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CHARACTERISTICS OF GRAIN SORGHUM REGROWTH FOR FORAGE USE IN INTEGRATED SYSTEMS

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ABSTRACT: The objective was to evaluate the morph-productive characteristics of grain sorghum regrowth, in an integrated system with different breadth of cultivation strips, for forage use, in the semi-arid region. The experiment was conducted in the year 2022, at the Limoeiro do Norte, Ceara State, Brazil. The experimental area consisted of an integrated system thinned by strips of native vegetation (6 x 50 m) interspersed by three arrangements for the cultivation areas: 7; 14 and 28 meters wide x 50 meters long. Grain sorghum was cultivated in rainfall regime. The evaluation of regrowth occurred 60 days after harvesting the grains. The adopted experimental design was completely randomized, with three treatments (plots of 7 (T7); 14 (T14) and 28 (T28) meters wide x 10 meters long) and 4 replications. It was found that sorghum regrowth in T7 was more affected by the effect of proximity to forest strips. At T14, only the BFT was significantly lower than at T28. It was concluded that the regrowth of grain sorghum as forage is feasible in an integrated system in strips in the semi-arid region, however the breadth of the cultivation strip must be greater than 14 meters.

Keywords: ICLF, S. Bicolor, Semi-Arid.

CARACTERÍSTICAS DA REBROTAÇÃO DO SORGO GRANÍFERO PARA USO FORRAGEIRO EM SISTEMAS INTEGRADOS

RESUMO: Objetivou-se avaliar as características morfo-produtivas da rebrotação do sorgo granífero, em um sistema integrado com diferentes larguras de faixas de cultivo, para uso forrageiro, no semiárido. O ensaio foi conduzido no ano de 2022, em Limoeiro do Norte, Ceará, Brasil. A área experimental era composta de um sistema integrado raleado por faixas de vegetação nativa (6 x 50 m) intercaladas por três arranjos para as áreas de cultivo: 7; 14 e 28 metros de largura x 50 metros de comprimento. O sorgo granífero, foi cultivado em sequeiro. A avaliação da rebrotação ocorreu 60 dias após a colheita dos grãos. O delineamento experimental adotado foi inteiramente casualizado, com três tratamentos (parcelas de 7 (T7); 14 (T14) e 28 (T28) metros de largura) e 4 repetições. Verificou-se que a rebrotação do sorgo no T7 foi mais afetada pelo efeito da proximidade das faixas de mata. No T14, apenas a BFT foi significativamente inferior ao T28. Concluiu-se que a rebrotação do sorgo granífero como forragem é viável em sistema integrado em faixas no semiárido, contudo, a largura da faixa de cultivo deverá ser superior a 14 metros.

Palavras-chave: ILPF, S. Bicolor, Semiárido.

1 INTRODUCTION

The crop-livestock-forest integration system is classified as one of the most suitable sustainable technologies for naturally ecosystems, such as the Brazilian semi-arid region. Despite the appeal for its adoption in recent decades, it is estimated that only approximately 1.3 million hectares are occupied by some type of integration in the Brazilian Northeast (Rangel *et al.*, 2022). To change this scenario, new forest x crop

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arrangements have been experimented with in an attempt to find a better fit between sustainability and agrosilvopastoral production. The strip system (forest strips interspersed with crop strips), for example, provides faster deployment and better logistics for harvesting products (wood, grains and forage) when compared to the savannah and grove models once recommended for the region.

Among the agropastoral crops indicated for this type of system, grain sorghum stands out. Smaller in size, with an early cycle and tolerant to water stress, grain sorghum has gained space in the region, with an average production of 2.8 tons of grain ha^{-1} (Sorgo, 2022). In addition, the choice of grain sorghum is also strategic in terms of future economic and climate scenarios, as it is the first substitute for corn in animal feed. In addition to the grains, after harvesting, regrowth can be obtained, on average 40-60% of the plant biomass produced in the first cut in a conventional system (Rahman; Fukai; Blamey, 2001). This biomass has a high forage value, bringing plasticity to the production system by providing, in addition to grain, an alternative food for the herd. In integrated systems, however, due to the interaction with the different possible arrangements with the forest component, more information is needed on the behavior of regrowth and the viability of its use for animal feed.

