Original Article: Herbicide Selectivity applied in post-emergence of Mulato II grass

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ABSTRACT

The objective of this work was to evaluate the selectivity of herbicides applied in post-emergence of mulato II grass, in different stages of forage development, in areas with in-row and broadcast seeding. In order to understand the influence of the time of application of the herbicides on the selectivity of mulato II grass, two experiments were designed: the first with application of treatments 15 days after emergence (DAE) and the second to 45 DAE. The experiments were installed in two areas, one with broadcast seeding and the other with in-row seeding. For all experiments, 5 herbicides were applied in two doses, in the double control system: [aminopyralide+fluroxipyr] 1.0 and 1.5 L ha^{-1}, [2,4D+picloran] 1.5 and 3.0 L ha^{-1}, [aminopyralide+2,4-D] 1.0 and 2.0 L ha^{-1}, [aminopyralide+metsulfuron] 0.075 and 0.150 kg ha^{-1} and [aminocyclopyrachlor+metsulfuron] 0.075 and 0.150 kg ha^{-1}. For applications performed at 15 DAE only [aminocyclopyrachlor+metsulfuron] was not selective in both tested sowing systems. For applications performed at 45 DAE in-row seeding, the treatments [aminocyclopyrachlor+metsulfuron] in the two tested doses and [aminopyralide+metsulfuron] in the highest dose caused injuries to mulato II grass. For applications carried out at 45 DAE in a field sown by broadcast seeding, only [aminocyclopyrachlor+metsulfuron] caused injury to the culture. At all times of application, the herbicides [aminopyralide+fluroxipyr], [2,4-D+picloram] and [aminopyralide+2,4-D] in the two doses tested, proved to be selective for the fields sown by broadcast and in-row. In the second productive cycle, there was no negative effect of treatments in the four experiments.

Introduction

Brazil occupies the position of the largest herd in the world (213.68 million head of cattle) and the second largest meat exporter (Abiec, 2020). Forage quality is one of the factors that determine animal performance, therefore, the optimization of forage resources is among the main management strategies to be adopted (Reis et al. 2012). Pastures play an important role in guaranteeing low meat production costs, which is enhanced due to climatic conditions and the country's territorial extension (Ferraz and Felício, 2010). Brachiaria grasses are widely used in pasture systems in Brazil, comprising 80% of the 100 million hectares of improved pastures (Silva et al. 2016). One hybrid that has stood out is mulato II grass, marketed as Convert HD364, which was obtained from the cross of three species (*Brachiaria ruziziensis* x *Brachiaria decumbens* x *Brachiaria brizantha*) by the International Center for Tropical Agriculture (CIAT) in Cali, in Colombia (Argel et al. 2007). Since it was recently introduced in Brazil, there are still no studies on the selectivity of herbicides for this forage.

Mulato II grass features high forage accumulation and nutritional value when managed correctly (Vendramini et al. 2012). In addition, it has a physiological mechanism that reduces water loss during periods of drought, enabling the maintenance of green forage (Cardoso et al. 2015). One of the greatest difficulties faced in pasture systems is the occurrence of weeds, because, in addition to competing for water, light and nutrients with forage, they can reduce its production and quality and, depending on the species, they can cause injuries and intoxication in the herd (Jakelaitis et al. 2010; Santos et al. 2015).

The presence of weeds in *B. brizantha* cultivation area reduces, on average, 32% of the dry weight of leaves and stems when compared to forage free from interference (Pereira et al. 2019). According to Jakelaitis et al. (2010), up to 40% loss of *B. brizantha* forage mass was observed during pasture formation when coexisting with weeds.

To mitigate the negative effects caused by weeds, the use of herbicides in pastures is the most important practice, mainly due to the operational performance and easy application (Anésio et al. 2017). However, currently, the number of products registered for use in pastures is limited, thus, it is essential to study new herbicide alternatives to assist in the establishment and productivity of the crop. Due to the importance of weed management in forages, the need for further studies to improve the understanding of forage selectivity to herbicides is emphasized, especially for the new hybrids available on the market.

Given the above, the objective of this work was to evaluate the selectivity of herbicides applied in post-emergence of mulato II grass, at different stages of forage development, in areas with two sowing modalities: in-row and broadcast.

