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HIGHLIGHTING THE PASTURE COMPONENT OF A LONG-TERM CROP-LIVESTOCK SYSTEM IN THE CERRADO BIOME, BRAZIL

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ABSTRACT
In the tropical region central of Minas Gerais State, integrated crop-livestock systems are characterized by annual rotation or succession of crops and pastures in a no-till system in which the pasture is used to produce either milk or meat. In this paper the system focus on integration of maize and sorghum in consortium with *Urochloa* and *Megathyrsus maximus*, respectively, for silage, followed by pasture were Nellore and 1/2 Nellore: Angus calves remain for one year, and then soybean is cultivated in no-till system. The green and dry biomass production, in t/ha, of grass forage cultivar 'Tanzânia-1' or 'Mombaça' are presented in annually data before and after stocking in rotated management during wet and transition seasons. The calves body weight gains recorded in these years of integrated crop-livestock system are above the average of Brazilian productivity. In average, the annual animal productivity was of 1,281 kg of live weight per hectare. In conclusion, the integrated systems in region provide the opportunity for intensification with sustainability.
Key words: Cerrado; Forage analysis; Guinea grass

INTRODUCTION

The Brazilian Cerrado is one of the most important region for agriculture and livestock production. This region presents a wide variation in rainfall rate and, invariably the rains are concentrated during spring and summer, with dry autumn and winter. As climate changes, these areas are being affected by water shortage and longer water stress periods, and this poses major challenges not only for inner but worldwide food supply. Integrated systems are one way to enhance the resilience of crop and livestock production (SZYMCZAK et al., 2020). The strong performance of integrated crop-livestock systems has showed relevant and presented positive impact in land productivity and in diversifying production and of itself for global sustainable development (REIS et al., 2021). This system allows the land sustainable use and its intensification by introducing no-till technology in synergy with crops and livestock activities with a minimal interface between them. While it increases productivity, the system also reduces costs and risks, improves the efficiency of machinery use, increases diversity, promotes gas mitigation, reduces weed incidence, and increases profitability and incomes to farmers (MORAES et al., 2014).

In the central region of Minas Gerais, with great aptitude for beef and dairy cattle, periods of water restriction are evidenced annually even during the summer as well as a scarcity of food supply for animals during the drought period, which makes it suitable for the use of integrated crop-livestock systems. A cyclic combination of no-till crop production – crop-forage consortium for silage – livestock pasture feed –feedlot has been evaluated in the last 15 years in Sete Lagoas, MG.

Data of pasture management and productivity in integrated crop-livestock systems represent an important component in the sustainability of the system. However, information about this component is scarce in literature, and it certainly cannot be relegated to a secondary plan because all risks evidenced in extensive pastures can be extended to integrated systems such as pasture degradation, low animal body weight gain, and low straw formation for the subsequent no-tillage crop cultivation.

This study was evaluated the animal body weight gain and biomass production of forage grass *Megathyrsus maximus* grazed in an integrated crop-livestock system using intermittent grazing with high stocking rate of calves per hectare, during the last six years.

MATERIAL AND METHODS

The study was conducted in an integrated crop-livestock system (CLS) installed in the Embrapa Maize and Sorghum experimental field, located at the geographical coordinates 19°29'4.37"S and 44°10'25.66"W, at 755 m altitude. The local and predominant climate in almost the entire Cerrado region is classified, according to the Köppen classification, as Aw - Type A: megathermic (tropical humid) - with average temperature of the coldest month above 18 °C and subtype w, dry winter and maximum summer rainfall (Macena et al., 2008). The average annual coverage is 1350 mm, distributed between the months of October and March. The soil is a Oxisol, dystrophic Red Latosol according to the Brazilian Soil Classification System (SANTOS et al., 2013), clayey and smooth wavy relief.

The total area of the integrated system was 22 ha divided in four areas of 5.5 ha, in which annually the treatment crops were rotated: corn + *Urochloa* cultivar, sorghum + *Megathyrsus maximus* (Guinea grass) cultivar, *M. maximus* pasture area for one year followed by soybean seeded on no-tillage area. *M. maximus* pastures formed after the sorghum harvest for silage were based on 'Tanzânia-1' in 2013-2014, and 'Mombaça' in 2015-2016, 2016-2017, 2017-2018, and 2018-2019. The pasture in this system benefits itself from the residual fertilization remaining from the annual crops in the three years of previous crops and was also fertilized every year with cover fertilization and corrections according to soil analysis. Nitrogen fertilization was always used as a strategic tool modulating pasture growth in order to supply the demand of the herd during the water period. Nitrogen fertilization used urea in quantities varying from 465 kg/ha, in the first years, to 200 kg/ha from 2015-2016 on, always divided in three applications during summer.

Pasture area was subdivided in five paddocks of 1.1 hectare each and the rotated management was adopted, mostly during the water surplus season. During the dry season all 22 ha area was used as pasture. Green (t/ha) and dry biomass yield (t/ha) was determined by clipping at ground level in ten randomly located 1 x 1m quadrats per paddock in pre- and post-stocking conditions. Samples were dried at 65°C for 72 hours and then weighed. Green and dry biomass yield was averaged in transition, wet and dry water seasons from 2013 to 2019.

