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Forage bromatology is affected by sowing density and cutting management in dual purpose wheat

F.L. da Silva¹, I.R. Carvalho², V.J. Szareski¹, J.R. Pimentel¹, C. Troyjack¹, F. Lautenchleger³, G.G. Conte¹, L.L. Ferreira⁴, J.A.G. da Silva², E.M. Matter², E.A. Pereira², A.V.S. Inhaquitti⁵ and V.Q. de Souza⁶

¹ Universidade Federal de Pelotas, Capão do Leão, RS, Brasil ² Universidade Regional do Noroeste do Estado do Rio Grande do Sul, Ijuí, RS, Brasil

³ Universidade Estadual Centro-oeste, Guarapuava, PR, Brasil

⁴Centro Universitário de Mineiros, Mineiros, GO, Brasil

⁵ Universidade Federal de Uberlândia, Uberlândia, MG, Brasil

⁶Universidade Federal do Pampa, São Gabriel, RS, Brasil

Corresponding author: I.R. Carvalho E-mail: carvalho.irc@gmail.com

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ABSTRACT. We evaluated the effects on the nutritional value of the forage of five genotypes of wheat with dual purpose submitted to different sowing densities, as well as different cutting managements. The experiments were carried out in the agricultural crop years of 2013 and 2014 in Frederico Westphalen, RS. The experimental design was a randomized block, organized in a factorial scheme with five genotypes of dual purpose wheat (BRS Tarumã, BRS Umbu, BRS Figueira, BRS Guatambu and BRS 277) x five sowing densities (75, 150, 225, 300 and 375 seeds per square meter) x three cutting managements (one, two and three cuttings), arranged in three replicates. The attributes of interest were obtained through the collection of all plants per experimental unit. These included percentage of crude protein, lipids, neutral detergent fiber and non-fibrous carbohydrates. The bromatological quality of forage from

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wheat with dual purpose depends on cutting management, genotype and sowing density. The maximum protein fraction and non-fibrous carbohydrates in the forage was obtained at intermediate sowing densities of 300 and 375 seeds per square meter, independent of the genotype for the largest number of cuts.

Key words: Forage wheat; Dual purpose wheat; Cutting management

INTRODUCTION

Wheat is one of the most widely cultivated cereals in the world; some genotypes have the capacity to produce both forage and grain (Szareski et al., 2016a; Koch et al., 2017). Brazil consumed 11 million tons of wheat grain in 2017 (Conab, 2018). It is traditionally produced in the Southern Region of Brazil due to the climate conditions (Jesus Junior et al., 2011; Ferrari et al., 2016a; Szareski et al., 2018). According to Meinerz (2012), the main limitations of livestock activity are the lack of forage in the cool parts of the year, which results in the reduction of milk and meat production; dual-purpose wheat can minimize the negative effects of forage scarcity (Bartmeyer, 2006; Carvalho et al., 2017), and is considered a good alternative for crop-livestock integration (Fontaneli, 2000; Szareski et al., 2016b).

Wheat intended for dual purpose requires that the management techniques be well employed and that they provide various cuttings, high forage yield and regrowth capacity (Carvalho et al., 2016a, Ferrari et al., 2016b; Gehlling et al., 2018). In order to maximize the use of the available resources in the environment, it is possible to increase the forage and grain yield, in the then optimal adjustment of the magnitude of plants in a given physical space, cutting height and mechanized management (Martin et al., 2010; Pelegrin et al., 2016). Del Duca et al. (1999) showed that winter cereals increase protein proportions due to plant arrangement and cutting management. In view of the importance and lack of information on the correct management and arrangement to be applied in dual purpose wheat genotypes, this study aimed to evaluate the effects on the nutritional value of the forage of five genotypes of wheat with dual purpose submitted to different sowing densities, as well as, cutting managements.

MATERIAL AND METHODS

The experiments were carried out in the agricultural crop years of 2013 and 2014 in Frederico Westphalen - RS, at the coordinates: Latitude 27°39'56" S and Longitude 53°42'94" W, with an altitude of 490 m. The soil is classified as Ferric Alumino Red Latosol (Oxisol) and the climate is characterized by Köppen as subtropical Cfa (Moreno, 1961). The experimental design was a randomized block, organized in a factorial scheme with five genotypes of dual purpose wheat (BRS Tarumã, BRS Umbu, BRS Figueira, BRS Guatambu and BRS 277) x five sowing densities (75, 150, 225, 300 and 375 seeds per square meter) x three cutting managements (one, two and three cuts), arranged in three replicates.

The experimental units were composed of 12 lines with two meters in length, spaced 17 centimeters, with a useful area of 4.08 m^2 . In both harvests the direct seeding

system was applied with 250 kg.ha⁻¹ of NPK 10-20-20 for base fertilizer, and 90 kg.ha⁻¹ of nitrogen in urea (45% N) for top dressing, with application performed in full tillering stage. The control of insect pests and diseases was carried out in a preventive way.

The cutting managements consisted of: one cut, two cuts, three cuts and the criterion used for the accomplishment of the cuts corresponds to 75% of the plants of the experimental unit presented average height of 30 cm, the cuts were performed manually with 10 cm of stubble. The attributes of interest were obtained through the collection of all plants per experimental unit. The evaluated characters were:

Crude protein (PTN): Measured through the methodology proposed by Nogueira and Souza (2005).

Lipids (LIP): determined by the technique proposed by Bligh and Dyer (1959).

Neutral detergent fiber (NDF): the samples were subjected to autoclaving with neutral detergent at 110°C for 40 min, followed the methodology of Senger et al. (2008).

Non-fibrous carbohydrates (NFC): following the methodology proposed by Carvalho (2015).

The data obtained were submitted to the assumptions based on the homogeneity and normality of the residual variances, after being submitted to analysis of variance at 5% probability by the F test, in order to examine the interaction between wheat genotypes with dual purpose x sowing density x cutting management. The characters that showed significant interaction were dismembered to the simple effects for the qualitative factors (dual purpose wheat genotypes and cutting managements), as well as, the quantitative factor (sowing density) was submitted to linear regression where the highest significance degree of the polynomial by the t test at 5% probability for each level of the qualitative factors. Statistical analyses were performed using the Genes software (Cruz, 2013).

RESULTSAND DISCUSSION

The analysis of variance revealed significance at 5% probability for the interaction of dual purpose wheat genotypes x sowing density x cutting management for crude protein, lipids, neutral detergent fiber and non-fibrous carbohydrates (Table 1). The PTN was expressed for the five genotypes tested (Figure 1; Table 2e; Table 6), being genotype BRS 277 submitted to one and two cuts responsible for the greater magnitudes of this character when the plants are cultivated in the density of 375 seeds/m², however, for three cuts the proportion of crude protein was increased in the density 300 seeds m².

Table 1. Summary of variance analysis for variables related to bromatology for five dual-purpose wheat genotypes under different sowing densities and cutting managements.

T 1X 7	DE	Medium Squares						
FV	DF	PTN	LIP	NDF	NFC			
Genotypes (G)	4	2.9446169*	12.8635897*	70.94854*	30.97544*			
Density (D)	4	4.7128124*	2.3463562*	12.46992*	40.57138*			
GxD	16	12.2793660*	2.9094635*	21.75466*	72.89365*			
Cutting management (C)	2	2.5734627	54.7224088*	7759.17866*	5119.60828*			
GxC	8	1.0135663*	4.6210465*	77.48841	72.14724*			
D x C	8	4.5186863*	3.8231411*	8.41616*	40.69268*			
GxDxC	32	5.8843464*	2.6066296*	20.76672*	43.72490*			
Block	2	1.5407339 ^{ns}	0.2700472 ^{ns}	0.43469 ^{ns}	0.19283 ^{ns}			
Residue	148	0.7574066	0.4949281	2.66339	5.05567			
CV (%)		14.04	16.73	2.99	8.40			

* and ns, significant at 5% probability and not significant, respectively. PTN = protein; NDF = neutral detergent fiber; NFC = non-fibrous carbohydrates.

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Figure 1. Crude protein at different sowing densities and under cutting managements for five dual-purpose wheat genotypes.

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Figure 2. Lipids at different sowing densities and cutting managements for five dual-purpose wheat genotypes.

