Diocléa Almeida Seabra Silva
(Organizadora)

Agronomia: Elo da Cadeia Produtiva 6

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APRESENTAÇÃO

A cadeia produtiva é um termo amplo que define com clareza onde cada segmento tem seu grau de importância seja na produtividade de frutos, venda de semente de capineira, na pesca, na aquicultura, na formação de resíduos para a indústria, no controle determinado de vírus, bactérias, nematóides para a agricultura e até mesmo na comercialização de espécies florestais com potencial madeireiro. Na verdade, o termo cadeia produtiva é um conjunto de ações ou processos que fazem presente em estudos científicos que irá dar imagem para o avanço de um produto final.

A imagem de um produto final se torna possível quando trabalhamos todos os elos da cadeia, como por exemplo: para um produtor chegar a comercializar o feijão, ele precisará antes preparar seu solo, ter maquinários pra isso, além de corririr o solo com corretivo, definindo a saturação de base ideal, plantar a semente de boa qualidade, adubar, acompanhar a produção fazendo os tratos culturais adequados, controlando pragas, doenças e ervas daninhas, além de encontrar mercados para que o mesmo possa vender sua produção. Esses elos são essenciais em todas as áreas, ao passo que na produção de madeira será necessário técnicas sofisticadas de manejo que começa na germinação de sementes, quebra de dormência para a formação de mudas, e além disso padronizar espaçamento, tratos silviculturais para a formação de madeira em tora para exportação.

Na pesca a cadeia produtiva segue a vertente do ganho de peso e da qualidade da carne do pescado, que está vinculada a temperatura, pH da água, oxigenação, alimentação e o ambiente para que haja produção. Também a cadeia se verticaliza na agregação de preço ao subproduto do pescado como o filetamento para as indústrias, mercado de peixe vivo e etc.

Na cadeia cujo foco são os resíduos da indústria açucareira, há mercados para a queima de combustível no maquinário da indústria, através da qualidade deste resíduo, além de mercados promissores para a fabricação de combustíveis, rações e até mesmo resíduo vegetal para incorporação nos solos, com a finalidade de manter ou melhorar as características químicas, físicas e biológicas, além de controlar erosão e elevar os níveis de produtividade nas áreas agrícolas, através da adição de nutrientes.

Contudo, sabemos que todos os elos que compõem a cadeia produtiva são responsáveis por agregar valor e gerar de maneira direta e indireta renda aos produtores e pescadores, possibilitando-os na melhoria da qualidade de vida, além da obtenção de produtos de alta qualidade. No entanto, aqui se faz presente a importância das pesquisas mostradas neste E-Book, v. 6 – Agronomia: Elo da Cadeia Produtiva para que o leitor possa perceber novidades que são contextualizadas, através dos trabalhos aqui publicados.

Diocléa Almeida Seabra Silva

SUMÁRIO

CAPÍTULO 22

THE HEIGHT OF CROP RESIDUES INFLUENCES INTAKE RATE OF SHEEP IN INTEGRATED CROP-LIVESTOCK SYSTEMS

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RESUMO: No sul do Brasil, soja e milho são as principais culturas utilizadas nos Sistemas Integrados de Produção agropecuária. Após a colheita, seus resíduos permanecem no solo enquanto o pasto está sendo restabelecido. O objetivo deste estudo é verificar se resíduos de culturas predecessoras em pastagens de azevém alteram a taxa de ingestão e os padrões de pastejo de cordeiros. Foram realizados dois experimentos, ambos com azevém, com quatro alturas de resíduo (0, 15, 30 e 45 cm) da safra de soja predecessora (experimento 1) e da safra de milho predecessora (experimento 2). A massa da mordida e a taxa de ingestão curto prazo foram estimadas pela técnica de dupla pesagem. Os padrões de pastejo foram medidos com gravadores comportamentais. A taxa de mordida foi a principal variável que determinou a taxa de ingestão. No experimento 1, poucas alterações ocorreram a nível de bocado. No experimento 2, a taxa de ingestão foi maior no resíduo da colheita de 15 cm ($p = 0{,}0115$). Portanto, não foram recomendadas alterações no manejo da altura do resíduo e azevém em pastagens com resíduos de soja.

No entanto, na colheita predecessora milho, recomenda-se resíduos de milho de 15 cm de altura.

