white clover, *Leucaena leucocephala*).

Low to moderately productive species—these establish and persist with low inputs of fertilizer and are not dependant on good management for survival (e.g. *Aeschynomene falcata, Lespedeza striata, Stylosanthes guianensis* (fine-stem stylo), *Cassia rotundifolia*, some native *Glycine* and *Desmodium* spp, and *Lotus* spp).

Considerable emphasis has been placed on the latter group during the past ten years of evaluation and seed multiplication. Seed of selected species is now available for use in the more specialized and critical stages of evaluation. Information on their effects on animal production is urgently needed.

The search for these 'low input' type legumes needs to go on, but there is also now a need to rethink our future objectives in plant introduction to serve a changing pattern of land use on the Northern Coast, particularly to aid diversification of rural enterprises. For example, increasing interest in combining forestry and grazing enterprises offers scope for the use of native legumes, and species such as *Aeschynomene falcata*.

By contrast, a more intensive agriculture is likely to develop in areas of more favourable rainfall and soil, e.g. horticulture, rural recreation, cropping, apiculture, seed production etc., for which we will require many 'high input' (e.g. fertilizer and irrigation), special purpose and multi-purpose species. We are making a start in this direction by evaluating a large collection of *Trifolium* species, particularly annuals.

Native legumes

Research into native legumes has been carried out at Grafton for many years, particularly on *Glycine, Desmodium* and *Galactia* spp. Some points of interest are:

— Native legumes fall into the same categories as introduced species, some requiring good management for persistence.

— All the native *Glycine* spp. tested have responded to low rates of phosphorus in glasshouse studies.

— Some native *Glycine* spp. are attacked by natural enemies such as Amnemus and white fringed weevil. Some *Desmodium* and *Vigna* spp. are very prone to nematode attack.

— Selected *Glycine* spp. have quite good seed production though Eastern Rosella parrots may reduce seed yield. Some lines (e.g. P7874) produce ripe seed as early as six weeks after sowing. Most *Glycine* spp. produce some cleistogamous flowers (closed, self-fertilized flowers mostly on or under the ground).

— Some *Glycine* and *Desmodium* spp. are well adapted to a forest environment and should be investigated in future forest/grazing studies.

THE ECOLOGY OF PASTURES UNDER GRAZING

A. D. O'BRIEN

This long term grazing trial studies the development of native-naturalized pastures following such inputs as fertilizer, summer and/or winter legumes, and chizel ripping. The addition of legumes plus fertilizer causes progressive pasture changes. These lead to potential increases in carrying capacity. If stocking rate is not increased, grass competition will reduce legume growth, thereby reducing nitrogen build-up and the potential for further changes.

The experiment, sown in 1972, looks at: (1) NP, unfertilized natural pasture; (2) NP + S, natural pasture with superphosphate (500 kg ha^{-1} initial, 250 kg ha^{-1} maintenance) oversown with joint vetch (*Aeschynomene falcata*) after four years; (3) NP + S, oversown with Japanese lespedeza (*Lespedeza striata*); (4) NP + S, oversown with Clarence naturalized white clover (*Trifolium repens*); (5) NP + S, oversown with Japanese lespedeza and naturalized white clover; and (6) NP + S, oversown with white clover with annual chizel ripping to 10 cm. An adjacent, complementary trial has two treatments, (a) NP + S oversown with Haifa white clover, and (b) NP + S oversown with Safari Kenya white clover (*Trifolium semipilosum*). All these legumes persist under heavy utilization. Because of wide variation in both summer and winter seasons, periodic intensive utilization occurs irrespective of general pasture development or stocking rate increases.

Large variation in seasonal liveweight changes occurred in both summer and winter seasons. In "good seasons", when there was good legume presence, there were large differences in animal responses to the treatments. In "poorer seasons", when there was little or no legume, there was little effect of sown species although stocking rate differences were maintained. Nitrogen inputs from legumes appear to remain in the system for a long time. Grass production is the basis of carrying capacity, whilst legume content is the basis of big per animal production increases.

Stocking rates were initially 1.1 heifers ha^{-1} on pastures without legumes and 1.67 heifers ha^{-1} with oversown legumes. Stocking rates were increased on the oversown legume pastures in October 1974, with some further increases since then as pastures improved. The stocking rates on the combined summer and winter legumes treatment, and on the white clover with annual chizel ripping, have been increased to 3.3 heifers ha^{-1}. The single legume treatments, summer or winter, are around 2.5 heifers ha^{-1}.

