（学位第３号様式）

学 位 論 文 要 旨

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題　目	ALLELOPATHIC POTENTIAL OF BANGLADESH INDIGENOUS RICE VARIETIES (バングラデシュ在来イネのアレロパシーに関する研究)

This Ph.D. project uses an application of the knowledge regarding the recent inclinations in ecological management of the weeds by using Bangladeshi indigenous rice (*Oryza sativa* L. spp. *indica*) allelopathy and their allelochemicals. A series of experiments was conducted in the laboratory, glasshouse, and field of University of the Ryukyus, Japan, from April 2015 to November 2017 to assess the allelopathic potential of 50 Bangladeshi indigenous rice.

Initially 'Boterswar', 'Goria', 'Biron' and 'Kartiksail' varieties were screened out as the most allelopathic by donor-receiver bioassay and equal compartment agar method tests, where *Lactuca sativa* L., *Lepidium sativum* L., *Raphanus sativus* L., *Echinochloa crus-galli* L. and *E. colona* L. were used as test species. Among these selected four varieties 'Boterswar' gave the strongest inhibitory effect on the growth of *E. crus-galli* seedlings in both aqueous methanol extract and aqueous extract tests.

Four biologically active compounds, syringaldehyde (4-hydroxy-3,5-dimethoxybenzaldehyde), (-)-loliolide, 3*β*-hydroxy-5*α*,6*α*-epoxy-7-megastigmen-9-one and 3-hydroxy-*β* –ionone, were isolated and identified from the ethyl acetate phase of 'Boterswar' plant extract which inhibited the root and shoot growth of *E. crus-galli* seedlings significantly in a minute concentration.

In the field study, the infestation levels of weeds were estimated using Simpson's Diversity Index (*SDI*) which ranged from 0.2 to 0.56, in which a significant correlation coefficient (0.87, $P < 0.001$) was obtained by comparing with the root inhibition(%) from the in vitro bioassay. The variety 'Boterswar' was found as the most allelopathic among six tested varieties.

The extent of allelopathic interference relative to resource competition between the varieties 'Boterswar', 'Hashikolmi' and *E. crus-galli* var. *oryzicola* in mixed culture was assessed in a hydroponic system. The results showed that the allelopathic effects of 'Boterswar' were much higher than the resource competition and verified that the allelopathic effect of 'Boterswar' was leading in rice-*E. oryzicola* interactions.

Allelopathic rice 'Goria' straw incorporation into the soil gave inhibitory effects on the growth and dry weight of *E. oryzicola* but had no autotoxicity on the growth of rice. Aqueous methanol extracts of 'Goria' straw inhibited the seedling growth of *L. sativum* and *E. oryzicola*, and two biologically active compounds (-)-loliolide and 3*β*-hydroxy-5*α*,6*α*-epoxy-7-megastigmen-9-one were isolated and identified. The inhibitory activity of 3*β*-hydroxy-5*α*,6*α*-epoxy-7-megastigmen-9-one on the seedling growth of *L. sativum* and *E. oryzicola* was more than (-)-loliolide as demonstrated by comparison of the I_{50} values, however, a strong synergistic inhibitory activity of both compounds was observed on the growth of test species.

Among identified compounds, syringaldehyde was tested to develop an understanding of rice allelopathy and the phytotoxicity of the allelochemicals. Syringaldehyde inhibited seed germination of *E. crus-galli* completely at 1000 µM, and delayed seed germination and significantly affected the germination indices at 100 µM. In general, with the increasing concentration from 100 to 1000 µM, the inhibitory effects on seedlings growth of test species increased and leaf blade wilting, chlorosis and necrosis occurred. Roots of *E. crus-galli* treated with 1000 µM syringaldehyde had black points on root nodes but had no root hairs, root pith cells contracted or reduced, and had fewer and larger vacuoles compared to the control. The syringaldehyde also showed remarkable effects on the growth, physiology and biochemical content of *E. crus-galli* seedlings, supporting the hypothesis that the allelochemicals caused a chemical interference.

Considering the results of all the experiments among 50 Bangladeshi indigenous rice varieties 'Boterswar' was found to be the most promising allelopathic variety. Thus, the allelopathic potential of Bangladesh indigenous rice raises the opportunity to be utilized for weed control in the form of allelopathic rice variety in crop rotation, use in allelopathic variety development, mulching or incorporation, and/or synthetization of natural herbicides to achieve sustainable weed management.