NOTES AND EXHIBITS MEETING HELD AT THE CUNNINGHAM LABORATORY, ST. LUCIA, BRISBANE ON JUNE 30, 1971

SUITABILITY OF TROPICAL PASTURES FOR MILK PRODUCTION

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Complete reviews of literature on the suitability of tropical pasture species for dairy production have recently appeared in the November 1971 issue of Tropical Grasslands. In general, experiments have shown that large quantities of herbage can be produced from tropical pasture species, although a large proportion of this feed is produced over a relatively short period, and that tropical pasture species usually have a lower milk production per cow. I will concentrate on some of the more recent findings of the C.S.I.R.O. dairy research unit at Samford which is primarily concerned with evaluating the quality of pasture species in terms of milk production per cow. Short-term grazing trials are conducted in which small herds of cows sequentially graze replicates of the various pastures under test. These experiments of a change-over design with experimental periods of 10-14 days duration. Milk production, milk composition and to a lesser extent grazing behaviour are measured on these trials.

Milk production from cows grazing tropical pastures

Milk production per cow from unsupplemented tropical pasture species is markedly lower than from temperate species at a similar stage of growth. Although individual cows grazing tropical pasture are capable of fairly high production, (the best cow produced 905 gal of milk at 5.1% B.F., i.e. 460 lb fat in 1970-71), a mean of approximately 2-2½ gal of milk per cow per day (or about 200-250 lb fat per cow lactation) is all that we have achieved from Jersey cows. Friesians and Illawarra Shorthorns are obviously capable of a higher level of production is low it is higher than the level predicted using estimates of the chemical composition obtained from laboratory and animal house studies (Hardison 1966). This is mainly due to the animals' ability to draw on body reserves for nutrients and also being able to select a more nutritious diet whilst grazing. Animals fistulated at the oesophagus are being used to collect herbage selected whilst grazing to get a better understanding of the quality of the feed eaten by cows. Analyses of the feed inputs in relation to milk output is currently being investigated and evidence to date suggests that a low intake of digestible nutrients, particularly energy, is the main cause of low production.

There is considerable variability between tropical pasture species in their ability to produce milk. For example 2-3 week old regrowth of pangola has been shown to produce approximately 10 percent more milk than rhodes grass at a similar stage of growth, with Kazungula setaria giving an intermediate level of production. Some slow maturing bullrush millets (*Pennisetum typhoides*), white panic (*Echinochloa crusgalli* var. *edulis*), *Digitaria smutsii, Setaria splendida,* kikuyu grass (*Pennisetum clandestinum*) and Gatton panic (*Panicum maximum*) are species which are currently being evaluated.

The voluntary intake of tropical legumes is usually higher than that of tropical grass of similar digestibility when fed to sheep indoors and hence higher production per cow would be expected. *Dolichos lab lab* was able to maintain a relatively high level of production in contrast to tropical grasses, Hamilton *et al.* (1970). However in recent trials we have obtained less milk from cows grazing pure stands of either Siratro or Greenleaf desmodium compared with nitrogen fertilised pangola (Stobbs, 1971). In 1971-72 it is also hoped to evaluate two legumes which are possibly more nutritious, namely Kenya white clover and *Lotononis bainesii.*

One of the reasons for the difference is probably the cows ability to harvest herbage more easily when grazing grass pasturs. The time cows spend grazing has been recorded for dairy cows using vibracorders attached to the necks of cows (Stobbs, 1970). Grazing time on tropical pastures, particularly trailing legumes and tall stemmy plants, have been shown to be excessively long. When cows have difficulty in satisfying their nutrient requirements grazing is extended into the night; at certain times of the year up to 55% of total grazing time was recorded between evening and morning milkings. This emphasises the need for good night paddocks when grazing tropical pastures.

The effect of pasture maturity upon milk production is recognised by every dairy farmer and as far as practicable he attempts to feed young material. By selective grazing cows can compensate to some extent for lower quality feed but a stage is quickly reached when herbage quality affects production. Milk production from cows grazing rhodes grass was the same with three and five week regrowths but with Kazungula setaria milk production was higher for the three week regrowths (Hamilton, 1968).