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PTN			
Couving domaiter	BRS 277		
Sowing density	1	2	3
75	5.25 Aβ ¹	5.83 Ααβ	4.58 Αβ
150	6.61 Aa	5.05 By	6.55 Αβ
225	3.25 By	5.14 Αγδ	5.55 Αβ
300	5.78 Ba	5.55 ABB	7.14 Αα
375	8.94 Αβ	7.92 Aa	6.42 Βαβ
Que to a tomation	BRS FIGUEIRA		
Sowing density	1	2	3
75	7.63 Αα	7.18 ABα	5.95 Ββ
150	6.62 Ba	8.53 Aa	7.42 ΑΒαβ
225	4.04 Βγ	4.49 Βδ	6.39 Ααβ
300	5.83 Ba	7.36 Αα	6.67 ABa
375	6.29 Ay	4.49 Βγ	5.04 Abβ
Source density	BRS GUATAMBU	U	
Sowing density	1	2	3
75	2.37 Βγ	6.42 Ααβ	5.29 Αβ
150	6.63 Aa	7.18 Ααβ	5.16 Ββγ
225	8.88 Aa	7.29 ΑΒβ	7.63 Αα
300	5.84 Aa	4.94 ΑΒβ	3.82 Bβ
375	6.29 Ay	5.84 Αβγ	6.11 Αβ
Source density	BRS TARUMÃ		
Sowing density	1	2	3
75	8.19 Aa	5.69 Bβ	7.22 Αα
150	5.97 Αα	6.53 Αβ	5.14 Αγ
225	5.97 Αβ	6.53 Ay	5.14 Ααβ
300	5.97 Aa	5.83 Ααβ	6.44 Αα
375	6.33 Ay	7.50 Αα	3.67 Ββ
Sowing density	BRS UMBU		
Sowing density	1	2	3
75	6.11 Αβ	5.97 Ααβ	6.94 Ααβ
150	5.61 Aa	5.97 Αβγ	6.78 Ααβ
225	6.44 Ββ	10.58 Aa	5.28 Βαβ
300	5.42 Αα	5.00 Αβ	4.75 Αβ
375	12.34 Aα	6.11 CB	7.63 α

Table 2. Percentage of crude protein (PTN) for five dual-purpose wheat genotypes under different sowing densities and cutting managements.

(1) First cut, (2) Second cut, (3) Third cut.¹ Means followed by the same capital letter in the row at each sowing density for each cultivar and the same Greek letter in the columns at each sowing density for each cut do not differ from each other by the t test at the 5% probability level.

For the LIP character genotype BRS 277 expressed the highest magnitudes when grown in the density of 150 seeds/m², as well, submitted to management with two and three cuts, when this genotype is submitted to one cut management, arrangements are obtained with 75 seeds/m² (Table 3, Figure 2e, Table 6). BRS Figueira showed that management with a cut in density of 375 seeds/m², management with two cuts in density of 225 seeds/m² and three cuts in the density of 75 seeds/m² (Table 3, Figure 2c, Table 6), expressed superiority for the accumulation of lipids in the forage produced.

BRS Guatambu submitted to management with two and three cuts was specific for the cultivation in the density of 225 seeds/m², but when it is only a cut, it is recommended to use 375 seeds/m² (Table 3, Figure 2d, Table 6). BRS Tarumã genotype grown at the density of 300 and 375 seeds/m² (Table 3, Figure 2a, Table 6) potentiates the magnitude in the cutting managements. Studies by Thacker and Widyaratne (2007), determined that the lipid fraction of the forage can be 1.4%.



Figure 3. Neutral detergent fiber at different sowing densities under cutting managements for five dual-purpose wheat genotypes.

The NDF showed that the genotype BRS 277 submitted to the management of a cut potentiated this character in the density of 225 seeds/m², for the management with two cuts this was specific for the density of 75 seeds/m2 and with three cuts greater effects were expressed in the 375 m² seed arrangements (Table 4, Figure 3e, Table 6). The fibrous proportions in forage

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are constituted of slow digestive structural carbohydrates, being necessary to weigh the food ingested, chewing, salivation and rumination (Branco et al., 2011; Carvalho et al., 2016b).

Table 3. Percentage of lipids (LIP) for five dual-purpose wheat genotypes under different sowing densities and cutting managements.

Sowing density BRS 277 1 75 7.29 Bα ¹ 150 5.43 Bαβ	2 4.82 Αα 6.99 Αα 4.29 ΑΒβ 4.18 Βαβ 2.14 Cγ	3 4.04 Αα 4.32 Βαβ 3.68 Ββ 4.21 ΑΒαβ	
Sowing density 1 75 7.29 Bα ¹ 150 5.43 Bαβ	2 4.82 Αα 6.99 Αα 4.29 ΑΒβ 4.18 Βαβ 2.14 Cγ	3 4.04 Αα 4.32 Βαβ 3.68 Ββ 4.21 ΑΒαβ	
75 7.29 Bα ¹ 150 5.43 Bαβ	4.82 Αα 6.99 Αα 4.29 ΑΒβ 4.18 Βαβ 2.14 Cγ	4.04 Αα 4.32 Βαβ 3.68 Ββ 4.21 ΑΒαβ	
150 5.43 Βαβ	6.99 Αα 4.29 ΑΒβ 4.18 Βαβ 2.14 Cγ	4.32 Βαβ 3.68 Ββ 4.21 ΑΒαβ	
	4.29 ΑΒβ 4.18 Βαβ 2.14 Cγ	3.68 Ββ 4.21 ΑΒαβ	
225 4.97 Αα	4.18 Βαβ 2.14 Cγ	4.21 ΑΒαβ	
300 5.33 Aα	2.14 Cy		
375 6.61 Aα		3.35 Βαβ	
BRS FIGU	JEIRA		
Sowing density 1	2	3	
75 4.33 Αβγ	4.04 Ααβ	3.57 Αα	
150 5.82 Aα	3.58 Bβ	3.55 Bβ	
225 5.22 Αα	4.15 Aβ	2.44 By	
300 4.59 Aα	3.53 ABβ	2.52 BB	
375 6.07 Αα	3.57 Bβ	1.22 Cy	
BRS GUA	TAMBU	·	
Sowing density 1	2	3	
75 5.11 Αβ	2.33 Cy	3.63 Ba	
150 5.89 Aα	3.75 Bβ	5.12 Αα	
225 4.47 Βαβ	5.48 ABa	6.43 Aa	
300 5.08 Aα	4.19 Ααβ	4.35 Αα	
375 6.51 Aα	5.27 Βαβ	4.17 Βα	
Saming density BRS TAR	UMÃ		
Sowing density 1	2	3	
75 3.89 Αγ	3.62 ABβ	2.54 Ββ	
150 4.39 Αβ	4.29 Αβ	2.95 Ββγ	
225 4.55 Aα	3.58 ABβ	2.70 Ββγ	
300 5.24 Aα	5.24 Aa	3.76 Βαβ	
375 3.96 Bβ	6.26 Aa	1.24 Cy	
BRS UME	U		
Sowing density 1	2	3	
75 3.29 Αγ	1.77 Bγ	3.88 Aa	
150 5.64 Aα	3.81 Bβ	2.11 Cγ	
225 3.63 Αβ	3.20 Aβ	3.61 Aß	
300 4.99 Aα	3.54 Bβ	3.27 Bβ	
375 5.49 Aα	4.27 Ββ	2.79 Cβ	

(1) First cut, (2) Second cut, (3) Third cut.¹ Means followed by the same capital letter in the row at each sowing density for each cultivar and the same Greek letter in the columns at each sowing density for each cut do not differ from each other by the t test at the 5% probability level.

BRS Figueira genotype with a cut obtained higher magnitude for the NDF content when grown at 75 seeds/m² and submitted to two-cut management (Table 4, Figure 3c, Table 6). The excess of neutral detergent fiber in the forage chemical composition may interfere with forage intake by ruminants, thus limiting the consumption and growth of the animal (Branco et al., 2011). For BRS Guatambu genotype with one and three cuts greater accumulations of fiber occur in crops using 375 m² seeds, however, it is possible to reduce sowing density to 300 seeds/m² (Table 4, Figure 3d, Table 6) when the recommended management is two cuts.