A ALTURA DE RESÍDUOS DE LAVOURAS INFLUENCIA A TAXA DE INGESTÃO DE OVELHAS EM SISTEMAS INTEGRADOS PRODUÇÃO AGROPECUÁRIA

ABSTRACT: In southern Brazil, soybean and corn are the main crops used in Integrated Crop-Livestock Systems (ICLS). After these crops are harvested, residues remain on the ground as the pasture is being restablished. The objective of this study is to verify if wood residues of predecessor crops on an Italian ryegrass pasture scan alter the intake rates and grazing patterns of lambs. Two experiments were performed, both using ryegrass (*Lolium multiflorum* Lam.), with four different residue heights (0, 15, 30 and 45 cm) from the predecessor soybean crop (experiment 1) and the predecessor corn crop (experiment 2). Bite mass and short-term entry rate were estimated by the double weighing technique. Necklace patterns were measured with behavioral recorders. Bite rate was the major variable determining the intake rate. In experiment 1, time rate was not high for crop residues of 14 cm ($p = 0.003$) due to pasture structure. In experiment 2, a reference rate was higher in the crop residue of 15 cm ($p = 0.0115$). Therefore, there were no recommended changes in the height management of ryegrass in pastures with soybean residues. However, when the predecessor crop is corn, a short-term permanence rate is recommended for improving animal grazing in a pasture with corn residues of 15 cm of height.

1 I INTRODUCTION

Integrated crop-livestock systems (ICLS) is the opposite of unilateral monoculture systems and is commonly used in integrated agricultural and livestock activities, at different spatial-temporal scales, concurrently or sequentially in rotation or succession (MORAES et al., 2014). Thus, rotation occurs in the same area, leading to residues of the predecessor crop at the pasture phase (GILLER et al., 2015). In Southern Brazil, soybean and maize (Glycine max L. and Zea mays L.) are the most prominent crops (BRAZILIAN INSTITUTE OF GEOGRAPHY AND STATISTICS, 2014). Italian ryegrass pastures are usually used during the winter as an option for rotation with those summer crops (CARVALHO et al., 2010). This annual pasture returns by natural reseeding in the following year (CARVALHO et al., 2005). Soon after the crop is harvested, some crop residues remain vertically on the soil. Consequently, crop harvesting is an important process in the subsequent pasture management, as the crop residues will be part of the grazing environment (BARTH NETO et al., 2014).

There is no information on how the vertical residues of precedent crops can affect the grazing process, and how it interferes modifying the grazing environment and / or constraining animal intake rate.

This is important because grazing animals have the ability to change their intake rate as a consequence of behavioral decisions (NEWMAN, 1994). Thus, modifications on grazing environment and sward surface structure can affect the grazing process: bite mass (BM), bite rate (BR), and non-biting rates (NBR).

The aim of this study was to quantify if predecessor soybean or maize crop residues can alter patterns of grazing at the bite level and verify if there is an ideal cut-off height of the predecessor crop that maintains the intake rate at its maximum.

2 I MATERIAL AND METHODS

2.1 Experimental area

This study was conducted at the experimental farm of the Federal University of Rio Grande do Sul, in Southern Brazil (30o05′ S; 51o39′ W). The ICLS protocol consisted in the rotation, on the same area, of an Italian ryegrass pasture grazed by ewe lambs during the winter and a soybean and maize ~~grain~~ crops rotation cultivated during the summer. Italian ryegrass pasture was established by self-seeding. The region is classified as subtropical humid (Cfa classification, KÖPPEN; GEINGER, 1928). The soil at the experimental site is determined as a Typic Paleudult (USDA, 1999) with 15.2% clay. This experimental protocol was conducted from November 2013 to August 2014.

Four paddocks of 150 m2 of Italian ryegrass, previously delimited and surrounded with electro-plastic fences were used.

The climatic conditions were similar in temperature during the evaluation period. Mean daily temperature variation was 7.5°C. The maximum temperature was 22 °C (July 13th, 2014) and the minimum temperature was 5 °C (July 19th and 07th, 2014) (ACCUWEATHER, 2014).

2.2 Treatments

Experiment 1 consisted of four heights of predecessor soybean crop residues (PSCR: 0, 7, 14 and 21 cm). Experiment 2 consisted of four heights of predecessor maize crop residues (PMCR: 0, 15, 30, 45 cm). In both experiments, the experimental design was a completely randomized block with four replicates, and the blocking criterion was the time of the day for the evaluation (morning and afternoon).