Quality of milk from cows grazing tropical pastures

The poor quality of tropical pastures not only results in low milk production but also results in important changes in milk composition. High producing dairy cows in the first month or two of lactation are a special case of undernutrition as they are usually in negative energy balance even when offered liberal amounts of an adequate diet (Stull *et al.* 1966). When on poorer quality tropical feeds the cow is forced to draw heavily upon body reserves and this affects milk composition.

When milk yield is depressed due to a low intake of digestible energy the percentage butterfat increases and the percentage of solids-not-fat, particularly protein and casein, decrease. With a market trend towards protein production and away from fat production this could be extremely important. Associated with the higher fat percentage when cows graze poor quality feed are changes in the composition of the fat. Milk fat is made up of fatty acids of varying chain lengths; the proportion of each of these acids being affected by the quantity and quality of feed consumed. Short chain fatty acids are synthesised within the mammary tissue from acids absorbed from the rumen whereas long chain are mainly derived from body fats. On restricted or poor quality diets cows produce insufficient acids in the rumen and they catabolise body fat reserves producing milk with a lower proportion of short-chain fatty acids and a higher proportion of long-chain fatty acids, particularly oleic acid. This emphasises that cows are continually laying down or milking off condition, and we should exploit this fully for economic dairy production from tropical pasture. These changes in milk composition are proving to be extremely valuable for selecting more nutritious species.

One other aspect of quality which has received some attention is the possible taints or odours which may be passed into milk. We have screened a number of species and obtained tainted milk after feeding *Dolichos lab lab, Leucaena leucocephala,* setaria silage and lucerne. These taints were accentuated by homogenisation but all except the taint caused by *Leucaena* were lost after pasturisation (Stobbs and Fraser, in press).

Production per acre from tropical pasture

Some new figures on the production per acre which can be achieved from tropical pasture are available. Between October and June this year we grazed 6 cows (3 calving in October,; 2 in January and 1 dry cow) on 3.1 acres of luecaena/ green panic. These unsupplemented cows produced 5612 lb milk per ac., 243 lb fat per ac. and 192 lb protein per acre. This is a tremendous improvement upon the mean of 17 lb of fat per acre which my colleagues have calculated for Queensland.

Thus the use of better quality species, better knowledge of their management and the strategic use of concentrates should enable good production per acre to be achieved from tropical pastures.

REFERENCES

HAMILTON, R. I. (1968)—in C.S.I.R.O. Division of Tropical Pastures Annual Report 1967-68, p. 45.

HAMILTON, R. I., LAMBOURNE, L. J., ROE, R., and MINSON, D. J. (1970)—Quality of tropical grasses for milk production. Proceedings of Eleventh International Grassland Congress, Surfers Paradise, Australia: p. 860.

HARDISON, W. A. (1966)—Chemical composition, nutrient content and potential milk producing capacity of fresh tropical herbage. Dairy Training and Research Institute, Philippines, Research Bulletin No. 1.

STOBBS, T. H. (1970)—Automatic recording of grazing time by dairy cows on tropical grass and legume pastures. *Tropical Grasslands* **4**:237.

STOBBS, T. H. (1971)—Production and composition of milk from cows grazing Sirato (*Phaseolus atropurpureus*) and greenleaf Desmodium (*Desmodium intortum*). *Australian Journal of Experimental Agriculture and Animal Husbandry* **11**:268.

STOBBS, T. H. and FRASER, J. S. (in press)—Composition and procession quality of milk produced from cows grazing some tropical pasture species. *Australian Journal of Dairy Technology.*

STULL, J. W., BROWN, W. H., VALDEZ, C., and TUCKER, H. (1966)—Fatty acid composition of milk. 3. Variation with stage of lactation. *Journal of Dairy Science* **49**:1401.