Materials and Methods

To evaluate the selectivity of herbicides applied in post-emergence on mulato II grass, four experiments were conducted on the Experimental Farm of the Universidade Católica Dom Bosco (UCDB), in Campo Grande – MS, Brazil, from November 2013 to May 2014. The soil in this area had the following characteristics: pH in water of 5.9, 3.73 $cmol_c$ of $H^+ + Al^{+3}$ dm^{-3} of soil, 3.67 $cmol_c$ dm^{-3} of Ca^{+2}, 1.0 $cmol_c$ dm^{-3} of Mg^{+2}, 0.11 $cmol_c$ dm^{-3} of K^+, 8.9 mg dm-3 of P, 31.32 g dm^{-3} of C; 37% sand; 15% silt and 48% clay.

In order to understand the influence of the time of herbicide application on the selectivity of mulato II grass, two experiments were designed: the first with application of treatments 15 days after emergence (DAE) and the second at 45 DAE. The experiments were installed in two different areas, one with broadcast seeding and the other with in row seeding, totaling four experiments.

The soil preparation was conventional for both areas, being carried out two weeks before sowing mulato II grass. The sowing of all experiments was carried out on November 20, 2013 and the full emergence of the crop was observed 15 days after sowing, on December 5, 2013. For the two experiments sown by broadcast seeding, the VD-TEC190 equipment was used, distributing 10 kg of seeds ha^{-1}, and after this operation, a roller was used to incorporate the seeds. For the experiments sown in row, a disk seeder with 45 cm spacing between lines and density of 20-25 seeds per linear meter was used.

For all experiments, the design was randomized in blocks, in a split-plot scheme with double control and four repetitions (Fagliari et al. 2002; Arantes et al. 2015; Arantes et al. 2017). The 10 treatments were randomized in the plots, which consisted of the application of five herbicide treatments in two doses (Table 1). The subplots were composed by the presence and absence of herbicidal treatments, that is, with adjacent control to each treatment.

On the occasion of the application of the first stage experiments (15 DAE) the plants of mulato II had a height of 10 to 13 cm, whereas in the second stage experiments (45 DAE), the plants presented 30 to 45 cm.

The applications were carried out using a pressurized backpack sprayer with a constant pressure of 40 lb in^{-2}, equipped with eight XR 110.02 tips, spaced 0.5 m apart and positioned 0.5 m from the target surface, providing an application rate of 150 L ha^{-1} of spray mix. In order to prevent the effects of competition between the weeds and the forage, during all the conduction period of the experiments all plots were also weeded manually when necessary.

To evaluate the effects of treatments on mulato II grass, two growth cycles were considered. The first cut of mulato II grass was carried out when the controls reached height between 55 and 60 cm, leaving 25 cm remaining, simulating the entry of animals in the area and the consumption of pasture. The aerial part cutting operation was performed at 65 DAE for the first cut and at 115 DAE for the second cut. In the first growth cycle, the following evaluations were carried out for all experiments: number of tillers per plant, stand (number of plants per square meter), plant height and productivity. In the second production cycle, evaluations of tillering (number of tillers per plant), plant height and productivity (kg ha-1 of green mass) were carried out. The data of the analyzed variables were submitted to the analysis of the basic assumptions of the analysis of variance by the Lilliefors tests and Bartlett's sphericity tests. After meeting the assumptions of normality of residues and homogeneity of variances, the data were subjected to analysis of variance by the F test at 10% probability, and when significant to the differences, they were compared by the Tukey test at 10% probability.

Table 1. Treatments and respective doses used in herbicide selectivity experiments applied in post-emergence of mulato II grass.