The Italian ryegrass sward surface height (SSH) was maintained constant at 18.5 cm during the experimental period, which is the recommended SSH for grazing (SILVA, unpublished data). The Italian ryegrass received application of 75 kg ha−1 of nitrogen (urea), on July 7th.

2.3 Management practices

The sowing of summer crops was, for experiment 1 and 2, held on November 25th and 27th of 2013 respectively (soy-BRX Power RR and maize hybrids DKB290), by direct seeding on the line, with row spacing of 43 cm.

The experimental area was manually prepared using brushcutters after crop harvesting (May 23th, 2014) according to the intended treatments ($p < 0.001$), which were close to the ground and 7, 14 and 21 cm from the ground (experiment 1/soybean residue) or close to the ground, 15, 30, and 45 cm (experiment 2/maize residue).

2.4 Sward measurements

In both experiments, Italian ryegrass pastures were considered in vegetative stage, because less than 0.5% of the tillers had inflorescences (Tables 1 and 3). Three were collected per experimental unit, in order to determine the post-grazing herbage mass and herbage density. Strata was cut every 5 cm using a 0.1089 m2 square. All samples were separated into leaf lamina, pseudo-stems+ stems + sheaths, dead material, weed mass and inflorescence and then weighed. Samples were then dried at 65 °C for at least 72 h to determine the dry matter (DM) content. The total herbage mass was determined as the sum of the mass of each component (leaf lamina, pseudo-stems + sheaths and dead material). To determine the SSH of Italian ryegrass, a sward stick was used to measure 150 points per experimental unit (≈ one point by m2) pre- and post-grazing (BARTHRAM, 1985). After the emergence of the Italian ryegrass, SSH were measured daily within the paddocks to monitor their development until reaching the pre-grazing SSH of 18.5 cm. The grazing tests started on July 9th for PSCR paddocks and on July 14th for PMCR paddocks.

The DM content of simulated grazing samples was estimated by cutting four samples from each experimental unit (HALLS, 1954). The samples were harvested in the superior stratum of the sward surface because there is a 50% proportional relationship between the herbage removed with each bite and the SSH (CANGIANO et al., 2002; GONÇALVES et al., 2009; LACA et al., 1992). Then samples were dried at 65 °C for at least 72 h to determine the dry matter (DM) content.

2.5 Animal measurements

In both experiments, approximately 60 days before the grazing tests, the animals were familiarized with observers, recording equipment, and the experimental procedures and remained in an adjacent paddock with Italian ryegrass sward.

Six Texel ewe lambs were used in each experiment, consisting of four “tester” animals (6 ± 1 months and 35 ± 2.6 kg of body weight), and two additional “peer” animals. This procedure was lead to prevent any effect of group size during lambs grazing time (PENNING et al., 1993). The animals were allowed to graze in periods of 45 min during peak grazing times, the first and the last grazing meals, respectively

(HODGSON, 1990). The animals were not fasted prior to the grazing periods because this reduce diet selection (NEWMAN et al., 1994). The experimental procedure was adapted from Penning and Hooper (1985).

At dawn, the animals were taken to a weighing area, and the four “tester” animals were fitted with feces and urine collecting bags. They were also fitted with IGER Behaviour Recorders (RUTTER et al., 1997), to identify and characterize jaw movements [biting (bite severing), non-biting jaw movements (manipulation + ingestive mastication)], and to determine the eating time [time at which ewe lambs were head down and completely involved in severing, manipulating, and masticating bites (grazing = eating + searching times)]. These data were used to calculate bite mass (BM), bite rate (BR), non-biting jaw movements (N-BJMR), and total jaw movements (TJM) per gram of herbage dry matter intake (DMI).

After approximately 45 min of grazing, the animals were removed from the paddock, reweighed and then kept in a non-vegetated area without access to water and food to determine the rate of insensible weight loss (evaporation of H2O, and gaseous losses; GIBB et al., 1999) during another 45 min. This entire procedure was repeated in the afternoon. Data were analyzed with the Graze software (RUTTER et al., 1997). The effect of period of day (morning and afternoon) was blocked in the analysis due to changes in the preferences of animals over the course of the day (RUTTER, 2006).

