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Control of *Brachiaria decumbens* and *Panicum maximum* by S-metolachlor as influenced by the occurrence of rain and amount of sugarcane straw on the soil

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ABSTRACT. With the objective to study the control of *Brachiaria decumbens* and *Panicum maximum* by herbicide S-metolachlor as influenced by the time interval between the herbicide application the occurrence of rain and the amount of sugarcane straw on the soil, two experiments were conducted in pots under greenhouse conditions. In the first, the factors were the amount of sugarcane straw left on the soil surface (0, 3, 6, 10, or 15 ton. ha^{-1}) and the S-metolachlor applied at doses of 0, 0.96, 1.44, 1.92, or 2.40 kg ha^{-1}. In the second, the factors were the amount of sugarcane straw left on the soil surface (0 or 10 ton. ha^{-1}), the interval of time elapsed between the application of S-metolachlor and simulated rain, which took place 1 day before and 0, 4, 8, 12, 16, or 20 days after the application. The herbicide doses were not affected by the amounts of straw left on the soil surface. When straw was not left on the soil surface, the control of the weeds by the herbicide was not influenced by the time interval up to 20 days after herbicide application. With 10 ton. ha^{-1} of straw, the control exerted by S-metolachlor was equally efficient whether it rained up to 12 days after the herbicide application. *P. maximum* was controlled even when the rain fell one day before the herbicide application.

Keywords: signal grass, buffalo grass, crop residues, herbicide leaching.

Controle de *Brachiaria decumbens* e *Panicum maximum* pelo herbicida S-metolachlor em função da ocorrência de chuva e da quantidade de palha sobre o solo

RESUMO. Com o objetivo de estudar o controle em pré-emergência de *Brachiaria decumbens* e *Panicum maximum* pelo herbicida S-metolachlor em função do intervalo de tempo entre a aplicação e a ocorrência de chuva e da quantidade de palha de cana-de-açúcar na superfície do solo, dois experimentos foram desenvolvidos em vasos mantidos em casa de vegetação. No primeiro, foram estudadas cinco quantidades de palha sobre o solo (0, 3, 6, 10 e 15 t ha^{-1}) e cinco dosagens de S-metolachlor (0; 0,96; 1,44; 1,92 e 2,40 kg ha^{-1}). No outro, foram avaliadas duas quantidades de palha sobre o solo (0 e 10 t ha^{-1}) e sete intervalos de tempo entre a aplicação de S-metolachlor e a simulação de chuva (1 dia antes; logo após; 4, 8, 12, 16 e 20 dias após a aplicação). As dosagens de S-metolachlor não foram afetadas pelos níveis de palha na superfície do solo. Além disso, sem a manutenção de palha sobre o solo, o controle das plantas daninhas pelo herbicida S-metolachlor não foi influenciado pelos intervalos de tempo entre a aplicação e a simulação de chuva, até 20 dias. Com 10 t ha^{-1} de palha, o controle de *B. decumbens* e *P. maximum* pelo S-metolachlor não foi prejudicado quando choveu até 12 dias da sua aplicação ou um dia antes, mas, nesse caso apenas para *P. maximum*.

Palavras-chave: capim-braquiária, capim-colonião, resíduos vegetais, lixiviação de herbicida.

Introduction

When sugarcane plants are mechanically harvested without previously having burned them, the straw left on the soil surface may reduce the ability of herbicides to reach the soil surface. This capacity is dependent upon the physical and chemical characteristics of the herbicide such as solubility, vapor pressure, and polarity (RODRIGUES, 1993). After the herbicide is applied, the amount and the timing of rain or irrigation as well as the decomposition of plant residues are important factors in determining the retention of the herbicide by the straw (CORREIA et al., 2007). When retained by straw, herbicide losses likely occur due to photodegradation, volatilization, and adsorption by the plant residues. The adsorption by plant residues is dependent on their degree of decomposition and age (MERSIE et al., 2006).

In one study, the amount of the herbicide amicarbazone that was removed from the straw (5, 10, 15, and 20 ton. ha^{-1}) to the soil decreased with the time interval (7 and 14 days) between the application of the herbicide and the occurrence of simulated rain (CAVENAGHI et al., 2007). In another study, Carbonari et al. (2010) reported that the mixture of clomazone and hexazinone efficiently controlled *Brachiaria decumbens* if applied over, under or, in the absence of straw, independently of the length of time without rain (0, 3, 7, 15, 30, or 60 days). The authors observed, though, that if the period without rain exceeded 60 days, the weed control efficiency tended to be reduced, particularly when the herbicide had been applied to the soil or the straw surface. These results indicate that the herbicide applied to either the soil or straw surface undergoes degradation when exposed to weather conditions for an extended period of time if no rain occurs to leach the herbicide into the soil profile.

