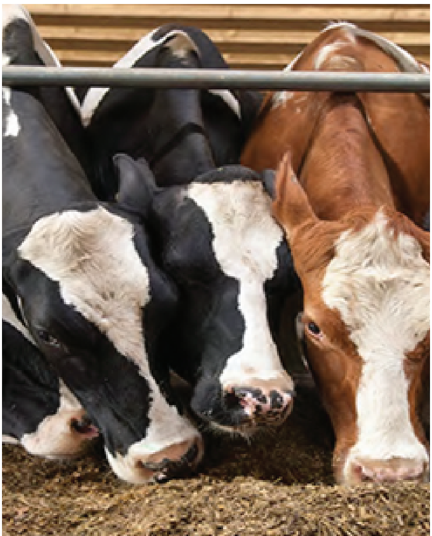
Sweetpotato Vines Silage for Improved Dairy Cattle Production



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Small-scale dairy cattle production in Uganda

Dairy cattle production is among the priority sectors to spur poverty eradication under Uganda Vision 2040 development framework. Small-scale farmers (Figure 1) dominate Uganda's dairy production owning over 90% of the cattle population.

Figure 1: Small-scale dairy farmer

Small-scale dairy cattle production systems are important for milk production which doubles as an important source of protein and income and is commonly referred to as the farmer's "**white gold**" in many communities. Compared to other ruminant production systems, small-scale dairy cattle production systems have the advantage of instant benefits from daily production of milk whose demand in Uganda is continuously increasing due to rapid population growth rates, dietary adjustments, growing incomes and urbanization.

However, small-scale dairy farmers are faced with many challenges/constraints, which are partly responsible for the poor production performance. Feed constraints are among the key constraints that small-scale dairy farmers grapple with. Feed costs contribute over 70 percent of the total costs of production in a profitable dairy cattle enterprise in Uganda. Pastures such as Napier grass commonly known as elephant grass (*Pennisetum purpureum) (*Figure 2) are the most important source of feed (nutrients) for dairy cattle. However, the quantity and nutritional quality of pastures declines greatly during the dry season leading to poor animal performance.

Figure 2: Napier grass

Uganda is increasingly experiencing changes in weather patterns as exhibited by flood and drought events which have had negative socio-economic impacts. Human induced climate change is likely to increase average temperatures in Uganda by up to 1.5ºC in the next 20 years. Changes in rainfall patterns and reductions in annual rainfall amounts are also expected. The changes in rainfall and temperature are likely to affect the productivity of pasture-based dairy cattle systems. Proper feed management will not only increase cattle milk yields but also save farmers significant time and resources. Dairy production efficiency is ensured by maximizing utilization of the available and good quality feed resources.Alternative sources of feeds to spur dairy cattle production and free cereal supplies for human consumption are therefore receiving closer attention.

Sweet potato production in Uganda

Uganda is the largest producer of sweet potatoes in Africa and sweet potatoes are ranked third in importance as a staple food after bananas and cassava. Uganda annual sweet potato production is estimated at 2.5 metric tons. Sweet potatoes are grown everywhere in Uganda because they are easier to grow as they require less labour input compared to other crops. Sweet potato tubers (Figure 3) withstand extreme weather conditions, grow well in marginal soils and can be kept for some time in the soil as a reserve crop. Sweet potato has higher biological efficiency as food and shows highest productivity (35-45 ton per hectare). Hence, fits nicely into tight cropping systems.

Figure3: Sweet potato tubers and vines

Importance of sweet potato crop

- Sweet potato is a key food in household food security both in raw and dry form. The leaves can also be eaten as vegetables.
- Sweet potato is high in carbohydrates and vitamin A and can produce more edible energy per hectare per day than wheat, rice or cassava. Orange Fleshed Sweet potato varieties have been developed to address vitamin A deficiency.
- The leaves are used as green manure.
- Sweet potatoes contain elements such as Chlorine and Manganese that help the brain function at its best.
- Sale of sweet potato planting materials, tubers, products and vines contribute to household income.

- The tubers may be processed into simple products such as chips, bread, local brew/drink, juice, pancakes and composite flour (mixed with maize, millet and soya flour).
- Sweet potatoes are used in industrial processes to make alcohol and starch.
- Sweet potato crop residues are a major source of feed resource for livestock. Forage of beta-carotene-fortified orange-fleshed sweet potato is essential for alleviation of cattle malnutrition.

