Silages from Tropical Forages: Nutritional Quality and Milk Production

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Introduction

There is a need for silage making technology under local conditions, especially in those areas experiencing drier months or where monsoonal conditions restrict the routine cutting of forages. The need for silage making is even more significant in dairy cattle feeding, where the demand for uniform and high quality feed is of great importance. The tedious daily harvesting of green forages throughout the year also posed problems with smallholders, particulary when family labour is not sufficient.

The objective of this paper is to evaluate the performance and suitability of six tropical grasses and three forage crop for silage making and a feeding trial for milk production.

Methods

Six grasses viz. setaria (*Setaria sphacelata* var. splendida), signal (*Brachiaria decumbens*), humidicola (*B.humidicola*), MARDI Digit (*Digitaria setivalva*), Napier (*Pennisetum purpureum)* and three crops viz. (*Zea mays*) forage sorghum (*Sorghum vulgare* x *S. bicolor*) and *S. almum* were planted. The grasses were cut at 6 weekly intervals. Corn was harvested at 75 days, forage sorghum at 70 days and *S. almum* at 63 days after planting.

Fresh samples were taken for DM% and water-soluble carbohydrates (WSC) (Dubois *et al.* 1956) and for silage making in the laboratory. The silage samples were analysed for pH, lactic acid analysis (MAFF 1973) and physical characteristics. In the second experiment, six multi-parous Sahiwal-Friesian cows in mid-lactation were used to test three dietary treatments in a double switch over experiment (Cochran *et al.* 1941). Treatments were levels of silage in the diet in direct substitution for cut fodder as follows a) fodder *ad libitum*, b) fodder+silage (50:50) *ad libitum* and c) silage *ad libitum*. In addition each animal received six kg of concentrate once daily. Feed samples were taken once weekly and composited by cow-period. Feed intake and milk production were recorded daily.

Results and Discussion

The mean value of the WSC and the DM% in the crops and quality of silage produced (pH and lactic acid content) are shown in Table 1. Corn and forage sorghum produced good silage with pH <4.0 and lactic acid level with the values of 2.72 and 3.7%, respectively (Table 1). For the grasses, it was found that without additives, setaria and Napier can be turned into acceptable silage with pH of 4.07 and 3.96, respectively. The pH of the grass silage was reduced with the addition of 4% molasses (Table 1).

The nutritional composition of sorghum silage and guinea grass used in the second experiment are shown in Table 2. Treatment means for feed DMI, milk yield and feed efficiency are in Table 3. Intake of DM from roughage was higher (P<0.05) on treatment B than either A or C. The higher roughage intake of treatment B appears to be attributable to a stimulatory effect of silage on intake. The difference in the total DMI reflects differences in roughage DMI. Expressed as percent body weight, total DMI on the respective treatments were within the range 2.0

to 2.4%. Average daily milk yield was higher (P<0.5) for cows fed sorghum silage compared with control. The difference in milk yield was 13% between treatments C and A. Mean feed efficiency value of cows on the silage-based diet was nearly twice as good as either treatment B or the control group A (Table 3).

Of the crops, forage sorghum and corn can be made into excellent silage without additives. Grasses are suggested to be cut at about 6 weeks regrowth. Napier and setaria can be ensiled into reasonable silage, but the quality can be improved with the addition of 4% molasses before ensiling. As for the second experiment, sorghum silage appears to be a better feed than the average guinea grass commonly fed to lactating cows in this country. This is reflected in its effect on milk yield and feed efficiency.