Studies of metolachlor report its possible retention by plant residues, which would reduce its efficacy (OLIVEIRA et al., 2001; TEASDALE et al., 2003; FONTES et al., 2004). The time interval between herbicide application and the first rain is another important factor; depending on how long that period is, the chances of herbicide loss by physical (such as volatilization) or chemical (such as photodegradation and adsorption) processes will be higher or lower. More detailed information about S-metolachlor is lacking. This herbicide is a metolachor stereoisomer (KURT-KARAKUS et al., 2010) that exhibits a high biological activity (MUNOZ et al., 2011). In Brazil, S-metolachlor is recommended for the pre-emergence control of monocotyledonous and some dicotyledonous species in soybean, corn, bean, cotton, and sugarcane crops. The herbicide is soluble in water (solubility = 480 mg L^{-1} at 25°C), poorly volatile (vapor pressure = 1.73 x 10^{-3} Pa at 20°C), non-ionic (pk = zero), and hydrophilic (K_{ow} = 3.05) (RODRIGUES; ALMEIDA, 2011). These values indicate that the molecule is stable with minimal losses to the environment and a moderate affinity with water.

B. decumbens and *P. maximum* are susceptible to control by S-metolachlor. These important weed species infest sugarcane fields. *B. decumbens* originated in Africa and was introduced to Brazil in 1950 as a forage crop. It is a perennial plant, decumbent, stoloniferous with roots arising from low nodes touching the soil surface. *P. maximum* originated in Africa and India and was introduced to Brazil during the slavery year s. It is a perennial species, robust, stoloniferous and with glaucous culms (KISSMANN, 1997).

This study tested the hypotheses that (i) sugarcane straw inhibits *B. decumbens* and *P. maximum* seedlings from emerging but not to the extent of dispensing with the need for herbicides such as S-metolachlor, (ii) the action of S-metolachlor is not affected by the presence of the mulch covering the soil surface, and (iii) S-metolachlor can withstand up to 20 rainless days after its application without losing its capacity to control these weeds. The objective of this work was to study the pre-emergence control of *B. decumbens* and *P. maximum* by the herbicide S-metolachlor as influenced by both the lag between its application and the occurrence of rain and the amount of sugarcane straw left covering the soil surface.

Material and methods

Two in-pot experiments were carried out under greenhouse conditions from January 12 to February 17, 2011 (the first experiment) and from April 2 to June 3, 2011 (the second experiment) at the Department of Phytosanitation of the Jaboticabal campus at Paulista State University (UNESP) in Jaboticabal, São Paulo State, Brazil.

Both experiments used a completely randomized design with four replications. In the first experiment (5 x 5 factorial), the first factor was the amount of sugarcane straw residue (0, 3, 6, 10, or 15 ton. ha^{-1}) left covering the soil surface, and the second factor was the applied dose (0, 0.96, 1.44, 1.92, or 2.40 kg ha^{-1}) of the herbicide S-metolachlor. In the second experiment (2 x 8 factorial), the first factor was the amount of sugarcane straw (0 or 10 ton. ha^{-1}) left on the soil surface, and the second factor was the time interval (1 day before, 0, 4, 8, 12, 16, or 20 days after herbicide application) between the herbicide application (at a rate of 1.92 kg ha^{-1}) and the occurrence of rain, and a control treatment without herbicide application.

Each experimental unit was formed by one 8-L plastic pot filled with a substratum formed by soil, sand, and an organic compound in a 3:1:1 ratio. After mechanically harvesting fourth-cut SP 903723 sugarcane plants for the first experiment and first-cut RB 835054 plants for the second one, the straw remaining on the soil surface was collected and taken to a greenhouse to dry.

The seeds of *B. decumbens* (1.3 g per pot) and of *P. maximum* (0.34 g per pot) were homogeneously distributed over the substratum in the pot and then covered with a 1-cm-thick layer of soil. In those treatments in which sugarcane straw was to be left on the substratum surface, the straw was cut into pieces short enough to fit into the pot and then placed over the substratum in a homogeneous layer in the appropriate amounts.

