Allelopathy of *Panicum maximum* Jacq. Cultivars on Tree and Shrub Forage Legumes: Tolerance Index

A. R. P. Almeida
Instituto de Zootecnia, Brazil

T. J. D. Rodrigues
Universidade Estadual Paulista, Brazil

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ALLELOPATHY OF *Panicum maximum* Jacq. CULTIVARS ON TREE AND SHRUB FORAGE LEGUMES: Tolerance Index

A.R.P. Almeida[1] and T.J.D.Rodrigues[2]

[1]Instituto de Zootecnia - Sertãozi, SP, Brasil.

[2]Departamento de Biologia Aplicada à Agropecuária, UNESP-FCAV, Jaboticabal, SP, Brasil.

Abstract

The objective of this work was to evaluate the tolerance of three forage legumes (*Leucaena leucocephala* (Lam.) de Wit., *Cajanus cajan* (L.) Millsp. cv. Kaki and *Sesbania sesban* (L.) Merr.) to the allelopathic effects of three cultivars of *Panicum maximum* Jacq. (cv. Mombaça, cv. Aruana and cv. Tanzânia-1), under greenhouse conditions. The root and shoot tolerance indexes were calculated using the data of dry mass of roots and shoots of plants cultivated in pots and moistened with water or aqueous extracts (0,10 and 20%) of the cultivars of *P. maximum*. The results indicated that: a) the root tolerance index of the forage legumes was an indicator more sensitive than the shoot tolerance index, since the strongest allelopathic effects were observed in the roots; b) *Sesbania* was more tolerant to the grass extracts, followed by pigeon pea and leucaena, being the last the more susceptible to the grass extracts.

Keywords: allelopathic effects, leucaena, pigeon pea, sesbania.

Introduction

The term allelopathy was created by Molish in 1937 to refer to benefits or harmful biochemical interactions among the plants and microorganisms (Rice, 1979). Many types of forage show allelophatic effects (Almeida, 1993; Rodrigues et al., 1993; Chung and Miller, 1995; Fagioli et al., 1997; Almeida et al., 1997; Almeida, 1999) that can affect the grass/legume association in pastures. The available information about *Panicum* allelopathy is scarce and inconclusive. This work was carried out aiming to verify the possible allelopathic effects obtained from three cultivars of *P. maximum* (Mombaça, Aruana and Tanzania), over three arboreus and shrub legumes (leucaena, pigeon pea and sesbania), in three concentrations (0, 10 and 20%), aiming to evaluate the legumes tolerance index to the allelophatic compounds of these grasses.

Material and Methods

The *Panicum maximum* cultivars were sown under field conditions in November 1997 and after 80 days of vegetative growth, the plants (shoot and roots) were harvested, washed and pressed under 4.5 metric tons of hydraulic pressure. The osmotic potential, pH and electrical conductivity of the grass extracts were measured in the extraction day and after thawing, in order to verify if the freezing altered these parameters. Legumes sowing in pots inside the greenhouse were made after scarification and inoculation of seeds. The soil used to fill the pots was analyzed, corrected to reach base saturation (V) of 70% and fertilized according to recommendation of the soil department of the University - Jaboticabal. Then, every pot received 50 mL of each *Panicum* aqueous extracts or water, according to sorted treatment. Shoot and roots of plants were cut after 50 days of sowing. Then they were dried fewer than 65°C temperature inside a forced air circulation oven until constant mass was obtained. With the dry mass data from the shoot and roots it was possible to calculate root tolerance index (RTI) and shoot tolerance index (STI) using the following formula by Taylor and Foy (1985):

$$\text{RTI (or STI)} = \frac{\text{Root (shoot) production with aqueous extracts}}{\text{Root (shoot) production without aqueous extracts}}$$

The adopted experimental design was the randomized blocks with the treatments placed on factorial scheme 3x3x3 (3 legumes, 3 *Panicum* cultivars and 3 extract concentrations), with 4 repetitions, totalizing 108 pots. The results were submitted to analysis of variance and all the analyses processed with "Estat" software, determining the least significant difference by the Turkey test with 5% probability level.