Sweet potato residues as a feed resource for dairy cows

Sweet potato crop contributes about 20% of total crop residues provided by roots and tuber crops. Sweet potato residues (vines, peels and non-commercial roots) are a major feed resource in small-scale dairy cattle production systems in Uganda. Sweet potato forage can be an emergency supply of cattle feed in periods of water stress (drought or dry seasons). Dried vines and foliage compare favorably with alfalfa hay for cattle feeding in terms of protein content. The dry matter content of sweet potato vines ranges from 21.7 to 34.8 percent which is more than that of cassava leaves (less than 30 percent).Sweet potato vines have high crude protein (about 22%). Swee potato tubers are a rich source of dietary energy from the carbohydrate component.

The tubers can be given to dairy cows in either fresh, chopped, dried chips or silage form as energy supplements along with locally available grasses during the dry season. Fresh sweet potato vines can be preserved to be used during the lean season when fodder availability is inadequate. They can provide high quality feed for dairy cows since they are high in protein and energy. On-farm and on-station studies have shown that dairy cows fed high protein sweet potato vines produce less methane gas compared to other feeds, potentially reducing emission of harmful greenhouse gases.
Sweet potato feeding can also be very beneficial in feeding of calves. The calf is the foundation for any future cattle stock of a nation and its care is therefore crucial for sustainable animal agriculture and maintenance of good quality germ-plasm. Studies conducted at the National Livestock Resources Research Institute (NaLIRRI) showed that sweet potato vine-based partial milk diet (Table 1) could substitute sole milk feeding to reduce the cost of rearing a calf without adversely affecting its health and yet save about 120 litres of milk which would have been fed to each calf over the 70-day study period that they had.

Table 1: Sweet potato vines-based partial milk replacer diet

Ingredient	Composition (%)
Chopped and dried SPV	60
Maize bran	30
Fish meal	9
Dairy Mineral Lick	1

SPV = Sweet potato vines; *Source: Taabu (2012)*

The results further demonstrate that Friesian bull calves can be raised under zero grazing dairy production systems with minimum resource input to add to the financial benefit of small-scale dairy farmers. Sweet potato vines-based partial milk diet can be offered in form of calf pellets mixed with molasses.

Expanded use of sweet potato as animal feed appears to be promising for both agro-biological and socio-economic reasons. On the agro-biological side, sweet potato has a relatively short vegetative cycle (4-5 months) which enables it to fit nicely into tight cropping systems compared to other tuber crops like cassava. It therefore produces much more daily dry matter per hectare compared to cassava.

Challenges in using sweet potato residues as a feed resource

Sweet potato residues (vines and roots) are highly perishable. After harvesting, farmers usually have a lot of residues which are wasted in the fields yet these same farmers keep dairy cows which would feed on these vines and roots. Research conducted by the International Potato Centre(CIP) in Kamuli district showed that farmers waste up to 24 and 21% of the vines (about 599 kg/acre of vines) and non-marketable roots, respectively. Table 2 shows how farmers in Kamuli district (Eastern Uganda) use the different parts/residues of the sweet potato crop.

Table 2: Utilisation of sweet potato parts/residues by Kamuli district farmers

	Usage (percent)						
Sweetpotatopart/residue	**Food**	**Planting material**	**Animal feed**	**Sell**	**Manure**	**Given to neighbours**	**Thrown away**
Big roots	67.5	0.0	0.0	32.5	0.0	0.0	0.0
Small roots	72.6	0.0	21.3	3.0	0.0	0.1	3.0
Low quality roots	16.9	0.0	59.5	0.6	0.4	0.8	21.8
Peels	0.0	0.0	82.7	0.0	5.2	1.0	11.1
Vines	0.0	28.6	44.2	2.2	0.6	0.2	24.2

Source: Asindu (2016)

The study findings further indicated that majority of dairy cattle farmers actively engage in sweet potato production and face feed scarcity between the months of February to July. In urban and pre-urban areas**,** sweet potato residues create a disposal problem as they are dumped within the markets after sale of the tubers. This causes an environmental hazard. In order to make good use of sweet potato residues**,** there is need to conserve them to mitigate seasonal feed shortages and assist in coping with seasonal feed price fluctuations that many smallholder livestock farmers experience.

