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ALLELOPATHIC SUPPRESSION OF ETHYLACETATE SOLUBLE FRACTIONS OF NUTGRASS (*Cyperus rotundus* L.) EXTRACTS ON THE GERMINATION OF *Mimosa pudica* AND *Hyptis capitata*

(Efek allelopati 'ethylacetate soluble fractions' ekstrak teki terhadap perkecambahan gulma Mimosa pudica *dan* Hyptis capitata*)*

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ABSTRAK

Percobaan mengenai pengaruh 'ethylacetate soluble fraction' ekstrak teki terhadap perkecambahan gulma *Mimosa pudica* dan *Hyptis capitata* telah dilaksanakan di Laboratorium Ilmu Gulma, Fakultas Pertanian Universitas Andalas Padang dari bulan Oktober sampai Desember 1998. Dua seri percobaan, masing-masingnya dalam Rancangan Acak Lengkap, dilakukan terhadap spesies gulma yang berbeda. Perlakuan adalah konsentrasi 'ethylacetate soluble fraction' yaitu 0; 500; 1000; 1500; dan 2000 ppm dan setiap perlakuan diulang sebanyak 3 kali. Lima puluh biji gulma disusun di dalam petri dish yang dialas dengan kertas saring dan dibasahi dengan larutan sesuai perlakuan. Petri dish diletakkan di dalam germinator datar selama 3 minggu. Hasil percobaan membuktikan bahwa perlakuan yang diberikan memiliki potensi dalam menekan perkecambahan gulma yang diuji. Secara umum terlihat bahwa peningkatan konsentrasi perlakuan diikuti oleh penekanan pertumbuhan peubah yang diamati. Perlakuan hanya memberikan pengaruh nyata terhadap persentase perkecambahan *M. pudica*.

INTRODUCTION

Allelopathy is a biochemical interactions among all plants direct or indirect (including fungi and bacteria), both stimulatory and inhibitory influence (Rice, 1984) that is caused by chemical substances which are plant metabolites or their products present in the micro environment, such as rhizosphere (Putnam and Tang, 1986). Allelopathy could be involved in biological control of weeds, specially in an integrated pest management which in turn would minimize agricultural dependence on the syntethic herbicides. This potential is important in attaining sustainable agricultural program (Putnam dan Duke 1974).

Nutgrass (*Cyperus rotundus* L.) is one of the most troublesome weeds in agricultural practices. Its presence causes the reduction of yield of food crops specialty in the tropical region. This reduction is mainly due to negative effects of the phenolic substances it produced. These phenolic substances enhances the nutgrass ability to compete for other plants (Friedman and Horowitz 1971). Meissner *et al.* (1982) reported that the growth of some species such as barley, sorghum, cucumber and tomato was impaired when grown in the soil previously heavily infested with red nutgrass. This allelopathic effects of the nutgrass significantly inhibited the growth of the tested species.

Reports indicated that nutgrass produces phenolic groups of allelochemicals such as salicylic acid, ρ-coumaric acid, vanillic acid, ρ-hydroxybenzoic acid, syringic acid, protocathecuic acid, caffeic acid and eugenol (Jangard *et al.*, 1971) which have the ability to suppress the growth of some crops (Meissner *et al.* 1982).

Komai and Ueki (1980) extracted 6 fractions of methanol extracts of nutgrass. They found that F.1 (essential oil) and F.6 (precipitates in methanol extracts) inhibited the germination of lettuce (*Lactuce sativa* L. cv. New York), white clover (*Trifolium repens* L.) and large crabgrass (*Digitaria adscendens* Henr.). These fractions also gave an effect of autotoxicity.

As data about the effect of the allelopathy of nutgrass to other weeds is still limited, it is important to carry out research to answer the problem. In this experiment, ethylacetate soluble fractions (F.5) was subject to study. The experiment was carried out at the Weed Science Lab. of Fac. of Agriculture Andalas University Padang from October to December 1998. The objective of the experiment was to find the concentration of ethylacetate soluble fractions of nutgrass extracts that has the most inhibitory activities towards the germination of *Mimosa pudica* and *Hyptis capitata*.

MATERIALS AND METHODS

The experiments were carried out at the Weed Science Lab., Fac. of Agriculture, Andalas University Padang during the period of October to December 1998. Two series of experiment, each arranged in a Completely Randomized Design, had 5 treatments and 3 replications. The treatments were different concentration of ethylacetate soluble fractions, i.e. 0; 500; 1000; 1500 and 2000 ppm towards the germination of *Mimosa pudica* and *Hyptis capitata* in each experiment.

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Extractions and fractionations of nutgrass tubers were conducted following the procedure of Komai and Ueki (1990).

