

## 学位論文要旨 Dissertation Abstract

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学位論文題目： Study on allelopathy of four invasive plant species  
Title of Dissertation (4種の侵略的植物種のアレロパシーに関する研究)

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Dissertation Abstract

Invasive plant species are serious problems worldwide because those plants often eliminate other plants and form huge monotypic stands, resulting in serious damage on native plant ecosystems. To understand such a phenomenon, investigation of the biological characteristics of those species is important. Some invasive plant species have potent allelopathic potential and allelopathy is suggested to be involved in the successful invasion. Therefore, the aims of this study were to investigate allelopathic potential of four invasive plant species cogongrass (*Imperata cylindrica* (L.) Raeusch.), Mexican sunflower (*Tithonia diversifolia* (Hemsl.)), Chinese violet (*Asystasia gangetica* (L.) T. Anderson) and burdock (*Arctium lappa* L.) and to identify allelopathic substances in those plants.

The extracts of cogongrass rhizomes inhibited the root and shoot growth of barnyard grass, ryegrass, timothy, cress, lettuce, and alfalfa. After bioassay-guided separations of the extracts, four growth inhibitory substances, 5-methoxyflavone, 5,2'-dimethoxyflavone, methyl caffeate, and abscisic acid were isolated. 5-Methoxyflavone, 5,2'-dimethoxyflavone, and methyl caffeate significantly inhibited the root and shoot growth of cress at concentrations  $\geq 0.03$ – $0.3$  mM and their concentrations required for 50% growth inhibition ( $I_{50}$ ) were 0.079–0.24, 0.23–1.1, and 0.59–0.88 mM, respectively. The other isolated substance, abscisic acid, has been reported to have strong growth inhibitory activity. Its  $I_{50}$  values on cress were 0.31–0.61  $\mu$ M.

The aqueous methanol extracts of Mexican sunflower leaves inhibited the growth of weed plants, ryegrass, timothy, and barnyard grass and cress. The extracts

were then purified by several chromatographic runs and a phytotoxic substance with allelopathic activity was isolated and identified by spectral analysis as tagitinin C. The substance inhibited the growth of ryegrass, timothy, barnyard grass, and cress at concentrations  $\geq 0.1$ - $0.3$  mM.

The extracts of Chinese violet leaves inhibited the root and shoot growth of cress, lettuce, alfalfa, barnyard grass, ryegrass, and timothy, where the level of inhibition increased with increasing extract concentrations. Bioassay-guided separations of the extracts led to isolation of two phytotoxic substances, indole-3-carboxaldehyde and (6*R*,9*S*)-3-oxo- $\alpha$ -ionol. Indole-3-carboxaldehyde significantly inhibited the root and shoot growth of cress at concentrations  $\geq 100$  and  $30$   $\mu$ M, respectively, and  $I_{50}$  values of the substance were  $210$  and  $127$   $\mu$ M for cress roots and shoots, respectively. The other substance, (6*R*,9*S*)-3-oxo- $\alpha$ -ionol, was reported to have strongly inhibited cress roots and shoots.

Both extracts of burdock leaves and roots inhibited the shoot and root growth of cress and barnyard grass, where the level of inhibition increased with increasing extract concentrations. The leaf extracts had 2.0-2.5 times higher activity than the root extracts. Bioassay-guided separations of the leaf extracts led to isolation of a phytotoxic substance, onopordopicrin. Onopordopicrin significantly inhibited the shoot and root growth of cress at concentrations  $\geq 0.3$  mM and those of barnyard grass at concentrations  $\geq 1$  and  $0.3$  mM, respectively.  $I_{50}$  values of the substance were  $0.27$  and  $0.26$  mM for cress shoots and roots, respectively, and  $1.86$  and  $0.35$  mM for barnyard grass shoots and roots, respectively.

Those results suggest that the four invasive plant species have allelopathic potential and the identified putative allelopathic substances from those plants may play an important role in their allelopathy. Their allelopathic potential may be involved in their invasiveness.