The genotype BRS Tarumã presented different ideal sowing densities for each cut management. With a cut, the highest magnitude in the density of 225 seeds/m², with two cuts the greatest magnitude for the character of NDF was revealed using the density of 300 seeds/m² and for the management with three cuts, in the density of 75 seeds/m², it was obtained the greater magnitude (Table 4, Figure 3a, Table 6). The increase of the fibers in the second and third cuttings in relation to the first one confirms the statements of Blaser (1964), where the advancement of the phenological stages of development of the plant potentiate the accumulation of fibers, cellulose and lignin. Research by Henz et al. (2016), when evaluating the bromatological performance of dual-purpose wheat, stated that the increase in crude protein results in the decrease of non-fibrous carbohydrates, where the neutral detergent fibers are fundamental for animal consumption and performance.

	NI	DF		
	BRS 277			
Sowing density	1	2	3	
75	41.70 $B\beta^{1}$	59.73 Αα	61.57 Αβγ	
150	42.80 Cβ	57.99 Ββγ	61.72 Ay	
225	47.09Ca	56.02 Bβ	60.96 Aβ	
300	45.77 Cα	55.36 By	61.94 Αα	
375	44.94 Cαβ	56.89 Bβ	62.14 Αβ	
Coursing demoites	BRS FIGUEIRA	•	·	
Sowing density	1	2	3	
75	44.19 Βαβ	59.12 Αα	59.12 Αγ	
150	43.00 CB	59.41 Bβ	68.23 Aa	
225	42.55 Bβ	62.45 Αα	64.41 Ααβ	
300	43.61 Ca	53.03 By	61.61 Ααβ	
375	44.06 Cβ	57.69 Bβ	60.53 Aβ	
Continue to activ	BRS GUATAMBU			
Sowing density	1	2	3	
75	40.50 CB	55.74 Ββ	63.84 Αβγ	
150	43.21 Cβ	55.99 Bγ	60.98 Ay	
225	44.09 Ββ	57.97 Αβ	57.97 Ay	
300	43.93 Ca	58.40 Bβ	63.54 Aa	
375	47.24 Cα	57.48 Bβ	64.22 Ααβ	
Servine densites	BRS TARUMÃ			
Sowing density	1	2	3	
75	39.62 Cβ	54.84 Bβ	67.33 Αα	
150	38.71 Cy	51.13 Bδ	65.51 Aβ	
225	46.93 Ca	49.58 Βγ	66.24 Aa	
300	38.52 Cβ	55.27 By	59.01 Αβ	
375	40.35 Cy	51.34 By	66.05 Aa	
C in the lite	BRS UMBU			
Sowing density	1	2	3	
75	42.26 Cαβ	57.83 Ba	61.17 Ay	
150	46.05 Ba	62.38 Aa	63.60 Αβγ	
225	39.10 By	61.22 Αα	62.88 Aβ	
300	44.55 Ba	63.54 Αα	63.06 Aa	
375	45.27 Βαβ	64.89 Aa	65.17 Ag	

Table 4. Percentage of neutral detergent fiber (NDF) for five dual-purpose wheat genotypes at different sowing densities and cutting managements.

(1) First cut, (2) Second cut, (3) Third cut.¹ Means followed by the same capital letter in the row at each sowing density for each cultivar and the same Greek letter in the columns at each sowing density for each cut do not differ from each other by the t test at the 5% probability level.

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The NFC show that the genotype BRS 277 when submitted to a cut, potentiate the magnitude of this character in the arrangement of 150 seeds/m², for two cuttings better results are obtained through the density of 225 seeds/m², for three cuts this bromatological aspect may be maximized by growing at the density of 75 seeds/m² (Table 5, Figure 4e, Table 6).



Figure 4. Non-fibrous carbohydrates at different sowing densities and under cutting managements for five dualpurpose wheat genotypes.

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The genotype BRS Figueira submitted to the two and three cut management obtained the highest magnitudes in the density of 375 seeds m^2 , but for a cut the optimal density was 225 seeds/m² (Table 5, Figure 4c, Table 6). Research indicates that high proportions of non-fibrous carbohydrates confer good forage quality and rapid digestibility by ruminants (Mertens, 1987).

Table 5.	Percentage	of non-fibrous	carbohydrates	(NFC)	for five	dual-purpose	wheat	genotypes	under
different	sowing dens	ities and cutting	managements.						