MEASUREMENT OF GRAZING TIME OF BEEF CATTLE

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Various methods have been used for determining the time animals spend grazing. They are listed below:

1. *Direct observation*—Observers record at intervals the activity of all, or a selected number, of animals within a herd. Grazing time can then be reported as a fraction of the total. For reasonable accuracy the activities should be recorded at least every 20 minutes, day and night. These studies are possible only where ample cheap labour is available.

2. *Vibracorders*. These have been used with sheep very successfully and also for dairy cattle by Dr. T. H. Stobbs at Samford. Considerable care is necessary to balance and position the vibracorder and in addition the charts have to be replaced daily. Other than for dairy cattle which are used to regular handling, the device has limited applicability.

3. *Telemetric recording*. Using transmitting and receiving devices it is possible to record the jaw movements of animals. In New Zealand it has been possible to differentiate between jaw movements due to grazing and those due to chewing the cud. By recording the movements on a moving chart running at constant speed the time spent grazing can be accurately measured. The high cost and the large amount of paper which accumulates are serious disadvantages.

4. *Elapsed time indicators.* This method offers scope for a cheap method of recording grazing time in a form suitable for most studies. It involves linking a mercury switch to an elapsed time recorder. When the mercury switch is engaged the elapsed time indicator records. When the switch is off, no recording takes place. The positioning of the mercury switch on the halter of the animal at such an angle that the switch is activated only when the animal lowers its head, ensures that the switch only operates when the animal is grazing.

Previous devices used for cattle necessitated the use of a large battery mounted on the animal's back, the battery having power only for one week at the most. It was considered necessary to devise a system which was capable of running for one month, but contained in a unit which could be mounted on a halter. Mr. L. J. Cowper of the Cunningham Laboratory, has devised such a unit using a commercially available (ex P.M.G.) elapsed time indicator with digital read out. A transistorised circuit has resulted in a low power drain. The whole assembly fits into two aluminium boxes mounted on either side of the halter. The grazing time is displayed and counted in units of 15 seconds. These can be read from a distance of 10 yards using x 8 binoculars. Thus the period spent grazing can be determined without yarding or handling the animal.

The device has been used successfully on a Hereford cow with calf at foot. Grazing time on mixed tropical pastures was about 8 hr/day.

RECOGNISING A NODULATION PROBLEM

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Early agronomic assessment of some tropical legumes in Queensland was delayed initially by the lack of effective nodule bacteria to nodulate these introductions. Such was the case with *Lotononis*, but with the introduction of an appropriate rhizobium from the original home of the plant, a dramatic improvement in growth and performance occurred. Today, effective nodule bacteria are available commercially for the major tropical and temperate legumes. Despite this however, there are still reports of nodulation problems. Because of the importance of the symbiotic association of rhizobia with the legumes, many establishment failures are attributed to faulty nodulation by conjecture, without careful consideration of other possible causes.

Nodulation failures have been described with numerous legumes from diverse areas and soils. These can arise from many entirely different causes and thus there is a need to recognise the essential features of nodulation problems, as distinct from the many other causes of poor plant growth. A nodulation problem is best described simply as one in which the growth of the plant is limited by inadequate nitrogen fixation arising from insufficient actively-fixing nodule tissue.

In a non-nodulated pasture, the first obvious signs appear as yellow foliar symptoms when the cotyledonous reserves are depleted. Since nodules supply only nitrogen to the plant, the symptoms are typically those of a nitrogen deficiency—stunted plants with yellow to pale green foliage and the older leaves yellowing and dying first. These symptoms might be confused with sulphur or potassium deficiencies in some legumes. However, sulphur deficiency is generally more pronounced on the younger growth and chlorosis associated with potassium deficiency is usually restricted to the margins of the leaf.