Fifty seeds of *M. pudica* and *H. capitata* were placed in petri dish on the No. 1 Whatmann filter paper that was wetted by extract solutions according to treatments. Petri dishes were placed in a germinator for three weeks. Germination days were recorded as the days needed by the seeds to germinate and has radicle > 5 mm. At the end of three weeks time, the number of germinating seeds, coleoptile lenght and radicle lenght were recorded. Data were subjected to Analysis of variance (ANOVA) at 95% level of confidence. When significant differences were detected, further analysis of multiple comparisons was conducted according to Tukey's w Procedure.

RESULTS AND DISCUSSION

In general, observations on different variables indicated that there was no significant difference of treatment effects on the germination of *M. pudica* and *H. capitata*. The only significant effect was noted on the percentage of germinating seeds of *M. pudica*. Data are presented in the following table.

Table 1. Effects of ethylacetate soluble fractions of nutgrass extracts on the germination of *Mimosa pudica* and *Hyptis capitata*, 3 weeks after germinated

treatments ppm)	Germinating days	Coleoptile length (cm)	radicle length cm)	% of germination	
					transformation
Mimosa pudica					
0	6.00	5.77	4.50	22.0	27.50 b
500	6.33	4.30	8.90	18.67	25.59 ab
1000	3.67	4.37	5.73	22.67	28.42 b
1500	6.67	4.37	4.63	18.00	24.96 ab
2000	5.33	4.10	3.67	8.00	16.35 a
Hyptis capitata					
0	7.00	2.43	0.60	2.00	
500	2.00	1.13	0.17	0.67	
1000	5.33	0.30	0.27	0.67	
1500	5.00	2.83	0.37	2.67	
2000	3.33	2.20	0.50	3.33	

Values within a column with different scripts are significantly different from one another according to Tukey's

For both weed species, ethylacetate soluble fractions of nutgrass extracts caused similar effects. As can be seen from the table that the treatments reduced the days needed for germination of the weeds compare to the one without extracts. An interesting trends could be noted for both weed species where data of germinating days, coleoptile length and radicle length fluctuate among different concentrations of treatments. *Mimosa pudica*, for instance, 1000 ppm of treatment resulted in shortest days needed for germination whereas 1500 ppm caused the longest even though no significant difference observed. Different trends occurred on *Hyptis capitata* where the concentration of 500 ppm resulted in the shortest days needed for germination whereas 0 ppm caused the longest. In this case, ethylacetate soluble fractions of nutgrass extracts played a role as growth stimulator that promotes germination.

Coleoptile length and radicle length of both species showed interesting trends. For *M. pudica*, 0 ppm of treatments showed the longest coleoptile whereas the longest radicle caused by the treatment of 500 ppm. *H. capitata* has the shortest coleoptile for the treatments of 1000 ppm whereas the shortest radicle caused by the treatment of 500 ppm. However, treatments did not cause significant difference for these observations.

The only significant effect of treatment was on the percentage of germination of *M. pudica*. Increasing concentration of ethylacetate soluble fractions followed by decrease of percentage of germinaton. The highest concentration (2000 ppm) caused least percentage which is significantly different to the concentration of 0 ppm.

Phenolic groups of allelochemicals such as salicylic acid, p-coumaric acid, vanillic acid, p-hydroxyhenzoic acid, syringic acid, protocathecuic acid, caffeic acid dan eugenol have been extracted from nutgrass and soil that was previously infested by nutgrass (Jangard *et al.*, 1971). Reports indicate that these compounds resulted in inhibitory effects at high concentration

(Zinsmeister and Hollumer 1964 *in* Meissner *et al*., 1982), meanwhile at low concentration these compounds might stimulate the growth of shoots and roots (Horowitz, 1973). Another report states that ferulic acid and p-coumaric acid extracted from wheat (*Triticum sativum* L.) mulch significantly reduced the germination and the growth of radicle of *Raphanus sativa* (Lodhi *et al*., 1987).

Pridham (1965) reported that phenolic compounds not only act as natural inhobitor but also as stimulator. Some of the compounds, even, actively involved in the process of respiration and photosynthesis. In general, allelochemicals could be stimulator or inhibitor (Whittaker and Feeney, 1971) and the toxicity depends upon the concentration of the compounds (Freeland, 1991), the nature of the compounds and the period of time when the compounds exist in the environment (Hale and Orcut, 1987).

CONCLUSION

The conclusion could be drawn from the experiment is that ethylacetate soluble fractions of nutgrass extracts has potential for the suppression of the germination of *Mimosa pudica* and *Hyptis capitata*. In addition, increasing concentration of the treatments caused decreasing % of germination of *M. pudica*.

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