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MANUAL ON THE MOST USED SILAGES IN MILK CATTLE FARMING

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INTRODUCTION

According to IBGE (2023), in 2022 Brazil produced approximately 34 billion and 609 million liters of milk. For this number to be reached, it was necessary, among other factors, to use appropriate foods produced according to the forage in each region, seeking to increase the yield in milk production aiming at an economically viable activity with a reduction in production costs, mainly due to food represents up to 70% of this item.

According to Oliveira and Moura (2020), obtaining a low-cost activity in the production of milk and meat in Brazilian livestock farming resides in the possibility of a greater proportion of food offered to animals based on forage, with this supply being as grazing, chopped in the trough or in the form of silage.

Taking into consideration, that Brazil, as a tropical country, has varied forage offerings depending on seasonality, silage as a way of preserving this food becomes attractive for all regions of the country, with the advantages of reducing fluctuations in the supply of volume and maintain forage quality for long periods. For Bernardes and Rêgo (2014), one of the ways to solve food shortages is the use of preserved forage, whether hay or silage. However, silage is the most commonly used, due to the access to information and simpler field operation actions.

For Strapazzon (2022), silage is an alternative for cattle producers, as it avoids daily cutting, chopping and transport operations with foods such as sugar cane or chopped grass.

It is worth noting that the set of steps in the production of preserved forage is called ensiling, that is, the process of crushing and compacting the crop, and the place where this food is stored is called a silo. The quality of preserved forage is due to several factors, such as the percentage of dry matter, soluble carbohydrates, microbial population, particle size of the material, sealing, silo filling speed, adequate compaction and handling for removal of the silo (D'OLIVEIRA; 2014).

According to Zanella (2022), to produce quality silage it depends on some factors, such as the dry matter content, low buffering capacity of the ensiled material and the amount of soluble carbohydrates and the rapid drop in pH (ZANELLA et al., 2023).

A quality silage, it is necessary for good fermentation to occur, where the fermentation process begins after sealing the silo, when there are anaerobic conditions, without the presence of oxygen, which can take 15 to 20 days for the bacteria to proliferate and thus acidification and conservation of silage (Zanella 2022, Ramos etal.,2021)

The fermentation process is divided into four phases: aerobic phase, anaerobic phase, stability phase and discharge. In each phase mentioned, several microorganisms act, some acting positively, while others negatively affect the process, which can result in many losses in the final product (FASOLO & CARVALHO, 2021).

According to Santos (2020), the ideal dry matter content affects both the ensiling and fermentation processes and depends on each species, a reference value is between 30 and 35% dry matter. If the silage has high humidity or a high dry matter content, it ends up reducing the nutritional value of the silage and excessive production of undesirable bacteria and protein degradation can occur (Ramos etal.,2021).

Bearing in mind the importance of choosing silage, evaluating and monitoring the ensiling process and how it is used for animal feed, this silage manual was created, covering the main silages used in dairy cattle farming.

SILAGE USED IN FEEDING DAIRY CATTLES

CORN SILAGE

Figure 1. Corn planted for silage production.
Source: https://rehagro.com.br/blog/milho-para-silagem

The forage most used in silage production is corn (Figure 1), especially for supplementation of dairy cows. Several factors justify the use of corn as the most used forage in silage production: ease of fermentation; high energy value; and high voluntary consumption, wet grain silage: it is made only with corn grains; production system already defined; ease of cultivation; adequate production of dry matter (D'OLIVEIRA; OLIVEIRA, 2014).

As pointed out by Jobim & Nussio, (2013) nutritional losses can occur from the moment of harvest until supply, with many variables influencing the topography of the land, ideal moment of harvest and chopping process where dry matter losses are directly linked., hence the importance of removing material with the ideal dry matter content so that adequate compaction and fermentation can occur (Santos 2020).

REGIONS THAT MOST USE CORN SILAGE

Milk production is the main indicator of the corn silage market in Brazil: it is concentrated in the mesoregions of Triângulo Mineiro/ Alto Paranaíba, South/Southwest of Minas, Northwest of Rio Grande, West Catarinense, Southwest Paraná, South and Center Goianos, although the municipalities of Castro and Arapoti, in the Center, it is in these regions that the largest areas of corn silage production are found; (Andrade et al, 2021).

