ALLELOPATHIC INFLUENCE OF *ERAGROSTIS CURVULA* WATER EXTRACT ON SEED GERMINATION AND SEEDLING GROWTH OF TWO OTHER SPECIES

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Abstract

Weeping lovegrass (*Eragrostis curvula* Schrad. Nees) is a very agressive tropical species and does not grow well with other species. This study was set up to investigate the allelopathic effect of various extract concentrations of weeping lovegrass on seed germination of white clover (*Trifolium repens* L.) and bentgrass (*Agrostis stolonifera* L.) and the seedling development of white clover. Labotatory and growth chamber studies were conducted. Extract concentrations of 13.6, 27.2, 40.8, 54.4, and 62.0 g/100mL of water were studied. Treatments were arranged in a completely ramdomized design with three replications. The allelopathic effect of weeping lovegrass was significant ($P<0.01$) on white clover and bentgrass. White clover was affected by lower extract concentration than bentgrass. The seedling growth of white clover was reduced when compared with the control ($P<0.01$) for root growth and ($P<0.04$) for whole plant. The osmotic potential also affected ($P<0.01$) seed germination of white clover. For the highest concentrated solution there was a decrease of 20% on the seed germination of white clover due to the water potential.

Keywords: bentgrass, white clover

Introduction

Plant succession, plant mixture, no-till agriculture, intercropping and crop sequence are all important plant to plant relationships where allelopathic effects can be harmful or beneficial, depending upon plant management. Rice (1984) defined allelopathy as the direct or indirect effect including both harmful and beneficial interactions between all types of plants on another through the production of chemical compounds that escape to the environment. Rice (1984) also pointed out that the effect of allelopathy depends on a chemical compound being added to the environment by an allelopathic agent, separating it from competitivity that involve the removal or reduction of light, water, and minerals which are required by some other plant sharing the espace. The allelopathic effect of nine forage grass extracts were studied as to their relation with alfafa poor establishment (Chung and Miller, 1995a), and the conclusion was that grass residue may affect alfafa growth and development because of inhibitory effects of allelochemicals present in grass residues. Coelho (1986) found *Eragrostis plana* Nees. to be allelopathic to white clover and to annual ryegrass (*Lolium multiflorum* L.) but had no effect on birdsfoot trefoil (*Lotus corniculatus* L.) seed germination and seedling growth. Chung and Miller (1995b) showed that alfafa autotoxicity may result from a release of one or more water soluble compounds from alfafa leaf tissue. The objective of this research was to determine the effect of aqueous extracts of weeping lovegrass leaves on the seed germination of white clover and bentgrass, and seedling growth of white clover.

Material and Methods

In August 1995, green leaves of weeping lovegrass were harvested, brought to the laboratory, and prepared for making the extracts. The leaves were soaked in water for 24 h at

room temperature, around 25ºC. The concentractions used in the experiment were 13.6, 27.2, 40.8, 54.4, and 68,0 g of leaves tissue per 100 mL of water. These extracts were first filtered through four layers of cheese cloth and again filtered through filter paper (Whatman nº 42).

Seed biossay. The germination tests were conducted according to the Seed Science and Technology Rules (ISTA, 1996) for each species. Before the germination test, bentgrass seeds were prechilled at 5ºC for 7 days. During the 28 days test these seeds were maintained in night/day temperature of 15 /30ºC and ligth/dark of 8 /16 h, KNO_3 was also applied. Germination test for the white clover seeds was 7 days long at constant temperature of 20ºC. One hundred seeds of each specie were evenly distributed on filter paper (Whatman nº 1) in sterilized 9 cm petri dishes. Ten milliliters of extract solution from each concentraction were added to each petri dish and distilled water was used as control.

Seedling growth. Seedings were grown in a chamber with temperature, light and humidity controlled to the best requirements for white clover growth. Pots with 600 g of a mixture of sandy and dry soil were seeded with clover. After germination the pots were thinned to ten seedlings per pot. Sixty milliliters of each extract concentration was applied three times to each pot at intervals of fifteen days. Distilled water was used for irrigation to all pots whenever needed. The control was always irrigated with distilled water. Dry weight of leaves, roots and whole plant were recorded 60 days after planting.