Treatments*	Concentration g a.i. L^{-1} or kg^{-1}	Dose g a.i. ha^{-1}	Dose c.p. ha^{-1}
1. [aminopiralide+fluroxipyr]	[40+80]	[40+80]	1.0 L
2. [aminopiralide+fluroxipyr]	[40+80]	[60+120]	1.5 L
3. [2.4-D+picloran]	[240+64]	[360+96]	1.5 L
4. [2.4-D+picloran]	[240+64]	[720+192]	3.0 L
5. [aminopiralide+2.4-D]	[40+320]	[40+320]	1.0 L
6. [aminopiralide+2.4-D]	[40+320]	[80+640]	2.0 L
7. 2/[aminopiralide+metsulfuron]	[525+94.5]	[40+7]	0.075 kg
8. 2/[aminopiralide+metsulfuron]	[525+94.5]	[79+14]	0.150 kg
9. 2/[aminocyclopyrachlor+metsulfuron]	[440+67]	[33+5]	0.075 kg
10. 2/[aminocyclopyrachlor+metsulfuron]	[440+67]	[110+17]	0.125 kg

*The use of adjuvants in treatments followed the label instructions for use; 2/Products under test, not commercial in Brazil.

Results and Discussion

Broadcast Seeding

At the end of the first productive cycle with application of herbicide treatments at 15 DAE, it is observed that only the treatment with [aminocyclopyrachlor+metsulfuron] in the highest dose affected the plant height in relation to the control without application. The tillering of mulato II was not affected by any of the treatments (Table 2).

As for the plant stand, it was observed that the treatments [aminopyralide+metsulfuron] and [aminocyclopyrachlor+metsulfuron] in the highest doses (T8 and T10) presented the lowest number of plants per square meter. Both treatments present metsulfuron in doses from 14 g a.i. ha^{-1}, which may be responsible for this difference in relation to the other treatments (Table 3). For *Brachiaria brizantha*, Pereira et al. (2000) observed up to 30% phytotoxicity in plants with two applications of metsulfuron (6 g ha^{-1} + 6 g ha^{-1}) during the pasture cycle.

The correct positioning of the dose and application stage of [aminocyclopyrachlor+metsulfuron] may be important for producers who need to manage yellow bell (*Tecoma stans.*), a difficult to control weed recently introduced in Brazil, as this herbicide has shown excellent control results (Reis et al. 2016).

Table 2. Effect of herbicide treatments applied to mulato II, 15 days after emergence on the variables height (cm) and tillering (number of tillers per plant) in area sown by broadcast seeding.

Treatments	Dose g a.i. ha^{-1}	[1/]Height		[1/]Tillers	
		Treat.	Cont.	Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	58.05 a	58.95 a	15.25	15.40
2.[aminopiralide+fluroxipyr]	60+120	58.23 a	58.35 a	16.20	16.82
3.[2.4-D+picloran]	360+96	57.15 a	59.15 a	15.40	15.91
4.[2.4-D+picloran]	720+192	56.85 a	60.17 a	14.70	15.97
5.[aminopiralide+2.4-D]	40+320	58.23 a	58.95 a	15.43	15.95
6.[aminopiralide+2.4-D]	80+640	59.60 a	61.85 a	15.08	15.10
7.[aminopiralide+metsulfuron]	40+7	59.43 a	61.55 a	15.05	15.81
8.[aminopiralide+metsulfuron]	79+14	52.33 a	59.65 a	13.38	14.85
9.[aminocyclopyrachlor+metsulfuron]	33+5	55.80 a	61.00 a	13.90	15.10
10.[aminocyclopyrachlor+metsulfuron]	110+17	50.65 b	59.62 a	14.83	15.71
[2/]VC (%):		10.35		22.54	
[3/]MSD:		6.16		3.53	

[1/]Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; [2/]Variation coefficient; [3/]Minimum significant difference between treat (treatment) and cont (double control).

Table 3. Effect of herbicide treatments applied 15 days after emergence on mulato II at the plant stand (nº plants m^{-2}) and productivity (green mass kg ha^{-1}) in an area sown by broadcast seeding.