Fodder conservation

Availability of nutritious fodder throughout the year is very essential for profitable dairy farming. However, feed availability (quality and quantity) varies from season to season. Therefore, every dairy farmer must preserve the surplus fodder (forages and crop residues) to ensure continuous feed supply for dairy cattle production**;** either to sustain growth, fattening or milk production, or to continue production in difficult periods when market prices are highest. The surplus forage of the two rainy seasons could easily be carried over to the succeeding lean periods of fodder supply. Conserved forages can take the form of: (a) silage, (b) hay or (c) haylage.

Hay

Fresh grass when cut generally has a moisture content of at least 80 percent (resulting in a dry matter value or DM of 20 percent or less). Cut forage intended for hay must be allowed to dry in the field to a moisture level of not more than about 20 percent (80 percent DM). Hay that is baled with a moisture level in excess of 20 percent will result in bales that are heavy, and at risk of mould and heating. Heating can happen because the presence of sufficient water in the forage allows metabolic activity to continue, resulting in heat accumulation within the bale. The heat can get so high that spontaneous combustion and barn fires are the potential outcome.

Silage

Silage is simply fermented fodder stored in airtight conditions to be fed to livestock at a later time. Any type of fresh grass plant can be used, including cereal grains such as corn, sorghum, and oats. Note however that, the grain is not the only part that can be ensiled (made into silage); the whole plant is cut and fermented. The ensiling process generally takes about 21-30 days. When the pH stops dropping, the ensiled feed is considered stable and ready for storage. The quality of the final product is determined by the quality of the forage that is used to prepare the silage and the level of completeness of the ensiling process.

SPV silage	26.2	11.3	27.5	40.1	4.2
Napier grass fodder	16.9	13.2	31.9	59.0	0.8
Napier grass fodder silage	16.4	10.3	27.2	46.2	5.9
SPV-Napier grass fodder (mixture)	19.8	14.2	35.2	51.4	1.0
SPV-Napier silage (mixture)	22.8	13.1	25.5	37.2	4.0

Napier grass was harvested at 7 weeks of age; SPV-Napier was mixed at a ratio of 1:1

Source: Lutwama and Ssentambi (2016)

Types of silos

There are several types of silos that can used for ensiling namely: (1) Trench/pit silos; (2) Tower silos, (3) Heap/stack silos, (4) Polythene tube/bag silos, and (5) bunker/walled-surface silos. The quantity of sweet potato vines silage that you will prepare will depend on the number of animals you have, the quantity of forage as well as the nutritional requirements of the dairy cattle.

Trench or pit silos

Trench silos are constructed by excavating soil to form a trench or a furrow on a slightly sloppy ground, meaning the forage will be ensiled below the ground surface. This enables easy compaction of the material being conserved. The pit or trench silo is shaped like the conventional tower **silo** but is inverted into the ground and resembles a well or cistern. The walls of a pit silo may or may not be lined.

Construction of a trench/pit silo

Constructing a trench/pit silo can by simply digging a trench/pit in the ground (Figure 4). The proportions of the hole will depend on the amount of feed you want to store, but generally, two cubic meters will store one thousand kilograms or twenty bags of freshly cut feeds. This quantity will need 20-30 litres of molasses and 10 meters of polythene sheeting.

Figure 4: A trench silo under construction

For pit/trench method, select location for making pit at higher level on ground so that rain water may not percolate in to pit. In rectangular pit, corner edges should be making round so that

1. Place polythene sheets along the sides of the trench silo to prevent loss of material (Figure 5).

Figure 5: A pit silo lined with polythene sheets

Preparing sweet potato vines silage materials

1. Chop wilted sweet potato vines into small pieces of about 2.5 cm long using a panga or chaff cutter.
2. Dilute a litre of molasses with water in a ratio of 1:2 (molasses to water) or use 10 kgs of maize bran per 100 kgs of chopped fodder.
3. Sprinkle the molasses-water mixture or maize bran over the chopped feeds. You can use a garden sprayer or a watering can to dispense the liquid evenly.
4. Put the chopped sweet potato vines mixed with molasses into the plastic lined pit and spread them evenly to a thin layer (Figure 6).