Even on the natural pasture there has been an increase in carrying capacity, to 1.9 heifers ha^{-1} (October 1977), following the absence of burning since 1968. The pasture was initially dominated by native grasses with some carpet grass (*Axonopus affinis*), but is now dominated by carpet grass with an increasing proportion of paspalum (*Paspalum dilatatum*), 5–10%.

The rate of botanical change has been greatest in the white clover with chizel ripping treatment. Paspalum has increased to at least 25%, seasonally reaching 60% of grass production. The differences in botanical change and carrying capacity between this treatment and the corresponding unripped treatment, could result from better infiltration and extended moisture supply, increased nutrient availability, and an increased number of germination sites for both legumes and grasses. The Kenya white clover pasture has given better animal production than the white clover pastures, and has increased carrying capacity.

Ecological development of the pasture following inputs of legumes and fertilizers has to be taken into account in the design and interpretation of grazing trials.

THE MAINTENANCE FERTILIZER REQUIREMENTS OF GRAZED PASTURES

P. T. Mears

Superphosphate

(Co-operative program of E. J. Havilah, R. D. H. Cohen, A. D. O'Brien and G. O'Neill)

A grazing experiment was conducted at Grafton for five years to measure the effects of annual rates of 0, 125, 250 and 500 kg ha^{-1} superphosphate on beef production from a white clover/naturalized grass pasture which had previously received 1500 kg ha^{-1} of superphosphate over a three year period. The response to superphosphate was measured at stocking rates of 1.67, 2.5 and 3.33 weaner steers ha^{-1}.

The grazing study complemented earlier work, which defined the superphosphate requirements for pasture establishment and development. The aims were to determine:

(1) the annual superphosphate requirement for maintenance of pasture and animal production.

(2) the effect of cessation of superphosphate use on pasture and animal production.

Measurements of the amount of available feed, its botanical composition and nitrogen and phosphorus content were taken every six weeks. Soil tests for phosphorus and other nutrients were taken at three monthly intervals. Litter decomposition rates were estimated twice. Animal measurements included liveweight gain, intake, digestibility and nitrogen content of feed eaten at critical times, blood copper levels, and bone phosphorus content. These data were used to interpret superphosphate effects and to develop models of superphosphate use in the beef cattle grazing system.

Highlights of the information obtained were:

1. The strong residual effect in the first two years of the experiment of previous applications of superphosphate—there were no differences in animal production between the four fertilizer application rates, irrespective of stocking rate.

2. The close relationship between fertilizer applied and the bicarbonate soil phosphorus test, suggesting that soil test information may be useful in making fertilizer recommendations.

3. At low stocking rates, an annual superphosphate rate of 125 kg ha^{-1} is sufficient to maintain production. However, at higher stocking rates 250 kg ha^{-1} annually would be required. Overall, the loss in animal production following cessation of fertilizer application was small and, at present beef prices, the application of superphosphate to these pastures could not be recommended.

The results of the experiment provide essential information for economic analyses, as well as a greater understanding of the factors operating in the superphosphate maintenance phase. The ultimate recommended rates will depend on economic considerations.

Potassium

(Co-operative program of **P. T. Mears, E. J. Havilah and A. D. O'Brien**)

The aims of this program are to determine:

(1) the effects of annual rates of potassium chloride applied to carpet grass/paspalum/white clover pasture, on exchangeable soil potassium, botanical composition and liveweight gain of steers.

(2) the residual effects of potassium chloride applied at rates of 0–375 kg ha^{-1} $year^{-1}$.

Pastures were stocked with 18 month old steers on 14th April, 1976 at a stocking rate of 2.5 beasts ha^{-1}, after potassium chloride had been applied. Steers were weighed off plots in December 1976.

Clover content was markedly increased by application of potassium fertilizer at the rate of 375 kg ha^{-1}. This response was more marked where Haifa clover had been sown originally.

Potassium fertilizer at 375 kg ha^{-1} increased animal growth in the autumn/winter period, but in the later period, compensatory growth in the control treatment tended to reduce this advantage. Potassium fertilizer markedly influenced fat cover over the eye muscle between the 10th and 11th rib—this was attributed to the increased clover available to the grazing animal.

