THE EFFECT OF COMPLEMENTARY GRAZING OF A FORAGE LEGUME RESERVE ON DRY SEASON MILK PRODUCTION

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In San Javier, Bolivia, with a system of dairy ranching where cows are Bilked once per day while raising a calf, it was shown that the grazing of a forage reserve of the legumes*Macrotyloma axillare* cv Archer and *Glycine wightii* cvTinaroo raised milk production by 11-20Z. The leguminous protein reserve also consistently increased the butterfat content of the milk by an average of 0.4 percentage points. It was calculated that coring the 5 aunties of the dry season from April to August' one hectare of reserved legume pasture in conjunction with 3 hectares of grass could provide about 50% more grazing than 4 hectares of unimproved grass. Suitable dry season stocking rates for good levels of production without problems of overgrazing are about 1.2 and 0.8 cows per hectare respectively for the protein reserve system and the unimproved traditional pasture.

Key words: Legumes, pasture legumes, milk production, stocking rate, dull purpose cows

The area of San Javier lies in the Province Nuflo de Chavez in the Santa Cruz Department of Bolivia, between latitudes 16º07' and 16º36' South and longitudes 62º24' and 62º53' West. It comprises about 2630 square kilometers of undulating country where the general altitude is 500-600 metres above sea level, although occasional granitic outcrops particularly to the north of the area, reach 1200 metres (Burgess 1979),

The soils are of three main types (Burgess 1979 after Cochrane 1973) these being:

- deep red well drained oxisols of pH in the range 5.5 to 6.0 with a natural vegetation of tall forest,
- dark brown to black well drained sandy loams of pH 6.5 to 7.0 carrying a natural vegetation of deciduous trees with a heavy undergrowth,
- yellow brown to grey ultisols, poorly drained and often shallow with pH in the range 5 to 6, and a cover of poor quality savannah or open woodland (pampa or pampa monte respectively).

The climate is humid and sub-tropical, with a well defined dry season in the period May to October and total rainfall of about 900 mm per annum. The winter months of May to August are characterised by periodic strong cold south winds which can sometimes bring showers. Mean monthly temperatures are 19-20!C in this period, compared with 22-25ºC in the other months. (Burgess 1979) .

The usual animal production system is the area is one of dairy ranching where mainly Zebu-Criollo cows are milked once per day while they suckle their calf. Milk sold on average is 393 kg per cow per year from a mean lactation of 179 days, although both measurements are characterised by high coefficients of variation, implying that large increases in average figures could be obtained by selection within existing herds (Burgess 1979).

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The cows graze pastures which are almost entirely sown to *Hyparrhenia rufa* (Nees) Stapf. (Yaragua), but which are quickly invaded by weeds and perennial grasses of lower productivity, mainly *Paspalum notatum* Flugge (grama negra). No concentrates are fed to the animals, and so pasture quality, particularly in the dry season, is the factor which limits animal production.

Improved pasture species suitable for the area have been detailed elsewhere (Burgess 1979; Paterson 1979; Paterson and Horrell 1981) while information on the growth of steers on old pastures into which were sown legumes is given by Paterson et al (1980). In view of the fact that milk production is of paramount importance in the area, it was necessary to measure the effect on yields of milk of the inclusion of grazed leguminous forage in the diets of cows in production. This work was started in the dry season of 1980.

Materials and Methods

Pastures: A mixture of the pasture legumes *Glycine wightii* (R. Grah, ex Wight and Arn.) Verde cv. Tinaroo, *Macrotyloma axillare* (E.Mey.) Verdc. cv. Archer and *Stylosanthes guyanensis* (Aubl.) Sw. CIAT 136 was sown into 1 ha of a 4 ha block of old existing Yaragua on a red oxisol. The sowing was carried out by hand in January 1979 after ploughing and discing, and the seed was lightly covered. A good establishment was achieved, and the area was grazed by steers in the 1979 dry season when the legume composition was approximately 60% Archer, 20% Glycine and 20% Stylo.

By the 1980 dry season the legume composition was approximately 60% Archer and 40% Glycine, with very little contribution from the Stylo, although plants still survived at an average density of about 1 per square metre.