Sowing density BRS 277 1.0 2.0 3.0 75.0 32.97 Ås ¹ 24.04 Bβ 22.22 Baβ 150.0 36.92 Åa 25.35 Ba 20.57 Caβ 225.0 34.55 Åγ 30.08 Ba 21.69 Cβ 300.0 35.55 Åβ 22.69 Baβ 13.93 Cβ 375.0 33.94 Åβ 27.72 Baβ 21.25 Cβγ Sowing density I.0 2.0 3.0 75.0 35.34 Åyδ 21.89 Bβ 24.21 Baβ 150.0 35.34 Åyδ 21.89 Bβ 24.21 Baβ 150.0 35.67 Åβ 25.30 Ba 23.02 Ba 300.0 35.67 Åβ 25.30 Ba 23.02 Ba 375.0 31.31 Åβ 28.93 Aa 29.13 Aa Sowing density I.0 2.0 3.0 75.0 44.63 Aa 27.22 Baβ 20.96 Cβ 150.0 30.25 Aδ 19.54 Cβ 25.36 Ba 205.0 30.25 Aδ 19.54 Cβ 25.36 Ba 300.0 33.17 Åβ 24.13 Bβ		NFC		
Sowing density 1.0 2.0 3.0 75.0 32.97 Åδ ¹ 24.04 Bβ 22.22 Bαβ 150.0 36.92 Åa 25.35 Ba 20.57 Cαβ 225.0 34.55 Åγ 30.30 Ba 21.69 Cβ 300.0 35.55 Åβ 22.69 Bαβ 13.93 Cβ 375.0 33.94 Åβ 27.72 Bαβ 21.25 Cβγ Sowing density BRS FIGUEIRA	<u> </u>	BRS 277		
75.0 $32.97 \ A \delta^1$ $24.04 \ B \beta$ $22.22 \ B \alpha \beta$ 150.0 $36.92 \ A \alpha$ $25.35 \ B \alpha$ $20.57 \ C \alpha \beta$ 300.0 $35.55 \ A \beta$ $22.69 \ B \alpha \beta$ $13.93 \ C \beta$ 300.0 $35.55 \ A \beta$ $22.69 \ B \alpha \beta$ $13.93 \ C \beta$ 375.0 $33.94 \ A \beta$ $27.72 \ B \alpha \beta$ $21.25 \ C \beta \gamma$ Sowing density BRS FIGUEIRA 10 2.0 3.0 75.0 $35.34 \ A \gamma \delta$ $21.89 \ B \beta$ $24.21 \ B \alpha \beta$ 225.0 $39.49 \ A \alpha$ $15.00 \ B \beta$ $14.82 \ B \gamma$ 225.0 $39.49 \ A \beta$ $20.68 \ B \beta$ $20.31 \ B \beta$ 300.0 $35.67 \ A \beta$ $25.30 \ B \alpha$ $23.02 \ B \alpha$ 375.0 $31.31 \ A \beta$ $28.93 \ A \alpha$ $29.13 \ A \alpha$ Sowing density $BRS \ GUATAMBU$ 1.0 2.0 3.0 50.0 $36.12 \ A \alpha$ $23.57 \ B \alpha$ $21.04 \ B \alpha \beta$ 300.0 $32.51 \ A \beta$ $23.90 \ B \alpha \beta$ $20.66 \ B \alpha$ 375.0 $30.25 \ A \delta$ $19.54 \$	Sowing density	1.0	2.0	3.0
150.0 $36.92 Aa$ $25.35 Ba$ $20.57 Ca\beta$ 225.0 $34.55 A\gamma$ $30.00 Ba$ $21.69 C\beta$ 300.0 $35.55 A\beta$ $22.69 Ba\beta$ $21.39 C\beta$ 375.0 $33.94 A\beta$ $27.72 Ba\beta$ $21.25 C\beta\gamma$ Sowing density $BRS FIGUEIRA$	75.0	32.97 Aδ ¹	24.04 Bβ	22.22 Βαβ
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	150.0	36.92 Aa	25.35 Βα	20.57 Cαβ
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	225.0	34.55 Ay	30.30 Ba	21.69 CB
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	300.0	35.55 Αβ	22.69 Βαβ	13.93 Cβ
Sowing density BRS FIGUEIRA 1.0 2.0 3.0 75.0 35.34 Aγδ 21.89 Bβ 24.21 Bαβ 150.0 35.34 Aγδ 21.89 Bβ 24.21 Bαβ 225.0 39.49 Aβ 20.68 Bβ 20.31 Bβ 300.0 35.67 Aβ 25.30 Bα 23.02 Bα 375.0 31.31 Aβ 28.93 Aα 29.13 Aα Sowing density 1.0 2.0 3.0 75.0 44.63 Aα 27.22 Bαβ 20.96 Cβ 150.0 36.12 Aα 23.57 Bα 21.04 Bαβ 225.0 30.25 Aδ 19.54 Cβ 25.36 Bα 300.0 34.51 Aβ 23.90 Bαβ 20.63 Bα 375.0 31.7 Aβ 24.13 Bβ 17.99 Cγ Sowing density I.0 2.0 3.0 75.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 36.74 Aγ 22.99	375.0	33.94 Aβ	27.72 Βαβ	21.25 Cβγ
Sowing density 1.0 2.0 3.0 75.0 $35.34 A\gamma\delta$ $21.89 B\beta$ $24.21 B\alpha\beta$ 150.0 $37.69 A\alpha$ $15.00 B\beta$ $14.82 B\gamma$ 225.0 $39.49 A\beta$ $20.68 B\beta$ $20.31 B\beta$ 300.0 $35.67 A\beta$ $25.30 B\alpha$ $23.02 B\alpha$ 375.0 $31.31 A\beta$ $28.93 A\alpha$ $29.13 A\alpha$ Sowing density Interpretation Interpretation Interpretation 75.0 $44.63 A\alpha$ $27.22 B\alpha\beta$ $20.96 C\beta$ 150.0 $36.12 A\alpha$ $23.57 B\alpha$ $21.04 B\alpha\beta$ 225.0 $30.25 A\delta$ $19.54 C\beta$ $22.5.6 B\alpha$ 300.0 $34.51 A\beta$ $23.90 B\alpha\beta$ $20.65 B\alpha$ 300.0 $34.51 A\beta$ $23.90 B\alpha\beta$ $20.63 B\alpha$ 375.0 $30.76 A\alpha$ $22.99 A\beta$ $12.58 C\gamma$ Sowing density Interpretation Interpretation Interpretation 10 2.0 3.0 30.0 Interpretation 300.0	Service develtes	BRS FIGUEIRA		
75.0 $35.34 A\gamma\delta$ $21.89 B\beta$ $24.21 B\alpha\beta$ 150.0 $37.69 A\alpha$ $15.00 B\beta$ $14.82 B\gamma$ 225.0 $39.49 A\beta$ $20.68 B\beta$ $20.31 B\beta$ 300.0 $35.67 A\beta$ $25.30 B\alpha$ $23.02 B\alpha$ 375.0 $31.31 A\beta$ $28.93 A\alpha$ $29.13 A\alpha$ Sowing density $BRS GUATAMBU$ 2.0 3.0 75.0 $44.63 A\alpha$ $27.22 B\alpha\beta$ $20.96 C\beta$ 150.0 $36.12 A\alpha$ $23.57 B\alpha$ $21.04 B\alpha\beta$ 225.0 $30.25 A\delta$ $19.54 C\beta$ $25.36 B\alpha$ 300.0 $34.51 A\beta$ $23.90 B\alpha\beta$ $20.63 B\alpha$ 375.0 $33.17 A\beta$ $24.13 B\beta$ $17.99 C\gamma$ Sowing density $BRS TARUM \tilde{A}$ $22.99 A\beta$ $12.58 C\gamma$ 25.0 $33.29 A\gamma$ $31.95 A\alpha$ $18.53 B\beta$ 300.0 $42.06 A\alpha$ $25.06 B\alpha$ $22.54 B\alpha$ 375.0 $41.16 A\alpha$ $25.91 B\alpha\beta$ $22.89 B\beta$ 50.0 <	Sowing density	1.0	2.0	3.0
150.0 $37.69 Åα$ $15.00 Bβ$ $14.82 Bγ$ 225.0 $39.49 Åβ$ $20.68 Bβ$ $20.31 Bβ$ 300.0 $35.67 Åβ$ $25.30 Bα$ $23.02 Bα$ 375.0 $31.31 Åβ$ $28.93 Åα$ $29.13 Åα$ Sowing density $BRS GUATAMBU$ 2.0 3.0 75.0 $44.63 Åα$ $27.22 Bαβ$ $20.96 Cβ$ 150.0 $36.12 Åa$ $23.57 Ba$ $21.04 Baβ$ 225.0 $30.25 Åδ$ $19.54 Cβ$ $25.36 Ba$ 300.0 $34.51 Åβ$ $23.90 Baβ$ $20.63 Ba$ 375.0 $33.17 Åβ$ $24.13 Bβ$ $17.99 Cγ$ Sowing density BRS TARUMÃ 1.0 2.0 3.0 75.0 $36.74 Å\gamma$ $22.99 Åβ$ $12.58 Cγ$ 150.0 $36.74 A\gamma$ $22.99 Åβ$ $12.58 Cγ$ 25.0 $33.92 Å\gamma$ $31.95 Åa$ $18.53 Bβ$ 300.0 $42.06 Aa$ $25.06 Ba$ $22.54 Ba$ 375.0 $41.16 Aa$ $25.91 Baβ$ 2	75.0	35.34 Αγδ	21.89 Bβ	24.21 Βαβ