All animals’ weights (pre- and post-grazing and pre- and post-insensible weight losses) were taken on a balance with an accuracy of 10 g. The short-term intake rate was calculated by the equation:

$$STIR = \frac{(W2 - W1)}{t2 - t1} + \frac{(W3 - W4)}{t4 - t3}\ x\ \frac{(t2 - t1)}{ET}$$

Where: STIR=short-term herbage intake rate; W1 and W2=animal’s weight after and before grazing; t1 and t2=time pre- and post-grazing; W3 and W4=animals’ weight pre- and post-insensible weight losses; t3 and t4=time pre- and post-insensible weight losses; and ET=effective eating time.

The STIR was corrected for the DM content. STIR was calculated as the product of the fresh weight intake rate and the DM content of the herbage consumed by animals (determined from hand-plucked samples).

For calculating effective eating time (ET, the total grazing time excluding intervals of jaw inactivity of more than 3 s; GIBB, 1998). Time spent for bite was calculated ET/total number of bites. The BM was calculated as the ratio between STIR and the number of bites. The BR was determined by dividing the total number of bites by the eating time. The TJM was calculated by adding the chewing and seizure movements (bites) recorded by the IGER. The N-BJMR refers to those movements that are not identified as bites during grazing and therefore include movements that have a masticatory or manipulative function.

These were calculated as the number of N-BJMR divided by the ET. The intra-meal interval of grazing was considered intervals of jaw inactivity from 3 until 300 s. The number of intra-meal interval of grazing (NIMI) was the total amount of intervals given during the evaluation (GIBB, 1998).

2.6 Data analysis

Data were subjected to analysis through R software for statistical computing version 3.1.3 (R Development Core Team, 2015) and through R studio. Mixed linear models were used and developed with the nlm4 package.

All variables (behavioral and sward) showed a normal distribution, checked by MASS package with the Box-Cox test ($p > 0.05$). In all analysis, paddock and test group were used as experimental unit. The structure of these models were selected based on interaction between time of day (morning and afternoon). Data were subjected to variance analysis (ANOVA) at 5% level of significance. The model included the fixed effects for treatment heights according to the experiment (1 or 2), and random effects of parcel and animal. If any significance was detected it was then compared by the Tukey test ($p < 0.05$).

3 I RESULTS

3.1 Predecessor soybean crop experiment – Experiment 1

The actual SSH was similar to the targeted SSH (Table 1). Vertical distribution of herbage mass and morphological components of sward surface (leaf, pseudo-stems + sheaths, dead material mass and inflorescence) are shown in Table 1. The amount of dead material mass and inflorescence mass did not differ between treatments.

	Predecessor soybean crop residue (cm)					
	0	7	14	21	Mean ± sd	*p* - value
Residue diameter (mm)	—	6.9	6.8	6.0	6.6 ± 1.9	<0.001
Pre-grazing SSH (cm)	19.8	20.1	18.4	21.7	20.1 ± 2.1	0.532
Post-grazing SSH (cm)	18.1	18.3	16.8	22.6	19.2 ± 2.5	0.116
HM (Kg DM ha^{-1})	1509.9	1362.8	1783.5	1250.0	1483.9 ± 341.2	0.174
LM (Kg MS ha^{-1})	928.1 ab	936.4 ab	1221.0 a	794.1 b	971.0 ± 257.5	0.018*
PSM (Kg DM ha^{-1})	499.1	379.5	479.3	400.1	445.5 ± 127.0	0.475
DMM (Kg DM ha^{-1})	72.9	40.0	54.8	46.6	55.20 ± 34.7	0.388
IM (Kg DM ha^{-1})	1.9	3.0	0.3	3.0	2.02 ± 3.0	0.412

Table 1: Residue diameter of predecessor soybean crop (experiment 1), pre-grazing sward surface heigth (SSH), post-grazing SSH, herbage mass (HM), leaf mass (LM), pseudostems and sheaths mass (PSM), dead material mass (DMM), inflorescence mass (IM) of Italian ryegrass (*L. multiflorum* Lam.) grazed by ewe lambs as a function of different predecessor soybean crop

residue heights.

sd = Standard deviation; *p* = significance level.