MANAGEMENT FOR CORN SILAGE PRODUCTION

There is a wide variety of recommended materials, both conventional and transgenic corn. The correct selection of the hybrid is crucial to increasing productivity and product quality. The choice of corn varieties for silage production depends on agronomic criteria, such as healthy foliage, high grain and dry matter productivity, favorable relationship between grains and dry mass, resistance to pests and diseases, adaptation to different conditions, (D 'OLIVEIRA, 2014).

The most productive corn hybrids are also the most demanding in terms of soil fertility. There are several recommendations for liming and fertilizing corn, but in general, it is important to maintain base saturation (V) at 60% of the Cation Exchange Capacity (CEC) to ensure high productivity. Corn has a high demand for nitrogen and potassium and, unlike grain corn cultivation, where part of the plant remains in the soil allowing nutrients to be recycled, silage corn requires larger amounts of potassium. Direct planting, green manure and crop rotation bring benefits to corn fields destined for silage (D'OLIVEIRA; OLIVEIRA, 2014).

The planting season in the South of Brazil is from August to September, and in the Central-West and Southeast states, the planting season

is from October to November (PEREIRA FILHO; CRUZ, 2001).

Generally, corn plant populations range from 55,000 to 72,000 plants/ha. The spacing between rows ranges from 0.55 to 0.8 m, with 3.5 to 5 plants/m. However, under rainfed conditions this number is lower (45,000 to 50,000 plants/ha). There is an influence between the number of plants per hectare on the productivity and quality of silage. Earing may be impaired due to high populations (D'OLIVEIRA, 2014).

SILAGE STORAGE SILOS

Trench silo (Figure 2): It is called a "trench" because it is built into the ground, creating a long, narrow ditch or trench to store the material. an advantage is the ease of construction and storage capacity.

According to KWS, (2022) the disadvantages are the high initial investment; Your construction site must be strategic for animal feeding, since it is fixed; Promotes great exposure of the ensiled mass to oxygen.

Figure 2. Open trench silo.

Source: https://blog.apecuariadeprecisao.com.br/tipos-de-silos-confinamento/

Half-slope silo (Figure 3): half-slope silos are built on slopes or sloping terrain, taking advantage of the natural slope of the land. They are common in mountainous areas or in regions where the topography makes it difficult to build traditional silos. An advantage of half-slope silos is that they save space and adapt to irregular topography.

Figure 3. Open half-slope silo.

Source: https://sigpos.uems.br/uems-sigpos/portal/trabalho-arquivos/download/3053

Surface silo (Figure 4): They are made of canvas and are constructed with flexible materials, such as high-resistance canvas, reinforced plastics or similar fabrics.

The disadvantages are: Takes up more space; Compaction is difficult (as it does not have walls); Greater care with adverse weather conditions and animals (KWS,2022).

Figure 4. Silo Covered surface.

Source: https://repositorio.ufersa.edu.br/handle/prefix/9251

HARVESTING CORN FOR SILAGE

To cut corn for silage, the dry matter content must be between 30 and 35% (Santos,2020; Ramos et al.2021). A silage of low nutritional quality is when the dry matter content is below 30%, this occurs due to the loss of nutrients through the slurry. If the dry matter content is above 35% we will have a worsening in the quality of the fiber, which reduces the digestibility of the material; makes it difficult to cut and pattern particles and compaction, which ends up causing losses

in the silo, as poor compaction favors fungal attacks (D'OLIVEIRA, 2014).

To resolve the producer's doubts about whether the timing of the harvest was appropriate, we have the cup test, which consists of collecting a sample of silage in a container with a volume of 1 liter, then we separate the grains and count those that are broken by 50%. or less. It is correct for the number to be less than 2 grains per sample, but it must not be more than 4. Separation by water facilitates separation and consequently counting, as the fibrous fraction floats and the grains sink. Then, a 1-liter container of water must be used, where we shake the sample, remove the fibrous fraction, drain the water and observe the grains (KWS, 2022; WIGGERS, 2021).

Depending on the harvesting method used, the particle size may differ. There is a correlation between particle size and the quality of corn silage (Figure 5), it is indicated that the average size must not exceed 2 cm, as very small particles (0.2 to 0.6 cm), as they can reduce losses in the ensiling process and in supply to animals (D'OLIVEIRA, 2014).