The comparative response to the addition of artifiicial nitrogen fertiliser is a reliable indicator of nitrogen availability. A foliar spray of 1% "Nitram" or urea gives the most immediate colour response in deficient plants although sulphate of ammonia added to the soil can also give a rapid response. With sulphur or molybdenum deficiencies there can be a partial response to this treatment where the main chlorosis is due to the malfunctioning of established nodules but the response is only temporary. This simple test, unfortunately is often overlooked. A negative result is a clear indication that other factors are limiting growth. Growth responses by effectively nodulated plants can also occur even though, theoretically, such plants receive optimum nitrogen supply. An exact explanation is difficult to find although it seems to be tied up with the expenditure of photosynthetic carbohydrates by the functioning nodules. Combined nitrogen causes a temporary cessation in the functioning of the nodule thus making additional carbohydrates available for growth.

To examine the plants for nodules is the next logical step. Nodule numbers can vary with environmental conditions, excessively wet or dry conditions reducing or even eliminating nodules. Grazing, competition for light or insect attack can also be factors which affect nodules. One instance of suppression of nodulation which can hardly be regarded as a problem, is where high levels of mineralized soil nitrogen occur in the soil. The plants remain green and vigorous. In agricultural soils this is comparatively rare but can frequently occur in newly cleared rain forest country or freshly ploughed native grassland.

Where nodules are present, their position and size can give an indication of whether the inoculation techniques were successful. Nodules high on the root system, termed crown nodules, are mainly the result of early infections of the emerging radicle by bacteria applied to the seed. Nodules confined to the lateral roots are often formed by native rhizobia from the soil. Although this criterion works very well on many of the temperate legumes, there are limitations on some tropical legumes. Firstly, high soil nitrates as previously mentioned can prevent early crown nodule formation. Secondly, some large seeded legumes such as Rongai dolichos and velvet bean rarely form crown nodules, and thirdly, some unspecialized legumes such as siratro and phasey bean can form crown nodules with native rhizobia from the soil.

The shape, size and colour of effective nodules varies between legumes. Among tropical legumes, spherical nodules are the most common although cylindrical and digitate shapes also occur. Generally speaking, large pink centred types are common in effective associations and small white centred nodules common with ineffective associations. This rule can serve only as a rough guide because the total amount of nodular tissue formed on the root system is the ultimate criterion and this can be achieved by either a large number of small nodules or a smaller number of large nodules. It would be difficult therefore, to judge the effectiveness of nodulation in Townsville stylo for example, by nodule size alone.

Since leg-haemoglobin is an essential component of the nitrogen fixing processes in legumes, the colour of the nodule tissue is a clear indicator of activity. Actively fixing nodules are salmon or pink centred but ineffective nodules lack the red pigment and are small and white centred. Young effective nodules which have not yet acquired the pigmented centre can sometimes be confused with ineffective nodules. As effective nodules age and lose activity, they first turn green for a short time then brown and finally decay. Truly ineffective associations (giving no growth benefits at all) are commonly seen in the field with medics, lucerne and clovers but are quite rare among the tropical legumes. In unspecialised legumes such as siratro or cowpea a wide range of rhizobia are accepted into an effective association but specific legumes such as *Lotononis* or centro are naturally able to exclude ineffective associations.

Where large populations of native rhizobia already exist in the soil, there can be competition between them and the seed inoculum for nodule formation. The success of inoculation under these circumstances is best gauged by serological methods. Rabbit serum is prepared containing specific antibodies against the inoculum strain. The reaction of antibodies with nodule bacteria taken from the nodule is followed in agar gel plates. A positive reaction leads to bands being formed and in this way the identity of the bacteria within the nodule can be established.

Each of these six indicators has some pit-falls which have been outlined and it is suggested that at least three be positive before poor legume establishment is attributed to faulty nodulation.

PROBLEMS OF SEED PRODUCTION OF NAROK SETARIA

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Narok is a cultivar of *Setaria sphacelata* selected from the introduction CPI 33452 by Dr. J. B. Hacker of C.S.I.R.O., Division of Tropical Pastures. It is outstanding in winter growth and production and is very palatable. It may be suitable for irrigated winter pastures. Information is presented here on problems of seed production and seed yield.