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	150.0	37.69 Aa	15.00 Bβ	14.82 By
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	225.0	39.49 Αβ	20.68 Bβ	20.31 Bβ
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	300.0	35.67 Αβ	25.30 Ba	23.02 Ba
Sowing density BRS GUATAMBU 1.0 2.0 3.0 75.0 44.63 Aa 27.22 Baβ 20.96 Cβ 150.0 36.12 Aa 23.57 Ba 21.04 Baβ 225.0 30.25 Aδ 19.54 Cβ 25.36 Ba 300.0 34.51 Aβ 23.90 Baβ 20.63 Ba 375.0 33.17 Aβ 24.13 Bβ 17.99 Cγ Sowing density BRS TARUMÃ 1.0 2.0 3.0 75.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 255.0 33.92 Aγ 31.95 Aa 18.53 Bβ 300.0 42.06 Aa 25.06 Ba 22.54 Ba 375.0 41.16 Aa 25.91 Baβ 22.54 Ba 375.0 41.16 Aa 25.91 Baβ 22.54 Ba Sowing density 1.0 2.0 3.0 75.0 40.99 Aβ 27.85 Ba 25.04 Ba 150.0 35.80 Aa 14.54 Cβ 19.59 Bβ 225.0 43.52 Aa	375.0	31.31 Aβ	28.93 Αα	29.13 Αα
Sowing density 1.0 2.0 3.0 75.0 44.63 Aa 27.22 Baβ 20.96 Cβ 150.0 36.12 Aa 23.57 Ba 21.04 Baβ 225.0 30.25 Aδ 19.54 Cβ 25.36 Ba 300.0 34.51 Aβ 23.90 Baβ 20.63 Ba 375.0 33.17 Aβ 24.13 Bβ 17.99 Cγ Sowing density BRS TARUMÃ 1.0 2.0 3.0 75.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 50.0 36.74 Aγ 22.99 Aβ 16.42 Cγ 225.0 225.0 33.92 Aγ 31.95 Aa 18.53 Bβ 300.0 300.0 42.06 Aa 25.06 Ba 22.54 Ba 375.0 41.16 Aa 25.91 Baβ 22.54 Ba 375.0 41.16 Aa 25.91 Baβ 22.54 Ba 25.91 Baβ 22.54 Ba Sowing density I.0 2.0 3.0 3.0 3.0 3.0 75.0 40.99 Aβ 27.85 Ba 25.04 Ba 25.04 Ba 150.0 35.80 Aa	Service develtes	BRS GUATAMBU		
75.0 44.63 Aα 27.22 Bαβ 20.96 Cβ 150.0 36.12 Aα 23.57 Bα 21.04 Bαβ 225.0 30.25 Aδ 19.54 Cβ 25.36 Bα 300.0 34.51 Aβ 23.90 Bαβ 20.63 Bα 375.0 33.17 Aβ 24.13 Bβ 17.99 Cγ Sowing density BRS TARUMĀ 20.0 3.0 75.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 37.66 Aα 24.99 Bα 16.42 Cγ 225.0 33.92 Aγ 31.95 Aα 18.53 Bβ 300.0 42.06 Aα 25.06 Bα 22.54 Bα 375.0 41.16 Aα 25.91 Bαβ 22.89 Bβ Sowing density I.0 2.0 3.0 75.0 40.99 Aβ 27.85 Bα 25.04 Bα 375.0 41.16 Aα 25.91 Bαβ 22.89 Bβ Sowing density I.0 2.0 3.0 75.0 40.99 Aβ 27.85 Bα 25.04 Bα 150.0 35.80 Aα 14.54 Cβ 19.59 Bβ	Sowing density	1.0	2.0	3.0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	75.0	44.63 Αα	27.22 Βαβ	20.96 Cβ
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	150.0	36.12 Aa	23.57 Ba	21.04 Βαβ
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	225.0	30.25 Aδ	19.54 Cβ	25.36 Ba
$\begin{array}{c c c c c c c c c c c c c c c c c c c $	300.0	34.51 Αβ	23.90 Βαβ	20.63 Βα
BRS TARUMĀ I.0 2.0 3.0 75.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 37.66 Aa 24.99 Ba 16.42 Cγ 225.0 33.92 Aγ 31.95 Aa 18.53 Bβ 300.0 42.06 Aa 25.06 Ba 22.54 Ba 375.0 41.16 Aa 25.91 Baβ 22.89 Bβ Sowing density 1.0 2.0 3.0 75.0 40.99 Aβ 27.85 Ba 25.04 Ba 150.0 35.80 Aa 14.54 Cβ 19.59 Bβ 225.0 43.52 Aa 14.60 Cγ 20.97 Bβ 300.0 32.87 Aβ 20.41 Bβ 20.91 Ba	375.0	33.17 Aβ	24.13 Bβ	17.99 Cγ
Sowing density 1.0 2.0 3.0 75.0 36.74 Aγ 22.99 Aβ 12.58 Cγ 150.0 37.66 Aα 24.99 Bα 16.42 Cγ 225.0 33.92 Aγ 31.95 Aα 18.53 Bβ 300.0 42.06 Aα 25.06 Bα 22.54 Bα 375.0 41.16 Aα 25.91 Bαβ 22.89 Bβ Sowing density 75.0 40.99 Aβ 27.85 Bα 25.04 Bα 150.0 35.80 Aα 14.54 Cβ 19.59 Bβ 225.0 43.52 Aα 14.60 Cγ 20.97 Bβ 375.0 43.52 Aα 14.60 Cγ 20.97 Bβ 300.0 32.87 Aβ 20.41 Bβ 20.91 Bα 375.0 26.51 Aγ 19.30 Bγ 18.11 Bγ	Corring density	BRS TARUMÃ		
75.0 36.74 Ay 22.99 A\beta 12.58 Cy 150.0 37.66 Aa 24.99 Ba 16.42 Cy 225.0 33.92 Ay 31.95 Aa 18.53 B\beta 300.0 42.06 Aa 25.06 Ba 22.54 Ba 375.0 41.16 Aa 25.91 Ba\beta 22.89 B\beta Sowing density 1.0 2.0 3.0 75.0 40.99 A\beta 27.85 Ba 25.04 Ba 150.0 35.80 Aa 14.54 C\beta 19.59 B\beta 225.0 43.52 Aa 14.60 Cy 20.97 B\beta 20.0 32.87 A\beta 20.41 B\beta 20.91 Ba 375.0 26.51 Ay 19.30 By 18.11 By	Sowing density	1.0	2.0	3.0
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	75.0	36.74 Ay	22.99 Αβ	12.58 Cy
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	150.0	37.66 Aa	24.99 Βα	16.42 Cy
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	225.0	33.92 Ay	31.95 Αα	18.53 Bβ
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	300.0	42.06 Αα	25.06 Βα	22.54 Βα
BRS UMBU 2.0 3.0 75.0 40.99 Aβ 27.85 Bα 25.04 Bα 150.0 35.80 Aα 14.54 Cβ 19.59 Bβ 225.0 43.52 Aα 14.60 Cγ 20.97 Bβ 300.0 32.87 Aβ 20.41 Bβ 20.91 Bα 375.0 26.51 Aγ 19.30 Bγ 18.11 Bγ	375.0	41.16 Αα	25.91 Βαβ	22.89 Bβ
Sowing density1.02.03.075.0 $40.99 \ A\beta$ $27.85 \ B\alpha$ $25.04 \ B\alpha$ 150.0 $35.80 \ A\alpha$ $14.54 \ C\beta$ $19.59 \ B\beta$ 225.0 $43.52 \ A\alpha$ $14.60 \ C\gamma$ $20.97 \ B\beta$ 300.0 $32.87 \ A\beta$ $20.41 \ B\beta$ $20.91 \ B\alpha$ 375.0 $26.51 \ A\gamma$ $19.30 \ B\gamma$ $18.11 \ B\gamma$	Corring density	BRS UMBU		
75.040.99 Aβ27.85 Bα25.04 Bα150.035.80 Aα14.54 Cβ19.59 Bβ225.043.52 Aα14.60 Cγ20.97 Bβ300.032.87 Aβ20.41 Bβ20.91 Bα375.026.51 Aγ19.30 Bγ18.11 Bγ	Sowing density	1.0	2.0	3.0
150.035.80 Åα14.54 Cβ19.59 Bβ225.043.52 Åα14.60 Cγ20.97 Bβ300.032.87 Åβ20.41 Bβ20.91 Bα375.026.51 Åγ19.30 Bγ18.11 Bγ	75.0	40.99 Αβ	27.85 Βα	25.04 Βα
225.0 43.52 Aα 14.60 Cγ 20.97 Bβ 300.0 32.87 Aβ 20.41 Bβ 20.91 Bα 375.0 26.51 Aγ 19.30 Bγ 18.11 Bγ	150.0	35.80 Aa	14.54 Cβ	19.59 Bβ
300.0 32.87 Aβ 20.41 Bβ 20.91 Bα 375.0 26.51 Aγ 19.30 Bγ 18.11 Bγ	225.0	43.52 Αα	14.60 Cγ	20.97 Bβ
375.0 26.51 Αγ 19.30 Βγ 18.11 Βγ	300.0	32.87 Αβ	20.41 Bβ	20.91 Ba
	375.0	26.51 Ay	19.30 By	18.11 By