Table 1. Silage Made from Tropical Grasses and Forage Crops

Crop Species	**Silage**		**Silage 4 % molasses**		**Quality**		
	DM%	**WSC %**	**pH**	**lactic acid (%)**		**pH**	**lactic acid (%)**
Grasses							
S. splendida	15.30	6.17	4.07	2.47	Good	3.64	1.96
B. decumbens	20.37	8.64	5.07	1.08	Poor	3.37	1.87
B. humidicola	20.85	2.35	5.32	1.26	Poor	3.31	2.03
D. setivalva	18.21	1.26	4.32	1.46	Poor	3.31	2.83
P. purpureum	15.77	9.88	3.96	2.53	Good	2.98	nd
P. maximum	19.35	3.03	4.71	1.84	Moderate	3.27	2.74
Crops							
Z. mays	21.20	22.99	3.72	2.72	Very good		
S. vulgare x *S. bicolor*	21.35	11.69	3.68	3.75	Very good		
S. almum	18.40	nd	4.40	nd	Moderate		

nd – not done

Table 2. Chemical composition of feedstuffs (%)

Feedstuff	DM	CP	TDN	CF	EE	NFE	Ash	Ca	P
Guinea grass	24.1	11.7	61.6	33.6	2.4	46.1	6.2	0.57	0.27
Sorghum silage	29.4	8.7	60.1	33.4	2.6	51.0	4.2	0.47	0.17
Concentrate	91.2	23.5	77.2	5.5	11.6	54.7	4.7	0.57	0.36

Table 3. Feed intake and efficiency and milk yield for the different treatments

Variables	A	B	C
Feed DM Intake (kg/d)			
Roughage	4.95b	6.22a	4.50b
Concentrate	5.40	5.40	5.40
Total	10.35b	11.63a	9.90b
DMI Per 100 kg BW	2.1	2.4	2.0
Milk Yield (kg/d)	7.01c	7.54ab	7.93a
Feed Efficiency (kg total DMI/kg milk)	2.16b	2.65b	1.37a

The values within rows with different letters are significantly different ($P<0.05$)

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Silage of Cratylia argentea as a dry season feeding alternative in Costa Rica

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Introduction

The legume *Cratylia argentea* (syn. *C. floribunda, Dioclea floribunda*), which occurs naturally south of the Amazon river through the area east of the Andes in Brazil, Perú, Bolivia and Argentina, is a shrub that branches from the base of the stem and reaches 1.5 to 3.0 m height (de Queiroz and Coradin 1995). It is well adapted to subhumid climates with a 5-6 month dry season and infertile acid soils with high aluminum content in tropical areas below 1200 masl.

Germplasm of *Cratylia* has shown good regrowth capacity after cutting and adaptation to biotic and abiotic constraints in several lowland sites in tropical America (Isla in Mexico, La Ceiba in Honduras, and several sites in Costa Rica, Colombia and Brazil) and in West Africa (CIAT 1995). CIAT and NARS have carried out studies on management and feed value of *Cratylia* in the region. Results indicate that yield of *Cratylia* fodder banks is increased when plant density is at least 20,000 plants/ha. As expected, digestibility (50–60%) and crude protein (20- 25%) vary with plant part and maturity. Intake of fresh material is increased when *Cratylia* is cut and wilted, given that direct animal intake of freshly harvested immature *Cratylia* forage is low (Raaflaub and Lascano 1995).

The value of *Cratylia* as a cut and carry protein supplement of sugarcane or king grass fed during the dry season to lactating dairy cows is being evaluated in smallholder dual-purpose cattle farms in Costa Rica (Argel and Lascano 1998). In addition, farmers are currently evaluating the option of utilizing excess *Cratylia* forage produced in the wet season for ensiling.

In this paper we present results from the on-station and on-farm evaluation of *Cratylia* when used as silage to supplement milking cows in the dry season.

Method of making silage with Cratylia

Ensiling *Cratylia* is a farmer-based initiative and as a consequence researchers in Costa Rica are now in the process of producing information for farmers in order to allow them to make good quality silage with this legume. Farmers testing the use of *Cratylia* for silage have developed their own system of harvesting and ensiling the harvested forage. Leaf and stem material from 3-4 month regrowth is cut fresh and mechanically chopped into 2-5 cm fine pieces. Harvested material is then placed in heap-type silos and covered with plastic after good compaction is achieved. Molasses is added when ensiling pure *Cratylia* (10-15 % dry matter bases), while a silage inoculum is added in a proportion of 1 kg/ ton of silage when mixed with King grass (30:70 proportion of legume:grass silage).