Seasonal liveweight gain was not related to pasture availability. However carcass quality, in particular calculated fat weight, was related to average clover available to the grazing animal over the whole 8 month period ($r = 0.94$).

Although potassium fertilizer influenced clover production the additional liveweight gain obtained would not warrant application of potassium. However, the results indicate potassium is an important factor in clover growth in the Clarence and legume content influenced the degree of finish of slaughter animals.

PASTURE IMPROVEMENT EVALUATION

A. C. Beck

A computer simulation model has been developed to evaluate the likely returns from a pasture improvement program. The program involves the oversowing of a naturalized strain of white clover into a native and naturalized grass pasture, with a 500 kg ha^{-1} establishment dressing of superphosphate. Subsequent maintenance dressings of 250 kg ha^{-1} are applied annually. The pasture is utilized for a beef breeding enterprise, turning off store weaners at approximately 9 months of age.

The model allows for the following factors to be considered:

Time. Pasture improvement is a long-term investment. Cost and benefits do not fall equally in each year of the program. To account for this the model uses a discounted cash flow technique where net cash outlay or return is calculated for each year of the simulated pasture improvement program. The net cash flow is then discounted to give a measure of the percentage return on funds invested.

Cost. Costs are calculated for each year of the program. Major costs include pasture establishment and maintenance, extra stock, and extra capital and operating costs.

Benefits. In a store breeding herd benefits from pasture improvement result from increased branding rates, increased weaning weights and increased stocking capacity. In the model the relationships between stocking rate and weaning weight, and stocking rate and branding rates are specified as simple mathematical functions.

Uncertainty. The returns from pasture improvement can never be certain because the value of production depends on future seasonal conditions and future beef prices. To allow for seasonal uncertainty the branding rate, weaning weight and stocking rate functions are specified for good, average and poor seasons. A probability is then determined for each type of season. For each year of the pasture improvement program the computer selects a seasonal condition based on these probabilities and then calculates animal production using the appropriate functions. To value weaner production the computer randomly selects a beef price from a specified price distribution.

The model has been used to determine the likely returns from pasture improvement for three alternative stocking rate strategies. For each strategy the model was run 100 times to generate a distribution of possible results, each based on a different series of seasonal conditions and prices. This approach allows the relative riskiness of the stocking rate strategies to be determined. Preliminary results indicate that the average return in investment from light stocking is about 2%; from moderate stocking 6%; and from heavy stocking 0%. The range of estimated returns from each strategy indicated that light stocking was the least risky, and heavy stocking the most risky.

Regardless of the stocking strategy this pasture improvement program appears to have a low probability of being economic if used for store weaner production.

A GRAZING EXPERIMENT ON THE SANDSTONE SOILS OF THE UPPER CLARENCE

D. L. Garden

A large grazing experiment has been conducted since 1972 in the Fineflower area, 60 km NW of Grafton, on an area of low fertility sandstone soil which supports predominantly native grass pastures having no naturalized white clover and very few native legumes present. The main enterprise is the breeding of store weaners, even though animal growth is slow and calving is around 65%.

In this experiment pasture and animal production from four pasture systems is evaluated using Hereford weaner heifers at a number of stocking rates. The pasture systems are:

Native pasture
Native pasture with superphosphate
Native pasture, superphosphate and oversown naturalized white clover.
Native pasture (roughly cultivated), superphosphate, white clover and lotononis.

Pasture establishment

Pastures were established in autumn 1972. All legume seed was inoculated, lime pelleted and oversown using a rollerdrill, white clover at 5 kg ha^{-1} and lotononis at 1 kg ha^{-1}. 500 kg ha^{-1} molybdenized superphosphate was applied in the first year and 250 kg ha^{-1} superphosphate each subsequent year with Mo every third year. Good germination of white clover occurred through winter/spring 1972, and of lotononis from late spring. The first group of experimental animals grazed the paddocks from autumn 1973.

Pasture and animal production

Carpet grass content of all pastures has increased since 1973. This has been accelerated by sowing legumes and by increased stocking rate.

White clover content of pastures has varied depending on rainfall and season and is normally at a maximum in spring. On the other hand, lotononis, which comprised 12% of the white clover/lotononis pastures in autumn 1973, has declined rapidly and is now present only in trace amounts. Seedling germination of lotononis is observed in most years, but plants do not persist.