Figure 6: Filling a trench/pit silo

5. Continue the process until the pit is full and dome shaped.
6. Apply proper tread pressure and complete sealing to prevent air from entering the silo as this results into damage/rotting of the silage.
7. Press down the fodder using your feet or using other forms of weight to ensure that air is forced out. By doing so, you inhibit fungal attack that may destroy the silage.
8. Repeat this process until the pit is full in a dome shape.
9. Cover the material with a polythene sheet (Figure 7) then cover with soil of at least 1-foot (30 cm) thickness to further compress the material.

Figure 7: Covering the silage pit

10. Use about 24 inches of soil for wet fresh feed and 36 inches for dry forage. By doing this, you will help keep air out and inhibit damaging of the polythene by birds, rain and rodents.
11. With proper sheets and sufficient soil on the pit, the silage can last for a long period. Make sure to use the silage in times of fodder shortage. The silage will be ready in about 21 to 30 days.
12. You can open the pit from its narrow end and take enough feed for one day and then cover the open end once more. DO NOT open the entire pit at once as air will enter the silage. Once you open the pit, make sure you remove/harvest the silage as fast as possible.

The major limitation of trench silos is their labour intensity during filling of the trench with forage material. Also, silage may get spoilt due to rain water seepage.

1. **Tower silos**

Tower silos (Figure 8) are good for making silage because of their elevated heights, which aid compaction and air exclusion. However, their major disadvantages are high cost of construction and need for specialized machinery to propel silage material over high elevations.

Figure 8: Tower silo

2. **Stack silos**

A plastic sheet (about 0.1 mm thick) is spread over the ground (Figure 9).

Figure 9: Stack silo

The silage materials are put on the sheet and covered with a plastic sheet. Silage stacks are best used for storing an unexpected surplus of forage or as an interim method when first trying silage. Stacks should be located in an area sheltered from the wind with a 15 to 30 cm slope away from the stack location. Stack width should be fitted to the size of plastic cover to be used. For instance, if a 13 x33 m (40 x 100 ft.) plastic cover is being used, the base of the pile should be 9 to10 m (27 to 30 ft.) in width.

The entire stack should be covered during breaks in harvesting and the end uncovered when harvesting resumes. The top is covered with plastic and sealed all round with soil. Since a stack has a large surface area exposed to oxygen and weather, potential for spoilage can be high. Prompt covering and effective anchoring of the cover is effective at reducing losses (Figure 10).

Figure 10: Stack silo partly covered with a polythene sheet

The sheeting can also be covered with used vehicle tires, close to one another to keep the silage compacted and at the same time prevent the polythene sheet from being blown open by the wind.

The use of a large stack also minimizes the amount of surface spoilage. The most efficient shape is a domed stack. This also permits tractor packing over the entire surface. The packing tractor must be operated carefully. The width and length of the stack are also affected by the removal rate for feeding. At least 10 cm (4 in.) should be removed daily, to minimize spoilage. The advantages of the stack silo are low cost and flexibility of placement. Always use large enough polythene sheets to avoid seams, but if this is not possible, ensure that the sheets overlap over a width of at least 45 cm then cover the seam with soil.

3. **Bunker or walled-surface silos**

Bunker silos are used in flat areas unsuitable for trench silos. Above-ground walls are constructed using concrete or timber braced with poles.

4. **Small-scale silage – using plastic tube silos**

Silage making has not been practiced by many small-sale dairy farmers in Uganda because the production method relies on heavy equipment**;** both to dig storage pits and to compress the grass, putting it beyond the reach of smallholder farmers.

Polythene tube silos making technology (Figure 11) is simple, cost effective and ideal for smallholder livestock farmers.

Figure 11: Polythene tube silos

Some innovative youth groups have identified the technology as a business opportunity and, in addition to selling, are providing the service of making sweet potato vines tube silage at a fee.

Advantages of polythene tube silos

- Polythene tube bags are an economical alternative to traditional silage storage systems, such as pit silos.
- It is an effective way for preserving feed with minimum nutrient loss. The anaerobic environment that is created eliminates spoilage from the growth of yeasts, moulds and adverse bacteria while maintaining essential proteins and nutrients.
- Allows farmers to store silage anywhere they need it.