The animals, from two blood groups of specialized breeds for meat production (Nellore and 1/2 Nellore: Angus), entered annually in the system in May/June live weighing on average 172.5 kg and remained around one year under grazing, when they entered the feedlot and a new batch of calves entered the pastures. Stocking rate of 1 AU/ha were used during winter, and achieved 7-8 AU/ha during summer when animals stayed exclusively in the 5.5 ha Guinea grass paddocks.

The data of biomass and animal production were organized by season and will be presented in the form of media with their respective standard deviations.

RESULTS AND DISCUSSIONS

Table 1 shows the biomass production characteristics of 'Tanzânia-1' and 'Mombaça' cultivars pasture evaluated in 2013/2014 and from 2015/2016 to 2018/2019, respectively. The average availability values for each period are demonstrated. The wet season presented the highest average availability, followed by the transition and dry season, as expected for this species. These results present grasses biomass production stability over the years and corroborate the feasibility and planning of integrated systems for the region, in order to ensure animal production. In addition, the system keeps the pasture and soil in adequate conditions for sowing the crop under no-tillage, allowing a sustainable intensification.

Table 1. Season means and standard deviations of the green and dry biomass available (t/ha) and consumed by animals in *Megathyrsus maximus* 'Tânzania-1', in 2013/2014, and 'Mombaça' pasture, in two seasons, years from 2015 to 2019.

Characteristic	**Wet season**	**Transition**
	2013/2014	
Green biomass availability– before stocking	27.82±13.27	16.14±6.76
Dry biomass availability– before stocking	5.56±2.65	3.23±1.35
	2015/2016	
Green biomass availability– before stocking	19.45±3.68	10.80±1.8
Dry biomass availability– before stocking	4.12±0.78	2.92±0.49
	2016/2017	
Green biomass availability– before stocking	19.48±3.84	9.38±0.48
Dry biomass availability– before stocking	4.24±0.83	3.06±0.16
	2017/2018	
Green biomass availability – before stocking	28.05±9.46	15.01±3.14
Dry biomass availability - before stocking	5.57±2.11	5.09±1.16
Green biomass – after stocking	14.38±6.15	12.9±2.4
Dry biomass - after stocking	3.05±1.22	4.75±0.97
	2018/2019	
Green biomass availability – before stocking	26.43±7.35	23.15±6.35
Dry biomass availability - before stocking	5.03±1.32	4.18±0.60
Green biomass – after stocking	14.70±4.98	16.45±5.70
Dry biomass - after stocking	2.80±0.48	3.10±0.28

In Table 1, the organization of the data allows the visualization of the average forage availability of Mombaça grass paddocks in pre- and post-stocking conditions. The data show that the average values of available forage (pre-stocking) were very close for the water period and transition within each agricultural year. However, the nutritive value of forage in the water period is almost double that observed for the transition period (data not shown). This fact reinforces the importance of having an area with postharvest forage (corn, sorghum, soybean), in order to balance this amount of forage still available in Mombaça grass pasture with the initial quality of forage of a *Urochloa* pasture, for this transition and dry period, and of course, together with strategic use of supplementation.

Considerable are also the average masses of forage available in post-stocking. This indicates that even under the criterion of fixed days of occupation and rest adopted in the system, it was possible to maintain sufficient amount of residue to stimulate the regrowth of pastures.

The average body weight gains (Table 2) in the six agricultural years evaluated ranged from 350 to 800 g/animal/day; 700 to 900 g/animal/day and 300 to 800 g/animal/day in the dry, wet and transition period, respectively (data not shown). The variations in gain are mainly due to the amount and quality of pasture in each of the seasons of the respective agricultural year, as well as the type of pasture supplementation, since the animals received supplementation with mineral and protein supplement of low consumption (0.1 to 0.2% of BW) in the wet and dry periods, respectively.

Table 2. Live body weight gain (LBWG), and grazing days (GD) per season (dry, wet and transition), over the years of conducting the integration crop-livestock system at Embrapa Maize and Sorghum, Sete Lagoas, MG, Brazil.

	Dry	**Wet**	**Transition**	**Total of Period**
		2013-2014 – 32 animal units		
LBWG (kg/ha)	64.65	619.18	351.81	1035.00
GD	109	167	81	357
		2014-2015 – 42 animal units		
LBWG (kg/ha)	71.14	699.90	401.00	1172.04
GD	96	114	79	289
		2015-2016 – 40 animal units		
LBWG (kg/ha)	157.14	549.36	628.45	1334.90
GD	65	167	63	295
		2016-2017 – 60 animal units		
LBWG (kg/ha)	74.09	1117.36	578.45	1769.90
GD	89	177	82	348
		2017-2018 – 45 animal units		
LBWG (kg/ha)	96.86	483.86	216.11	796.83
GD	145	142	56	343
		2018-2019 – 47 animal units		
LBWG (kg/ha)	192.09	1030.54	357.54	1580.17
GD	103	165	59	327

Using pasture fertilization, supplementation and pasture management it was possible to guarantee high production of body weight per unit area. Moreover, the productivity values recorded in these years of integrated crop-livestock system are above the average of Brazilian productivity (ABIEC, 2020; BARBOSA et al., 2015).

CONCLUSIONS

The animal gains recorded in the pasture phase over the years reflect the potential of pastures associated with the proper management, and group animal evaluated. Therefore, the integrated crop-livestock system in region provides the opportunity for intensification with sustainability.

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