In March each year a new group of heifers weighing approximately 160 kg liveweight is put on the pastures. Those grazing native pastures have lost weight during each winter and only grown during spring and summer. Application of superphosphate has given no additional benefit although the phosphorus content of grass doubled. Heifers grazing pastures with oversown legumes have shown a marked improvement in growth rate (Table 1).

TABLE 1

Mean liveweight gains and oestrus cycling of heifers grazing native and improved pastures 1973-77

Pasture	Mean daily liveweight gain (adjusted to mean stocking rate) (kg day^{-1})	Mean proportion heifers standing for service at 19 months (%)
Native pasture	.06	3
Superphosphate alone	.14	19
Superphosphate/naturalized clover	.34	89
Superphosphate/white clover/ lotononis	.40	100

After grazing, the heifers (aged approximately 19 months) were joined to teaser bulls with marker harnesses. The numbers standing for service (indicating oestrus cycling) are shown in Table 1. These results are important as they show that on improved pastures, joining could be carried out much earlier than the normally practised age of 3 years.

In conclusion, the results show the lack of response to superphosphate on these soils in the absence of sown legumes.

FUTURE PASTURE RESEARCH—WHERE TO NOW?

R. D. H. COHEN

During the course of the experiment outlined by Mr. Garden, measurements were made on the climate (rainfall, temperature, evaporation, solar radiation), soil moisture and fertility (N, P, K, exchangeable bases), pasture dry matter on offer (green and dead grass and legume), animal nutrition (dietary green, dead, grass and legume fractions, digestibility (OMD), nitrogen, calcium, sulphur, phosphorus and digestible organic matter intake (DOMI)—using animals fistulated at the oesophagus —rumen VFA, ammonia and phosphorus levels—using animals fistulated at the rumen—animal liveweight and incidence of oestrus).

The data indicate that dietary digestibility of the heifers grazing the improved pastures after the clover had senesced was the factor most limiting liveweight gain from these pastures. For example, extrusa samples taken in September 1974, when white clover was present were 70.3% OMD while November samples taken after the clover had senesced were 51.8% OMD. The mean OMD of the green grass fraction of the diet was 55.3% while that of the legume was 75.6%.

A computer simulation model has been constructed and tested against data from the Fineflower experiment. Using the model it has been predicted that a 10% increase in dietary digestibility throughout the year would have increased the mean liveweight gains of the heifers during the three years 1973–6 from 0.22, 0.33 and 0.36 kg day^{-1} to 0.61, 0.62 and 0.76 kg day^{-1} respectively. These liveweight gains would allow earlier fattening and mating of young cattle. A worthwhile objective therefore seems to be to increase dietary digestibility and it is suggested that this could be achieved by the inclusion of introduced grasses or additional legumes to extend the period when legumes are available to the animal.

It would also be of interest to determine the superphosphate maintenance requirement of the improved pastures at Fineflower because of the results from the superphosphate maintenance experiment at Grafton discussed by Dr Mears. In that experiment only a small decline in animal production was recorded five years after the cessation of fertilizer application to a white clover/carpet grass pasture.

The soil type at Fineflower is different (*viz.* derived from sandstone compared with shale) and current soil P levels are lower (*viz.* 25 ppm compared with 40 ppm at the start of the Grafton experiment). The computer simulation model developed by Mr Beck indicates that internal rates of return on investment in pasture improvement are very sensitive to fertilizer rates and any reduction would be economically desirable to the beef industry.

Finally the role of low soil phosphate tolerant legumes in improving animal production from native pastures with low or zero fertilizer applications should be tested. Several potentially suitable species were described by Mr Wilson. Preliminary information suggests that the digestibility and nitrogen content of these legumes is good; for example the OMD of *Glycine* spp. P7874 ranged between 66–81% while the mean N contents of green leaf and stem were 3.1 and 1.9% respectively. A small area of *Aeschynomene falcata* established into native grass at Fineflower resulted in weight gains of heifers of 0.58 kg day^{-1} between October 1977 and March 1978 compared with 0.34 kg day^{-1} for heifers grazing native pastures during the same period.

SUMMER GRAIN LEGUME RESEARCH

P. J. DESBOROUGH

One of the major aims of this research is to develop viable options for diversification of enterprises by beef cattle producers on the North Coast. As most beef production occurs on traditionally non-arable land, which is low in fertility and/or undulating, current cropping technology is basically unsuitable.