An adjacent 4 ha block of typical Yaragua based pasture with a moderate degree of invasion by grama negra was also fenced off to be used as the control paddock. Both paddocks were grazed at the beginning of April 1980, and then rested for 42 days prior to the start of the trial.

When the experimental grazing periods were completed in August 1980, samples were taken in the control paddock, and in both the grass and legume areas of the complementation paddock. In each of these three blocks, eight samples, each of about 1 m x 1 m were selected at random, and cut at a height of 5 cm above the soil. The samples were individually weighed, mixed together and sub-sampled for the determination of dry matter content.

Animals: At the beginning of 1980, 34 cows with calves of 3 - 4 months of age were selected from the general herd of 108 Criollo/Zebu cross-bred animals in production. Individual yields were recorded for 3 consecutive days, while the whole herd grazed together on yaragua based pasture. At the end of this period, 8 pairs of cows were selected from the 34 marked animals, the pairing being based upon phenotype, age and mean milk yield of the cows in this period, and on the age of calf, as recommended by Minson et al (1976). A cross-over design was employed (Cochran and Cox 1975) in which one of each pair of cows was assigned at random to each of two groups, and each group spent 13 days (9 days of standardization followed by 4 days of measurement) in each of the two different pastures.

One composite milk sample was taken from each group of cows at the start, at the time of change of paddocks, and at the end of the trial period (days 0, 13 and 26 respectively) and during the whole period cows were milked once per day in the

morning and then spent about 6 hours with their calves before being separated from them for the night under the normal dairy ranching management system used in the area.

The paddocks were rested in the period June-July, and the trial repeated in August 1980 using newly selected cows with calves of between 2 and 3 months of age In this second trial, one calf in the group with access to the legumes died of undetermined causes on day 11 of the recording period, and its mother would not let down her milk in the absence of the calf. Results from this cow, and from her pair in the other group were therefore omitted from the milk yield computations, these being based on the remaining 7 pairs of cows.

Results

Trial 1. *May 1980*: The grouping of the cows was such that there was no significant difference between groups during the pretreatment period. (2.26 compared with 2,29 kg/day, SED ± 0.067 kg/day).

Table 1:
Mean yield (kg/day) and butterfat content (%) of milk in May 1980

	Yield/day			% Butterfat	
	Legume	No legume	SE(±)	Legume	No legume
Pretreatment	-	2.28	0.033	-	5.2
Period 1	2.33	2.09	0.097	5.6	5.4
Period 2	1.86	1.57	0.097	6.0	5.3
$P_1 + P_2$	2.09	1.83	0.068	5.8	5.4

Average yield (kg/day) and butterfat content (%) level are shown in Table 1. The yield in the pretreatment period is the mean of all 16 cows for 3 consecutive days and in the other periods it is the mean of 8 cows in each group for the final 4 days of each 13 day grazing period.

During the course of the trial, milk yields fell steadily. Period 2 produced less milk than Period l ($P<0.01$), while access to legumes had a beneficial effect on milk production ($P<0.05$). Average butterfat content was also improved by access to legumes,

Trial 2. August 1980: As in trial 1 cows were grouped such that there was no significant difference between treatment groups during the pretreatment period. (2.20 compared with 2.28, SED ± 0.069 kg/day).

Average yield (kg/day) and butterfat content (%) of the milk are shown in Table 2. The yields in the pretreatment period is the mean of all 14 cows for 3 consecutive days, and in the other periods is the mean of the 7 cows in each group for the final 5 days of each 14 day grazing period.

Period 2 produced more milk than Period 1 ($P< 0.05$) while access to the legumes increased milk production ($P <0.01$). Average butterfat content was again improved by the feeding of legumes.

Available pasture in each of the paddocks at the end of the grazing period is shown in Table 3. Since the complementation paddock consisted of 3 ha of grass to 1 ha of legume, the average over the total of 4 ha was 2457 kg/ha of dry matter, or 697 kg/ha more than in the control paddock.