Treatments	Dose g a.i. ha^{-1}	[1/]Plant Stand		[1/]Productivity	
		Treat.	Cont.	Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	10.13 a	10.50 a	13.060 a	13.441 a
2.[aminopiralide+fluroxipyr]	60+120	10.00 a	10.62 a	13.122 a	13.475 a
3.[2.4-D+picloran]	360+96	12.12 a	12.75 a	13.108 a	13.626 a
4.[2.4-D+picloran]	720+192	11.62 a	11.75 a	12.916 a	13.377 a
5.[aminopiralide+2.4-D]	40+320	11.50 a	11.81 a	13.134 a	13.455 a
6.[aminopiralide+2.4-D]	80+640	11.62 a	12.31 a	13.042 a	13.455 a
7.[aminopiralide+metsulfuron]	40+7	10.50 a	11.12 a	13.316 a	13.544 a
8.[aminopiralide+metsulfuron]	79+14	8.62 b	11.50 a	13.15 a	13.321 a
9.[aminocyclopyrachlor+metsulfuron]	33+5	10.07 a	11.37 a	12.99 a	13.742 a
10.[aminocyclopyrachlor+metsulfuron]	110+17	9.00 b	12.43 a	12.19 b	13.740 a
[2/]VC (%):		21.73		6.90	
[3/]MSD:		2.47		934.00	

[1/]Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; [2/]Variation coefficient; [3/]Minimum significant difference between treat (treatment) and cont (double control).

Among the effects observed in the variables height and number of plants m^{-2}, only the treatment [aminocyclopyrachlor+metsulfuron] in the highest dose (T10) showed losses in productivity, with a reduction of 1,550.00 kg ha^{-1} of green mass or 11.28 % (Tables 2 and 3).

It is worth mentioning that even when the treatments are applied in an initial stage (plants approximately 12 cm), mulato II showed good selectivity to the treatments, being able to compensate losses to the plant stand caused by the treatment with [aminopyralide+metsulfuron - methyl] in the highest dose (Table 3), maintaining productivity similar to that of the control. Giraldeli et al. (2019) also observed excellent selectivity of the herbicide 2,4 D + picloram under early application (plants with 20 to 30 cm) in plants of *Urochloa brizantha* cv. Palisade grass.

When the treatments were applied at 45 DAE, there was a greater negative effect of treatments on the height of mulato II plants. In this case, only the treatments [2,4-D+Picloran] and [Aminopyralide+2,4-D] in the two doses (T3, T4, T5 and T6) did not affect this variable in relation to the control. However, for the variable number of tillers, there was no difference in treatments in relation to the adjacent double controls (Table 4).

Table 4. Effect of herbicide treatments applied 45 days after emergence on mulato II regarding variables height (cm) and tillering (number of tillers per plant) in area sown by broadcast seeding.

Treatments	Dose g a.i. ha^{-1}	1/Height				1/Tillers	
		Treat.		Cont.		Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	51,25	b	60,50	a	15,35	15,62
2.[aminopiralide+fluroxipyr]	60+120	51,25	b	61,00	a	16,20	16,83
3.[2,4-D+picloran]	360+96	58,75	a	60,63	a	15,45	15,98
4.[2,4-D+picloran]	720+192	55,50	a	60,38	a	16,45	16,48
5.[aminopiralide+2,4-D]	40+320	60,25	a	61,50	a	15,43	15,45
6.[aminopiralide+2,4-D]	80+640	60,25	a	60,75	a	15,10	15,20
7.[aminopiralide+metsulfuron]	40+7	54,00	b	60,62	a	16,05	16,44
8.[aminopiralide+metsulfuron]	79+14	52,00	b	60,58	a	15,10	15,60
9.[aminocyclopyrachlor+metsulfuron]	33+5	51,50	b	60,38	a	16,10	16,40
10.[aminocyclopyrachlor+metsulfuron]	110+17	51,00	b	60,50	a	15,90	16,00
2/VC (%):		9,26				23,25	
3/MSD:		5,52				3,75	

1/Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; 2/Variation coefficient; 3/Minimum significant difference between treat (treatment) and cont (double control).

Some grasses are sensitive to the application of auxin-mimicking herbicides, such as aminopyralide or 2,4-D; unlike what happened to mulato II grass, which showed tolerance to almost all treatments (Belcher and Walker, 2010; Brecke and Unruh, 2010).

For the variable plant stand there was no difference in treatments regarding to the adjacent double controls. When the forage productivity was evaluated in the treatments applied at 45 DAE, there is great plasticity of mulato II, since, even though several treatments have presented smaller plant size, only the treatment [aminocyclopyrachlor+metsulfuron] in higher dose (T10) showed lower productivity, with a reduction of 1,846.00 kg ha-1 of green mass (-12.72% in relation to the controls) (Table 5).