The KPS (Kernel Processing Score) test, intended to verify harvesting efficiency, is very effective, reports Heidrich et al. (2023);, the objective of the test is to determine the degree of processing of the grains, using a 4.75mm sieve, the value obtained is the percentage of starch processed to the point of passing through the sieve. KPS levels above 70% indicate excellent processing, levels between 50% and 70% indicate adequate processing and levels below 50% indicate a low degree of processing (Buriol et al 2021) Silva et al. (2022).

Reports Buriol et al (2021) the tests are complete, as the cup test helps in decision-making at the time of harvest and allows some precise adjustments, while the KPS test is more specific and allows an evaluation only after opening the silo, allowing you to observe mistakes made and make necessary changes to correct them in the next harvest.

Heidrich et al. (2023) Reports that the assessment of starch content in feces aims to observe the digestibility of the grain and is the answer to demonstrating that starch is not digestible (Buriol et al 2021).

According to Silva et al. (2022) if the amounts of starch are very low, there will be a shortage to meet the needs of the animals, as a result of which milk production decreases, there will be less synthesis of microbial protein in the rumen, thus lower protein levels in the milk and even, increases urea nitrogen values in milk. Teresinhagebert and Demorais (2022) report that if there is an exorbitant increase in starch in the animals' diet, in addition to the animals' needs, there will be a drop in ruminal pH, which will lead to episodes of subclinical ruminal acidosis, greater predisposition to laminitis, lameness, lower fat levels milk and reproductive problems.

Figure 5. Crushed corn silage showing particle size.

Source: ttps://www.3rlab.com.br/aspectos-nutricionais-de-forragens-ensiladas-silagem-de--milho/

SILAGE LOADING AND COMPACTION

Loading and compacting a silo are important steps. The silo must be loaded within 72 hours from the start of cutting. You must not load and compact the silo on the same day, as this time allows the material to settle and eliminates excess air. Every time the silo receives a new load of material,

compaction must be repeated, generally using a tractor. The compaction process must be done through distribution throughout the silo (D'OLIVEIRA, 2014).

According to KWS (2022), compaction must be approximately 20% longer than the time used for harvesting, that is, for every 1 hour of crop cutting, approximately 2 hours must be compacted.

Figure 6. Demonstration of how to perform compression.

Source: ttps://www.3rlab.com.br/aspectos-nutricionais-de-forragens-ensiladas-silagem-de--milho

SORGHUM SILAGE

Figure 7. Soybean crop for use as silage.

Source: https://ainfo.cnptia.embrapa.br/

Due to its agronomic and nutritional value, sorghum (Figure 7) is a plant of great relevance for animal feed, being an alternative as it adapts to drought, and produces dry matter in areas with less fertile soil (JALES, 2023).

One of the advantages reported in the literature, sorghum is cited for having a lower production cost compared to corn, however, its commercial value is evaluated as being 80% in relation to the price of corn, which becomes viable due to its greater rusticity in production (MARTINKOSK et al., 2013). Since its precocity allows for a four-month harvest, thus advancing forage production (Rodrigues,2012).

REGIONS THAT MOST USE SORGHUM SILAGE

The use of sorghum silage may vary from region to region, depending on factors such as climate, land availability and local agricultural practices, with the Southeast region being the main producer of silage sorghum, followed by the South and Central-West regions. (VIANA, 2017).

SILAGE PRODUCTION METHOD

Currently, we have availability of three main types of cultivable sorghum: forage sorghum, which produces more dry matter than grain sorghum, has thick stems and is widely used for silage, and grain sorghum, which has intermediate production potential and can be used for pasture, hay or silage (FERNANDES; THEODORO; GURGEL; COSTA; COSTA; SANTANA; SILVA; BOMFIM, 2020).

Corrections for planting must be in accordance with soil analysis, such as acidity, and fertilization. Sorghum has a greater requirement for nitrogen and potassium (RODRIGUES, 2013).

Reports Silva (2021), reinforces that sorghum is resistant, in addition to demonstrating a high yield of dry matter and concentration of soluble carbohydrates. Having bromatological characteristics corresponding to 85 to 90% of corn silage.

SORGHUM PLANTING TIME

Although sorghum cultivation is carried out in different climatic conditions as it is a widely adapted crop, in general, it is necessary to be at the beginning of the rains in the region considered chosen.