(1) First cut, (2) Second cut, (3) Third cut.¹ Means followed by the same capital letter in the row at each sowing density for each cultivar and the same Greek letter in the columns at each sowing density for each cut do not differ from each other by the t test at the 5% probability level.

The genotype BRS Guatambu submitted to one and two cuts showed that the density of 75 seeds/m² increased this character, for three cuts this genotype obtained greater magnitude when grown with 225 seeds/m² (Table 5, Figure 4a, Table 6). BRS Tarumã intended for a cut can maximize this character through the density of 300 seeds m², in two cuts it indicates 225 seeds/m² and three cuts should increase this item to 375 seeds/m² (Table 5, Figure 4a, Table 6). This study is essential for the maximization of the bromatological quality of the forage obtained through dual purpose wheat genotypes, since the genetic specificity of the characteristics of the genotypes reflects in the peculiarities of the adjustment of the optimum sowing density and the number of cuts to be used so that the forage production system is sustainable.

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Table	6.	Equations	for	nutritional	values	of	five	dual-purpose	wheat	genotypes	at	different	sowing
densiti	es a	and cutting	man	agements.									

Trait	Cuts	Genotypes	Equations	
NFC	1	BRS Tarumã	$\hat{Y} = -22.8 + 1.54x - 0.01x^2 + 0.00004x^3 - 0.0000000x^4 R^2 = 0.92$	
NFC	2	BRS Tarumã	$\hat{Y} = 85.13 - 1.65x + 0.01x^2 - 0.00004x^3 + 0.00000005x^4 R^2 = 0.62$	
NFC	3	BRS Tarumã	$\hat{Y} = 10.5 + 0.03x R^2 = 0.73$	
NFC	1	BRS Umbu	$\hat{Y} = 143.9 - 2.58x + 0.02x^2 - 0.00006x^3 + 0.0000001x^4 R^2 = 0.88$	
NFC	2	BRS Umbu	$\hat{Y} = 66.1 - 0.71x + 0.003x^2 - 0.000009x^3 R^2 = 0.82$	
NFC	3	BRS Umbu	$\hat{Y} = 40.0 - 0.28x + 0.001x^2 - 0.000001x^3 R^2 = 0.78$	
NFC	1	BRS Figueira	$\hat{Y} = 29.4 \pm 0.09x - 0.0002x^2 R^2 = 0.84$	
NFC	2	BRS Figueira	$\hat{Y} = 44.0 - 0.43x + 0.0021x^2 - 0.000002x^3R^2 = 0.80$	
NEC	3	BRS Figueira	$\hat{Y} = 89.9 - 1.51x + 0.01x^2 - 0.00003x^3 - 0.00000003x^4 R^2 = 0.88$	
NEC	1	BRS Guatambu	$\hat{Y} = 25.1 \pm 0.65x - 0.007x^2 \pm 0.00002x^3 - 0.00000003x^4 R^2 = 0.97$	
NEC	2	BRS Guatambu	$\hat{Y} = 33.5 - 0.10x + 0.0002x^2 R^2 = 0.45$	
NEC	3	BRS Guatambu	$\hat{Y} = 62.7 - 1.08x + 0.009x^2 - 0.00002x^3 + 0.00000003x^4 R^2 = 0.63$	
NEC	1	BRS 277	$\hat{V} = 34.6$	
NEC	2	BRS 277	$\hat{\mathbf{Y}} = 84.0 \pm 1.60 \mathbf{x} \pm 0.01 \mathbf{x}^2 \pm 0.00004 \mathbf{x}^3 \pm 0.00000005 \mathbf{x}^4 \mathbf{R}^2 = 0.55$	
NEC	3	BRS 277	$\hat{\mathbf{Y}} = 73.9 \pm 1.35 \mathbf{x} \pm 0.01 \mathbf{x}^2 \pm 0.0000 \mathbf{x}^3 \pm 0.00000005 \mathbf{x}^4 \mathbf{R}^2 \pm 0.67$	
EDN	1	DRS 277 DDS Torumã	$\hat{V} = 128 \ 1 - 2.28 \ x + 0.01 \ x^2 - 0.00005 \ x^3 + 0.0000001 \ x^4 \ P^2 = 0.04$	
EDN	2	DRS Tatulla	$\hat{\mathbf{Y}}_{-72,2} = 0.25 \text{ m} + 0.001 \text{ m}^2 = 0.000000 \text{ m}^3 \text{ m}^2 = 0.42$	
FDN	2	BKS Taruma	$\hat{\mathbf{Y}} = 73.2 - 0.35\mathbf{X} + 0.001\mathbf{X} - 0.000002\mathbf{X}^{2} \mathbf{K} = 0.45$ $\hat{\mathbf{Y}} = 115.0 - 1.24\pi + 0.01\pi^{2} - 0.00002\pi^{3} + 0.0000000\pi^{4} \mathbf{P}^{2} - 0.82$	
FDN	3	BKS Taruma	$\hat{\mathbf{Y}} = 115.0 - 1.24 \hat{\mathbf{X}} + 0.01 \hat{\mathbf{X}} - 0.00003 \hat{\mathbf{X}} + 0.0000000 \hat{\mathbf{X}} \hat{\mathbf{K}} = 0.82$	
FDN	1	BRS Umbu	$Y = -35.6 + 1.94X - 0.01X^{2} + 0.00004X^{2} + 0.00000005X^{2}K^{2} = 0.56$	
FDN	2	BRS Umbu	Y = 42.0	
FDN	3	BRS Umbu	$Y = 53.9 + 0.14x - 0.0006x^2 + 0.000001x^3 R^2 = 0.72$	
FDN	1	BRS Figueira	$Y = 45.7 - 0.02x + 0.0000006x^2 R^2 = 0.35$	
FDN	2	BRS Figueira	$Y = 118.5 - 1.58x + 0.01x^{2} - 0.00004x^{3} + 0.0000001x^{4} R^{2} = 0.87$	
FDN	3	BRS Figueira	$Y = 33.7 + 0.48x - 0.002x^2 + 0.000002x^3 R^2 = 0.79$	
FDN	1	BRS Guatambu	$Y = 32.1 + 0.15x - 0.0007x^2 + 0.000001x^3 R^2 = 0.91$	
FDN	2	BRS Guatambu	$Y = 55.3 + 0.007 x R^2 = 0.27$	
FDN	3	BRS Guatambu	$Y = 35.5 + 0.79x - 0.007x^2 + 0.00002x^3 + 0.0000003x^4 R^2 = 0.91$	
FDN	1	BRS 277	$\hat{Y} = 67.4 - 0.67x + 0.005x^2 - 0.00001x^3 + 0.0000002x^4 R^2 = 0.88$	
FDN	2	BRS 277	$\hat{Y} = 59.6 - 0.01 \text{ x } \text{ R}^2 = 0.26$	
FDN	3	BRS 277	$\hat{Y} = 61.2$	
LID	1	DDC T~~	$\hat{\mathbf{y}} = 2.5 \pm 0.01 \text{m} = 0.00003 \text{m}^2 \text{R}^2 = 0.32$	
LIP	1	BRS Taruma	I = 2.5 + 0.01 - 0.00005 $I = 0.52$	
LIP LIP	2	BRS Taruma BRS Tarumã	$\hat{Y} = -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83$	
LIP LIP LIP	1 2 3	BRS Tarumã BRS Tarumã BRS Tarumã	$\hat{Y} = -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.000000009x^4 R^2 = 0.83$ $\hat{Y} = -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81$	
LIP LIP LIP LIP	1 2 3 1	BRS Taruma BRS Tarumã BRS Tarumã BRS Umbu	$ \hat{Y} = -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} = -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.00000009x^4 R^2 = 0.81 \\ \hat{Y} = -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.81 \\ $	
LIP LIP LIP LIP LIP	1 2 3 1 2	BRS Taruma BRS Tarumã BRS Tarumã BRS Umbu BRS Umbu	$ \hat{Y} = -9.05 + 0.01X^{-0},00003X^{-0} + 0.000008X^{-0} - 0.00000009X^{4} R^{2} = 0.83 \\ \hat{Y} = -7.33 + 0.25X - 0.002X^{2} + 0.000007X^{3} - 0.00000009X^{4} R^{2} = 0.81 \\ \hat{Y} = -23.1 + 0.63X - 0.004X^{2} + 0.00001X^{3} - 0.00000002X^{4} R^{2} = 0.87 \\ \hat{Y} = -10.6 + 0.28X - 0.001X^{2} + 0.000005X^{3} - 0.00000001X^{4} R^{2} = 0.89 $	
LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Umbu	$ \hat{Y} = -9.05 + 0.31 x - 0.0025 x^2 + 0.000008 x^3 - 0.00000009 x^4 R^2 = 0.83 \\ \hat{Y} = -7.33 + 0.25 x - 0.002 x^2 + 0.000007 x^3 - 0.00000009 x^4 R^2 = 0.81 \\ \hat{Y} = -2.31 + 0.63 x - 0.004 x^2 + 0.00001 x^3 - 0.00000002 x^4 R^2 = 0.87 \\ \hat{Y} = -10.6 + 0.28 x - 0.001 x^2 + 0.000005 x^3 - 0.00000001 x^4 R^2 = 0.89 \\ \hat{Y} = 8.5 - 0.09 x + 0.0004 x^2 - 0.0000005 x^3 R^2 = 0.36 $	
LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1	BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Umbu BRS Figueira	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0003x R = 0.00008x^3 - 0.000000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -2.31 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.000008x^3 R^2 = 0.76 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP	$ \begin{array}{c} 1 \\ 2 \\ 3 \\ 1 \\ 2 \\ 3 \\ 1 \\ 2 \\ 2 \\ 1 \\ 2 \\ 2 \\ 1 \\ 1 \\ 2 \\ 1 \\ 1 \\ 2 \\ 1 \\ 1 \\ 2 \\ 1 \\ $	BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Umbu BRS Figueira BRS Figueira	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0003x R^2 + 0.000008x^3 - 0.000000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000008x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.000000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.81 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000008x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21x - 0.001x^2 + 0.000005x^3 - 0.000000006x^4 R^2 = 0.86 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3 1 2 3 1	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Figueira BRS Guatambu	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0003x R = 0.00008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.00000009x^4 R^2 = 0.81 \\ \hat{Y} &= -2.31 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000005x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000005x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21x - 0.001x^2 + 0.0000005x^3 R^2 = 0.50 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3 1 2 3 1 2	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu	$\begin{split} \hat{Y} &= -9.05 + 0.31 x - 0.0025 x^2 + 0.000008 x^3 - 0.000000009 x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25 x - 0.002 x^2 + 0.000007 x^3 - 0.000000009 x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63 x - 0.004 x^2 + 0.00001 x^3 - 0.00000002 x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28 x - 0.001 x^2 + 0.000005 x^3 - 0.00000001 x^4 R^2 = 0.87 \\ \hat{Y} &= 8.5 - 