The phytointoxication observed by the application of [aminocyclopyrachlor+metsulfuron] in its highest dose, may be linked to the fact that aminocyclopyrachlor is a very active herbicide in very low doses. For example, 1% of the herbicide that reached *Tecoma stans* roots was enough to control the species (Reis et al. 2015). So far, the mechanisms of grass tolerance to this herbicide are not completely known.

For all evaluations carried out in the second productive cycle (tillering, height and productivity), no differences were observed between the herbicide treatments and the respective controls for any application period (15 and 45 DAE).

In-row seeding

The results of the experiment with application of herbicides at 15 DAE and sowed in row indicate that only the treatments with [aminocyclopyrachlor+metsulfuron] (T9 and T10) presented plants of mulato II with a smaller size than the respective controls which not received herbicide. Regarding tillering, no herbicide showed a significant difference in relation to the control (Table 6), which are very similar results to the experiment sown by broadcast with application at 15 DAE.

Table 5. Effect of herbicide treatments applied 45 days after emergence on mulato II at the plant stand (nº plants m^{-2}) and productivity (green mass kg ha^{-1}) in area sown by broadcast seeding.

Treatments	Dose g a.i. ha^{-1}	1/Plant Stand		1/Productivity	
		Treat.	Cont.	Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	10,69	11,00	13.687 a	13.707 a
2.[aminopiralide+fluroxipyr]	60+120	10,19	10,25	12.209 a	12.708 a
3.[2,4-D+picloran]	360+96	12,50	12,68	12.502 a	13.043 a
4.[2,4-D+picloran]	720+192	11,50	11,87	12.606 a	13.356 a
5.[aminopiralide+2,4-D]	40+320	12,00	12,06	14.159 a	13.915 a
6.[aminopiralide+2,4-D]	80+640	11,38	11,81	13.330 a	13.179 a
7.[aminopiralide+metsulfuron]	40+7	10,81	11,87	12.566 a	13.281 a
8.[aminopiralide+metsulfuron]	79+14	11,13	11,80	13.137 a	13.920 a
9.[aminocyclopyrachlor+metsulfuron]	33+5	11,88	12,25	12.454 a	13.426 a
10.[aminocyclopyrachlor+metsulfuron]	110+17	11,63	12,00	12.670 b	14.516 a
2/VC (%):		20,16		8,69	
3/MSD:		2,37		1.174	

1/Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; 2/Variation coefficient; 3/Minimum significant difference between treat (treatment) and cont (double control).

Table 6. Effect of herbicide treatments applied 15 days after emergence on mulato II on the variables height (cm) and tillering (number of tillers per plant) in an area sown in row.

Treatments	Dose g a.i. ha^{-1}	1/Height		1/Tillers	
		Treat.	Cont.	Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	59,50 a	60,00 a	14,25	14,38
2.[aminopiralide+fluroxipyr]	60+120	60,00 a	60,50 a	15,00	15,58
3.[2,4-D+picloran]	360+96	59,00 a	60,87 a	15,45	15,60
4.[2,4-D+picloran]	720+192	60,25 a	60,62 a	14,95	15,98
5.[aminopiralide+2,4-D]	40+320	58,75 a	59,37 a	15,42	15,45
6.[aminopiralide+2,4-D]	80+640	59,87 a	60,25 a	15,10	15,20
7.[aminopiralide+metsulfuron]	40+7	60,25 a	60,87 a	14,85	15,64
8.[aminopiralide+metsulfuron]	79+14	57,60 a	60,50 a	11,85	15,10
9.[aminocyclopyrachlor+metsulfuron]	33+5	56,00 b	61,25 a	11,42	15,38
10.[aminocyclopyrachlor+metsulfuron]	110+17	52,40 b	60,08 a	11,37	15,75
2/VC (%):		7,01		25,39	
3/MSD:		4,28		3,85	

1/Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; 2/Variation coefficient; 3/Minimum significant difference between treat (treatment) and cont (double control).

As for the plant stand, no herbicidal treatment showed differences in relation to the control, which differs from the experiment with broadcast seeding, in which the treatments [aminopyralid+metsulfuron] and [aminocyclopyrachlor+metsulfuron] in the highest dose had the lowest plant stand.