Use of Cratylia silage as a supplement for lactating cows

In areas with 5-6 month dry season in Costa Rica, there is a need to supplement dairy cows with concentrates or chicken manure to maintain acceptable levels of milk production. However, farmers are looking for alternatives as grain imports are becoming too expensive and milk prices are decreasing. An alternative considered by farmers to reduce supplementation costs is to replace concentrates and or chicken manure by fresh or ensiled *Cratylia* fed in combination with sugarcane or king grass during the dry period.

An initial experiment was carried out in the Escuela Centroamericana de Ganaderia (ECAG), Atenas, Costa Rica (460 masl, annual mean temperature of 23.7 ºC, mean precipitation of 1600 mm). Six mature Jersey cows (50 days postpartum) were randomly assigned to the following treatments arranged in a 3 x 3 crossover Latin Square design: T1=sugarcane (1.0% BW) + rice polishing (0.5% BW) + concentrate (1.48% BW) + urea (0,02% BW) ; T2=sugarcane (1.3% BW) + concentrate (0.5% BW) + freshly cut *C. argentea* (1.2% BW) ; T3=sugarcane (0.1% BW) + concentrate (0.5% BW) + silage of *C. argentea* (2.4% BW)

Each treatment period comprised 12 days of which 7 were for adaptation and 5 for measurement. Concentrate (0.5 % BW) was fed with the *Cratylia* treatments as cows used in the experiment were accustomed to receiving some concentrate during milking.

Results shown in Table 1, indicate that milk yield was similar in cows supplemented with concentrate as those supplemented with *Cratylia* fresh or ensiled. However, it was interesting to observe that milk fat was greater in cows fed *Cratylia* silage. The higher cost and lower benefit: cost ratio of feeding *Cratylia* silage were due to high labor cost in ECAG for harvesting and separating edible portions of 6-month old *Cratylia* regrowth, which is not the case in farms as indicated in a subsequent on-farm trial

Table 1. Dry matter intake and milk production of Jersey cows fed different diets during the dry season in Costa Rica (F. Romero and J. Gonzalez, unpublished data).

Treatments	DM intake (kg/cow)	Milk yield (kg/cow/d)	Fat (%)	Protein (%)	Solids (%)	*Cost of supplement ($/kg DM)	Benefit /Cost Ratio
T1. Concentrate	10.8	11.1	3.5	3.4	12.4	0.20	1.33
T2. Fresh *Cratylia*	10.7	10.9	3.7	3.2	12.5	0.16	1.68
T3. Silage of *Cratylia*	10.4	10.7	3.8	3.2	12.5	0.43	0.62
Sig. Difference	Ns	Ns	P< 0.06	P< 0.01	Ns		

* Includes the cost of all ingredients in the supplement except sugarcane

One farmer in the Central Pacific subhumid coast area of Costa Rica evaluated with the assistance of researchers the use of *Cratylia* as silage. Six crossbreeds Swiss Brown x Brahman dual-purpose cows in the third month of lactation were assigned to the following treatments arranged in a 3 x 3 cross-over Latin Square design: T1 = 12 kg sugarcane + 6 kg *C. argentea* silage + 0.6 kg rice polishing; T2=12 kg sugarcane + 6 kg *C. argentea* fed fresh + 0.6 kg rice polishing; T3=12 kg sugarcane + 3 kg chicken manure + 0.6 kg rice polishing

The results shown in Table 2 corroborate on-station results of little difference in milk yield, but higher milk fat when chicken manure was replaced by *Cratylia* silage. Results also indicate that the cost of supplementation was lower when *Cratylia* was fed fresh or ensiled, which resulted in higher economical benefit for the farmer as compared with chicken manure.

