Scientific Paper

Characterization of the plant community in a commercial dairy farm in Matanzas province, Cuba

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Abstract

Objective: To characterize the plant community of the pastureland in a dairy farm under commercial conditions in Matanzas province, Cuba.

Materials and Methods: A study was conducted of the pastureland community on a Ferralitic Red soil, in a typical dairy farm of 120 animals and an area of 72,4 ha. From them, 57,8 dedicated to grazing, distributed in 29 paddocks of 1,9 ha each as average. The variables pasture availability, floristic composition of the pastureland, stocking rate and forage balance, were analyzed.

Results: The natural pastures predominated in the system, with a contribution of more than 60,0 % in the dry season and close to 70,0 % in the rainy season. The species *Paspalum notatum* Alain ex Flügé, *Dichanthium annulatum* (Forssk.) Stapf and *Dichanthium caricosum* (L.) A. Camus prevailed. The highest pasture yield was obtained in the rainy season (2,86 t/ha) and the lowest value, in the dry season (1,79 t/ha). Nevertheless, the dry matter supply throughout the year did not exceed 16 kg DM/animal/day. The effective stocking rate values (1,3 LAU/ha) exceeded the established optimum value. The forage balance showed a dry matter deficit higher than 3,0 kg /LAU/day in both seasons.

Conclusions: The low pasture yield throughout the year was linked to the high predominance of natural species and weeds present in the pastureland. The highest availability was reached in the rainy season. The stocking rate values are over the optimum value.

Keywords: feeding balance, stocking rate, natural pastureland

Introduction

Animal husbandry in tropical systems is mostly based on extensive systems, in which most of the areas dedicated to grazing are established with natural pastures. These are characterized by their low biomass production and poor nutritional quality, which is denoted by their low content of crude protein and soluble carbohydrates, high fiber concentration, low digestibility and low content of metabolizable energy (Ku-Vera *et al*., 2014). Given the low productivity of native pastures and in order to increase the carrying capacity in animal husbandry systems, the establishment of cultivated pastures with introduced grasses is essential. However, poor management practices during the establishment and production phases lead to their deterioration and soil degradation (Carangui-Quintuña *et al*., 2019).

In addition to the above-explained facts, there are extreme climate variations, such as long winters and prolonged droughts, seasonal production of pastures, which reduce the forage supply by more than 50 %, as well as protein content and digestibility. This implies low voluntary intake, loss of productive levels of meat or milk and decrease in the body condition of the animals, which has repercussions on the reproductive and productive status of livestock (Ramírez-de-la-Ribera *et al*., 2017). Based on these antecedents, the objective of this work was to characterize the pastureland plant community in a dairy farm under commercial conditions in Matanzas province, Cuba.

Materials and Methods

Research location. The study was conducted in a commercial dairy farm, belonging to the Genetic Enterprise of Matanzas province, Cuba, located at 22°95′32″ North latitude and 81°45′97″ West longitude.

Farm characteristics. The dairy farm is a typical farm, with a total area of 72,4 ha. From

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these, 57,8 ha are for grazing, distributed in 29 paddocks of 1,9 ha. The water comes from a local well and is extracted with a pump. Its distribution is carried out through a network of hoses that reaches all the sheds and drinking troughs.

Edaphoclimatic characteristics. The soil of the unit is Ferralitic Red (Hernández-Jiménez *et al*., 2015) and the relief is slightly undulated. The average temperature is 26,5 and 22,4 °C for the rainy (RS) and dry (DS) seasons, respectively (table 1).

Animal management and feeding. The dairy farm has 108 cows, with an average live weight of 340 kg. Of these, 50 % are under milking. The animals are milked twice a day in a mechanized way. The first milking takes place at 3:00 a.m., when concentrate feed is supplied at a rate of 580 g/animal. Later, they go out grazing until 9:00 a.m., when they return to the sheds until 3:00 p.m., where they are milked again and then return to grazing again until the next day when early-morning milking begins. The prevailing breed is a cross between Mambí de Cuba fathers and Holstein x Zebu mothers. The system stocking rate is shown in table 2.

Determination of the floristic composition of the pastureland. It was estimated by the method of steps (EEPFIH, 1980). For such purpose, the paddock was divided into two strips and each one of them was walked. Every two steps, the observer classified the pasture species that matched the toe of his left shoe. This measurement was done in the rainy and dry season.