Many of the grain legumes should fill this requirement in that they are independent of nitrogen fertilizer, are adapted to the variable moisture regimes of the region, and, most importantly, many types currently are attracting high market prices. Some 3,000 ha of raingrown soybeans are being grown on the North Coast in the 1977/78 season, mostly on poorer, hilly country.

Legumes that satisfy these criteria and are being studied at Grafton include soybeans, black and green gram (mung beans), and adzuki beans.

Yield potential, planting date effects, soybean rust, grain weathering tolerance, phosphate strategies in low P soils and direct drilling are being studied.

Participants in the Tropical Grasslands Society excursion were able to inspect successful establishment of soybeans by direct drilling into carpet grass pastures using wavy coulters and specially developed sowing tynes. The advantages of direct drilling were explained, including reduced erosion risk, more timely planting, less delay with wet weather at harvest and longer term effects on soil nutrient status, soil texture and weed build-up. The herbicides Glyphosate, MSMA and DSMA are being evaluated for their effectiveness in controlling carpet grass pastures but dry conditions prior to sowing led to less control than can be achieved under better grass growth conditions.

In another trial inspected there was a visible response to rates of superphosphate up to 550 kg ha^{-1} in soybeans grown on a conventionally tilled, low P soil. Increased response to higher rates of superphosphate appeared slight, and the response overall appeared more rapid when the fertilizer was drilled at sowing, rather than broadcast and cultivated.

Finally, attributes of adzuki beans and black grams were explained whilst inspecting plots of these three species grown on a low fertility soil under dryland conditions. Adzuki beans and black gram (cv. Regur) appear to be well adapted to this environment, producing high yields under experimental conditions. The reduced weathering tolerance of Berken green gram at maturity makes it unsuitable for the North Coast.

NUTRITIONAL DEFICIENCIES OF PASTURES FOR BEEF PRODUCTION ON THE NORTH COAST

D. W. HENNESSY

Other presentations have described the limitations to animal production imposed by the poor nutritive value of the summer growing grasses. Total beef production on such pastures is low because of poor animal performance (heifers are not consciously joined to bulls until three years old), and low stocking rates, one cow to 3–4 ha.

In the late 1960's research commenced at Grafton which was aimed at understanding the nutritional limitations to production and ultimately devising management systems which would overcome these nutritional problems. The initial approach was based on the simple concept of keeping nutritional variables constant except one, which was altered. Any response by the animal would therefore be due to the changing variable and we could conclude that it was a primary limitation to growth.

By this approach, Mr Cohen and I found that major minerals, e.g. P, Na and S and the minor minerals, such as Co, Cu, Zn were not primary limitations to cattle growth on the native/naturalized pastures of this area. Urea, a form of non protein nitrogen, did not significantly improve the performance of cattle but it did effect improvements in rumen ammonia and plasma urea which suggested that N was involved in the low production syndrome. Urea with molasses was also examined, but under both pen and our field conditions merely acted as a supplement to the animals without allowing cattle to better utilize the pasture or hay.

The next stage of the research program was to examine additions of preformed protein to the diet, rather than non protein N additions. Linseed meal given to cows (450 g day^{-1}) improved the liveweight of calves without improving cow liveweight. In pens, additions of cottonseed meal to a low quality hay also brought about increases in liveweight. Gains of up to 700 g day^{-1} in 300 kg liveweight steers were obtained when 2 kg of cottonseed meal was added to low quality hay—without reducing the intake of hay.

This work led to a field trial wherein a protein meal was devised which had a better balance of amino acids than cottonseed meal, and was made less soluble by heating and pelleting. In this way we hoped the protein would by-pass rumen degradation and provide amino acids at the sites of absorption in the intestine. The results were spectacular. Weaner steers, given a complete mineral mix lost, on average, 40 g day^{-1} in liveweight during the 1977 winter/spring period of the trial. Steers given 600 g day^{-1} of the protein meal, either daily or 2100 g twice-a-week, gained 370 g day^{-1} and at the end of spring were 250 kg liveweight; 73 kg heavier than the control steers.

Further field and pen studies are to be done in the next three years to understand the role of protein in the nutrition of reproducing and lactating cattle.