- The silage is completely sealed in the bag. This means that all the lactic acid is retained in the silage, unlike in pit silage when it seeps out through the bottom of the pit as effluent. This compensates for the longer pieces of forage and poorer compaction than that found with silage machinery, so that the quality of the silage is just as good.
- Ensiling in a bag avoids the hard work of having to remove silage, as is the case with a pit silo, when it must be dug out every day.
- Because the whole bag is fed out to the animal, it means the rest of the silage which is in the other bags is not exposed to air at removal and is therefore unspoiled. Much of the silage in pits has been found to be spoiled due to poor sealing and exposure to air daily whenever the silage is removed for feeding.
- The bag is easily stored and easily portable so that any member of the family can carry it to the feed trough for the cow.
- A plastic bag (600-800mm) of 1.5 metres can compact 50-70 kg of silage depending on material used and the type of silage produced.

Disadvantages of polythene tube silos

- Containment and disposal of the plastic, once silage is removed from the bag.
- The need to chop the green mass as chopped material gives better silage, because more air can be squeezed out of it during the packing process and the small pieces cannot puncture the bag.
- Most losses of silage during the process occur due to unnoticed bird/rodent damage to the bags resulting in spoilage loss and too wet (gaseous/seepage losses) or too dry silage (spoilage).

Materials required for the polythene tube silo technology in making SPV silage

- Sweetpotato residues
- Black polythene tubes, 2.5 metres, gauge 600-800 mm or reusable polythene silos
- Maize bran
- Forage chopper or a machete
- Tarpaulin
- 100 kg synthetic sacs
- Weighing scale
- Sisal twine
- 4 labourers to produce 1,000 kg of silage.

STEPS FOR SWEETPOTATO SILAGE PREPARATION

Step 1: Wilt and chop sweet potato vines

After harvest, green and healthy sweet potato vines are carefully pre-wilted for 1-4 hours in the sun so that moisture content is reduced by 40-45%. The material is then chopped to 2-5 cm length using a forage chopper or a panga. Chopping facilitates compaction and enables attainment of the anaerobic stage; releases plant juices which stimulate the growth of lactic acid bacteria, increases silage intake by improving quality of fermentation and accelerating rate of passage of feed particles through the rumen. However, very finely chopped silage reduces rumination and may decrease milk fat content. Thus, 10-15 percent of the silage material should be above 2.5 cm in length in order to maintain effective fibre function.

If non-marketable sweet potato tubers are available, a ratio of 75 kg of vines, 20 kg of non-marketable tubers and 5 kg of maize bran can be used. A ratio of 10% of wilted or dried young leaves and stems of Mexican sunflower foliage (Figure 12), 70% chopped sweet potato vines and 10% maize bran can be added to improve the protein content of silage. Salt (0.5%) can be added to improve the taste.

Figure 12: Mexican sunflower

Step 2: Add a substrate to chopped sweet potato vines

Mix pre-wilted material thoroughly with 10% maize bran or diluted molasses (Figure 13).

Figure 13: Mixing maize bran with chopped sweet potato vines

Sweet potato silage can also be made by adding I litre of molasses mixed with 2 litres of water. Maize bran produces better sweet potato vines silage than molasses because maize bran reduces the quantity of effluent from the silage**.** The fermentation process takes 20-30 days.

Step 4 Making a plastic tube silo

First open the polythene tubing. Pleat the black polythene tube (about 1.5 metres long, gauge of 600-800 mm for every 70 kg of residues) lengthwise, tie firmly with the sisal twine at 30 cm distance from the cut edge, fold back the edge and tie once again to exclude air (Figure 14).

Figure 14: Tie one end of the tube

The container in which silage is kept is called a "**silo**". A 100 kg plastic drum can also be used as a silo (Figure 15). Reusable plastic silo bags (Figure 16) are also available in the Container village in Kampala.

Figure 15: Plastic tanks used as silos

Figure 16: Reusable plastic silo bags

Step 5: Protect the polythene silo with a synthetic sack

Place the polythene tube into another 100 kg capacity sack (Figure 17). Synthetic sacks are usually used for packing sugar, salt, rice and maize flour. The synthetic sack protects the polythene tube from being damaged by rodents and hot weather.

Figure 17: Place the polythene tube into a synthetic sack

Step 6 Filling the silo with sweet potato residues:

In a standing position, fold the top half of the tubing over the sides of the lower part. Fill the tubing a little at a time with chopped mixed material. After adding about 25 kg of material at filling, step over it to compact before adding more (Figure 18).