Determination of pasture availability. It was estimated by the alternative method proposed by Martínez *et al*. (1990), based on estimates of the average height of the pastureland. Sampling was carried out upon the entrance and exit of the animals from each paddock. Eighty observations were made per hectare. From these measurements in the paddocks, the forage balance per season was also calculated.

Statistical analysis. A distribution of frequencies per season was done on the percentage values of the floristic composition. The statistical program used was SPSS® Statistics version 22.

Results and Discussion

Figure 1 shows the floristic composition per season. Natural pastures as a whole remained over 69 % in the rainy season and 64 % in the dry season, with predominance of the species *Paspalum notatum* Alain ex Flüggé and *Dichanthium annulatum* (Forssk.) Stapf. The cultivated grasses [*Urochloa*: *Urochloa* sp. *Cynodon dactylon* (L.) Pers.] only represented 5 % in the rainy season, and hardly appeared in the dry season.

Table 1. Performance of the climate variables per season.

Variable	RS	DS
Average temperature, °C	26,5	22,4
Average relative humidity, %	79,6	73,5
Cumulative rainfall, mm	1 338,8	222,4

DS: dry season RS: rainy season

Table 2. Performance of management in the system

Indicator	Value
Large animal unit, LAU	76,5
Global stocking rate, LAU/ha	1,1
Real stocking rate, LAU/ha	1,3

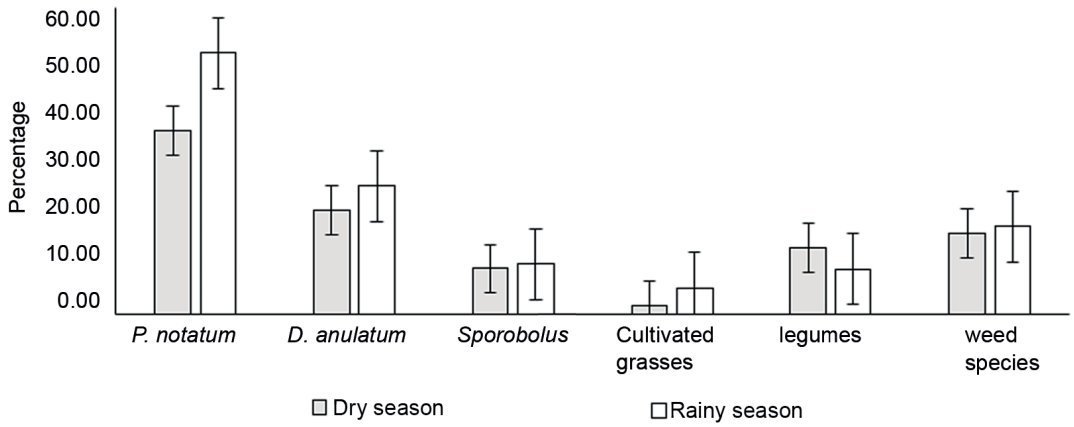

Figure 1. Floristic composition of the pastureland per season.

Such a high proportion of natural pastures is unfavorable, if good productive results are to be achieved in milk production based on pastures and forages, because they are characterized by low production (4,0-8,0 t DM/ha/year) and poor nutritional value. Thus, they fail to meet the nutritional requirements of grazing animals, due to their multiple deficiencies of nitrogen and other mineral elements (Domínguez-Escudero, 2020). This, along with the instability of rainfall, produces imbalance in the yield between seasons, which has repercussions on the productive performance of the animals and on aspects related to health and reproduction (López-Vigoa *et al*., 2019).

Legumes were represented by the herbaceous ones *Neonotonia wightii* (Wight & Arn.) J. A. Lackey (glycine) and *Teramnus labialis* (L.F.) Spreng (teramnus), with a percentage between 13,0 and 8,7 % for the dry and rainy seasons, respectively. However, in general, their population during the evaluation time was low in both, mainly caused by the effective stocking rate used in the pastureland, which was 1,3 LAU/ha. When stocking rates over 1,0 LAU/ha are used, under low-input conditions, herbaceous legumes tend to decrease in the paddocks, as a result of trampling and the selection made by the animals, which does not allow adequate regrowth or production of sufficient seeds for subsequent dissemination in the paddocks (Milera-Rodríguez *et al*., 2019). In turn, the highest values corresponded to the dry season, which is due to the photosynthetic path of legumes, which are C3 plants, which behave better when solar radiation and temperature decrease, contrary to grasses, which are C4 and need more light intensity for their growth.