The bottoms of the pots were lined with a sheet of newspaper to prevent soil loss. Each pot was placed in a plastic tray with a diameter larger than that of the pot and without holes to ensure a consistent water supply. The soil moisture was monitored on a daily basis. Water was added to the containers as needed and was distributed through the soil by capillary action.

In both experiments the herbicide was sprayed on the weeds at the indicated doses during pre-emergence. A backpack sprayer equipped with two flat-fan nozzles (XR 110015) spaced 0.5 m apart and calibrated to deliver an equivalent of 200 L ha^{-1} was used at a constant pressure of 2.0 kgf cm^{-2} (maintained by CO_2). At the time of application, the soil was dry, and the following conditions were recorded: 95% relative humidity, 23.7ºC air temperature, and 24.2ºC soil temperature (at a depth of 5 cm). The dates, times, and the environmental conditions during the second experiment are presented in Table 1.

In the first experiment, one hour after the application of the herbicide, a 25-mm rainfall was simulated. In the second experiment, 30 mm of rainfall was simulated one day before herbicide application, soon after the application of the herbicide, or 4, 8, 12, 16, and 20 days later, depending on the assigned rainfall treatment.

The rain simulator was a circular device with a diameter of 0.2 m formed by flexible polyethylene tube containing seven nozzles (FL 10) that were 0.09 m from one another. This simulator was placed 2.5 m above the soil surface and uniformly sprayed a 1.5-m^2 area. Before the simulation, pluviometers were distributed over the entire area, which allowed calculations of how long the device needed to operate to attain the desired amount of rain (25 or 30 mm).

At 14 and 35 days after the application of the herbicide (DAA) in the first experiment and at 21 and 42 days after rain simulation (DARS) in the second, the number of emerged weed plants was counted. At 35 DAA and 42 DARS for the first and second experiments, respectively, the plants were trimmed close to the surface, placed inside paper bags and dried in a forced ventilation oven at 50ºC to constant biomass to determine the dry matter of the plants' aerial parts.

An F test of the analysis of variance was used to test the effects of the amounts of straw and the herbicide dose (first experiment) and their interactions following a polynomial adjustment of the data. The effects of the rain intervals and those of soil covering (second experiment) and their interactions were compared using Tukey's test whit a 5% level of probability.

Results and discussion

The control of *Brachiaria decumbens* and *Panicum maximum* by the herbicide S-metolachlor in association with sugarcane plant straw covering the soil surface (first experiment)

There was a significant effect of the herbicide dose and an interaction between the straw and herbicide for all of the evaluated characteristics (Table 2). The amount of straw covering the soil surface had a significant effect on the number of *P. maximum* plants 35 DAA and also on the number and the dry matter of plants of *B. decumbens* at 14 and 35 DAA.

Table 1. Description of the treatments used in the experiment in addition to the dates, times and meteorological conditions at the moment of the S-metolachlor(1) application in the second experiment.

Rain simulation(2) - days after herbicide application	Straw (ton. ha^{-1})	Application of S-metolachlor						
		Date	Time	Temperature (ºC) Air	Temperature (ºC) Soil	Air relative humidity (%)	Wind speed (km h^{-1})	Nebulosity (%)
One day before	0 10	04/22	10:00	27.7	31.1	61	0.8	0
Soon after	0 10	04/22	10:00	27.7	31.1	61	0.8	0
Four days later	0 10	04/18	7:10	21.1	25.1	79	0.0	0
Eight days later	0 10	04/14	9:25	23.3	28.1	90	0.0	0
Twelve days later	0 10	04/10	10:00	22.7	26.6	80	2.2	0
Sixteen days later	0 10	04/06	9:00	24.3	25.0	78	1.3	95
Twenty days later	0 10	04/02	13:00	29.4	29.1	66	3.5	90
Control treatment without herbicide application(3)	0 10	-	-	-	-	-	-	-

(1)Dose of 1.92 kg ha^{-1}. (2)30 mm of rain. (3)Rain simulated at the same day the herbicide was applied in the other treatments.

Table 2. Results of an F test of the analysis of variance for number of plants of *Brachiaria decumbens* and *Panicum maximum* at 14 and 35 days after the application (DAA) of S-metolachlor and the dry matter of the aerial parts of plants 35 DAA.