Figure 18: Compact the mixture firmly to exclude all the air

Take care not to tear the polythene tube. Fill until about one quarter of a meter is left.

Step 7: Tie the bag

Use sisal twine to tie off the top firmly excluding the air in order to encourage the growth of fermentative bacteria (Figure 19).

Figure 19: Tie the bag firmly

Step 8: Store the silo bags

Store the silo bags away from direct sunlight or rain. It may be useful to place some weight (rocks/stones) on the tied sacks to maintain the compacting of material. The tube silos should be stored under shade, for example in a store or under shelter. (Figures 20 and 21). Rodents like rats that could tear the tubes need to be controlled. Under anaerobic conditions, silage can be stored for up to 3 years.

Figure 20: Silage bags stored with plastic drums

Figure 21: Silage stored outside but covered with tarpaulin to protect it from rain and direct sunlight

Maintenance of silo bags

Birds, rodents, and other animals can puncture the polythene tubes. This lets air in the bag and can result in spoilage. Children and cattle can do the same. For maintenance of the stored bags containing silage, the following recommendations should be followed:

- Inspect the bags on regular basis and if possible, mend holes.
- Do not allow dogs, cats, children and other animals to climb the bags.
- Number and date the bags for easy identification and recall of materials bagged.
- Do not leave the silage bags opened overnight.
- Inspect the tubes frequently and immediately seal any observed holes.
- If damage is extensive, the silage needs to be re-bagged as soon as possible.
- If maintenance is appropriate, excellent lactic acid fermentation will result and silage will be ready for use in 3-5 weeks. The bags can be kept well for six months, with no or little fungal spoilage.
- After emptying, the bags must be carefully washed, dried and stored in a safe place for use the following year.

Rodent control

Silage bags attract rodents that could easily hide between the bags and chew through the polythene resulting in aerobic spoilage. Monitor the silage bags on regular basis for any rodent, bird or livestock damage. Estimated cost of producing sweet potato vines silage from one acre of land using polythene tube silo technology Tables 4a, 4b and 4c show estimated costs of producing sweet potato tubers and SPV and roots silage. The cost of labour and inputs may vary from place to place.

Table 4a: Estimated cost of producing sweet potato tubers and SPV and roots silage from one acre of land

Operation	**Quantity**	**Rate (Ushs)**	**Sweet potato tubers**	**Sweetpotato vines and roots silage production**
Hiring land	1	150000	150000	150000
Tools	1	100,000	100,000	100,000
sweetpotato vines	15	15,000	225,000	225,000
Land preparation	1	100,000	100,000	100,000
Manure application	1	50,000	50,000	50,000
Prepare of mounds	1	100,000	100,000	100,000
Planting (acre)	1	50,000	50,000	50,000
Weeding (twice)	1	180,000	180,000	180,000
Sub-total			**955,000**	**955,000**

Table 4 b: Estimated income from one acre of sweet potatoes

Operation	Quantity	Rate (Ushs)	Sweetpotato tubers production	Sweetpotato vines and roots silage production
Sale of sweetpotato tubers (average number of sacks)	40	60,000	2,400,000	2,400,000
***Sale of sweetpotato silage (kgs)	9,750	500		4,785,000
Total income (Ushs			**2,400,000**	**7,185,000**
Profit (Ushs per acre)			**1,595,000**	**2,870,000**

****The cost of producing I kg of sweetpotato silage (vines produced from own field) is Ushs 345*

Table 4 c: Average income from growing one acre of sweetpotatoes for food (tubers) and silage

Operation	Quantity	Rate (Ushs)	Sweetpotato tubers production	Sweetpotato vines and roots silage production
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****The cost of producing I kg of sweet potato silage (vines produced from own field) is Ushs 345*

Nutritive value of silage

Apart from its nutrient content, good silage has higher vitamin A content and better palatability than hay and other dry roughages. Cattle prefer silage to coarse, mature and less palatable green fodder. During ensiling, the concentration of toxic constituents such as hydrocyanic acid, nitrate and oxalic acid is reduced drastically thus, the fodder with originally very high concentrations can be safely fed to animals after ensiling.

