



HOKKAIDO UNIVERSITY

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学位論文内容の要旨

博士の専攻分野名称：博士（農学）

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学位論文題名

Development of biopesticide from bottle gourd (*Lagenaria siceraria*) leaves and black plum (*Syzygium cumini*) leaves for eco-friendly pest control in cabbage and potato fields

(キャベツ畑やジャガイモ畑における環境に優しい害虫防除のためのユウガオ (*Lagenaria siceraria*) 葉とクロウメ (*Syzygium cumini*) 葉由来の生物農薬の開発)

Synthetic pesticides can have negative effects on human health and the environment. Ecofriendly biopesticides offer a potentially safer alternative to synthetic pesticides by targeting specific pests, biodegradable and leading to less pollution. Therefore, the present study was carried out to determine the efficacy of a bottle gourd leaf and black plum leaf extract in controlling cabbage looper and 28-spotted ladybird on field-grown cabbage and potato respectively, to determine the effects of the extract on the growth and yield of cabbage and potato, and to analyze the biopesticide compounds of the bottle gourd leaf and black plum leaf.

1. Efficacy of bottle gourd (*Lagenaria siceraria*) leaf extract in protecting against cabbage looper (*Trichoplusia ni*) (Lepidoptera: Noctuidae) infestation

Cabbage crops are frequently attacked by cabbage looper larvae (*Trichoplusia ni*), which severely reduce cabbage production. This experiment was conducted in the late spring crop season from April 15, 2024, to August 20, 2024, at the Field Science Center for the Northern Biosphere, Hokkaido University, Japan. In this study, the efficacy of an ethanolic extract of bottle gourd (*Lagenaria siceraria* (Molina) Standl.) leaves was compared with those of the chemical insecticide permethrin 3.2 EC and aqueous dimethyl sulfoxide (DMSO; the control). The experiment was carried out using a randomized complete block design in which each treatment comprised three replications consisting of 24 plants in total. Compared with the control, the bottle gourd leaf extract had high biopesticide activity against cabbage looper, increasing the cabbage yield by 15.98%. Compared with the control, the application of the extract significantly decreased looper larval infestation in field-grown cabbage by 41.18%, 39.71%, 52.08%, and 37.96% at the fifth, sixth, seventh, and eighth weeks, respectively. Five possible biopesticide compounds,

namely, apigenin-7-*O*-glucoside, indole-3-butyric acid, strychnine, phytol and hexadecanoic acid, were identified in the ethanolic extracts of bottle gourd leaves by liquid chromatography–mass spectrometry analysis. Bottle gourd leaf extract has potential as an environmentally friendly and sustainable alternative to toxic chemical pesticides for controlling cabbage looper infestation.

2. Efficacy of black plum (*Syzygium cumini* L. Skeels) leaf extract against the 28-spotted potato ladybird (*Henosepilachna vigintioctomaculata*) on field-grown potatoes

Larvae of the 28-spotted potato ladybird (*Henosepilachna vigintioctomaculata*) can severely reduce potato yields by feeding on the leaves. This study examined the effectiveness of an ethanol extract of black plum (*Syzygium cumini* L. Skeels) leaves was compared with that of the chemical pesticide permethrin 3.2 EC and aqueous dimethyl sulfoxide (control) from May 19, 2025, to August 6, 2025, at the Field Science Center for Northern Biosphere, Hokkaido University (Sapporo, Japan). The experiment was laid out in a randomized complete block design where each treatment comprised three replications consisting of 30 plants in total. The black plum leaf extract showed high biopesticide activity against 28-spotted potato ladybirds and enhanced the potato yield by 14.06% compared with the control and 11.68% compared with permethrin. Application of the extract decreased 28-spotted potato ladybird infestation in field-grown potatoes by 71.43%, 52.94%, 47.62%, and 63.33% at 50 days after sowing (DAS), 58 DAS, 66 DAS, and 73 DAS, respectively, compared with the control. Two possible chemicals for biopesticides, acacetin-7-*O*-rutinoside and amorphigenin were identified by liquid chromatography–mass spectrometry analysis of the black plum leaf ethanol extract. The extract is a potential environmentally friendly, sustainable, and cost-effective biopesticide substitute for hazardous chemical pesticides for control of 28-spotted potato ladybirds.