Table 2 :
Yield (kg/day) and butterfat content (%) of milk in August 1980

	Yield/day			% Butterfat	
	Legume	No legume	SE(±)	Legume	No legume
Pretreatment	-	2.24	0.034	-	3.6
Period 1	3.09	2.58	0.127	4.0	3.8
Period 2	3.36	2.95	0.127	4.5	4.0
$P_1 + P_2$	3.23	2.77	0.090	4.3	3.9

Table 3:
Available pasture (kg/ha) at the completion of the August grazing

	Pasture	Fresh Material (kg/ha)	Dry Matter (%)	Dry Matter (kg/ha)
Control	grass	3060	57.5	1760
Complementation	grass	3780	63.9	2415
	legume	5630	45.9	2584

Discussion

In San Javier, the dry season is generally in the period April to September. In these 6 months the 28 year means (1950-1977) show an average of 255 of rainfall, compared with an annual total of 977 mm (Paterson and Horrell 1981). It was therefore planned to conduct Trial 1 at the start of, and Trial 2 in the most severe part of, the dry season. In 1980, good rains fell in April and May, so conditions were not as severe as normal at this time of the year. Pasture quality was, however, limited by the advanced stage of physiological maturity of the Yaragua which formed the bulk of the grazing in both areas; it is thought that this was the reason for the steady fall in milk yields during the 26 days observations in the first trial. Yields were always higher from the group with access to the legume, and this advantage was 0,24 litres/day (11.5%) in the first period and 0.29 litres/day (18.6%) in the second period of the trial with averages of 0.26 litres/day (14.5%) overall. Butterfat content was increased by an average of 0.4 percentage points over the trial period.

In trial 2 which was carried out towards the end of the dry season in a period when ambient temperatures were increasing, rains fell in the second week of August, and-these factors resulted in a general upward trend in milk yields due to the-growth of fresh grass stimulated by the improved climatic conditions, Again yields were always higher from the cows in the group with access to the legumes, this advantage being 0,51 litres/day (19.8%) in the first period and 0.41 litres/day (13.9%) in the second period of the trial, with an overall average of 0.46 litres/day (16.6%). Butterfat content was increased by an average of 0.4 percentage points, and this consistent effect would be of considerable importance in the manufacture of butter and cheese.

In the year in question, the most severe part of the dry season fell in the period from mid June to the end of July, and unfortunately at this time, milk yields were not being measured. Nevertheless in the second half of Trial 1, (2nd to 5th June) and the first half of Trial 2 (4th to 8th August) access to the legumes increased milk yields by 18.6% and 19.8% respectively. In the first two weeks of June, on a neighboring property, limited daily access to Glycine based pastures increased the milk yield of 15 cows by 24% (Paterson and Samur 1980), It would therefore seem reasonable to assume that in the worst part of the dry season the legumes could increase milk yield by 20%. It is thought that in a normal season in San Javier this increase could be observed over a period of some 4 months, with a smaller increase in the less severe weeks before and after this period of maximum stress.

In the period April to August inclusive, both pasture areas were grazed at 2 cows per hectare for 2 of the 5 months, or 0.8 conga/ha on average. At the end of the grazing period, the available dry herbage was estimated to be 697 kg/ha more in the complementation paddock than in the control, and assuming that a cow of about 400 kg liveweight together with its calf will consume about 12 - 15 kg of dry matter per day, and spoil a further 4-5 kg by trampling etc , the complementation paddock could have provided at least 35 days of grazing per ha more than the grass only area. This would represent an increase of 56% in potential usage of the legume supplemented area in the dry season for a suitable stocking rate of 1.2 cows/ha. Paterson et al (1980) report carrying 1.35 Animal Units/ha as steers for 4 months of the dry season of 1979 on this same area. The calculated 1980 results therefore support the 1979-observations.

With once per day milking, higher yields also mean an increase in the milk available to the calf, which should consequently grow faster, (Pullan and Grindle 1980), have greater weaning weight and therefore be of higher value. Unfortunately it proved impossible to measure this effect in the present work, but calf weights will be recorded in 1981

With better nutrition, the fertility of the herd should increase (Pullan and Grindle 1980) above current level which Burgess (1979) shows to be about 60%. Fertility levels should be continually monitored in the area to detect changes due to development practices.

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