Allelopathic Interactions Among Forage Grasses and Legumes

A P.S Souza Filho
EMBRAPA-CPATU

T de J.D. Rodrigues
UNESP

L.R. de A. Rodrigues
UNESP

R A. Reis
UNESP

ALLELOPATHIC INTERACTIONS AMONG FORAGE GRASSES AND LEGUMES

A.P.S. SOUZA FILHO[1], T. de J.D. RODRIGUES[2], L.R. de A. RODRIGUES[2], R.A. REIS[2]*
[1] EMBRAPA-CPATU- CP 48, 66095-970 Belém-PA, Brazil
[2] UNESP-14870-000- Jaboticabal-SP, Brazil
* Supported by CNPq

ABSTRACT
Aqueous extracts at 10% were prepared with the shoots of the grasses *Brachiaria brizantha* cv. Marandú, *B. decumbens*, *B. humidicola*, and of the legumes *Calopogonium mucunoides*, *Leucaena leucocephala*, *Stylosanthes guianensis* cv. Mineirão. The effects of the extracts were evaluated on the germination and on the radicle-elongation of the forages. The pH, the electric conductivity and the osmotic potential of the extracts were determined. The germination and radicle biossays were conducted in germination chambers, with controlled temperature and photoperiod. The pH and the presence of ions did not contribute to the effects observed. The extracts of the legumes tended to reduce the growth of the grasses to a greater extent than the grasses reduced the growth of the legumes. The radicle-elongation was a more sensitive indicator to evaluate the effects of the extracts than the germination (%). The *C. mucunoides* was the legume with higher allelopathic effect, while among the grasses there was not a remarkable species.

KEYWORDS
Allelopathy, aqueous-extract, germination, radicle-elongation, tropical forages

INTRODUCTION
Up to date informations on allelopathy in forage plants cultivated in Brazil have suggested that some species have a greater competitive ability or are easier to establish in mixed pastures than others, probably due to their allelopathic properties.

Allelopathy must be considered in agronomy because it allows the selection of forage plants that can control undesirable species, as well as influence the establishment of grasses and legumes, increasing the productivity and the persistence of the pastures (WARDLE, 1987).

The objective of this study was to determine and characterize potentially allelopathic interactions among three grasses and three forage legumes.

MATERIALS AND METHODS
Signal grass (*Brachiaria decumbens*), Marandu grass (*B. brizatha* cv.Marandu), Humidicola grass (*B. humidicola*), Leucaena (*Leucaena leucocephala*), Mineião (*Stylosanthes guianensis* cv. Mineião) and Calopogonio (*Calopogonium mucunoides*) were grown in 100 L boxes containing a dark-red Latossol fertilized with 100 kg/ ha of N, 100 kg/ ha of P_2O_5 and 60 kg/ ha of K_2O, applied as ammonium sulphate, single superphosphate and potassium chloride, respectively.

All plants were cut close to the ground four months after sowing, washed and dried at 39°C for 72 hours. The material was ground to prepare aqueous extracts at 10%, which had their osmotic potential (OP), pH, and electric conductivity (EC) determined .

The allelopathic potential of the forages was evaluated considering the effects of the aqueous extracts on the germination percentage and radicle-elongation. The germination experiments were conducted in germination chambers, with constant temperature of 25°C for legume seeds and 35/15°C for the grass seeds, with a photoperiod of 12 hours. The radicle-elongation biossays were conducted at 25°C and a photoperiod of 24 hours for all species.

Calopogonio and Mineirão seeds were scarified with sand paper, and leucaena seeds were soaked in hot water (80°C) for 4 minutes to break dormancy. Each germination box received 6 ml of aqueous extract or of water (control). Seeds were considered germinated when the radicle was ž 2 mm, and the radicle-elongation was recorded after 10 days.

The OP effects were evaluated using polyethylene-glycol solutions containing 0; 78.49; 119.57; 151.40; and 178.34 g of PEG per liter of water, corresponding to OPs of 0; -0.1; -0.2; -0.3; and -0.4 MPa.

The experimental design was a complete randomized block, with three replications.

RESULTS AND DISCUSSION
The values of pH, EC (mm.ho) and OP (MPa) determined in each extract were, respectively: *humidicolagrass* (5.68; 3,36; -0.26), signalgrass (3.72; 3.62; -0.28), Marandugrass (5.00; 3.13; -0.22); Leucaena (5.74; 3.22; -0.28); Mineirão (5.23; 2.96; -0.18) and Calopogonio (5.49; 4,04; -0.31).

The pH and the values of the EC due to presence of cations in the aqueous extracts can affect the germination of seeds (CHOU, 1989), but this seems not to have happened in this work in agreement with REDMANN & ABOUGUENDIA (1979) and RUMBAUGH *et al*. (1993).

Assuming the additive character of the OP and allelopathy (WARDLE *et al*., 1992) the effect of the OP of the aqueous extract was discounted from the total reduction observed using regression equations.

The grass extracts had little effect on the germination of the legumes. Only Marandugrass and signalgrass showed potentially allelopathic effects on the cv. Mineião, causing reductions of 19.14% and 28.36, respectively (Table 1).