In the savannah region, sowing takes place

in September and November. In the Southeast and Center-West of the country, plantings made from mid-December may already cause a reduction in plant size, depending on the cultivar used (RODRIGUES, 2013).

In the case of large forage cultivars, it is appropriate to use wider spacing between rows (70 to 90 cm) and a lower planting density (100 to 140 thousand plants/ha). For dual-use varieties, with medium size (140 to 170 thousand plants/ha). With regard to cultivars aimed at grain production, which have a more compact size, it is recommended to use narrower spacing (50 to 70 cm) and higher densities (greater than 170,000 pl/ha). Generally, it is advisable to add 25% more seeds during planting to achieve the desired density (RODRIGUES, 2013).

They show that sorghum is tolerant to drought and heat, and has a high production of dry matter per hectare. These are the advantages of being used, in addition to the possibility of using the regrowth of the plant, but the regrowth presents a degree of toxicity, as at the time of its flowering it produces hydrocyanic acid, which can cause poisoning to animals (RIBEIRO, 2022).

SILAGE STORAGE SILOS

Choose the type of storage according to your need and ease, we have trench silos, half slopes, surface and bales.

KWS (2022) reports the disadvantages of the bale silo (Figure 8) are regular monitoring for holes and tears, avoiding losses of dry matter; Higher cost of plastic film per m^3 stored; Plastic disposal; promotes great exposure of the ensiled mass to oxygen.

Figure 8. Bale silo.

Source:https://www.fundacaoroge.org.br/blog/tipos-diferentes-de-silo-vantagens-e-desvantagens

HARVESTING SORGHUM AT THE RIGHT TIME

The rule for determining the ensiling point is by the dry matter (DM) content of the sorghum plants. The dry matter content must be that which allows good compaction, easy fermentation and lower risks of losses. Sorghum must be ensiled when the crop has a DM content between 30% and 35%. The ideal cutting height varies from 15 cm to 25 cm from the ground (Figure 9).

The objective of harvesting at this time is to avoid the presence of soil in the silage, reducing contamination by the presence of soil microbes (MINAS GERAIS, 2015).

Rodrigues, Julio and Menezes (2021) argue that the quantity of grains in the sorghum plant determines the quality of the silages as they contain the largest energy fraction of the plant.

Figure 9. Time to harvest sorghum for use as silage.

Source: https://ainfo.cnptia.embrapa.br

CRUSHING SORGHUM FOR SILAGE

The forage needs to be crushed to a size ranging from 0.8 cm to 1.5 cm (Figure 10). With this small size, we can easily compact the forage and remove the air, which allows for adequate fermentation of the ensiled mass, the conservation and quality of the silage, a quality silage has benefits on the animal's rumination (MINAS GERAIS, 2015).

Sorghum ensiling will need to be with the grains in the milky to pasty stage, thus avoiding a reduction in the digestibility of the dry matter of the fibrous fractions, avoiding the elimination of grain in the animals' feces (RODRIGUES; JULIO; MENEZES,2021).

Figure 10. Crushed sorghum ready to be ensiled.

Source: https://ainfo.cnptia.embrapa.br/

SILAGE LOADING AND COMPACTION TIME

It is a phase in which the forage is placed in the chosen location for storage, such as surface silos, and it is packaged and sealed to carry out anaerobic fermentation. When carried out according to the instructions, the silage is ready to be fed to the animals after 21 days, but, as a guarantee, it is good to wait at least 30 days before opening the silo (MINAS GERAIS, 2015).

In silages, many microbial inoculants are used as they aim to alleviate the losses that occur, but they have a high cost. They usually use sorghum silage and seek to overcome the financial situation by using more accessible products such as whey and brown sugar. Whey, which is a source of lactic acid bacteria, and brown sugar, which increases the amount of carbohydrates available to be used by lactic acid bacteria. The use of whey, microbial inoculant and brown sugar will provide quality silage (FÜHR, 2020).

In sorghum we have the presence of tannin, they are essential phenolic compounds for plants, but consuming high levels of tannin can cause some harmful effects in the ruminant's diet, observing a decrease in palatability, protein digestibility and weight gain rates. (PESCUMO; IGARASI, 2013).

Figure 11: Demonstration of Sorghum Silage Compaction.

Source: https://ainfo.cnptia.embrapa.br/

BRS CAPIAÇU SILAGE

Figure 12. BRS Capiaçu plantation for silage.