Animal behaviour variables	Predecessor soybean crop residue (cm) 0	7	14	21	Mean ± sd	*p*-value
STIR (g DM.min^{-1})	5.1 ± 1.9 b	5.4 ± 2.1 b	8.3 ± 4.5 a	5.4 ± 2.1 b	6.2 ± 3.2	0.005*
BM (mg DM.min^{-1})	88.5 ± 34.9	99.7 ± 34.3	144.6 ± 88.2	94.2 ± 36.9	107.8 ± 58.6	0.055
BR (bite. min^{-1})	60.9 ± 14.9	55.4 ± 14.0	58.9 ± 12.6	58.7 ± 18.9	58.9 ± 14.3	0.486
N-BJMR (no. min^{-1})	68.1 ± 18.8	65.4 ± 18.4	67.0 ± 16.3	72.0 ± 23.4	67.9 ± 18.2	0.782
TSB (sec.bite^{-1})	1.1 ± 0.3	1.14 ± 0.3	1.5 ± 0.2	1.1 ± 0.3	1.1 ± 0.3	0.835
TJM (no. min^{-1})	128.9 ± 9.6	120.7 ± 6.8	125.9 ± 12.9	130.5 ± 6.9	126.7 ± 10.1	0.809
NIMI (nº)	18.3 ± 5.7 b	33.1 ± 14.9a	18.2 ± 13.5b	21.8 ± 6.7ab	21.9 ± 11.8	0.025*
IMID (min.)	0.2 ± 0.1 b	0.3 ± 0.1 a	0.2 ± 0.1 ab	0.2 ± 0.1 ab	0.2 ± 0.08	0.027*

Table 2: Short-term intake rate (STIR), bite mass (BM), bite rate (BR), non-biting jaw movements rate (N-BJMR), time spent for bite (TSB), total jaw movements rate (TJM), number of intra-meal interval of grazing (NIMI), and Intra-meal interval duration (IMID) for ewe lambs grazing Italian ryegrass (*Lolium multiflorum* Lam.) as a function of different predecessor soybean crop residue heights.

sd = Standard deviation; *p* = significance level.

3.2 Predecessor maize crop – Experiment 2

There was no significant difference between the mean of pre and post grazing SSH in any of the treatments ($p = 0.626$).

	Predecessor maize crop residue (cm) 0	15	30	45	Mean ± sd	*p*-value
Diameter of residue (cm)	—	18.1	18.6	19.5	18.8 ± 3.17	<0.001
Pre-grazing SSH	16.7 b	19.5 a	21.1 a	21.6 a	20.1 ± 2.8	0.001*
Post-grazing SSH	14.4 b	18.5 a	19.2 a	20.5 a	18.6 ± 3.3	0.002*
HM (kg DM ha^{-1})	1357.1	1343.1	1416.2	1532.7	1439.0 ± 259.7	0.640
LM (Kg MS ha^{-1})	854.2	745.3	982.9	970.0	919.5 ± 201.5	0.337
PSM (Kg DM ha^{-1})	314.5	395.1	317.4	412.9	369.3 ± 100.5	0.193
DMM (Kg DM ha^{-1})	135.9	99.9	76.3	110.0	105.0 ± 36.36	0.377
IM (Kg DM ha^{-1})	31.0	9.3	11.2	6.2	8.7 ± 3.9	0.208

Table 3: Residue diameter of predecessor maize crop, pre-grazing sward surface heigth (SSH), post-grazing SSH, herbage mass (HM), leaf mass (LM), pseudostems and sheaths mass (PSM),

dead material mass (DMM), inflorescence mass (IM) of Italian ryegrass (*Lolium multiflorum* Lam.) grazed by ewe lambs as a function of different predecessor maize crop residue heights.

Sd = Standard deviation; p = significance level; Means followed by lowercase letters on the same line differ based on comparisons multiple contrasts ($p < 0.05$).

Higher STIR were observed for PMCR of 15 cm of height ($p = 0.0115$; Figure 2A). The mean value was 3.015 ± 0.94 g DM min^{-1}. There was no difference ($p > 0.05$) between the PMCR residues height concerning BM. The mean was 48.5 mg DM bite^{-1}, ranging from 22.1 to 80.5 mg DM bite^{-1}. Higher values of BR (Figure 2B) were observed under PMCR of 15 cm of height ($p = 0.0163$) and lower values in 45 cm of height. The BM mean was 61.56 g DM min^{-1}. The TSB, presented higher values for the 45 cm ($p = 0.0162$; Figure 3A), and lower in 15 cm. The mean was 1.0 g DM min^{-1}. The N-BJMR was lower for 45 cm ($p = 0.0175$, Figure 3 B). The mean value was 58.63 g DM min^{-1}. There was no significant difference for the PMCR for TJM ($p > 0.005$), remaining constant.