0.09 x + 0.0004 x^2 - 0.0000006 x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11 x - 0.0005 x^2 + 0.0000008 x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21 x - 0.001 x^2 + 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 2.25 + 0.06 x - 0.0003 x^2 + 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.00000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13 2 - 0.31 x + 0.0028 x^2 - 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 0.0000000000000000000000000000000000$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3 1 2 3 1 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu	$\begin{split} \hat{Y} &= -9.05 + 0.31x + 0.00025x^2 + 0.000008x^3 + 0.000000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x + 0.002x^2 + 0.000007x^3 + 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x + 0.004x^2 + 0.00001x^3 + 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x + 0.001x^2 + 0.000005x^3 + 0.0000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 + 0.09x + 0.0004x^2 + 0.000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x + 0.0005x^2 + 0.0000008x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21x + 0.001x^2 + 0.000005x^3 + 0.00000006x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06x + 0.0003x^2 + 0.000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 + 0.31x + 0.0028x^2 + 0.000005x^3 + 0.0000001x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS Guatambu BRS Guatambu	$\begin{split} \hat{Y} &= -9.05 + 0.31x + 0.00025x^2 + 0.000008x^3 + 0.000000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x + 0.002x^2 + 0.000007x^3 + 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x + 0.004x^2 + 0.000005x^3 + 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x + 0.001x^2 + 0.000005x^3 + 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 + 0.09x + 0.0004x^2 + 0.0000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x + 0.0005x^2 + 0.0000005x^3 + 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= -4.69 + 0.21x + 0.001x^2 + 0.000005x^3 + 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06x + 0.0003x^2 + 0.000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 + 0.31x + 0.0028x^2 + 0.000009x^3 + 0.00000001x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 0.9 + 0.004x + 0.00009x^2 R^2 - 0.59 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.00000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000005x^3 - 0.000000006x^4 R^2 = 0.89 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21x - 0.012x^2 + 0.0000005x^3 - 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06x - 0.0003x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04x + 0.00009x^2 R^2 = 0.59 \\ \hat{Y} &= 0.0000000000000000000000000000000000$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277	$\begin{split} \hat{Y} &= -9.05 + 0.31 x - 0.0025 x^2 + 0.000008 x^3 - 0.00000009 x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25 x - 0.004 x^2 + 0.000001 x^3 - 0.000000009 x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63 x - 0.004 x^2 + 0.00001 x^3 - 0.00000002 x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28 x - 0.001 x^2 + 0.000005 x^3 - 0.00000001 x^4 R^2 = 0.87 \\ \hat{Y} &= 8.5 - 0.09 x + 0.0004 x^2 - 0.0000006 x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11 x - 0.0005 x^2 + 0.0000008 x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21 x - 0.001 x^2 + 0.0000005 x^3 - 0.000000006 x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06 x - 0.0003 x^2 + 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31 x + 0.0028 x^2 - 0.000009 x^3 + 0.00000001 x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04 x + 0.00009 x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63 x - 0.004 x^2 + 0.00001 x^3 + 0.00000002 x^4 R^2 = 0.81 \\ \hat{Y} &= 4.36 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 3 1 2 3 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277 BRS 277 BRS 277 BRS 277	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.87 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000008x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21x - 0.001x^2 + 0.0000005x^3 - 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06x - 0.0003x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.000009x^3 + 0.00000001x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04x + 0.00009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x - 0.004x^2 + 0.00001x^3 + 0.00000002x^4 R^2 = 0.81 \\ \hat{Y} &= 4.36 \\ \hat{Y} &= 7.66 \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP		BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277 BRS 277 BRS Tarumā BPS Tarumā	$\begin{split} \hat{Y} &= -9.05 + 0.31x + 0.0003x R = 0.020 \\ \hat{Y} &= -9.05 + 0.31x + 0.00025x^2 + 0.000008x^3 + 0.000000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x + 0.002x^2 + 0.000007x^3 + 0.00000002x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x + 0.004x^2 + 0.00001x^3 + 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -1.06 + 0.28x + 0.001x^2 + 0.000005x^3 + 0.0000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 + 0.09x + 0.0004x^2 + 0.0000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x + 0.0005x^2 + 0.0000005x^3 + 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= -2.5 + 0.06x + 0.0003x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 + 0.01x + 0.00028x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 + 0.04x + 0.00009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x + 0.0000x^2 R^2 = 0.59 \\ \hat{Y} &= -3.6 \\ \hat{Y} &= -21.5 + 0.05x + 0.0003x^2 + 0.0000001x^3 + 0.00000002x^4 R^2 = 0.81 \\ \hat{Y} &= 4.36 \\ \hat{Y} &= 7.66 \\ \hat{Y} &= -2.2 + 0.07x + 0.0003x^2 + 0.0000005x^3 R^2 = 0.66 \\ \end{split}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS Quatambu BRS 277 BRS 277 BRS 277 BRS 277 BRS Tarumā BRS Tarumā BRS Tarumā	$\begin{split} \hat{Y} &= -9.05 + 0.31x + 0.00028x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.000005x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.0000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000008x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000008x^3 R^2 = 0.76 \\ \hat{Y} &= 4.69 + 0.21x - 0.001x^2 + 0.000005x^3 - 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06x - 0.0003x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.000009x^3 + 0.0000001x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04x + 0.0009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x - 0.0003x^2 + 0.0000006x^3 R^2 = 0.66 \\ \hat{Y} &= 2.2 + 0.07x - 0.0003x^2 + 0.000006x^3 R^2 = 0.66 \\ \hat{Y} &= 2.2 + 0.07x - 0.0003x^2 + 0.0000006x^3 R^2 = 0.66 \\ \hat{Y} &= 14.9 - 0.15x + 0.00007x^2 - 0.000006x^3 R^2 = 0.66 \\ \hat{Y} &= 14.9 - 0.15x + 0.00007x^2 - 0.0000000000000000000000000000000000$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 3 1 2 3 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 3 1 2 3 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277 BRS 277 BRS 277 BRS 277 BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā	$\begin{split} \hat{Y} &= -9.05 + 0.31 x - 0.0025 x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25 x - 0.002 x^2 + 0.000007 x^3 - 0.000000009 x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63 x - 0.004 x^2 + 0.00001 x^3 - 0.00000002 x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28 x - 0.001 x^2 + 0.000005 x^3 - 0.00000001 x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28 x - 0.001 x^2 - 0.0000005 x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11 x - 0.0005 x^2 + 0.0000005 x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11 x - 0.001 x^2 + 0.0000005 x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21 x - 0.001 x^2 + 0.0000005 x^3 - 0.000000006 x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06 x - 0.0003 x^2 + 0.0000005 x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31 x + 0.0028 x^2 - 0.000009 x^3 + 0.00000001 