Source: https://ainfo.cnptia.embrapa.br/

BRS Capiaçu (Figure 12) stands out in relation to other varieties of elephant grass due to its resistance to falling over, ease of mechanical harvesting, absence of joçal (hair) and erect and dense clumps (PEREIRA et al., 2016).

Elephant grass is one of the tropical grasses that generates the highest biomass per unit of planted area, and the majority of this yield occurs during periods of precipitation (MATOS, 2021).

BRS Capiaçu can be planted in regions with a tropical climate. The variety is demanding in relation to soil characteristics, and cultivation in deep, adequately drained soils with good fertility is recommended (PEREIRA et al., 2016).

It stands out from other elephant grass cultivars for presenting, on average, 30% higher productivity (OLIVEIRA, 2023).

A difficulty encountered with "invasive" plants that cause large losses of up to 42% in forage production. Days 23 to 42 after planting are a crucial period for the prevention of weeds in BRS Capiaçu, so preventive practices must be carried out (SOARES, 2022).

CAPIAÇU PLANTING METHOD

According to botanical research, elephant grass is of the species Pennisetum purpureum, belonging to the family Graminae, subfamily Panicoideae, tribe Paniceae, genus Pennisetum L. Rich and species P. purpureum, Schumacher (MATOS, 2021). The soil is prepared conventionally, harrowing as necessary. Fertilization and liming must be based on the results of the soil analysis (PEREIRA et al., 2016). Even though the grass is resistant, it is recommended that it be planted at the beginning of the rain because in times of scarcity it has 80% less production (MATOS, 2021).

The culms must be removed from parent plants with regrowth in around 90 to 120 days (MATOS, 2021). Planting must be carried out at the beginning of the rainy season, in furrows approximately 20-30 cm deep and spaced 0.80 m to 1.20 m apart; The BRS Capiaçu variety has an average production of 100 t/ha/cut of fresh biomass, that is, 300 t/ha/year in three annual cuts (PEREIRA et al., 2016).

Initial fertilization must be based on soil analysis results. In most tropical soils, the main limitations are related to acidity and low phosphorus levels, which must be corrected (MATOS, 2021).

A disadvantage of tropical grasses, in general, is that they have characteristics that tend to harm their conservation in the form of silage as they have a low content of soluble carbohydrates, the main substrate used by bacteria to form the acids that preserve the silage. The advantage of BRS Capiaçu is that this deficiency is not so worrying, as it has a high nutrient content when compared to other grasses. The second characteristic is the high humidity, or low percentage of DM, that the grasses present when they are ensiled (OLIVEIRA, 2023).

TYPES OF SILOS FOR STORING SILAGE

After choosing how to store this chopped forage (Figure 13), the livestock farmer can adapt his property to the types of silos. For larger properties and productions, the grass storage option can be done in surface and trench type silos.

Figure 13. Silage storage in the chosen location.

Source: https://ainfo.cnptia.embrapa.br

WAYS AND TIMING OF HARVESTING BRS CAPIAÇU FOR SILAGE

There is the possibility of manual or mechanized harvesting (Figure 14) (PEREIRA,

2016). Being harvested, approximately, 90 days of age of the plant is when the forage reaches 1.80m in height or 3.5 to 4m in height, as it avoids some problems, according to research it was observed that it is recommended, for ensiling, the plant is to obtain a benefit in the relationship between biomass production and dry matter content and, consequently, in its nutritional value (MATOS, 2021).

Figure 14. Harvest time for BRS Capiaçu grass

Source: https://ainfo.cnptia.embrapa.br

CORRECT WAY TO CRUSH CAPIAÇU FOR SILAGE

According to researched data, particle size of 1-2 cm (Figure 15) favors compaction, improves density, accelerates fermentation, facilitates digestibility (MATOS, 2021).

Figure 15. Crushed capiaçu already in silage form.

Source: https://ainfo.cnptia.embrapa.br/

SILAGE COMPACTION

The method of compaction at the time of storage (Figure 16) uses the method of using weight to eliminate all air, which favors better fermentation. If the silage is small in size, you can choose to use the feet to compact it as much as possible, as this process can be considered one of the most important in the process. When the silo has large extensions, this process can be done with the help of machinery (MATOS, 2021).