The weed species sicklebush (*Dichrostachys cinerea* (L.) Wight & Arn). and touch-me-not (*Mimosa pudica* L.) occupied about 30 % of the sampled area, which is unfavorable, since they can develop their complete vegetative cycle, until reaching maturity, which culminates with the incorporation of their seeds into the soil and the proliferation of new plants, to the detriment of pasture. In addition, they could also mask the actual availability of consumable feedstuffs in the farm.

Table 3 shows the performance of the biomass yield/ha of the system and the daily supply of dry matter (DM) per animal in both seasons of the year. The highest values were found in the RS (2,9 t/ha and 15,9 kg DM/animal/day); while in the DS biomass availability did not exceed 2,0 t/ha, with a supply lower than 10 kg. Regarding pasture height, the trend was similar to that of the other indicators.

This performance proved the seasonality of tropical pastures, motivated by the decrease in rainfall in the DS, as well as by the decline in solar radiation and temperatures, factors that influence plant growth, mainly grasses (Sánchez- Velez, 2018). Only 14,0 % of the year rains fell in the DS and the temperature dropped more than 2 °C. Added to this is the high percentage of natural pastures in the pastureland, which has low yields. In addition, cultural attentions were not applied in the farm, such as the use of organic fertilizers and rehabilitation of pastures.

The dry matter supply in both seasons did not exceed 16 kg DM/animal/day, a value that is considered

Table 3. Pastureland yield, offer and height per season.

Season	DM, t/ha	Offer, kg DM/animal/day	Pasture height, cm
Rainy	2,9	15,9	15,9
Dry	1,8	10,0	6,5

low in systems with dairy cows. This result was lower than that indicated by Stobbs (1978) and Duque-Quintero *et al*. (2017), who state that the daily availability per animal in systems based on tropical pastures should be between 35 and 55 kg DM/animal/day so that approximately 40-45 % is used, and milk production does not decrease.

Grazing height is a practical tool for evaluating the forage resource, due to the direct correlation that exists between the height of the herbaceous stratum and animal behavior (Donzelli and Burges, 2013). This correlation may be due to the higher available aerial phytomass, as well as to the proportion of leaves in the upper grazing strata, which allows higher accessibility, higher weight per bite, higher consumption rate (g DM/min) and less grazing time.

In this research, the pasture height varied from 6,5 in the DS to 15,9 cm in the RS. The greatest height of the pasture in the rainy season is fundamentally ascribed to the higher values of temperature and rainfall, characteristic of this time of year (table 1), which determine higher growth of pastures and the existence of a positive relationship between pasture availability and height. The opposite occurred in the DS, in which rainfall was lower. Hence the low height found in the pastureland and the poor daily supply.

Both heights can be considered inappropriate for good animal intake, because they are below the reports in literature for stable productions (between 25 and 35 cm) to occur. Wesp *et al*. (2016) stated that heights close to 30 cm allow an increase in the amount of forage available per animal, better pastureland structure and better quality of consumed forage. In this pastureland stratum, the animals can reach large masses of bite, with preponderance of leaves and fresh stems, which allows them to evade the selection process and overgrazing. According to Hodgson and Silva (2002), grazing horizons lower than 10,0 cm correspond to serious restrictions in the formation of the bite. This results in a significant reduction in its size and higher biting rate, which causes fatigue in the animals and a decrease in voluntary intake and production.

This is in addition to the inappropriate leaf-stem ratio of natural pastures, which causes higher intake of the mature and fibrous portions of the plants, affecting the nutritional content of the diet and, consequently, animal productivity (Arcos-Álvarez *et al*., 2019). Animals usually prefer fresh leaves and stems (Cazzuli *et al*., 2016), because they are more digestible and nutritious. The leaves are consumed in higher quantity than the stems, since they have lower content of neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin and, therefore, have less resistance to cutting and chewing (Baldini *et al*., 2016).

The unfavorable leaf:stem ratio generates changes in animal behavior, by allocating a higher amount of energy for grazing and for the search for sites with better accessibility to fresh foliage.

The stocking rate is an important element to establish in any grazing so that the animals consume the highest amount of pasture and the efficiency of its utilization is increased (Flórez-Delgado, 2017; Milera-Rodríguez *et al*., 2019). This variable has a significant importance in the efficiency of grazing dairy systems, because the establishment of an adequate stocking rate is the most critical point to achieve high nutrient utilization, maintain quality pasture and cover most of the needs throughout the animal's lactation.

Regarding the global (1,1 LAU/ha) and effective (1,3 LAU/ha) stocking rate of the unit under study, their values were found to be above the optimal value, if it is considered that in the system the natural pastures prevailed.