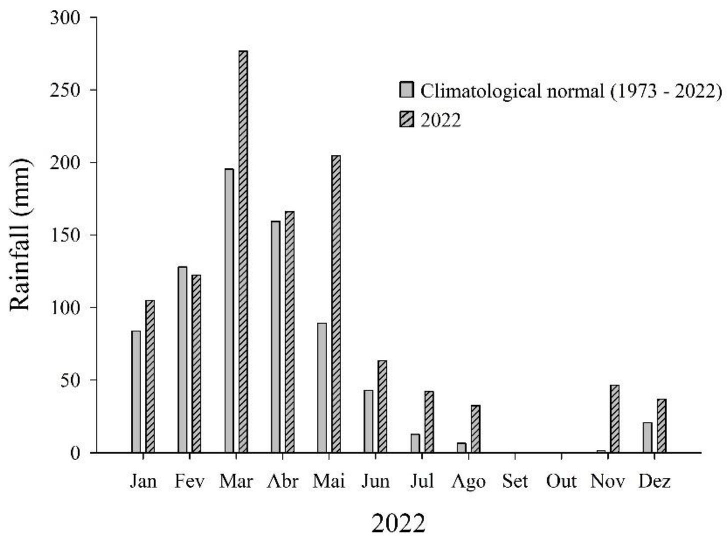
Given the above, this work sought to evaluate the morphological and productive characteristics of grain sorghum regrowth, in an integrated system with different breadth of cultivation strips, in a rainfed regime, in the semi-arid region.

2 MATERIAL AND METHODS

2.1 Characterization of the experimental site

The experiment was conducted at the Unidade de Pesquisa Ensino e Extensão (UEPE) of the Instituto Federal de Educação, Ciência e Tecnologia (IFCE), Campus Limoeiro do Norte, in Chapada do Apodi, Ceará State. The experimental area is characterized by flat relief and predominance of Cambisol soils (Santos *et al.*, 2013) with geographic coordinates of 05°10'5" S and 38°00'43" W and altitude of 146 m at level sea. The climate is hot and semi-arid, classified as BSh (Köppen, 1936), with a rainy season (January to July) and a dry season (August to December) (Figure 1).

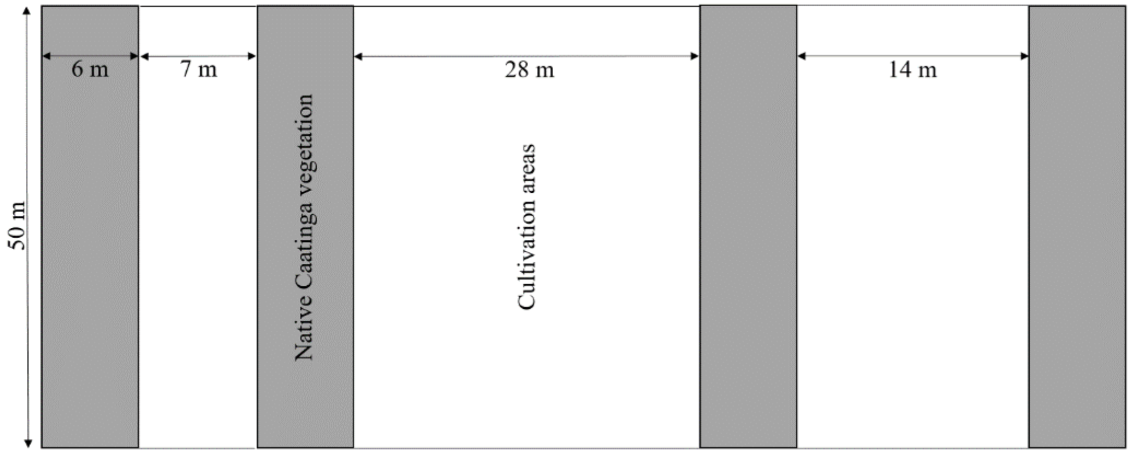
Figure 1. Rainfall history (climatological normal) and rainfall record in the year 2022 measured in Limoeiro do Norte-CE



Fonte: Fundação Cearense de Metereologia (2022).

The experimental area consisted of an integrated system trimmed by strips of native Caatinga vegetation (6 x 50 meters in length) arranged in three arrangements for the cultivation areas: 7; 14 and 28 meters wide x 50 meters long. The experimental plots measured 7; 14 and 28 meters wide x 10 meters long, with 4 replicates each and 10 subsamples for each replicate to compose the average of the plot. In the year 2022, grain sorghum (Pioneer 84G05 hybrid) was cultivated in a rainfed regime, with spacing of 0.45 rows and 7 plants linear meter^{-1}, totaling a population equivalent to 155,555 thousand plants ha^{-1}.