One of the main concerns is the high moisture content that ends up hindering the ensiling process as it leads to undesirable fermentation and thus considerable nutrient losses through effluents. At high levels of organic compounds, proteins and organic acids, silage effluents are present. In order to solve this problem, we use wilting techniques or absorbent additives (SOARES, 2022).

Figure 16. Silage storage demonstration.

Source: https://ainfo.cnptia.embrapa.br/

SUGAR CANE SILAGE

Figure 17. Sugar cane plantation for animal feed.

Source: https://rehagro.com.br/blog/cana-de-acucar-cultura-de-facil-conducao/

One of the most important activities of Brazilian agribusiness is the cultivation of sugar cane (Figure 17); One of the advantages is the high productivity and being mature in the winter period, it can be an excellent alternative as a forage resource, due to the large accumulation of sugar in the stalks and because it does not significantly lose its nutritional value during the period of use in animal feed (STRAPAZZON, 2022). In the Center-South of Brazil, it has the additional advantage of the sugarcane harvest roughly coinciding with the dry season (RETI, 2011).

Due to the low amount of crude protein in sugar cane, when urea is used, it is used as a supplement or added to feed, and aims to increase nutritional value. Increases the protein content in forage from 2% -3% to 10% -12% in DM (FREUS; SILVA, 2022).

A disadvantage of urea is that poisoning can occur, for some reason the animal consumes high amounts of urea in food without having gone through the initial adaptation process, or it could be due to error in handling and knowledge of how to use it (BERNARDO et a, 2022).

HOW TO PLANT SUGAR CANE

Sugarcane is a plant from the Graminea family and belongs to the genus Saccharum. The moment of harvest coincides with the dry period, when the supply of forage in the pastures is limited and, consequently, there is a greater demand for supplementation for the animals. Furthermore, it is easy to administer and has a reduced risk, since total losses of this crop rarely occur (STRAPAZZON, 2022).

It is essential to carry out soil analyzes to understand the specific soil conditions in a given cultivation area (Figure 18) and, based on these results, apply fertilizers appropriately to meet the nutritional needs of sugarcane. Appropriate nutritional management is crucial to optimizing crop yield and quality.

The environment suitable for planting has two distinct phases: a hot and humid phase intended for vegetative growth, and a cold and dry phase aimed at ripening and accumulation of sucrose in the stem. (STRAPAZZON, 2022).

Figure 18. Sugar cane planting

Source: https://alexandriusmb.blogspot.com/2019/02/sistemas-de-plantio-na-cultura-da-cana.html

Sugarcane has a high production of green matter per hectare, which can be from 80 to 120 tons per hectare, with the potential to reach productivity of more than 150 tons, in addition to a low cost per unit of DM produced (STRAPAZZON, 2022).

TYPES OF SILAGE STORAGE

Silage storage can be done in different types (Figure 19), each with its specific characteristics. Some of the types of silos commonly used for sugarcane silage include: trench, covered trench, surface silo.

The choice of silo type depends on several factors, including the size of the property, the amount of forage to be stored, the availability of resources and the farmer's preference. Regardless of the type chosen, it is essential to ensure good ensilage practices to preserve the quality of the silage throughout storage.

Figure 19. Bagged silage.

Source: https://www.mfrural.com.br/detalhe/275937/silagem-de-milho-ensacado

HARVESTING SUGAR CANE FOR SILAGE

Whether the harvest is carried out 12 months after planting, it can be done manually (Figure 20) or mechanized depending on the reality of the farm (SANTOS, 2004).

CORRECT WAY TO CRUSH SUGAR CANE FOR SILAGE

The particle size must be 2.5 mm (SANTOS, 2004). Large particles disrupt the compaction process and allow the animal to make greater selection, increasing losses in the trough. Extremely small particles cause a marked loss of nutrients via the effluent and favor marked compaction.

Figure 20. Manual harvesting of sugar cane.

Source:https://www.bigtires.com.br/blog/post/dia-do-cortador-de-cana-de-acucar-importancia

SILAGE COMPACTION

When compaction is performed appropriately (Figure 21), ensiling regulates microbial activity by creating an anaerobic environment through the natural fermentation of sugars by lactic acid bacteria present in the crop. Therefore, efficient compaction is essential for successful ensiling. This fermentation occurs simultaneously with the decrease in pH, preventing the development of other undesirable anaerobic microorganisms (STRAPAZZON, 2022).