Sources of variation	*B. decumbens*			*P. maximum*		
	Number of plants		Dry matter	Number of plants		Dry matter
	Days after application					
	14	35	35	14	35	35
Straw	11.12**	17.24**	17.77**	2.07	4.39**	0.22
Herbicide	160.99**	250.94**	220.04**	229.39**	162.13**	153.73**
Straw x Herbicide	11.54**	10.55**	10.70**	5.21**	6.71**	2.22*
CV (%)	33.55	23.07	25.98	25.09	28.94	22.57

**, *Significant at 1 and 5% probability, respectively, by the F test of the analysis of variance.

Examining the interaction between straw and dose shows that in the control treatment without herbicide, the number of plants of *B. decumbens* was linearly reduced with increasing amounts of straw (Figure 1). The same behavior was observed when the aerial part of the plant dry matter was analyzed. The dry matter decreased in a polynomial form with increasing amounts of straw covering the soil surface. The number and the dry matter of *P. maximum* plants decreased linearly with increasing amounts of straw on the soil surface. Plant counts conducted 35 DAA showed that 15 ton. ha^{-1} of straw on the soil surface reduced *B. decumbens* and *P. maximum* plants emergence by 74 and 65%, respectively, compared to plots not covered with straw. Despite this reduction with the straw treatment (15 ton. ha^{-1} of straw), an average of 33 plants of *B. decumbens* and 50 of *P. maximum* per pot were found, and under field conditions, this situation would demand complementary control of those weeds.

For each of the five levels of straw, the number and the dry weight of *B. decumbens* and of *P. maximum* plants underwent polynomial reductions as the dose of S-metolachlor increased (Figure 2). S-metolachlor was efficient in controlling the weeds and, in general, the dose of 0.96 kg ha^{-1} was adequate for the efficient control of *B. decumbens* and *P. maximum* for all the amounts of straw (up to 15 ton. ha^{-1}). The results indicate that the 25 mm of simulated rain was sufficient to remove S-metolachlor from the straw to the soil because the biological control of *B. decumbens* and *P. maximum* was not affected.

The herbicide remaining in the straw (that is, the part that did not leach into the soil) may have been absorbed by the surviving seedlings when they were growing up through the straw layer. For S-metolachlor, this is possible because it is absorbed by the mesocotyl and coleoptile of seedlings before they emerge above soil surface. In the second experiment, *P. maximum* seedlings (but not those of *B. decumbens*) were capable of absorbing S-metolachlor from the straw. These data were sequentially presented.

Contrary to the observations made in this study, when beans in another study were directly sown under corn straw, metolachlor was not detected 15 days after its application in any of the soil layers (0-5, 5-10, and 10-15 cm) analyzed (FONTES et al., 2004). Teasdale et al. (2003) found that metolachlor had lower initial concentrations in the soil when the herbicide was sprayed over *Vicia villosa* straw, and the low concentrations resulted in poor control of *Panicum dichotomiflorum*. In both studies, the authors ascribed the results to the retention of the herbicide by the plant residues covering the soil surface and also to increased losses of the herbicides to the surrounding environment. S-metolachlor is a stereoisomer of metolachlor (KURT-KARAKUS et al., 2010) that has a high biological activity (MUNOZ et al., 2011). The amount of rain after the herbicide was applied may have had an important effect on the retention of the herbicide. Oliveira et al. (2001) speculated that the low precipitation during the first days after a mixture of atrazine and metolachlor was applied might explain the limited removal of the metolachlor from the plant residues to the soil.

Other authors have studied the effect of sugarcane straw on herbicide interception. Cavenaghi et al. (2007) reported that in amounts of straw equal to or higher than 5 ton. ha^{-1}, the herbicide amicarbazone (solubility = 4,600 mg L^{-1} at pH 4-9) was almost completely intercepted. Therefore, the amount of the product capable of reaching the soil when amicarbazone was applied was nearly zero. However, a 20-mm rain that fell over the area removed a large portion of the herbicide. After applying a mixture of clomazone and hexazinone (solubility = 1,100 and 29,800 mg L^{-1} at 25°C, respectively), 2.5 mm of rain was enough to wash the mixture away from sugarcane straw at a rate of 5.0 ton. ha^{-1} (NEGRISOLI et al., 2011). These findings indicate that herbicides with higher solubility than that of S-metolachlor can be retained by a straw layer and that, depending on the solubility of the molecule, only small amounts rain or irrigation water is needed for the herbicide to be leached into the soil.