Table 2. Average milk yield of dual-purpose cows supplemented with *Cratylia* either fresh or as silage and with chicken manure. (M. Lobo, V. Acuña and A. López unpublished data)

Treatments	Milk yield (kg/ cow/d)	Total solids (%)	Fat (%)	Cost of supplement ($/kg DM)	Benefit to cost ratio
T1. *Cratylia* as silage	5.1 b	12.3	3.6	0.17	1.58
T2. Fresh *Cratylia*	5.5 a	12.2	3.4	0.11	2.37
T3. Chicken manure	5.3 a b	11.7	3.0	0.22	1.14

Conclusions

The use of *Cratylia argentea* for making silage has been a farmer led initiative in dual-purpose cattle farms in hillsides of Costa Rica. On-farm use of *Cratylia* silage as a supplement to milking cows has been shown to be a viable option for small dairy farmers given that it economically replaces expensive concentrates with no effect on milk yield. Research is underway to better define ways of producing high quality *Cratylia*-based silage.

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Kikuyu Grass Composition and Implications for Silage Production

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Introduction

Kikuyu grass (*Pennisetum clandestinum*), often top-dressed with nitrogen (N) fertiliser, is an important summer growing pasture along the east coast of Australia, especially in NSW and south east Queensland. Cutting surplus summer and autumn growth for silage would improve forage utilisation and the management of these pastures (Kaiser *et al.* 1993). Strategic silage cuts could be integrated with grazing to maintain the grass at a more vegetative, higher quality stage of growth for dairy and beef cattle. In order to ensile kikuyu grass with an organic matter digestibility of 0.60 to 0.70 a regrowth interval of 20 to 50 days would be required. This interval would vary with the prevailing growing conditions. There are few data on the ensiling characteristics of kikuyu grass when cut at this stage of growth.

Materials and Methods

Fresh kikuyu grass samples were collected at silage cutting in 11 experiments conducted in the Nowra district of coastal NSW. Regrowth intervals varied from 20 to 50 days and N fertiliser was applied at 50 or 100 kg N/ha at the commencement of the regrowth period. Samples were dried in a forced-air oven at 80°C for 24 h to determine DM content, and were then ground prior to analysis for water soluble carbohydrate (WSC), starch and total N content. Buffering capacities were determined on fresh forage using the method of Playne and McDonald (1966). A summary of the data from the 11 experiments are presented in Table 1.

Table 1. Composition of kikuyu grass at the time of cutting for silage - summary of results from 11 experiments

	DM content (g/kg)	Water-soluble carbohydrates (g/kg DM)	Starch* (g/kg DM)	Total N (g/kg DM)	Buffering capacity* (m eq./kg DM)
Mean	195.9	44.5	38.9	25.6	350.6
Range	108.5-323.0	23.4-68.4	14.2-57.8	17.4-35.1	224.7-495.7

* Starch data available from 4 experiments, and buffering capacity from 2 experiments

Results and Discussion

Although there was some variation in kikuyu grass composition, it generally had low DM content, low WSC content, high N concentration and intermediate buffering capacity. Low DM content in the range 100 to 160 g/kg is common, and it is only under dry conditions when kikuyu grass is moisture stressed that DM content can reach 300 g/kg at cutting. The mean buffering capacity, an indicator of the ability of the forage to resist pH change, was similar to published values for temperate grasses (McDonald *et al.* 1991).

The results from four experiments indicate that kikuyu grass contains an appreciable quantity of starch. While starch will not contribute directly to the silage fermentation, as silage bacteria cannot ferment starch, hydrolysis of starch to sugars during wilting and prior to the establishment of anaerobic conditions in the silo could boost the supply of sugars available for fermentation, provided there are not significant losses due to respiration.

The low WSC content, low DM content and intermediate buffering capacity indicate that there is a significant risk of a poor fermentation if kikuyu is ensiled without wilting or with only a minimal wilt (<300 g/kg DM content). Data based on UK studies with temperate grasses have shown that the critical sugar level for successful (low risk) silage production is 25-30 g/kg fresh crop (Wilkinson 1990). In our experiments the mean sugar content of kikuyu grass on a fresh crop basis was only 8.7 g/kg, well below this critical level.