Results and Discussion

Table 1 shows pH value from 6.4/6.9 for aqueous extracts, with little variation among fresh and frozen extracts. Everitt (1983) studying tree legumes observed that germination and radicle growth were suppressed only under pH conditions equal or lower to 2.0 and higher than 12. The electrical conductivity values varied from 1.69 to 4.59 mmho, with a positive correlation between the higher values of conductivity and the highest concentration of the grasses extracts (Table 1). Everitt et al. (1983) verified that conductivity values up to 20 mmho did not present influence on the germination of *Kochia scoparia.* The values of osmotic potential (MPa) varied from –0.099 to –0.311 MPa and were higher at the 20% concentration. Small variation occurred among fresh and frozen extracts. Wardle et al. (1992), studied the osmotic effect of aqueous extracts of four grass species: *Dactylis glomerata, Phalaris tuberosa, Festuca arundinacea* and *Holcus lanatus*, and found out values between -36,7 and -45,8 KPa. They concluded that these osmotic potentials inhibited germination and radicle elongation of several species. The values of pH, electrical conductivity and osmotic potential determined in our research for the grasses extracts, apparently were not variation factors. The values of osmotic potential were lower than those cited and may have caused delay of germination, but they did not attain inhibitory values for germination, which, in general, are lower than –0.5 MPa, e.g. Pereira (1991) and Rodrigues (1993). Related to dry mass of the three legumes when moistened with aqueous extracts from *P. maximum* cultivars, only the dry mass of sesbania root decreased ($P < 0.05$) when moistened with aqueous extracts of mombaça and aruana cultivars (Table 2). Almeida et al. (1993) also found out that the aqueous extracts of the *Brachiaria brizantha* cv. Marandu reduced dry mass production of *Centrosema pubescens*, *Calopogonium mucunoides*, *Macrotyloma axillare* cv. Guata and *Stylosanthes guianensis* roots, that varied according to the evaluated plant. There was not significant difference ($P > 0.05$) on dry mass production of the legumes shoot moistened with aqueous extracts of the grasses. Root tolerance index (RTI) with 10% concentration was higher ($P < 0.05$) in sesbania than in leucaena, showing more tolerance of this legume in lower concentration of the grasses aqueous extracts (Table 2). Based on this index, it was clear that this legume showed higher tolerance to aqueous extracts from *P. maximum* cultivars. Taylor and Foy (1985) verified that SIT shows lower precision than RTI, when evaluating aluminium tolerance of 20 *Triticum aestivum* cultivars, growing in nutritive solution with and without aluminium. It was concluded that the *P. maximum* cultivars studied showed allelopathic effect, varying according to evaluated legume; to them, RTI was a more sensitive indicator than SIT because higher allelopathic effects were found in roots. Sesbania showed to be more tolerant to aqueous extracts from grass cultivars in low concentrations, followed by pigeon pea and leucaena that was more sensitive to allelochemicals.

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Table 1 - The pH, electrical conductivity (mmho), and osmotic potential (MPa) of the extracts of *Panicum maximum* cultivars (10 and 20%), in the moment of extraction and after the thawing.

P. maximum cultivars	Concentrations	Fresh	Thawed
		pH	
Aruana	10%	6,6	6,8
	20%	6,5	6,4
Mombaça	10%	6,7	6,7
	20%	6,5	6,6
Tanzânia-1	10%	6,7	6,9
	20%	6,4	6,6
		Electrical conductivity (mmho)	
Aruana	10%	1,69	1,71
	20%	3,09	3,06
Mombaça	10%	2,46	2,93
	20%	4,42	4,59
Tanzânia-1	10%	1,99	2,03
	20%	3,45	3,39
		Osmotic potential (MPa)	
Aruana	10%	-0,099	-0,126
	20%	-0,201	-0,205
Mombaça	10%	-0,179	-0,152
	20%	-0,311	-0,249
Tanzânia-1	10%	-0,148	-0,135
	20%	-0,293	-0,187

Table 2 - Root dry mass and root tolerance index of three forage legumes, under effect of aqueous extracts obtained from three *Panicum maximum* cultivars.

	Cultivars		
Legumes	Mombaça	Aruana	Tanzânia-1
	.... Root Dry Mass (g)		
Leucaena	0,83 Ac	0,92 Ac	0,87 Ab
Pigeon pea	2,89 Aa	3,14 Aa	2,90 Aa
Sesbania	2,33 Bb	2,55 Bb	3,08 Aa
	Concentrations		
	10%	20%	
	.... Root Tolerance Index (RTI)		
Leucaena	0,73 Ab	0,89 Aa	
Pigeon pea	0,92 Aab	0,97 Aa	
Sesbania	1,07 Aa	0,93 Aa	

Means followed by same letters, capital letters in lines and lower case letters in columns, are not significantly different by the Tukey test (P > 0,05).