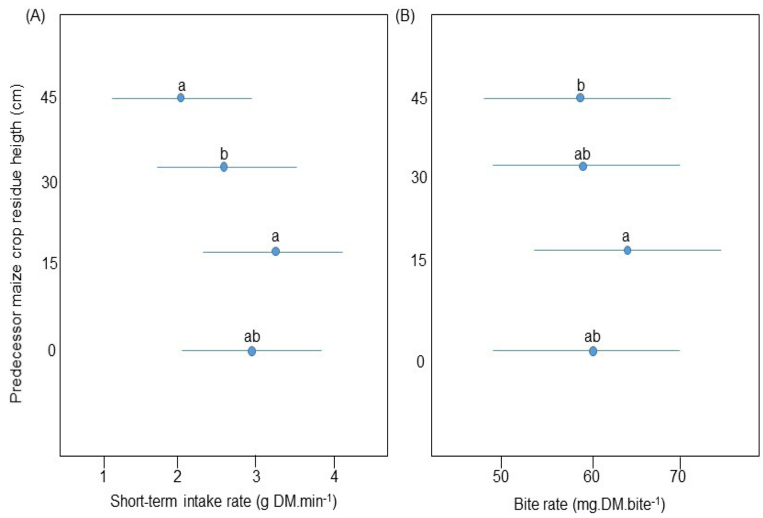

Figure 1: Short-term intake rate (A) and bite rate (B), for ewe lambs grazing Italian ryegrass (*Lolium multiflorum* Lam.) as function of different PMCR heights.

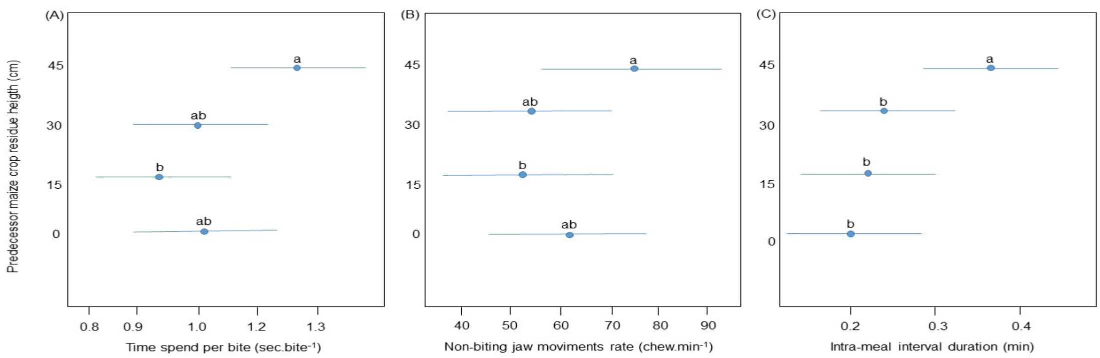

Figure 2: Time spent per bite (A), non-Biting jaw movements rate (B) and intra-meal interval duration (C), for ewe lambs grazing Italian ryegrass (*Lolium multiflorum* Lam.) as a function of different PMCR heights.

4 I DISCUSSION

4.1 Predecessor soybean crop – Experiment 1

Bite Rate, N-BJMRs and BM determine STIR (YAYOTA et al., 2015), as shown in experiment 1, in which there was no difference in variables BR, N-BJMRs among treatments. It is worth noting the trend ($p = 0.055$) for the treatment of BM 14 cm (Table 1). The difference in STIR for PSCR at 14 cm was effective because of the higher leaf mass in that treatment. The amount of dead material mass and inflorescence mass did not differ between treatments. Thus, the animals did not need to avoid undesirable structures and could capture the preferred component of the canopy in abundance (FONSECA et al., 2012). Therefore, concerning the animal grazing behavior there was no influence of residues on PSCR, however, results were influenced by sward structure.

Table 2 revealed that ewes lambs essentially exhibited similar patterns of N-BJMRs, TSB and TJM, regardless of the remarkable differences in residues heights (Table 1). Similar results were reported by Yayota et al. (2015). It can be inferred that ewe lambs did not need to perform more harvesting movements or manipulate the harvested material since these variables remained constant (Table 1). Besides that, the TSB did not increase in the time spent capturing and harvesting herbage, regardless of treatment (BENVENUTTI et al., 2009). Therefore, it is possible to suggest that the animals avoided places where bites could contain residue.