Characteristics of good quality silage

- Good silage usually preserves well the original colour of the standing plant. When green raw material produces silage with green or yellow colour, it can be considered of good quality.
- Good silage usually has a mild, slightly acidic and fruity smell, resembling that of cut bread and of tobacco (due to lactic acid). A rancid and nauseous smell signifies a failed ensiling process. A musty smell is a sign of deficient compaction and presence of oxygen. A distinctive unpleasant smell of sow's urine and fecal matter is always indicative of marked protein degradation during ensiling.
- Plant structures (stems and leaves) should be completely recognizable in the silage. A destroyed structure is a sign of severe putrefaction.

Recommendations on feeding sweet potato vines silage to lactating dairy cows

- Wait for 21 to 30 days until the fermentation process is complete before use.
- Well-prepared sweet potato vines silage is bright or light yellow-green in colour, has a strong sweet smell similar to that of fermented milk and has a firm texture.
- Poor quality sweet potato vines silage tends to smell similar to rancid butter or ammonia.

Supplementing sweet potato vines silage to lactating dairy cows improves milk yield, body weight and reproductive efficiency.

- Lactating dairy cows should be supplemented at a level of 10% sweet potato vines silage of the daily feed intake. Supplementing beyond 10% increases milk yield and body weight **but is not cost effective**.
- To prevent tainting the milk (off-flavour), do not feed sweet potato vines silage to lactating dairy cows within 30 minutes of milking.
- Provide adequate basal feed e.g. grass hay, fresh grass, maize stover haylage etc.
- Provide clean water and mineral supplements *ad libitum*. (as much or as often as necessary or desired)
- Supplement the animals with a source of energy such as dairy meal or dairy pellets and mineral licks.
- Carry out tick control and other animal health routine management practices (vaccinations, deworming, and disease control).
- Maintain a clean environment for the animals.
- Sweet potato leaves are more nutritious than the stems. Therefore, to ensure best results, minimize leaf losses during handling and silage preparation to maintain as high as possible a high leaf to stem ratio.

The potential for sweet potato vines silage for improving dairy feeds

- Vines and small roots unsuitable for human consumption are rich in protein (vines) and energy (roots) and can be used for improvement of locally available feeds such as poor-quality roughages. With a root/vine ration of between 1.5 and 2.0, vines can be cut twice during the growth period of the crop without compromising the tuber yield.
- During the dry season most grass feeds are rich in fibre (cellulose and lignin) and poor in sugar and protein. Providing dairy cows with energy and protein feeds such as that obtained from sweet potato vines can help livestock make use of dry season feeds. Sweet potato vines contain up to 19% crude protein. Both vines and very small tubers/roots can be conserved as silage to be used during times of feed scarcity.
- Sweet potato vines silage is high-quality feed rich in proteins (18 percent), carbohydrates and vitamins. It is highly digestible by the animals. It is therefore an excellent complement to low quality feeds.
- Dairy cattle farmers can boost the Napier grass protein content by including sweet potato vines as well as storage tubers in making ‘super’ silage. A combination of the vines with Napier grass in the ratio of 5:3 respectively, gives about 13 per cent crude protein and a digestibility of 80 per cent of dry matter.
- Helps to mitigate seasonal feed shortages and cope with feed price fluctuations that many dairy cattle producers experience.
- Reduces wastage of sweet potato residues during harvesting period.
- Provides an opportunity to reduce waste in urban markets and at household level.
- Sweet potato vines silage is a promising diet for beef fattening as well.
- An improvement in the nutritional content of animal diets**.**
- An increase in milk yield which translates into increased profits**.**
- Sustaining milk production through the dry spells and periods of feed scarcity**.**
- Maintaining good body condition scores of the animals during the dry season**.**
- The potential of sweet potato vines silage to contribute to the improvement of livelihoods goes beyond farmers who keep livestock or grow sweet potatoes, it can be extended far beyond to contribute extra source of income to other groups such as the youth.

Please note that:

The area required to make the silage is calculated from the expected fodder crop or pasture yields, which are in turn determined by growth curves and management practices (including fertilisation). The silo space required to accommodate the yield is calculated from the known density of well compacted pasture silage. Generally, a ton of silage compacted at 60 per cent moisture content requires a space of 1.4 cubic meters. This translates to between 650 to 700 kg of silage per cubic meter. It is also important to obtain the right machinery best-suited to the silo of choice and magnitude of silage making operation.

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