Conclusion

Because of its low DM content, low WSC content and intermediate buffering capacity, farmers ensiling kikuyu grass will need to rely on wilting or silage additives to improve the probability of achieving a satisfactory lactic acid fermentation.

Acknowledgments

We are greatly indebted to the Australian Dairy Research and Development Corporation and NSW Agriculture for funding this research, and for assistance from local dairy producers who provided access to land and equipment .

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Wet Season Silage Production at Taminmin High School

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1. Feed Resources in the Wet Tropics

The main limiting factor for ruminant production in the Tropical Top End of Australia is the lack of good quality feed throughout the year. Seasonal rainfall provides a period of abundant herbage at its peak nutritional value during the wet season, followed by a period of lower quality mature herbage in the dry season. It makes sense to try and conserve the abundance of good quality vegetation when it is available in the wet, and use it later in the dry season when plant growth is severely restricted, natural feed is in short supply, and commercially available feed is relatively expensive.

This is exactly what has been done at Taminmin High School, which is located near Humpty Doo, approximately 40 km South East of Darwin, Northern Territory, Australia. The precise location is 12° 24' S, 131° 15' E.

2. Taminmin's Silage Program

As a regular part of their farm management strategy, Taminmin makes baled silage during late January or early February each year. Making hay at this time is not an option because it is too difficult to dry the plant matter to the required 85%DM or more.

Fig 1. Baled Silage being transported on the Taminmin Trailer

On the other hand, wet season pasture can be baled at lower dry matter (DM) content and higher moisture than hay, wrapped in plastic film and allowed to ferment into silage.

Almost any pasture can be made into silage, but the best silage is made from the best pasture. At Taminmin, silage is regularly made from Pangola grass, Cavalcade legume, and Wynn Cassia legume.

The trick is to watch the weather, then cut only enough pasture that you can comfortably wilt, bale, wrap and stack in a single day without any rainfall.

3. A Typical Day of Making Silage

As long as we are confident of getting a rain free day we go ahead. Trial and error has taught us to process no more than 1.5 hectares.

Check with the Weather Bureau. They regularly track tropical storms by radar and are very competent predictors of storm incidence, arrival times, and intensity/duration. We have found their accuracy decreases as distance inland increases, but for the cost of a phone call they are a terrific advisory service.

Pasture is cut at 0900 hours. Sunrise is usually just after 0700, and the two hours is enough time to get most of the free water evaporated from the pasture.

A second tractor forms up the windrows almost immediately. This is usually done by 10.30. We turn the windrows over just once, starting at 11.00. This is usually done by 12.30. We sample the windrows and estimate the dry DM content. This is easily done in 10 mins using a microwave oven, but we are lucky enough to have a probe (Farmscan 2180) to do this in the field. We start baling as soon as the DM content is 40% or more. (Actually, the last two seasons the contractor has made this process much more efficient: he has used a mower/conditioner to cut, condition, and windrow in one operation. This has also allowed the cut pasture to dry out quicker.)

We get about 60 bales, and baling is normally finished by 1730. We start wrapping as soon as the bales are formed. This takes longer than baling, but is completed just before 1900.

We do not provide any additives such as molasses, urea, or lactic acid bacteria inoculant. Our research has shown that the cost of the additive cannot be justified. Weight increases of stock being fed silage with or without additives are not significantly different. However, it is extremely important to wilt the material to about 40%DM before baling. Ensiling wet material (e.g. less than 30% DM) will almost certainly result in production of poor quality silage, high amounts of wastage, and a high degree of stock rejection.

It is a very busy day that we usually repeat, weather permitting, two or three times in 7-10 days. The end result is a harvest of between 70-80 tonnes of reasonable quality feed stored away for use later in the dry season.

After baling, we spread fertiliser. Late wet season rains give us a good regrowth which can be grazed or harvested a second time. The second harvest is usually made into hay as per normal practice for our area.