On the other hand, it is possible that 7 cm residue was not easily perceived in the pasture, possibly hindering the bite selection process, leading to higher NIMGI and IMID. It can be considered that the high NIMG was a reflection of the great selection of sites in the feeding station for maximum bite potential, related to a greater IMID. This may be related to the pasture harvesting behavior of the animal, because when the animal harvests the herbage, there is a proportional relationship between the herbage removal depth and SSH, of about 50% SSH (e.g., LACA et al., 1992). Thus, the sward height of 18.5 cm and residue height at 7 cm height seems to define a very close limit in relation to the potential proportionality, with a potential reduction in bite depth and bite area

4.2 Predecessor maize crop – Experiment 2

The Italian ryegrass pre and post grazing height did not varied significantly in any of the treatments. Therefore, the same sward structure was presented to the animal all for all grazing tests (Table 3).

The BR was higher for the PMCR of 15 cm, leading to a higher STIR, compared to 45 cm indicating that the largest residue reduced the BR (Figure 1). The relationship between BR and STIR was observed in Yayota et al., (2015). Moreover, BR includes the time spent searching (locomotion, recognition and decision) and handling food (PRACHE, 1997).

The PMCR may have acted as a vertical barrier interfering with the process of bite formation and affecting BR and STIR at 30 and 45 cm (Figure 1). Barrier effects on ingestive behavior at the bite level were discussed previously by Benvenutti et al. (2009). The effect of the vertical barrier was previously observed with stems + sheaths for some plant species by Benvenutti et al. (2008). Furthermore, BR depends on the dispersion of food, which determines the encounter rate. When bites remain close, the animals may increase BR. However, if bites are farther apart (i.e., with the distribution of PMCR within a sward surface, bites can become more dispersed), animals may not increase BR because they are limited by encounter rate with acceptable bites (SEARLE et al., 2007).

The dispersion of food, due to PMCR, can bring changes in TSB (eating time per total number of bites), in which time spent on searching, especially when the height of the residue was higher (45 cm), may have been the main factor leading to a significant difference (Figure 2. A), as evidenced by the intra-meal interval duration (IMID, Figure 2. C). This occurs due to the selectivity of food, in which the TSB is related to the time spent by the animal on searching and manipulating the sward surface (Figure 2. A; PRACHE, 1997). Thus, it may not be related to BM (PRACHE, 1997; BENVENUTTI, 2006). The manipulation, in addition of mastication time, is dependent of the apprehension time, which is considered independent of BM (PARSONS et al., 1994). Furthermore, TSB is related to the gradual decrease of STIR in the treatments 30 and 45 cm (Figure 1 and 2). The STIR is determined (in addition BM) by the relationship of TSB to BR (LACA et al., 1992). Thus, more time per bite results in lower STIR (MEZZALIRA et al. 2014). Indeed, TSB can bring longer time in bite formation leading to a decrease in STIR (BENVENUTTI et al., 2009).

Another characteristic related to bites was that N-BJMR increased in the greater residue height, similar to BR (Figure 1 and 2). The animals were able to avoid PMCR, which occurred possibly due to the increased N-BJMR, mainly in the 45 cm treatment (Figure 2). The N-BJMR refers to the movements that are not identified as bites during eating time and therefore it includes movements that have a masticatory or manipulative function (AMARAL et al., 2012). Lambs use manipulative movements to maintain their foraging preferences and to avoid non-preferred items (BREMM et al., 2012). Moreover, ewe lambs exhibit great selectivity indicating acute ability to discriminate food (LACA et al., 2010).

This ability can be seen in the intra-meal interval, which is the “non-activity” or “other-activity” between two main grazing events (GIBB, 1998), in this study represented by the variable IMID (Figure 2, $p = 0{,}005$). Probably the IMID activities were the residues deviation by the animal and reorientation to a grazing site. Thus, searching activity was affected by differences in the pasture area occupied by the predecessor crop residues.

5 I CONCLUSION

Significant changes in the animal's grazing pattern can occur due to the presence of predecessor maize crop residues, influencing short-term intake rate.

This study showed that the height of the maize crop residue should not exceed 15 cm to allow higher levels of intake rate.

Predecessor soybean crop residues showed less influence in grazing patterns and short-term intake rate.

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