Seed of Narok was sown on March 26, 1970 at Eumundi into a seed bed on a creek flat which has been fallowed for from 6 to 12 months. Before seeding the area (20 ac) received 560 lb of superphosphate and 112 lb of urea per acre. The fertilizer was cultivated in and the seed sown with a combine drill in rows 21 in. apart and accompanied by a further dressing of 112 lb per acre of superphosphate. Germination was satisfactory, but was noticably better on the drier outside edges of the paddock.

Although the plants flowered, the onset of cold weather prevented seed formation, and the area was mown and used either for green feed or made into hay. In spite of the poor conditions for hay-making, the hay contained 7.9% protein and 47% TDN. As the vegetative material was removed during August 1970, a dressing of 280 lb/acre of "Nitram" was applied.

Growth in spring was spectacular, and by November the stand was so dense that it was difficult for observers to walk through it, and the plants began to lodge. Harvesting commenced on December 23, 1970 but only four acres were harvested before floods flattened the crop. The header used was an open-fronted short-fingered John Deere 55 Auto Header Harvester fitted with stump-jump crop lifters designed to handle a crop producing about four tons of dry matter per acre. During most of the harvest, much of the material was horizontal and in some areas standing water covered the cutter-bar.

The yield of cleaned seed from the 20 ac was 1022 lb. The removal of residue from the field was prevented by continuing rain, and although regrowth arose from nodes, it soon died and a dense layer (6-12 in. deep) of plant material covered the paddock. This thinned out the stand and large areas were killed out completely.

A dressing of 224 lb/acre of "Nitram" was applied on March 20, 1971 and the stand quickly recovered. Cool weather again prevented an autumn seed crop and the next crop was expected in November 1971.

Seedling counts in April 1971 on a small area which had been burnt two weeks previously, revealed a germination of 1000 plants per sq ft, indicating the presence on the ground of at least 200 lb of seed/ac. It is probable that with high rates of nitrogen, yields of approximately 200 lb/ac at each of two harvests are theoretically possible. In practice the highest yield obtained on a commercial scale is 50 lb/ac of clean seed.

Because there is a danger that Narok may hydridize with other setarias and lose some of its desirable characters, it is recommended that farmers should use only certified seed which has been grown in isolation. Narok is the first tropical grass cultivar to be certified in Queensland and the current price of certified seed is $4.00 per pound.

PITFALLS IN APPLYING CHEMICALS TO CONTROL EUCALYPTS

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Experimental evidence from south-eastern and western Queensland has shown that injections at the base of a number of eucalypt species with a tree injector gave better results than injections made at a waist level with an axe and vaccinator. The reason for this difference is not absolutely clear, but certain factors are of interest.

The circumference of most eucalypts close to ground level is generally 8-10 in. greater than that at waist level and the larger the tree the greater this difference. This means that a tree injected close to ground level at 5in. centres would receive two more injections than one similarly injected at waist height. Two injections may often be as much as 25% of the total amount of chemical injected into the tree and depending on the species may reduce the final kill by from 10 to 40%.

Most commercial tree injectors are fitted with curved cutting blades, which make a neat pocket in the bark and these retain all the chemical injected and in rough bark species prevent it coming in contact with and being asorbed by the dry bark.

Injection pockets made with a full-sized axe when chemicals are applied at waist height are inverted cups from which solutions and emulsions of chemicals may run or leak into the dry bark at the base of the cut. Dry bark absorbs the chemical, but does not translocate it throughout the tree. The blade of a full-sized axe is 5 in. wide, so when used waist high, it is impossible to obtain the desired 5 in. interval between injection centres without virtually ringbarking the tree (Plate I). Ringbarking is most complete when the axe is "heeled" after each cut. Injections made this way allow for upward movement of the chemical but if the phloem tissue has been severed completely the chemical may not be able to move below the cut except by gravity and regrowth may take place from below this point.