4. The Benefits

- Fodder conservation from our improved pastures has increased by more than 40%.
- We get two harvests instead of one (and a grazing period).
- The same small areas previously were only lightly grazed and turned into hay during May: although it was good quality hay, it is nutritionally lower than the silage made in February.
- Weed control is improved. Small amounts of weed that are present are ensiled before they head out. Consequently we spend less time and money on weed control, whilst continually giving our pastures a competitive advantage.
- The process manages Wynn Cassia really well. Wynn Cassia makes good silage, but very poor hay (see section below).
- Our feed costs during the dry season are dramatically reduced. We still buy supplements, but the vast bulk of the feed is provided by the conserved silage.
- Conserved forage is a cash crop: we have always sold our excess hay, but also having baled silage for sale improves our management options as well as our annual income.

5. The Disadvantage

The major difficulty with the program is the need to use a contractor. The making of silage is not difficult, but the program depends on having the equipment readily available. Although late January / early February is a time of inactivity for baling contractors, most do not have wrapping machines, and anyhow it is costly to move the equipment about in order to process a relatively small amount of forage.

Hopefully, as more people try this management strategy, costs will reduce, and efficiencies due to processing larger amounts of forages can improve.

6. Special Benefit: Wynn Cassia

This vigorously growing tropical legume has a positive benefit for soil nitrogen content, and is an excellent ground cover for weed control. However,

- cattle and buffalo only eat Wynn Cassia reluctantly under normal grazing conditions, and

- it is extremely difficult to make into hay. This is because the plant is very leafy. The leaves shatter easily as they dry out. They also shatter and drop off when moving through a baler. If you are successful at all in making a bale of Wynn Cassia hay, it will be nearly all stem.

The positive benefit is that Wynn Cassia silage is easy to make: the higher moisture leaves do not shatter, and the bale is much easier to form. Silage made from a mixed Wynn Cassia / grass pasture is even easier to make, and usually better quality. Secondly, stock love Wynn Cassia silage: they accept it immediately, and eat it all when it is presented.

7. For the Technically Minded

A summary for the silage quality, including nutrition data is shown in the table.

Table 1. *Harvest Summary: Baled Silage*

	Pangola	***Cavalcade***	***Wynn Cassia***
Dry Matter (%)	42	45	52
Digestibility (%DM)	57	55	58
Metabolisable Energy (MJ kg^{-1}DM)	8.5	9.0	8.8
Crude Protein (%DM)	9.1	13.5	12.0
Mean Bale Weight (kg)	383	430	390
No Bales Produced	57	75	45
Estimated total DM conserved (kg)	9169	14513	9126
Productivity (tonnes DM ha^{-1})	6.1	7.3	6.1

Total fresh: 71.6 tonnes   Total DM: 32.8 tonnes

Silage quality and losses due to ensiling of Napier grass, Columbus grass and maize stover under small holder conditions in Kenya

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Introduction

On behalf of the National Dairy Development Project, several ensiling experiments were conducted at the National Animal Husbandry Research Centre (NAHRC) at Naivasha, Kenya, in the period 1983-1989. The aim of the experiments was to develop methods and techniques suitable for smallholders for the ensiling of Napier grass, Columbus grass and maize stover to overcome feed shortages during the dry season.

Materials and methods

The following six series of ensilage experiments were conducted:

Series A: 2 silages of chopped, wilted Napier grass with or without addition of molasses, ensiled in an number of netted nylon bags and placed inside a larger silage clamp

Series B: 6 pits of wet long or chopped Napier grass with addition of 3.5% or 6% or without molasses

Series C: 4 pits of wet long or chopped Napier grass with addition of 3.5% molasses or MUM (molasses/urea mixture)

Series D: 6 pits of wet long or chopped Napier grass with addition of 3% molasses

Series E: 4 pits of wet long or chopped Columbus grass with addition of 3% molasses

Series F: 3 pits of chopped maize stover or maize stover mixed with lablab, without additive.