The main fermentation that occurs in sugarcane silages is the production of alcohol. In order to overcome this problem, we use chemical, biological and moisture-sequestering additives (PEREIRA et al., 2019).

Figure 21. Silage compaction.

Source:https://www.portaldoagronegocio.com.br/pecuaria/nutricao/noticias/silo-cincho-opcao-de-baixo-custo-para-conservacao-de-forragem-na-agricultura-familiar

PINEAPPLE SILAGE

Figure 22. Pineapple plantation

Source:https://www.agazeta.com.br/es/agro/doce-doce-doce-igual-ao-mel-e-o-abacaxi-de-marataizes-no-sul-do-es-1119

In times of pasture scarcity, we have to look for alternative food for livestock, such as forage stored in the form of silage, and among them is silage made from remains of the pineapple crop (Figure 22), which transforms plants, seedlings, crowns and stalks, which would be discarded as feed for cattle. The silage made from these residues has a high protein content, a lot of sugar and has been shown to be nutritious and palatable for animals (Rosas, 2021).

According to CONAB (2020), using data compiled until 2017, the Northeast is the main pineapple producing region (35.0%), North (30.0%) and Southeast (28.0%), Central-West (6.0%) and South with 1.0%. The main producing states, by region, are: Northeast (Paraíba, Bahia and Rio Grande do Norte); North (Amazonas and Tocantins); and in the Southeast (Minas Gerais and Rio de Janeiro). Thus, the North, Northeast and Southeast represent 71.0% of national production.

SILAGE PRODUCTION METHOD

Ensiling of the pineapple by-product is carried out after the seedlings and fruits have been collected, and can occur 18 to 22 months after cultivation. In small areas, collection can be manual or done by machines (Figure 23). This way, cutting plants close to the ground can be done in this scenario (MELLO et al., 2020).

CORRECT WAY TO CRUSH PINEAPPLE FOR SILAGE

To grind into small particles (Figure 24) of 15 to 20 cm as this is the ideal size for ensiling and avoiding problems with compaction and digestibility of the animal.

A disadvantage cited by PIMENTEL (2023) is the bushing in the machinery used for crushing and harvesting, where producers report that they do not have their own machinery for the crop as the plant has dense and rigid foliage.

PINEAPPLE SILAGE STORAGE METHODS

Various types of storage structures can be created: surface, trench, bale, among others.

Figure 23. Mechanized pineapple harvesting.

Source:https://incaper.es.gov.br/Not%C3%A-Dcia/silagem-do-abacaxizeiro-alternativa-de--alimentacao-do-gado-no-sul-capixaba

Figure 24. Shredding the silage material.

Source: https://www.nucleodoconhecimento.com.br/zootecnia/silagem-do-abacaxizeiro

SILAGE COMPACTION

Due to the high humidity present in the pineapple by-product, it is crucial to pay special attention when compacting the crushed material and depositing it in the storage structure to avoid dispersion. In the case of this food resource, compaction is more efficient in prepared structures such as trenches.

For this type of food, the fermentation process occurs satisfactorily, regardless of the use of bacterial additives. After preparation,

the structures can be opened after a period of 30 days (MELLO et al., 2020).

The by-product silage has nutritionally similar values in some aspects, when compared with the silage of other forages, such as corn, elephant grass and sugar cane. Being the crude protein (CP) contents, in which the silage of the pineapple crop residues presented values of 7.0% CP, while the corn silage presented 7.2%. We can observe that the levels of total digestible nutrients (TDN) are lower than corn silage and sugar cane, even with this difference it can still be corrected with adequate supplementation (PIMENTEL, 2023).

QUALITY SILAGE

Based on Santos et al (2014), quality silage must have a pleasant aroma and light color. Large volumes of effluent flowing suggest the possibility of inadequate fermentation. Excessively dry silage indicates potential problems during the compaction phase.

COMPRESSION ISSUES

The presence of mold indicates air entry due to inadequate compaction or ineffective sealing. The pH of quality silage must be less than 4.2. The analysis of organic acids must reveal a proportion greater than 2% of lactic acid and less than 0.1% of butyric acid in relation to the dry matter. Protein degradation is a sign of undesirable fermentation, while the ammonia nitrogen content in suitable silage must be less than 11% of total nitrogen (Santos et al. 2014).

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