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Insecticidal Activities of Various Vegetable Extracts against Five Agricultural Insect Pests and Four Stored-Product Insect Pests

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Abstract : Ethanol extracts from 46 vegetables were tested their insecticidal activities toward five agricultural insect pests and four stored-product insect pests. The efficacy varied with both agricultural insects/stored-product insects and vegetable species used. Potent insecticidal activities, at the concentration of 5,000 ppm, were produced from extracts of *Nelumbo nucifera* and *Ulva lactuca* against *Myzus persicae, Zea mays* and *Z. mays* (leaf) against *Nilaparvata lugens, Citrullus vulgaris* (seed) and *U. lactuca* against *Plutella xylostella, N. nucifera, Z. mays,* and *Z. mays* (leaf) against *Spodoptera litura,* and *C. vulgaris* (seed), *Daucus carota, Helianthus annuus* (leaf), *H. annuus* (flower), *Lactuca sativa,* and *Zingiber officinale* against *Tetranychus urticae.* Potent insecticidal activities at the concentration of 2,500 ppm were exhibited from the extracts of *N. nucifera* and *U. lactuca* against *M. persicae, Z. mays* against *N. lugens, C. vulgaris* (seed) and *U. lactuca* against *P. xylostella, N. nucifera* and *Z. mays* against *S. litura,* and *C. vulgaris* (seed), *H. annuus* (flower), and *L. sativa* against *T. urticae.* Against four stored-product insect pests at 50 ppm, extracts of *C. vulgaris* (seed) and *Cucurbita moschata* (seed) against *Sitophilus oryzae* and *C. vulgaris* (seed), *H. annuus* (seed), and *Z. officinale* against *Plodia interpunctella* revealed potent insecticidal activities over 80% mortality. In tests with *Callosobruchus chinensis* and *Lasioderma serricorne,* extracts of all vegetables tested exhibited meager and no activity.(Received April 11, 2001; accepted April 18, 2001)

Key words : insecticidal activity, vegetable, stored-product insect pests, agricultural insect pests.

Introduction

The pre-harvest and post-harvest losses due to arthropod pests in world crop production may be approximately 11.8 and 24.8%, respectively, or even higher in developing countries (Eclert and Ogawa, 1985; Oerke, 1994). Over the several decades, various attempts to control insect pests have taken an effort toward effective eradication or prevention through the development of synthetic insecticides. However, their continued uses cause many adverse effects such as human intoxication, environmental pollution (Brown, 1978; Hayes and Laws, 1991), resurgences (Ripper, 1956), resistance (Georghiou and Saito, 1983; Georgopoulos, 1987), residue and toxicity to non-target organisms. Both economic consideration and increasing concern on adverse effects of the earlier types of insecticides have brought about the need for the development of alternatives for alternative control methods without or with reduced use of organic pesticides.

Plants may provide an alternative to the insecticides currently used against insect pests, because they are virtually constituted with a rich source of bioactive chemicals (Swain, 1977; Wink, 1993). Since these are often active against a limited number of pest species, biodegradable to nontoxic products, and potentially suitable for use in integrated management programs, they could lead to the development of new classes of possibly safer control agents. Therefore, much efforts have been focused on plant materials for potentially useful products as commercial insecticides or as lead compounds (Balandrin et al., 1985; Benner,

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1993; Isman, 1995; Hedin et al., 1997). However, little work has been done on the insecticidal activities of various vegetable extracts in spite of their excellent nutritional, pharmacological and industrial significance (Olabanji et al., 1997; Gibson et al., 1998; Billson et al., 1999; Kipopoulou et al., 1999).

In the laboratory study described herein, we have examined extracts of various vegetable for plant-derived insecticides against five agricultural insect pests (*Myzus persicae, Nilaparvata lugens, Plutella xylostella, Spodoptera litura,* and *Tetranychus urticae*) and four stored-product insect pests (*Sitophilus oryzae, Callosobruchus chinensis, Lasioderma serricorne,* and *Plodia interpunctella*).

Materials and Methods

Plant materials and sample preparation

The vegetables were randomly and anecdotally collected. They were dried in an oven at 60°C for 3 days and finely powdered using a blender (Model: RM 100, F.Kurt Retsch GmbH & Co. KG, Germany). Each sample was extracted twice with 500 ml 70% ethanol at room temperature and filtered (Toyo filter paper No. 2, Toyo Roshi, Japan). The combined filtrate was concentrated *in vacuo* at 35°C using a rotary vacuum evaporator (Model: N-3NW, EYELA, Japan). The yields of 46 vegetable extractions are shown in Table 1.

Insects

Five agricultural insect pests were used in this study. Brown planthopper (*Nilaparvata lugens* Stål) was reared on rice plant (*Oryza sativa* L.) seedlings (7~10 days after germination) in acrylic cages (26×30×20 cm). Green peach aphid (*Myzus persicae* Sulzer) and diamondback moth (*Plutella xylostella* L.) were reared on tobacco plant (*Nicotiana tabacum* L.) and beet (*Rhaphanus sativas* L.) seedlings (5~6 days after germination), respectively, in acrylic cages (26×30×20 cm). Tobacco cutworm (*Spodoptera litura* Fab.) was reared on artificial diet (Lee et al., 2000) in plastic container (24×16×8 cm), and two-spotted spider mite (*Tetranychus urticae* Koch) was reared on kidney bean (*Phaseolus vulgaris* var. *humilis*). They have been maintained in the laboratory without exposure to any insecticide at 24 ± 2℃ and 50~60% relative humidity (RH) under 16 : 8 h light : dark cycle.