Silages were made in small earthen pits in quantities varying from 1000 to 2000 kg fresh material, thus more or less representing conditions for small-scale farmers. Sides and top of the pit were covered with 2 m wide polyethylene plastic sheets covered with a layer of about 50 cm of sand on top and sides

Results

Percentage non-edible silage (mouldy and rotten silage) varied from 0 to 2.5%, indicating that sealing with polyethylene sheet and soil cover was good. Levels of butyric acid and contents of ammonia nitrogen often were below 0.3% and 12 respectively for silages of wilted Napier grass and wet chopped Columbus grass with the addition of molasses and for silage of maize stover. These fermentation characteristics indicate good silage quality. Smell was good as well. For some wet Napier grass silage and for silages made with addition of MUM of unchopped Columbus grass, results were less good.

Long, unchopped Napier grass wilted for one or two days to about 30% dry mater and with the addition of molasses and with proper compaction, often resulted in good silage as well.

Dry matter losses due to ensiling of Napier grass averaged 15.2 ± 4.2%. Losses were lower for silages made of grass wilted for one or two days and higher for silages made of wet unchopped grass and grass with the addition of MUM. For wet Columbus grass, there was also a clear positive effect of chopping. Average dry matter losses for ensiled maize stover were 8.1%.

Losses of crude protein averaged 16.9%, but variation was large, partly due to sampling errors. Losses were lower for wilted silages and much higher for silages with the addition of MUM.

In vitro organic matter digestibility decreased due to ensiling and was more than 10 units lower in case of poor quality silages. For well-preserved silages, the decrease in digestibility was often limited to 5 units or less. Losses of digestible organic matter for Napier silages averaged 28.5±7.9%. Losses were lower for wilted silages and much higher for wet silages of series D and silages made with the addition of MUM.

Results show that under smallholders' conditions, good silage can be made. Poor quality silages of poorly digestible Napier grass however, will not meet maintenance requirements of animals.

Conclusions and practical recommendations

1. Under small farmer's conditions, good silage can be made, provided that air-tight sealing with plastic polyethylene sheets is applied, with at least a cover of 50 cm of soil on top and sides of the pit, and with good drainage of rain water. Ensiling and covering has to be completed within one day.

2. As shown by good fermentation characteristics and smell, wilting one or two days to reach a dry matter content of 30% often results in good silage, especially when molasses is added. Wilting to a dry matter content of more than 30%, or wilting of old stemmy material is not recommended, because of the higher weather risks and difficulties with compaction.

3. Dry matter losses due to ensiling of wilted or wet, chopped Napier grass with the addition of molasses could be limited to 15%.

4. Dry matter losses of silages made of wilted, un-chopped long Napier grass are probably slightly higher than from chopped Napier grass. Provided proper compaction, addition of molasses, air-tight sealing and covering with at least 50 cm soil, making silage of long, wilted Napier grass may be a good alternative for smallholder conditions.

5. Although it is not very clear from the limited experience provided by these experiments, addition of 3% molasses to wet and long wilted Napier grass will probably be sufficient to obtain good quality silage, especially when hand-mixed through chopped silage. To increase chances for good quality silages addition rates of up to 6% are suggested when molasses is applied in the silage pit on layers of grass. For chopped, wilted Napier grass and for chopped Columbus grass, addition of molasses can be lower.

6. MUM as an alternative additive for molasses does not produce good silages.

7. Silages of chopped Columbus grass with molasses and chopped maize stover without molasses made good silage. Dry matter losses appeared to be lower compared to Napier grass.

8. Because of a higher risk for leaching, dilution of molasses with water in order to ease application should not exceed a 1-to-1 ratio. A relatively small quantity of molasses should be used at the bottom layers of the pit, and more to be added to the middle and top layers.

9. Losses of crude protein and digestible organic matter were not accurately measured in these experiments, because of the limited number of samples and because of sampling errors.

Based on good quality silages in these experiments, losses are about 15% and 25% for crude protein and digestible organic matter respectively.

10. Poor silages of overgrown Napier grass will at best supply sufficient energy for maintenance. Feeding overgrown Napier grass as standing hay, or mulching might be a better alternative then. Proper storage and utilisation of crop residues like maize stover and preserving feeds like sweet potato vines, fodder beets, cassava or fodder trees may prove better in those situations.