García-Trujillo (1983) determined that, for sites with a predominance of natural pastures without fertilization, and where there is no forage source, the stocking rate should vary between 0,5 and 1,0 LAU/ha, which decreases the grazing intensity in the pasturelands and favors a higher supply of pasture (30-35 kg DM/ha/day). It is known that the increase in grazing intensity reduces the residual leaf

area and, therefore, the growth of the pastureland, through lower growth rate and a higher need to mobilize reserves, a situation that varies depending on the plant species and the degree of intensity with which they are defoliated (Reategui *et al*., 2019).

In the studied dairy farm, it is necessary to reduce the stocking rate and achieve a longer resting time for the pastures, which can favor the reappearance of cultivated species, highly consumed under the current conditions, which has caused their depopulation and deterioration.

In general, the stocking that should be used in the rainy season is the one that allows the animals to cover their requirements with pasture, almost entirely; while in the DS it is necessary to cover part of them with other feed sources, in order to supply the pasture deficit that occurs at this time. Milera-Rodríguez and Machado-Castro (2011) confirmed the above-stated fact, when comparing two permanence times (3,5 and 7 days) with three stocking rates (2,5, 3,5 and 4,5 cow/ha). The use of the lowest permanence time and the lowest stocking rate not only allowed to achieve the highest milk production (9,4 kg/cow/day) and pasture persistence (82 %), but also made it possible to segregate 43 % of the grazing area for cutting pastures and making silage.

Table 4 shows the forage balance of the farm per season. It was proven that the production of pastures could not satisfy the need for dry matter of the animals throughout the year.

The highest deficiency occurs in the DS, in which 53,7 % of the DM requirements of grazing cows are not satisfied, with a value of -5,4 kg DM/cow/day. This is a dairy farm where more than 80 % of the total grazing area is covered by natural pastures and weeds. This becomes a limitation for milk production, because the energy requirement of a cow increases from 1 kg of glucose/day during the end of pregnancy to 2,5 kg/day during the first three weeks postpartum. This causes an extensive mobilization of body tissue, mainly of its fat reserves, but also of amino acids, minerals and vitamins to supply the nutrient demand of the mammary gland in the process of milk synthesis (Bisinotto *et al*., 2016). Therefore, it is necessary to use external feedstuffs, mainly concentrate feeds, in order to increase animal production and improve the indicators related to reproduction and health. Pregnant animals and recently-calved cows have a high energy demand, which is not supplied by low-quality natural pastures, because these animals physically have lower digestive capacity, as a consequence of uterine growth and rumen compression (Marini and Di-Masso, 2018), for which they are the most affected when there is low availability of quality feedstuff, as in this case.

The dairy farm does not have a feeding basis, in quantity and quality, to feed its herd throughout the year. Hence, cultivated grasses should be incorporated and trees planted for the benefits they have on milk production.

Tree species improve the nutritional value of the diet, but they can also play an important role in the symbiotic fixation of atmospheric nitrogen, which is used in the association by grasses (Escobar-Pachajoa *et al*., 2019).

If a silvopastoral system is developed in the dairy farm under study, the productivity and net benefit of the system could be increased in the long term, because the associations of grasses with woody and multipurpose legumes guarantee better forage quality, higher crude protein and digestibility, with regards to monocultures constituted only by grasses (López-Vigoa *et al*., 2017).

Conclusions

The characterization of the plant community of the studied dairy farm showed a high presence of natural pastures and weeds in the grazing areas in both seasons, which caused low availability of pastures, mainly in the DS. The effective stocking rate on the system was 1,3 LAU/ha, which is above the optimal value and causes high grazing pressure, with low daily pasture offers.

Table 4. Forage balance per season.

Season	Estimated intake, kg DM/LAU/day	Pasture offer, kg DM/LAU/day	Surplus or deficit, kg DM/LAU/day	Surplus or deficit. %
RS	10	6,8	-3,2	-31,7
DS	10	4,6	-5,4	-53,7

DS: dry season RS: rainy season

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Conflict of interests

The authors declare that there is no conflict of interest among them.

Authors' contribution

- Flavia Garcia-Sanchez. Design and setting up of the research, data analysis and interpretation, manuscript writing and revision.
- Tania Sanchez-Santana. Research design and advisory, manuscript writing and revision.
- Luis Lamela-Lopez. Research design and advisory, manuscript writing and revision.
- Dariel Morales-Querol. Research advisory, manuscript writing and revision.
- Fernando Ruz-Suarez. Research setting up and data collection.

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