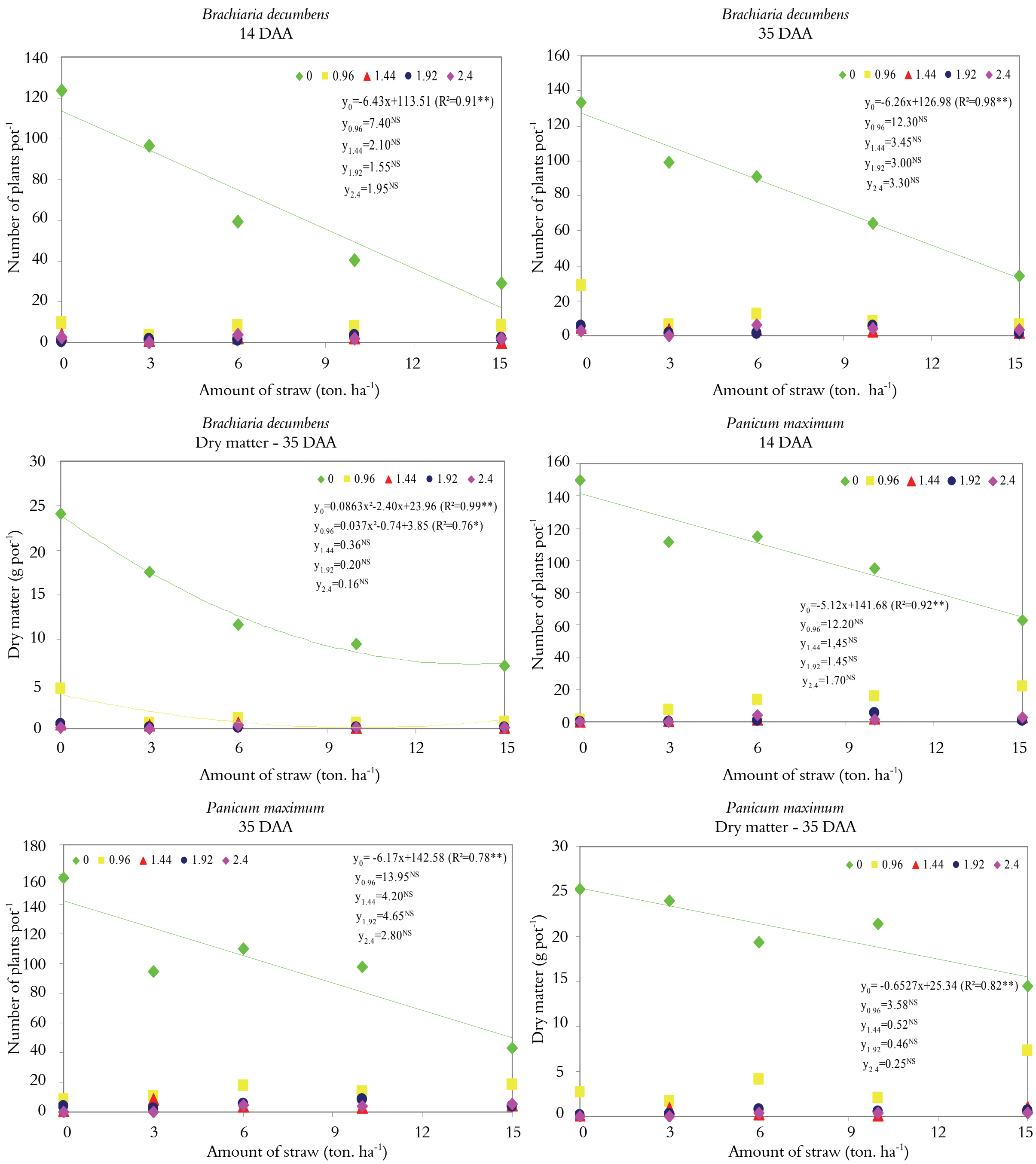

Figure 1. The number of *Brachiaria decumbens* and *Panicum maximum* plants at 14 and 35 days after the application of the herbicide S-metolachlor and the dry matter of the plants 35 DAA as functions of the amount of straw covering the soil surface and the doses of the herbicide.