The cutting edge of tommy-axes commonly used for applying chemicals are generally 2.5 in. wide and like the full-sized axe also make a cut like an inverted cup. Some chemical may run into the dry bark, but the tommy-axes do leave strips of live bark between the edges of successive injection pockets and presumably allow downward movement of tree-killing chemicals.

Because of the escape of chemicals into dry bark through the down-turned edges of cuts made with full-axes or tommy-axes, trees treated with these implements are often underdosed and odd branches may remain green after injection or regrowth may appear on the stem and branches above the injection site.

When the cutting width of a full-sized axe or tommy-axe is reduced to 1.25 in. by removing the heels and toes a straight pocket can be made. Cuts made with these modified axes retain a greater volume of chemical than the cuts of a full-sized axe or tommy-axe and higher percentage kills of trees may be expected. Even better results may be expected if commercially available concave blades are welded to the axe heads. Resultant cuts form neat pockets that retain the full volume of chemical injected. This type of pocket is preferred for all injection heights (Plates I and II).

Irrespective of the implement used, complete penetration of the bark into the sap wood is essential for good kills. If the bark is not penetrated, translocation of chemicals throughout the tree is poor and percentage kills may be low.

When using a tree injector to treat trees that fork close to the ground, it is essential to make injections in the stems just above as well as below the fork. The number of injections placed above the fork depends on the size of the individual stems.

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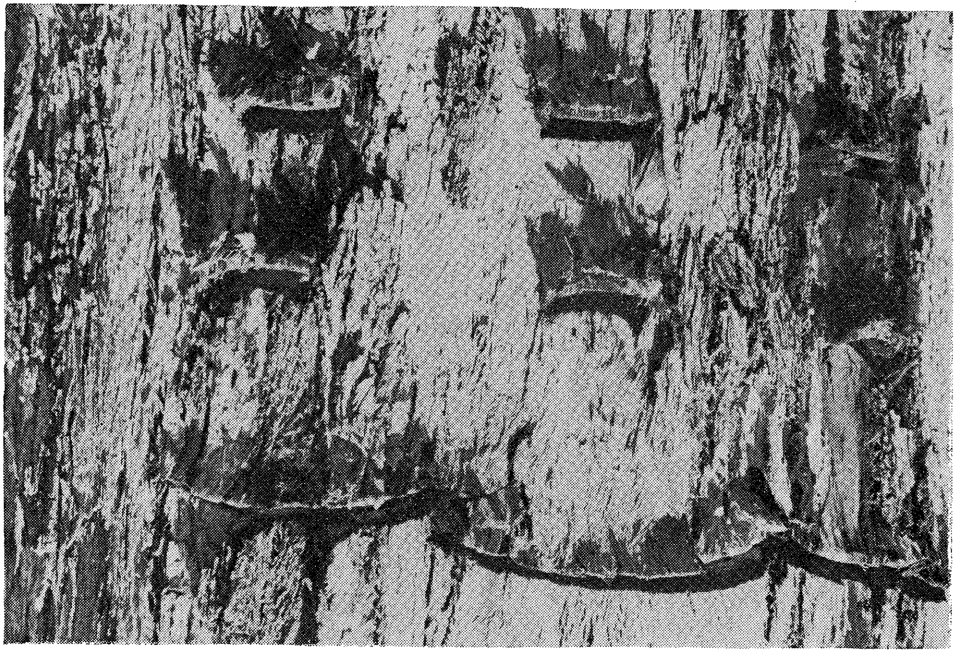

PLATE I
Injection pockets made by a full axe (5 in. blade); a curved blade from a tree injector; and the pocket made by an axe with heel and toe removed to leave a cutting width of 1.25 in. Note the almost complete ringbarking by full axe cuts.

PLATE II
Same photo as Plate IV except the bark has been removed from injected trees. From the top down: pockets made by a 2.5 in. wide tommy-axe; by a full sized axe; the curved injector blade; and the cut down axe. Contrast the inverted cup like cuts made by the tommy-axe and full-sized axe wih the pocket made by the curved injector blade.