A Comparison of the Nutritive Value of Cavalcade legume pasture and Pangola grass pasture preserved as silage or hay

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Experiment Location

This small study was conducted at Humpty Doo, approximately 40 km South East of Darwin, Northern Territory, Australia (12° 24' S, 131° 15' E). The area receives a mean annual rainfall between 1500-2000mm, 80% of which falls in the four months between December 1st and March 31st.

Description of the Experiment

The nutritive values of Cavalcade legume (*Centrosema pascuorum*) and Pangola grass (*Digitaria eriantha*) pastures were compared with the nutritive values of the same pastures preserved as 7 month old hays and silages. The pastures were harvested (Cavalcade by slashing and Pangola using a disc mower) and wilted under field conditions to obtain forage with dry matter contents ranging from 221 - 865 g kg^{-1}. The wilted pastures were made into small cylindrical bales (800mm long x 450mm wide) which were either wrapped in plastic film for preservation as silage, or left unwrapped as hay. Each bale was sampled and analysed for nutritive content (DM, DDM, ME, and CP). At harvest the Cavalcade and Pangola pastures were 125 days and 45 days old respectively.

The results are given in Table 1 and Table 2 (This data is the nutritive values of the silages and hays after 7 months storage. This corresponded to a complete Dry Season. Other data is available on request showing the nutritive values of the silages and hays at the time of formation (ie at the beginning of the storage period)

Table 1. A Comparison of the Nutritive Value of Cavalcade legume pasture preserved as wilted silage or hay

Cavalcade legume				
	Pasture	**Silage**		**Hay**
		Wilted	**Heavily Wilted**	
DM (%)	23.3	41.4	61.8	92.2
Digestibility (%DM)	55.1	53.4	50.1	42.5
ME (MJ/kg DM)	8.2	7.8	7.3	6.1
CP (%DM)	20.4	16.1	16.1	13.1
Bale Weight (kg)		25.7	15.9	9.7
pH		4.50	4.60	
Ethanol		2.49	1.44	
Acetic acid		13.99	5.10	
Butyric acid		1.79	0.34	
Lactic acid		16.61	13.44	
Ammonia N (g/kg TN)		52.30	32.20	

Units for ethanol, and Acetic, Butyric, and Lactic acids are g / kg DM

The nutritive values of the Cavalcade forage and the Pangola grass reduced as DM content increased, but nutritive contents during storage were maintained. Silages had better nutritive value than hays. Silage quality was good. The Cavalcade silage had high lactic acid contents, lower acetic and minor butyric acid production being associated with low pH. Spoilage was generally low (11.5 %). In the Pangola grass silage the main fermentation product was ethanol, but the silage quality was still good with lactic acid contents higher than acetic acid content, minor butyric acid production being associated with high pH (4.95). Spoilage was consistently low (2.82%). Ammonia-N production, which was always less than 60 g kg^{-1} Total N, was highest for low DM content silages for both species.

Table 2. A Comparison of the Nutritive Value of Pangola grass pasture preserved as wilted silage or hay

Pangola grass					
	Pasture	Silage			Hay
		Minimum Wilt	Wilted	Heavily Wilted	
DM (%)	22.1	44.3	55.4	63.7	91.9
Digestibility (%DM)	59.8	60.8	57.0	55.5	48.7
ME (MJ/kg DM)	9.0	9.0	8.4	8.1	7.1
CP (%DM)	13.0	10.7	10.8	11.3	9.8
Bale Weight (kg)		24.8	22.3	18.4	10.7
pH		4.50	4.90	5.40	
Ethanol		16.27	12.52	7.38	
Acetic acid		4.12	1.87	1.30	
Butyric acid		0.45	0.06	0.04	
Lactic acid		11.74	5.05	2.52	
Ammonia N (g/kg TN)		40.00	30.70	28.90	

Units for ethanol, and Acetic, Butyric, and Lactic acids are g / kg DM