The control of *Brachiaria decumbens* and *Panicum maximum* by the herbicide S-metolachlor as functions of the interval of time between herbicide application and the occurrence of rain and the amount of straw covering the soil surface (second experiment)

All the evaluated characteristics were significantly influenced by the interval of time between the herbicide application and the occurrence of simulated rain as well as by the interaction between rain and straw (Table 3). The presence or absence of straw on the soil surface had a significant influence on the emergence of *B. decumbens* at 21 and 42 DARS, the emergence of *P. maximum* at 21 DARS and on the dry matter of both species.

Without sugarcane straw, the number of plants and the dry matter of *B. decumbens* and *P. maximum* did not differ significantly among the time intervals between the application of S-metolachlor and the simulation of rain (Tables 4, 5, and 6). These results indicate that, when no straw covered the soil surface, the efficiency of S-metolachlor in controlling weeds is not hampered by rain regardless of whether the rain occurs one day before the application of the herbicide or 20 days later. However, when straw covered the soil surface, the time intervals had a significant effect on the herbicide efficacy. The results thus show that the emergence and the dry matter of *B. decumbens* plants were lower when rain was simulated to occur just after the application of the herbicide and that these values were not significantly different from those obtained at 4, 8, and 12 DARS. Therefore, the control of *B. decumbens* by S-metolachlor was not affected by a 30-mm rain occurring up to 12 days after the herbicide application.