Figure 2. Experimental design of integrated system trimmed by strips of native Caatinga vegetation (6 x 50 meters in length) arranged in three arrangements for the cultivation areas: 7; 14 and 28 meters wide x 50 meters long



The evaluation of regrowth occurred 60 days after harvesting the grains, when the plants began to emit the panicle, where the following measurements were made: plant height (cm), total forage biomass (kg of DM ha^{-1}), density of plant (number of plants m^{-2}) and number of live leaves (counting the number of leaves with at least 75% of the blade green).

The adopted experimental design was completely randomized, with three treatments (plots of 7 (T7); 14 (T14) and 28 (T28) meters wide x 10 meters long) and 4 replications. Data were treated by analysis of variance and means comparison test. For the effect of treatment (T7; T14 and T28), means were compared by Tukey's test ($p<0.05$). As a tool to aid in the statistical analysis, the SISVAR software was used (Ferreira, 2011).

3 RESULTS AND DISCUSSIONS

There was a significant effect of the treatments, with the analyzed parameters showing increasing increments with the increase in the breadth of the crop strips (Table 1). This behavior was somewhat expected, since there is no limitation of water and nutrients, tropical grasses suffer from limited growth when they receive full solar radiation (Anjos; Chaves, 2020). Otherwise, plants that suffer a significant understory effect, such as shading and intra and interspecific competition, may have compromised supply of light (Bungenstab *et al.*, 2019), water (Maranhão *et al.*, 2021) and nutrients (Momesso *et al.*, 2022), which can affect growth, especially in semi-arid conditions.

It is important to highlight the use of sorghum regrowth in a rainfed regime, most of the time, conditioned to rain events that may occur after the harvest of the grain. When comparing the rains that occurred in 2022 in relation to the climatological normal of rains in the municipality of Limoeiro do Norte, an above average condition is verified (Figure 1), that is, a favorable condition for the accumulation of forage via regrowth. For rainfed planting in the State of Ceará, specifically, it is recommended that it be carried out in the first half of February, a period in which the influence of the atmospheric system called the Intertropical Convergence Zone occurs (Ferreira; Mello, 2005). However, due to the stochastic nature of rainfall distribution throughout the wet season (February to May), it is not possible to predict whether there will be enough rain to achieve good regrowth. In this sense, planning the use of upland sorghum regrowth should start from the analysis of the rainfall history of the region and the time of the crop's intended cycle.

Table 1. Variables analyzed in regrowth of grain sorghum (Pioneer 84G05 hybrid) in an integrated system in thinned Caatinga with different breadth of crop strips.

Variables	**Breadth of cutting strips (m)**			**CV**	**Value-P**
	7	**14**	**28**	**(%)**	
height (cm)	63.1b	77.1ab	96.6a	21,6	0.013
TFB* (kg of DM ha^{-1})	664.5b	713.1b	1221.3a	18,2	<0.001
Density of plant (m²)	14.8b	26.0a	29.5a	28,6	0.005
Number of live leaves	3.6b	5.5a	6.0a	18,3	0.001

*Note: Total Forage Biomass.

The lower plant height at regrowth affected biomass production, however it is compensated by the higher plant density and the number of live leaves, making a good relationship between height and number of leaves. Considering that at planting the density is approximately 15 plants m^{-2}, an increase in the plant population was verified in the tillering of T14 and T28. As for T7, in addition to the understory effect, mechanized harvesting caused greater damage to the thin area, compacting and damaging the cultivated lines in order to impair regrowth, an effect that is better distributed in treatments T14 and T28. An advantage of the BFT produced in regrowth concerns the possibility of total forage removal by grazing without causing damage to soil protection. Once the biomass from the first cut was dispersed in the area by the harvester, the regrowth starts from an area already covered by straw, contributing to the protection and increase of organic matter in the soil.

The good productive and morphological characteristics of grain sorghum regrowth qualify it for use in an integrated system in the semi-arid region. At T14, only the BFT was significantly lower than at T28. In this case, its application can meet the variations of this type of system, when, for example, one of the objectives of the farm is to produce wood, which requires larger areas covered by woody vegetation to the detriment of areas for grain or forage cultivation. Due to its small size and fast cycle, the use of biomass produced after cutting can help in the forage budget of the property as an important source of food produced at low cost.

4 CONCLUSIONS

The production of forage through regrowth of grain sorghum was presented as a viable option in an integrated system in strips of thinned vegetation in the semi-arid region.

The 14 and 28 m breadth cultivation strips favored the manifestation of the best productive and morphological characteristics of the plant.

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