BEEF CATTLE CROSSBREEDING

H. HEARNSHAW, R. BARLOW, J. THOMPSON, and G. R. WANT

Simmental, Friesian, Brahman and Hereford bulls were joined to Hereford cows over 5 years. First cross calves were 7–12 kg heavier at weaning than Hereford calves, and their survival was as good or better than that of the Herefords. The combined advantage of survival and growth of first-cross calves resulted in an increase of 9 to 19 kg turned off per calving cow.

Weaner steers from the four breed groups (HxH, SxH, FxH, BxH) were sent to five sites in N.S.W. and one in Victoria for growth rate and carcase comparisons. Under all conditions the average growth rate of first-cross steers has been greater than that of HxH steers. When the environment was favourable (Glen Innes and Trangie) SxH steers had the greatest weight gain. Under prolonged dry conditions (Deniliquin) and in the unfavourable coastal environment (Grafton), BxH steers grew fastest. HxH and BxH steers have been better finished at the same liveweight than SxH and FxH steers.

Weaner heifers remain on the Research Station and are allocated to three levels of nutrition.

HIGH nutrition is the best clover/grass pasture. Heifers are grain supplemented to allow joining at 15 months of age.

MEDIUM nutrition is a kikuyu/rhodes grass pasture. Heifers in this group are joined at 27 months of age.

LOW nutrition is unimproved carpet grass/blady grass pastures on soils of poor fertility at low stocking rates. Heifers are joined at 27 months of age. This nutrition level is equivalent to poor quality North Coast pastures.

First-cross heifers grew faster to 30 months of age than HxH on all levels of nutrition. BxH heifers grew significantly faster than the other crosses on Medium and Low nutrition.

All first-cross and HxH cows were back-crossed to Hereford bulls over three joinings. Fertility of first-cross cows was similar to HxH on High and Medium nutrition but superior to HxH on Low nutrition. On High nutrition first-cross cows weaned vealer calves which were 44 kg heavier than calves weaned by HxH cows. On

Medium nutrition, first-cross cows weaned calves 38 kg heavier than calves from HxH cows. On Low nutrition BxH and FxH and SxH cows weaned calves 88, 57 and 19 kg heavier respectively than HxH cows on similar pastures. The combination of first-cross cow and back-cross calf gives a production advantage on all levels of nutrition. On Low nutrition, each BxH cow produced 125 kg, and each FxH, 68 kg more saleable calf than HxH cows.

On North Coast pastures first-cross BxH cows offer the greatest potential for increasing production. Research results from other centres indicate that any alternative to the first-cross Brahman x British breed cow (i.e. Brahman derived breeds) will be less productive.

FARM VISIT—"AMARINA", CASINO

Introduction

The property and the history of pasture improvements were described by the manager, Mr R. Lehman. The property comprises 1,950 hectares (4,800 acres) and runs a herd of 1300 head of which 600 are Hereford breeders, and the remainder are two year old heifers, weaner heifers and steers. It is planned to introduce some *Bos indicus* into the herd in the future.

Pasture improvement

Approximately two-thirds of the property has been improved, mainly by oversowing naturalized white clover and applying superphosphate. There are small areas of tropical legume based pastures. It is planned to sow more of both pasture types.

Two pastures were inspected. The first was sown in 1975 to Greenleaf desmodium, rhodes grass, Nandi setaria and naturalized white clover, after a "clearing" cash crop of soy beans in 1974. Greenleaf desmodium did not persist but the rhodes grass and white clover have formed a good pasture. At the time of inspection (April) there was virtually no white clover perennating, but the pasture was open enough for a good seedling strike on the next autumn rain. The pasture had received about 1,000 kg of superphosphate ha^{-1} and Mr Lehman said that, despite current economic difficulties, he would keep the phosphate level as high as possible.

The second pasture inspected was sown in 1972 to Makarikari panic (1.2 kg ha^{-1}) Nandi setaria (1.8 kg ha^{-1}), Greenleaf desmodium (1.2 kg ha^{-1}), Siratro 1.2 kg ha^{-1}) and lotononis (0.6 kg ha^{-1}). The pasture was still very productive, the main species present being setaria, Siratro and lotononis. The pasture was usually ungrazed during the growing season and was set-stocked over autumn, winter and spring. Interest was expressed about the persistence of lotononis under this form of management. Greenleaf desmodium was promising initially but only persisted for two years. Nandi setaria was used in preference to Kazungula setaria.