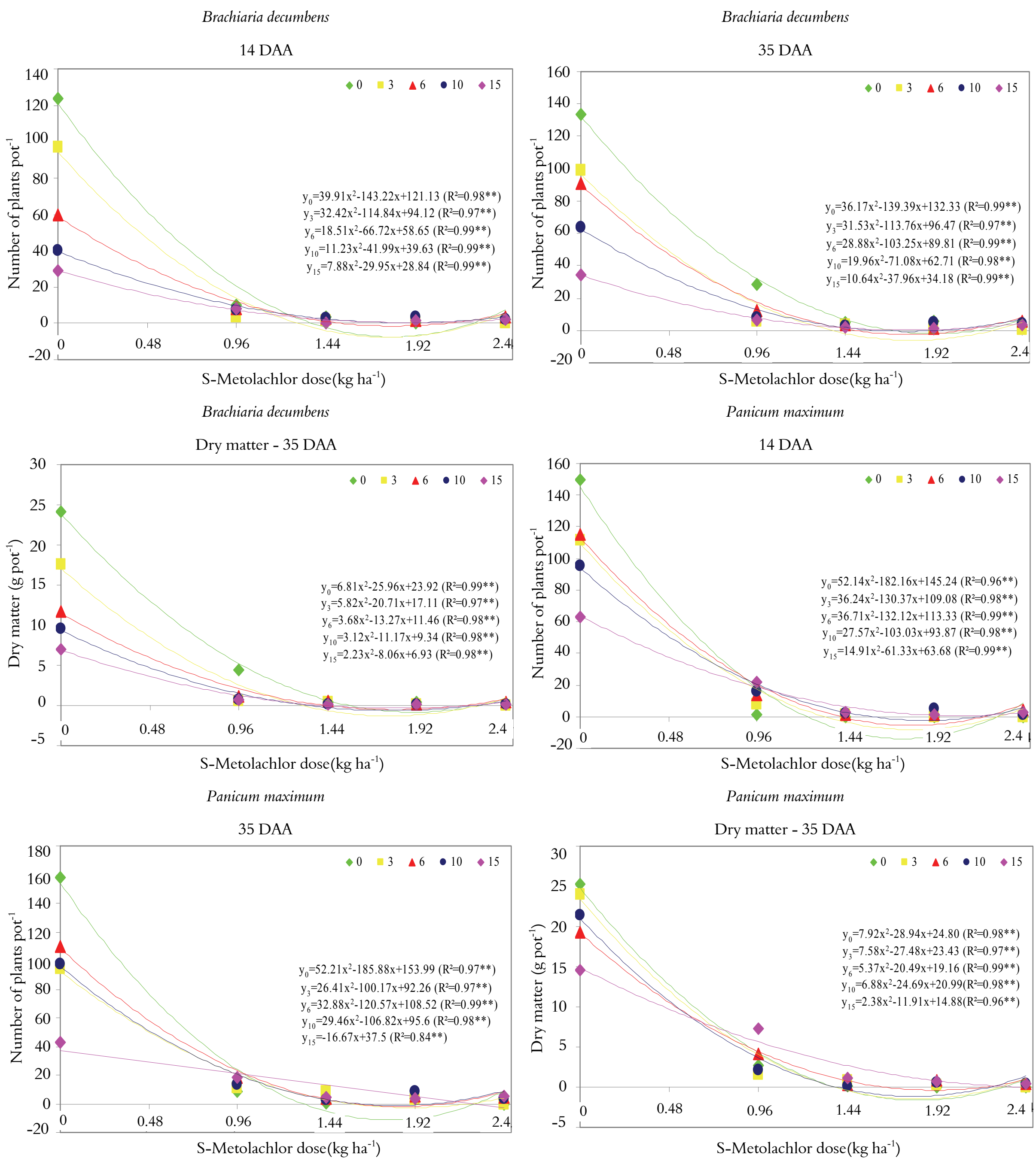

Figure 2. Number of *Brachiaria decumbens* and *Panicum maximum* plants at 14 and 35 days after the application (DAA) of the herbicide S-metolachlor and the dry matter of the plants 35 DAA as functions of the herbicide dose and the amount of straw on the soil surface.

Table 3. Results of an F test of the analysis of variance for number of plants of *Brachiaria decumbens* and *Panicum maximum* at 21 and 42 days after rain simulation (DARS) and dry matter of the aerial parts at 42 DARS.

Sources of variation	*B. decumbens*			*P. maximum*		
	Number of plants		Dry matter	Number of plants		Dry matter
	Days after herbicide application					
	21	42	42	21	42	42
Rain	101.99**	155.62**	231.89**	89.89**	103.68**	50.95**
Straw	4.81**	7.02*	0.26	9.85**	0.68	16.91**
Rain x Straw	64.26**	86.19**	130.28**	19.72**	19.38**	9.23**
CV (%)	28.09	24.31	6.26	34.31	34.06	49.24

**, * Significant at the levels of 1% and 5% of probability, respectively, by the F test of the analysis of variance.

Table 4. The number of plants per pot of *Brachiaria decumbens* at 21 and 42 days after rain simulation (DARS) as functions of the time interval between the application of S-metolachlor and rain simulation and of presence or absence of straw covering the soil surface.

Rain simulation - days after the herbicide application	21 DARS		42 DARS	
	Straw (ton. ha^{-1})			
	0	10	0	10
One day before	3.50 a A[(1)]	36.25 c B	2.50 a A	34.00 cd B
Soon after	4.25 a A	5.25 a A	3.50 a A	4.50 a A
Four days later	8.00 a A	16.75 ab B	7.00 a A	14.75 ab B
Eight days later	4.25 a A	17.75 ab B	3.00 a A	14.00 ab B
Twelve days later	8.00 a A	15.00 ab A	9.00 a A	14.50 ab A
Sixteen days later	9.50 a A	26.00 bc B	7.75 a A	24.00 bc B
Twenty days later	8.75 a A	32.50 c B	6.25 a A	30.25 cd B
Control treatment[(2)]	111.00 b B	34.00 c A	106.00 b B	35.25 d A
LSD (by row)	8.50		6.82	
LSD (by column)	13.41		10.75	

[(1)]Means within a column followed by the same lowercase letter and means in a row followed by the same uppercase letter are not significantly different at the 5% level of probability according to Tukey's test. [(2)]Rain simulation occurred on the same day as the herbicide application in the other treatments.

Table 5. The number of plants per pot of *Panicum maximum* at 21 and 42 days after rain simulation (DARS) as functions of the time interval between the application of S-metolachlor and rain simulation and of the presence or absence of straw covering the soil surface.

Rain simulation - days after the herbicide application	21 DARS		42 DARS	
	Straw (ton. ha^{-1})			
	0	10	0	10
One day before	0.75 a A[(1)]	28.00 ab B	2.00 a A	17.25 ab B
Soon after	7.50 a A	12.25 a A	7.00 a A	8.75 a A
Four days later	8.50 a A	23.50 ab B	8.50 a A	16.00 ab A
Eight days later	6.75 a A	22.00 ab B	4.50 a A	17.25 ab B
Twelve days later	16.00 a A	20.75 ab A	15.50 a A	20.00 ab A
Sixteen days later	10.25 a A	33.75 b B	12.50 a A	26.50 ab B
Twenty days later	15.00 a A	33.50 b B	17.25 a A	31.50 b B
Control treatment[(2)]	139.50 b B	70.75 c A	143.00 b B	67.75 c A
LSD (by row)	12.90		13.37	
LSD (by column)	25.14		18.64	

[(1)]Means within a column followed by the same lowercase letter and means in a row followed by the same uppercase letter are not significantly different at the 5% level of probability according to Tukey's test. [(2)]Rain simulation occurred on the same day as the herbicide application in the other treatments.