When evaluating the productivity of mulato II, a similar response is observed for the treatments applied at 15 DAE for both sowing methods. Only the treatment [aminocyclopyrachlor + metsulfuron] in the highest dose (T10) affected the forage productivity (Tables 3 and 7). However, the reduction in productivity for the in-row seeding system was 13% higher (1,814.00 kg ha^{-1} of green mass) compared to the broadcast seeding system.

Table 7. Effect of herbicide treatments applied 15 days after emergence on mulato II at the plant stand (nº plants m^{-2}) and productivity (green mass kg ha^{-1}) in an area sown in row.

Treatments	Dose g a.i. ha^{-1}	1/Plant Stand		1/Productivity	
		Treat.	Cont.	Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	6,62	7,00	13.277 a	13.472 a
2.[aminopiralide+fluroxipyr]	60+120	6,00	6,06	13.000 a	13.287 a
3.[2,4-D+picloran]	360+96	6,12	6,56	12.662 a	12.775 a
4.[2,4-D+picloran]	720+192	6,37	6,75	13.463 a	13.602 a
5.[aminopiralide+2,4-D]	40+320	6,25	6,31	13.959 a	14.031 a
6.[aminopiralide+2,4-D]	80+640	5,62	5,84	12.906 a	12.935 a
7.[aminopiralide+metsulfuron]	40+7	5,37	5,89	12.956 a	13.225 a
8.[aminopiralide+metsulfuron]	79+14	4,87	5,50	12.574 a	13.528 a
9.[aminocyclopyrachlor+metsulfuron]	33+5	5,50	6,56	12.586 a	13.402 a
10.[aminocyclopyrachlor+metsulfuron]	110+17	4,75	5,88	11.516 b	13.300 a
2/VC (%):		27,50		6,90	
3/MSD:		1,69		1.258	

1/Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; 2/Variation coefficient; 3/Minimum significant difference between treat (treatment) and cont (double control).

When evaluating the results of the experiment with herbicides applied at 45 DAE and sown in row, it is observed that the treatments with [aminopyralide+metsulfuron] in the highest dose and with [aminocyclopyrachlor+metsulfuron] in both doses (T8, T9 and T10) affected plant height of mulato II. Yet, the number of tillers was not affected by any treatment (Table 8).

Regarding the experiment applied to the 15 DAE and sown in row, a greater sensitivity of the pasture is observed in the late application (45 DAE), since the treatment [aminopyralide+metsulfuron] did not affect the plant height in the earlier application (Tables 6 and 8).

Comparing the sowing methods for the same moment of application of the herbicides, there is a small difference regarding the effects of treatments on plant height, where the treatment [aminopyralide+metsulfuron-methyl] in the lowest dose (T7) affected this variable when sowing by broadcast seeding (Tables 4 and 8).

The plant stand was not affected by any treatment. On the other hand, the productivity of mulato II was affected in the treatments with [aminopyralide + metsulfuron] in the highest dose and with [aminocyclopyrachlor + metsulfuron] in both doses (T8, T9 and T10), with reductions close to 12% (Table 9).

A lower recovery capacity of the plants is observed for late application (45 DAE), for the treatment [aminopyralide+metsulfuron] in the lowest dose did not affect the forage productivity when applied at 15 DAE (Tables 7 and 9).

The selectivity of auxinic herbicides in grasses can be closely related to the stage of application, having as main example the wheat culture. In that the herbicide 2,4 D can only be applied between the stages of double ridge and terminal spikelet, if applied before it can cause deformations in the wheat leaf flags and ears, but without drop in productivity, on the other hand, if applied after this period it can cause a decrease in crop yield of up to 60% (Rodrigues et al. 2006).

When comparing sowing methods for experiments with late application (45 DAE), greater recovery of cultivation is observed in the system of broadcast seeding, in which only the treatment [aminocyclopyrachlor+metsulfuron] in the highest dose affected the forage productivity (Tables 5 and 9).

Table 8. Effect of herbicide treatments applied 45 days after emergence on mulato II, on the height (cm) and tillering (number of tillers per plant) in an area sown in a row.

