BIOLOGICAL EFFECTS OF ALLELOCHEMICALS FROM BARLEY

By

Supawan Kianmatee

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Dedicated to my mother: *Gee Thapanavoragiat*

PREFACE

I certify that the substance of this thesis has not already been submitted for any degree and is not currently being submitted for any other degree.

I certify that to the best of my knowledge, any help received in preparing this thesis, and all sources used, have been acknowledged in this thesis.

[redacted]

Supawan Kianmatee

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ABSTRACT

The biological effects of allelochemicals from barley were investigated. A barley cultivar that contains high gramine concentrations (cv.Lara) was found to have adverse effects on the growth and development of larvae of the common armyworm, *Mythimna convecta* (Walker). Larvae fed on cv.Lara had lower head width (by about 10%) and body weight (by about 30%) than larvae fed on cv.Schooner. Gramine concentration in leaves of cv.Lara was more than 200x that of leaves of cv.Schooner. There were no significant differences in the survival of larvae on the two cultivars.

Gramine, when incorporated into artificial diets, was found to have no significant effect on the growth and development of *M. convecta*, although the concentrations of gramine present were higher than in leaves of cv.Lara.

Hordenine is also found in roots and leaves of barley. Studies on its synergistic effects with gramine on *M. convecta*, *Agrotis ipsilon* (Hufnagel) and *Helicoverpa punctigera* (Wallengren) were further investigated. Under laboratory conditions, gramine in combination with hordenine at the concentrations naturally occurring in barley (cv.Lara) had synergistic effects in reducing survival of *M. convecta* but not of *A. ipsilon* and *H. punctigera*.

Gramine alone at a concentration similar to that found in barley leaves (cv.Lara) delayed the developmental period of *M. convecta* by 3-7 days. However, hordenine alone at the concentration found in barley leaves (cv.Lara) did not show any adverse effect on the growth and development of the insect. Possible synergistic effects of gramine in combination with hordenine (at the concentrations found in barley cv.Lara) on developmental periods of *M. convecta* could not be investigated because no insect survived in this treatment.

Gramine, hordenine and the combination of gramine and hordenine did not show adverse effects on the growth and development of *A. ipsilon* and *H. punctigera*. However, the study on the effect of gramine and hordenine on *A. ipsilon* needs to be repeated because of high mortality during the experiment.

The feeding deterrent effect of gramine and hordenine on *M. convecta* was also investigated. Second and fourth-instar *M. convecta* larvae were offered barley leaves (cv.Schooner which has low concentrations of gramine and hordenine) treated with gramine, hordenine, the combination of gramine and hordenine (at the concentrations

found in barley cv.Lara) and control in choice and no-choice bioassays. The results showed that gramine, hordenine and their combination did not reduce feeding of second and fourth-instar larvae both in choice and no-choice bioassays.

Gramine in combination with hordenine showed synergistic effects in reducing survival of *M. convecta* but did not reduce feeding of the insect. Therefore, it is likely that the synergistic effect of these allelochemicals on *M. convecta* is toxicity rather than deterrence.

Studies on the effect of gramine and hordenine on biology of insect pests of barley may be valuable in breeding resistant cultivars. Reports in the literature show that high gramine concentration in barley affects the palatability of barley to grazing animals and hordenine also showed adverse effects on animals. Consequently, cultivars with very high gramine and hordenine content may be not desirable. Cultivars that contain lower gramine and hordenine concentrations may be useful when used in an integrated pest management program.

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