The extracts of the legumes caused a reduction on the germination of the grasses, except for Mineião which did not affect (P>0,05) the germination of humidicolagrass. Calopogonio presented the greater allelopathic potential causing an average reduction of 63.90% on the germination of the grasses (Table 2).

The radicle- elongation of the legumes was reduced by the grasses extracts (Table 1) as found by WESTON & PUTNAM (1986). Marandugrass showed a higher potential to reduce the growth of the legume-radicles causing an average reduction of 50.07%.

The legume-extracts also reduced the radicle growth of the grasses (Table 2). Calopogonio caused an average reduction of 74.03% on the elongation of the grass-radicles. The extracts of the legumes tended to reduce the germination and radicle- elongation of the grasses to a greater extent than the grasses reduced the same processes in the legumes.The radicle elongation was a more sensitive indicator to evaluate the allelopathic effects than the germination percentage.

REFERENCES

CHOU, C.H. 1989. Allelopathic research of subtropical vegetation in Taiwan. IV - Comparative phytotoxic nature of leachate from four subtropical grasses. J. Chem. Ecol., **15:** 2149-2159.

REDMANN, R.E., ABOUGUENDIA, Z.M. 1979. Germination and seedling growth on substrate with extreme pH. Laboratory evaluation of buffers. J. Appl. Ecol., **16:** 901-907.

RUMBAUGH, M.D., JOHNSON, D.A. PENDERY, B.M. 1993. Germination inhibition of alfalfa by two component salt mixtures. Crop. Sci., **33:** 1046-1050.

WARDLE, D.A. 1987. Allelopathic in New Zealand pasture grassland ecosystem. New Zealand J. Exp. Agric., **15:** 243-255.

WARDLE, D.A., NICHOLSON, K.S., AHMED, M. 1992. Comparison of osmotic and allelopathic effects of grass leaf extracts on grass seed germination and radicle elongation. Plant Soil, **140:** 315-319.

WESTON, L.A., PUTNAM, A.R. 1986. Inhibition of legumes seedling growth by residues and extracts of quackgrass (*Agropyron repens*). Weed Sci., **34:** 366-372.

Table 1

Effects of extracts of the shoots of three grasses on the germination (G-%) and radicle-elongation (RE-cm) of three legumes.

Donnor grass species	Extract	Acceptor legume species: Leucaena G	Leucaena RE	Mineião G	Mineião RE	Calopogonio G	Calopogonio RE
Humidicola	n**	55.46 a	7.13 a	48.84 a	2.07 a	62.98 a	8.14 a
	w	50.78 a	2.70 b	46.53 a	1.37 b	63.94 a	3.42 b
TR(%)*			62.13		33.81		57.98
AR(%)			62.13		26.74		39.79
Marandu	n	56.81 a	6.83 a	52.34 a	1.79 a	65.96 a	6.20 a
	w	62.14 a	2.88 b	42.32 b	1.05 b	60.82 a	2.01 b
TR(%)			57.83	19.14	41.34		67.58
AR(%)			57.83	19.14	35.97		56.40
Signal	n	64.38 a	2.43 a	54.75 a	2.11 a	65.45 a	8.06 a
	w	61.97 a	1.57 b	39.22 b	1.44 a	63.96 a	3.53 b
TR(%)			33.39	28.36	31.75		56.20
AR(%)			35.39	28.36	23.81		34.87

*TR = Total reduction %; AR = Allelopathic reduction.

**n = no extract; w = With extract

+ Means followed by the same letter in each column are not different (P(0.05) by the test of Tukey.

Table 2

Effects of aqueous extracts of the shoots of three legumes on the germination (G-%) and radicle-elongation (RE-cm) of three grasses.

Donnor legume species	Extract	Acceptor grass species: Humidicola G	Humidicola RE	Signal G	Signal RE	Marandu G	Marandu RE
Leucaena	n**	58.09 a	3.56 a	63.45 a	4.51 a	53.95 a	2.11 a
	w	43.85 b	1.31 b	36.46 b	2.95 b	31.51 b	1.91 a
TR(%)*		24.51	63.20	42.53	34.59	41.59	4.47
AR(%)		24.51	63.20	39.84	34.59	29.85	9.47
Mineirão	n	52.35 a	4.17 a	58.11 a	9.16 a	51.18 a	3.65 a
	w	54.74 a	1.79 b	29.76 b	4.10 b	36.86 b	2.32 b
TR(%)			57.07	48.79	55.24	27.98	36.44
AR(%)			57.07	48.79	55.24	19,31	28.17
Calopogonio	n	38.45 a	3.80 a	66.96 a	6.35 a	43.85 a	3.35 a
	w	29.32 b	0.91 b	3.82 b	1.78 b	9.26 b	0.70 b
TR(%)		23.74	76.05	94.29	71.97	78.99	79.10
AR(%)		23.74	76.05	93.87	71.97	74.08	74.07

*TR = Total reduction %; AR = Allelopathic reduction.

**n = no extract; w = With extract

+ Means followed by the same letter in each column are not different (P(0.05) by the test of Tukey.