Treatments	Dose g a.i. ha^{-1}	[1/]Height		[1/]Tillers	
		Treat.	Cont.	Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	52,50 b	60,50 a	15,50	16,02
2.[aminopiralide+fluroxipyr]	60+120	50,00 b	60,38 a	15,63	15,78
3.[2,4-D+picloran]	360+96	56,75 a	60,75 a	15,35	15,43
4.[2,4-D+picloran]	720+192	55,50 a	60,38 a	16,45	16,78
5.[aminopiralide+2,4-D]	40+320	58,75 a	60,00 a	16,53	16,68
6.[aminopiralide+2,4-D]	80+640	58,00 a	61,62 a	15,10	16,45
7.[aminopiralide+metsulfuron]	40+7	59,25 a	61,00 a	16,00	16,43
8.[aminopiralide+metsulfuron]	79+14	49,50 b	60,50 a	15,45	15,60
9.[aminocyclopyrachlor+metsulfuron]	33+5	50,25 b	60,12 a	14,33	15,65
10.[aminocyclopyrachlor+metsulfuron]	110+17	51,25 b	60,87 a	15,75	15,76
[2/]VC (%):		6,91		22,33	
[3/]MSD:		4,10		3,61	

[1/]Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; [2/]Variation coefficient; [3/]Minimum significant difference between treat (treatment) and cont (double control).

Table 9. Effect of herbicide treatments applied 45 days after emergence on mulato II at the plant stand (nº plants m^{-2}) and productivity (green mass kg ha^{-1}) in an area sown in row.

Treatments	Dose g a.i. ha^{-1}	[2/]Plant Stand		[2/]Productivity	
		Treat.	Cont.	Treat.	Cont.
1.[aminopiralide +fluroxipyr]	40+80	6,13	6,19	13.444 a	13.791 a
2.[aminopiralide+fluroxipyr]	60+120	5,69	5,75	13.016 a	13.460 a
3.[2,4-D+picloran]	360+96	6,38	6,25	13.764 a	13.445 a
4.[2,4-D+picloran]	720+192	6,69	6,63	13.078 a	13.332 a
5.[aminopiralide+2,4-D]	40+320	5,38	6,28	13.440 a	13.566 a
6.[aminopiralide+2,4-D]	80+640	6,38	7,28	13.108 a	13.688 a
7.[aminopiralide+metsulfuron]	40+7	6,63	6,13	13.284 a	13.443 a
8.[aminopiralide+metsulfuron]	79+14	7,25	6,94	11.614 b	13.120 a
9.[aminocyclopyrachlor+metsulfuron]	33+5	6,88	6,13	11.917 b	13.616 a
10.[aminocyclopyrachlor+metsulfuron]	110+17	6,63	7,12	11.916 b	13.799 a
[2/]VC (%):		23,24		4,99	
[3/]MSD:		2,50		662	

[1/]Means followed by the same letters, within the same line, do not differ from each other by Tukey's test at 10% probability; [2/]Variation coefficient; [3/]Minimum significant difference between treat (treatment) and cont (double control).

For both application times, the herbicides [aminopyralide+fluroxipyr], [2,4-D+ picloram] and [aminopyralide+2,4-D] in the two tested doses, showed selective treatments, both for broadcast as well as in-row seeding.

For Lima et al. (2016) the herbicide 2,4 D proved to be selective to the species *Brachiaria ruziziensis*, even being applied at different times (30, 60, 90, 120 and 125 DAE) and seeding systems (broadcast seeding, broadcast seeding with incorporation and in row).

As for experiments sown by broadcast seeding, no treatment differed from its control in the second productive cycle, regardless of the time of herbicide application (15 or 45 DAE), indicating that any injuries caused by such treatments in the first productive cycle did not influence the capacity for regrowth, growth and forage development after cutting.

Conclusion

For both application times, the herbicides [aminopyralide+fluroxipyr], [2,4-D+picloram] and [aminopyralide+2,4-D] in the two tested doses, showed selective treatments, both for broadcast and in-row seeding. In the second productive cycle of mulato II grass, there was no treatment negative effect on any of the variables evaluated in the four experiments.

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Conflicts of Interest

No conflicts of interest have been declared.

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