Table 6. Dry matter (g pot^{-1}) of the aerial part of *Brachiaria decumbens* and *Panicum maximum* plants 42 days after rain simulation as functions of the time interval between the herbicide application and rain simulation and the presence or absence of straw covering the soil surface.

Rain simulation - days after the herbicide application	*B. decumbens*		*P. maximum*	
	Straw (ton. ha^{-1})			
	0	10	0	10
One day before	0.39 a A[(1)]	4.84 e B	0.08 a A	2.02 ab A
Soon after	0.19 a A	0.23 a A	0.18 a A	0.21 a A
Four days later	0.29 a A	0.76 ab A	0.51 a A	2.59 ab B
Eight days later	0.17 a A	0.84 ab A	0.16 a A	2.36 ab B
Twelve days later	0.62 a A	0.83 ab A	0.42 a A	2.91 ab B
Sixteen days later	0.54 a A	1.77 bc B	0.44 a A	3.76 b B
Twenty days later	0.31 a A	2.31 c B	0.53 a A	5.05 b B
Control treatment[(2)]	12.97 b B	3.59 d A	14.16 a B	8.79 c A
LSD (by row)	0.71		2.01	
LSD (by column)	1.12		3.17	

[(1)]Means within a column followed by the same lowercase letter and means in a row followed by the same uppercase letter are not significantly different at the 5% level of probability according to Tukey's test. [(2)]Rain simulation occurred on the same day as the herbicide application in the other treatments.

The emergence of *P. maximum* plants was also reduced when rain was simulated to occur just after the application of the herbicide. This level of emergence was significantly different from that resulting from intervals of 16 days (at 21 DARS and for dry matter), 20 days and control treatment. Keeping 10 ton. ha^{-1} of straw covering the soil surface and rainfall from 1 day before to 12 days after the application of the herbicide had no negative significant effects on the efficacy of S-metolachlor in controlling *P. maximum*.

Generally, S-metolachlor was more efficient in controlling *B. decumbens* when the soil surface was free of straw and when rain occurred 1 day before or 16 or 20 days after the herbicide application. In the other time intervals, the straw treatments did not differ among themselves. *P. maximum* plants were more efficiently controlled by S-metolachlor when no straw covered the soil surface and when the simulated rain occurred 4, 8, 12, 16, or 20 days after the herbicide was applied. However, the straw treatments did not differ among themselves when the rain took place one day before or soon after the herbicide was applied.

In the control treatment with straw, there was a reduction in plant emergence and dry matter accumulation in comparison with the control treatment without straw; the reduction in plant emergence of *B. decumbens* was 72% and that of *P. maximum* was 53%. These results are an indication that straw has an inhibitory effect on the emergence and development of those weeds due to physical, chemical or biological processes.

The inhibiting effect of sugarcane straw on the emergence of weeds was also reported by Correia and Durigan (2004). According to these authors, covering the soil with raw sugarcane straw reduced *B. decumbens* seed viability because the ungerminated seeds, after straw removal, were not capable of germinating even under favorable environmental conditions. The authors attributed the loss of *B. decumbens* seed viability to physical, chemical or biological factors inherent to the straw. Sugarcane straw maintained on the soil surface interferes with the germination of *B. decumbens* seeds and, consequently, the soil seed bank composition.

Conclusion

The response of *B. decumbens* and *P. maximum* to varied doses of S-metolachlor was not affected by the amount of sugarcane straw left on the soil surface.

When there was no straw covering the soil surface, simulated rain occurring before or up to 20 days after the application of the herbicide did not affect the efficacy of S-metolachlor in controlling *B. decumbens* and *P. maximum*. With 10 ton. ha^{-1} of straw, S-metolachlor was capable of efficiently controlling the weeds even when it rained up to 12 days after application. *P. maximum* was controlled even when the rain fell one day before the herbicide application.

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