x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04 x + 0.00009 x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63 x - 0.004 x^2 + 0.0000006 x^3 R^2 = 0.66 \\ \hat{Y} &= 14.9 - 0.15 x + 0.0007 x^2 + 0.0000005 x^3 R^2 = 0.63 \\ \hat{Y} &= 1.4 + 0.07 x - 0.0003 x^2 + 0.0000000000000000000000000000000000$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	$ \begin{array}{c} 1 \\ 2 \\ 3 \\ 1 \\ 2 \\ 2 \\ 3 \\ 1 \\ 2 \\ 2 \\ 3 \\ 1 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 1 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 2 \\ 2 \\ 3 \\ 3 \\ 2 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3$	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277 BRS 277 BRS 277 BRS 7arumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000001x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.87 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000006x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000008x^3 R^2 = 0.76 \\ \hat{Y} &= 4.07 \\ \hat{Y} &= -4.69 + 0.21x - 0.001x^2 + 0.0000005x^3 - 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06x - 0.0003x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.000009x^3 + 0.00000001x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04x + 0.00009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x - 0.004x^2 + 0.0000006x^3 R^2 = 0.66 \\ \hat{Y} &= 14.9 - 0.15x + 0.0003x^2 + 0.0000006x^3 R^2 = 0.66 \\ \hat{Y} &= 2.4 + 0.007x - 0.0003x^2 + 0.0000000x^3 R^2 = 0.66 \\ \hat{Y} &= 2.4 + 0.015x + 0.0007x^2 - 0.000000x^3 R^2 = 0.61 \\ \hat{Y} &= 7.66 \end{aligned}$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 3 1 2 3 1 2 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS 277 BRS 277 BRS 277 BRS 277 BRS 177 BRS 170 BRS 170 BR	$\begin{split} \hat{Y} &= -9.05 + 0.31x + 0.0003x R = 0.020 \\ \hat{Y} &= -9.05 + 0.31x + 0.00023x R = 0.000008x^3 - 0.000000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x + 0.002x^2 + 0.000001x^3 + 0.00000002x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x + 0.004x^2 + 0.00001x^3 + 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x + 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 + 0.09x + 0.0004x^2 + 0.000008x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x + 0.0005x^2 + 0.0000005x^3 - 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= -1.3 + 0.11x + 0.001x^2 + 0.000005x^3 - 0.000000000006x^4 R^2 = 0.86 \\ \hat{Y} &= -2.5 + 0.06x + 0.0003x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 + 0.01x + 0.00028x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= -4.64 \\ \hat{Y} &= 9.9 - 0.04x + 0.0009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x + 0.00009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x + 0.0003x^2 + 0.0000006x^3 R^2 = 0.66 \\ \hat{Y} &= 14.9 + 0.15x + 0.0003x^2 + 0.0000006x^3 R^2 = 0.63 \\ \hat{Y} &= 2.4 + 0.07x + 0.0003x^2 + 0.0000000000000000000000000000000000$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	$ \begin{array}{c} 1 \\ 2 \\ 3 \\ 1 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2 \\ 2$	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277 BRS 277 BRS 277 BRS 277 BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā	$\begin{split} \hat{Y} &= -9.05 + 0.31x + 0.0003x^2 R^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.0000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000008x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000005x^3 - 0.000000006x^4 R^2 = 0.89 \\ \hat{Y} &= 4.69 + 0.21x - 0.001x^2 + 0.000005x^3 - 0.000000006x^4 R^2 = 0.86 \\ \hat{Y} &= 2.25 + 0.06x - 0.0003x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.000009x^3 + 0.00000001x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04x + 0.0009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x - 0.004x^2 + 0.000006x^3 R^2 = 0.66 \\ \hat{Y} &= 14.9 - 0.15x + 0.0007x^2 - 0.000005x^3 R^2 = 0.63 \\ \hat{Y} &= 24.1 - 0.47x + 0.004x^2 - 0.00001x^3 + 0.00000002x^4 R^2 = 0.94 \\ \hat{Y} &= 57.0 - 1.33x + 0.01x^2 - 0.000003x^3 R^2 = 0.73 \\ \hat{Y} &= 3.36 + 0.08x - 0.0005x^2 + 0.0000000000000000000000000000000000$	
LIP LIP LIP LIP LIP LIP LIP LIP LIP LIP	1 2 3 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 3 1 2 3 2 3	BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Umbu BRS Figueira BRS Figueira BRS Guatambu BRS Guatambu BRS Guatambu BRS 277 BRS 277 BRS 277 BRS 277 BRS 277 BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Tarumā BRS Umbu BRS Umbu BRS Umbu BRS Umbu	$\begin{split} \hat{Y} &= -9.05 + 0.31x - 0.0025x^2 + 0.000008x^3 - 0.00000009x^4 R^2 = 0.83 \\ \hat{Y} &= -7.33 + 0.25x - 0.002x^2 + 0.000007x^3 - 0.000000009x^4 R^2 = 0.81 \\ \hat{Y} &= -23.1 + 0.63x - 0.004x^2 + 0.00001x^3 - 0.00000002x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.28x - 0.001x^2 + 0.000005x^3 - 0.00000001x^4 R^2 = 0.87 \\ \hat{Y} &= -10.6 + 0.0004x^2 - 0.0000005x^3 - 0.00000001x^4 R^2 = 0.89 \\ \hat{Y} &= 8.5 - 0.09x + 0.0004x^2 - 0.0000005x^3 R^2 = 0.36 \\ \hat{Y} &= -1.3 + 0.11x - 0.0005x^2 + 0.0000005x^3 R^2 = 0.36 \\ \hat{Y} &= 4.69 + 0.21x - 0.001x^2 + 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.0000005x^3 R^2 = 0.50 \\ \hat{Y} &= 13.2 - 0.31x + 0.0028x^2 - 0.000009x^3 + 0.00000001x^4 R^2 = 0.82 \\ \hat{Y} &= 4.64 \\ \hat{Y} &= 9.9 - 0.04x + 0.00009x^2 R^2 = 0.59 \\ \hat{Y} &= -21.5 + 0.63x - 0.004x^2 + 0.0000005x^3 R^2 = 0.66 \\ \hat{Y} &= 14.9 - 0.15x + 0.0007x^2 - 0.000000x^3 R^2 = 0.63 \\ \hat{Y} &= 7.66 \\ \hat{Y} &= 2.4 + 0.07x - 0.0003x^2 + 0.0000005x^3 R^2 = 0.63 \\ \hat{Y} &= 5.1 - 0.47x + 0.004x^2 - 0.000000x^3 R^2 = 0.73 \\ \hat{Y} &= 3.36 + 0.08x - 0.0005x^2 + 0.0000009x^3 R^2 = 0.73 \\ \hat{Y} &= -10.5 + 0.48x - 0.004x^2 + 0.000001x^3 - 0.0000002x^4 R^2 = 0.91 \\ \hat{Y} &= 3.36 + 0.08x - 0.004x^2 + 0.000001x^3 - 0.0000002x^4 R^2 = 0.76 \\ \hat{Y} &= 10.5 + 0.48x - 0.004x^2 + 0.000001x^3 - 0.0000002x^4 R^2 = 0.76 \\ \hat{Y} &= 0.50 + 0.48x - 0.004x^2 + 0.000001x^3 - 0.00000002x^4 R^2 = 0.76 \\ \hat{Y} &= 0.50 + 0.48x - 0.004x^2 + 0.000001x^3 - 0.00000002x^4 R^2 = 0.76 \\ \hat{Y} &= 0.50 + 0.48x - 0.004x^2 + 0.000001x^3 - 0.00000002x^4 R^2 = 0.76 \\ \hat{Y} &= 0.50 + 0.48x - 0.004x^2 + 0.000001x^3 - 0.00000002x^4 R^2 = 0.76 \\ \hat{Y} &= 0.50 + 0.04x^2 + 0.000001x^3 - 0.00000002x^4 R^2 = 0.76 \\ \hat{Y} &= 0.50 + 0.48x - 0.004x^2 + 0.0000000x^3 R^2 = 0.73 \\ \hat{Y} &= 0.50 + 0.48x - 0.004x^2 + 0.0000000x^3 R^2 = 0.73 \\ \hat{Y} &= 0.50 + 0.48x - 0.004x^2 + 0.0000000000000000000000000000000000$	
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NFC: Non-fibrous carbohydrates, NDF: Neutral detergent fiber, LIP: Lipids, PTN: Crude protein.

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The genotype BRS Guatambu submitted to one and two cuts showed that the density of 75 seeds/m2 increased this character, for three cuts this genotype obtained greater magnitude when grown with 225 seeds/m2 (Table 5, Figure 4a, Table 6). BRS Tarumã intended for a cut can maximize this character through the density of 300 seeds m2, in two cuts it indicates 225 seeds/m2 and three cuts should increase this item to 375 seeds/m2 (Table 5, Figure 4a, Table 6). This study is essential for the maximization of the bromatological quality of the forage obtained through dual purpose wheat genotypes, since the genetic specificity of the characteristics of the genotypes reflects in the peculiarities of the adjustment of the optimum sowing density and the number of cuts to be used so that the forage production system is sustainable.

CONCLUSIONS

The bromatological quality of forage from wheat with dual purpose depends on cutting management, genotype and sowing densities. Maximization of protein fraction and non-fibrous carbohydrates in the forage is obtained at intermediate sowing densities of 300 and 375 seeds per square meter, independent of the genotype, for the largest number of cuttings.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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