

## 学位論文要旨 Dissertation Abstract

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学位論文題目： **Allelopathic Potential and Allelochemicals in Four Weed Species**  
Title of Dissertation (4種の雑草種のアレロパシー活性とアレロパシー物質)

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Dissertation Abstract

Allelopathy is an important interference mechanism between donor and receptor plants in the environment. In allelopathy, allelochemicals are released from plants which have an effect on the growth, survival and development of its associated plants. The allelopathic potential of plants and allelochemicals are suggested as an alternative tool of managing weeds. During the search for plants with allelopathic potential, there has been a lot of focus on discovering allelopathic weed species. During this search, many species of weed have been studied and have been discovered to have allelopathic properties.

Four different species of weed, namely *Fimbristylis dichotoma* L. (Cyperaceae), *Cyperus difformis* L. (Cyperaceae), *Marsilea crenata* Presl. (Marsileaceae) and *Rumex maritimus* L. (Polygonaceae) were used in the study to investigate their allelopathic potential and to search allelochemicals. The aqueous methanol extracts of *F. dichotoma*, *C. difformis*, *M. crenata* and *R. maritimus* showed significant inhibitory effects on the shoot and root growth of cress, lettuce, alfalfa, rapeseed, barnyard grass, Italian ryegrass, timothy and foxtail fescue test plants in a way which was concentration-dependent. Total inhibition of shoot and root growth of cress, lettuce, alfalfa, and foxtail fescue was discovered at 0.3 g DW equivalent extract/mL by the extracts of *C. difformis*, *F. dichotoma*, *M. crenata*, and *R. maritimus*. Different inhibition levels were also discovered by the extracts when the tested plants underwent other concentrations of treatment. The  $I_{50}$  values (concentration required for 50% inhibition) of four weed species for shoot and root growth of all test plants also differed. Concentration- and species- specific growth inhibitory effects of *F. dichotoma*, *C. difformis*, *M. crenata* and *R. maritimus* on the test plants suggest that these weeds have allelopathic potential and therefore might possess allelochemicals with allelopathic properties.

Two growth inhibitory substances were isolated after a series of chromatography from the aqueous methanol extracts of *M. crenata* and determined by HRESIMS, and <sup>1</sup>H- and <sup>13</sup>C NMR as loliolide and isololiolide. Loliolide and isololiolide inhibited the shoot and root growth of cress at concentrations greater than 10 and 30 μM, respectively, and for barnyard grass both allelochemicals started growth inhibition from 30 μM. There was an increase in inhibition as concentration of loliolide and isololiolide increased. The *I*<sub>50</sub> values of cress and barnyard grass seedlings ranged from 32.1 to 128.5 μM for loliolide and 37.0 to 176.2 μM for isololiolide. These results indicate that loliolide and isololiolide are main growth inhibitory substances which might bear responsibility for the *M. crenata* allelopathic potential.

An aqueous methanol extract of *R. maritimus* was subsequently purified by using chromatography and three growth inhibitory substances were determined by spectroscopic analysis as altechromone A, 5,7-dihydroxyphthalide and 2-methoxystyandrone. 2-Methoxystyandrone, altechromone A and 5,7-dihydroxyphthalide exhibited significant inhibitory effects on the shoot and root growth of cress at concentration higher than 3, 100, 3000 μM, respectively. The *I*<sub>50</sub> values of 2-methoxystyandrone, altechromone A and 5,7-dihydroxyphthalide for cress shoot and root growth were 5.8, 1406.7, 1732.1 and 11.8, 662.4, 2481.2 μM, respectively. The growth inhibitory results of the substances indicate that 2-methoxystyandrone, altechromone A and 5,7-dihydroxyphthalide might be potential allelochemicals in *R. maritimus*.

In this research, four different weed species have shown strong allelopathic potential on the shoot and root growth of test plants, which indicates those weed may contain allelochemicals. Five potent allelochemicals were isolated and identified from *M. crenata* and *R. maritimus* and those allelochemicals also displayed strong allelopathic effects on the growth of cress and barnyard grass seedlings. The study was the first attempt of finding out allelopathic potential in the weed species. Those findings might have greater value for weed allelopathy as well as crop-weed interference mechanism understanding and to use other strategies for weed management.