Osmotic potential. In order to verify which was the extent of osmotic potential on the seed germination of white clover an osmotic potential essay was performed. Solutions of Mannitol were prepared at similar osmotic potentials of that of the weeping lovegrass extracts used in the seed germination and seedling development assays. The osmotic potential of these solutions varied from – 0.75 to – 5.15 bars. Treatments were arranged in a

completely randomized design with three replications of 100 seeds each one. Data were analysed by analysis of variance (Proc GLM).

Results and Discussion

At extract concentrations of 54.4 and 68.0 g/100 mL the percentage of seed germination was for white clover 25.0 and 5.3 and for bentgrass 67.7 and 52.3, respectively (P 0.01). The seed germination decreased ($P<0.01$) with increasing extract concentration, for both, white clover and bentgrass (Table 1). There was specificity of allelopathic effect, where, white clover had germination reduced in 91.7 percentual points, while bentgrass germination was reduced in 44.0 percentual points when compared with each control (Table 1). These results are similar to many others found in the literature that reported inhibition of seed germination of many species when used plant extract of the same or different species (Chung and Miller, 1995a and 1995b, and Rice 1984). The type of effect of weeping lovegrass extracts on seedling development of white clover was also evaluated. There was an inhibitory effect on the development of roots ($P<0.02$) and whole plants ($P<0.04$) of white clover (Table 2). The extract concentraction of 27.2 g/100 mL and over significantly inhibited growth of root and the whole plant of white clover seedlings (Table 2). Dry weight of leaves follows the same trend of unhibitory effect as roots and whole plant. As the extract concentration increased, the effect of phytotoxicity became evident in poor seedling development and by causing seedling death at the concentration of 40.8, 54.4, and 68.0 g/100 mL. The highest extract concentration 68.0 g/100 mL was the most inhibitory and reduced the total dry weight of white clover roots by 72.4% and whole plant weight by 67.7% (Table 2). Seed germination of white clover was affected ($P<0.01$) by the osmotic potential of the Manitol solutions . For the highest concentration solution (-5.15 bars) there was a decrease of 20% on seed germination due to osmotic potential. The important aspect is that water

potential plays a role in this kind of response and its effect may be confounded with allelopathy. This type of study need to be carefully conducted and high concentrations of plant extract should be avoided.

White clover and bentgrass, were affected by the allelopathic effect of weeping lovegrass extracts. There was also an effect of the osmotic potential on the seed germination of white clover.

References

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Table 1 - Influence of aqueous extract concentration of weeping lovegrass on the germination of white clover and bentgrass seeds.

Species	Germination, by extract concentraction (g/100 mL)						S E
	0	13.6	27.2	40.8	54.4	68.0	0.01
	---------- % ----------						
white clover[a]	97.0	78.3	80.0	71.7	25.0	5.3	2.1
bentgrass[b]	96.3	87.3	87.6	75.0	67.7	52.3	0.8

[a] Effect of extract concentration on white clover ($P<0.01$)
[b] Effect of extract concentration on bentgrass ($P<0.01$)

Table 2 - Influence of aqueous extract concentration of weeping lovegrass on the dry weight of roots, leaves and whole plant of 60 days old white clover seedlings.

Plant Parts	Total dry wt. by extract concentration (g/100 mL)						S E
	0	13.6	27.2	40.8	54.4	68.0	0.01
	---------- g/pot ----------						
Roots [a]	0.87	0.70	0.63	0.63	0.60	0.24	0.1
Leaves[b]	2.2	2.0	1.8	1.6	1.4	0.8	0.3
Whole Plant[c]	3.1	2.7	2.4	2.2	2.0	1.0	0.4

[a] Effect of extract concentration on white clover roots ($P<0.02$)
[b] Effect of extract concentration on white clover leaves ($P<0.06$)
[c] Effect of extract concentration on white clover whole plants ($P<0.04$)