Four stored-product insect pests were used in this study. Laboratory-reared strains of *S. oryzae* (L.) and *C. chinensis* (L.) were reared on rice grain and *C. chinensis*, respectively, in plastic containers (26×30×20 cm) at 28 ± 1℃ and 50~60% RH under 16 : 8 h light : dark cycle. Laboratory-reared strain of *P. interpunctella* (Hubner) were reared on peanut in plastic containers (26×30×20 cm) at 28 ± 1℃ and 50~60% RH under 16 : 8 h light : dark cycle. A susceptible strain of *L. serricorne* (F.) was reared in 0.5 liter mason rearing jar containing 150 g of sterilized diet (wheatfeed/yeast, 95 : 5) at 28 ± 1℃ and 70~75% RH under 12 : 12 h light : dark cycle.

Bioassay

In relation to the search for new bioactive substances against agricultural insect pests, we have established a bioassay method suitable for rapid mass-screening of synthetic organic compounds or plant-derived extracts for insecticidal activities with reproducible results, using only a minute quantity of compounds. The vegetable extracts were tested at concentration of 5,000 and 2,500 ppm for insect pests. If a vegetable extract exhibited activity, titration studies were performed. Test samples were suspended in distilled water with Triton X-100 added at the rate of 0.1 ml/L.

Spray method was used for the bioassay of *N. lugens* (BPH). Twenty female adults were transferred into a test tube (3×20 cm) containing five 'Chucheong' rice seedlings wrapped with cotton and 20 ml water. Spray of test materials was done with a glass spray unit connected to a forced air supply (Pacific Chemical Co., Ltd., Seoul).

Leaf-dipping method was used for aphid, lepidopteran larvae, and mite. Chinese cabbage (*Brassica oleracea* var. *capitata* L.) leaves for 3rd larvae of each *P. xylostella* and *S. litura*, kidney bean for *T. urticae*, and tobacco leaves for *M. persicae* females from each plant species grown in greenhouse were collected, and disks (5.5 cm diameter) were punctured from each leaf. Three leaf disks were dipped in each test solution for 30 sec. After evaporation in the air for 2 hr, 20 individual larvae of each *P. xylostella* and *S. litura* and 20 *M. persicae* females and 30 *T. urticae* adults were placed onto the treated and control leaf disks in petri dishes (6×1.5 cm).

The insecticidal activity of the vegetable materials to stored-product insect pests was laboratory determined by the direct contact application.

Appropriate rates of each test compound dissolved in 100 μL of methanol were applied to filter papers (Whatman No. 2; 5.5 cm dia.). Controls received 100 μL of methanol. After drying in a hood for 2 min, each paper was placed in the bottom of a petri dish (5.5 dia.×1.2 cm), and then 20 adults of each of *S.*

oryzae, *P. interpunctella*, *C. chinensis*, and *L. serricorne* were placed in each petri dish and covered with a lid. Treated and control insects were held under the conditions described earlier. Mortalities were determined 24 hr after treatment. Test insects were considered dead if appendages did not move when prodded with a camel's hair brush. All treatments were replicated three times. The insecticidal activities were classified as follow: the very strong activity ++++, mortality>90%; strong +++, mortality 81~90%; moderate ++, mortality 61~80%; weak +, mortality 40~60%; and little or no activity -, mortality<40%.

Results

The vegetable samples were randomly and anecdotally collected (Table 1).

In this study, insecticidal activities of 70% ethanol extracts from 46 vegetables in Actinidiaceae (1), Amaranthaceae (1), Araceae (1), Brassicaceae (4), Cheno-

Table 1. The yield of 70% ethanol extracts from 46 samples

Scientific Name	Family Name	Fresh Weight(g)	Dried Weight(g)	Yield[a](%)
Actinidia arguta	Actinidiaceae	500	60.4	4.8
Allium cepa	Liliaceae	500	46.6	5.5
Allium fistulosum	Liliaceae	500	17.2	4.9
Allium monanthum	Liliaceae	500	92.6	1.9
Allium sativum	Liliaceae	500	23.4	1.4
Allium tuberosum	Liliaceae	500	31.8	2.0
Amaranthus mangostanus	Amaranthaceae	500	32.2	2.5
Asier glehni	Compositae	389	59.0	14.2
Brassica campestris subsp. napus var. *pekinensis*	Brassicaceae	500	108.3	4.3
Brassica campestris var. *chinensis*	Brassicaceae	500	23.8	1.3
Capsella bursapastoris	Brassicaceae	500	111.1	1.8
Capsicum annuum	Solanaceae	500	17.9	3.8
Capsicum frutescens	Solanaceae	500	50.0	4.1
Chrysanthemum coronarium var. *spatiosum*	Compositae	500	35.7	1.6
Cichorium intybus	Compositae	500	20.0	1.2
Citrullus vulgaris	Cucurbitaceae	500	21.3	2.3
Citrullus vulgaris (Seed)	Cucurbitaceae	267	35.8	8.2
Colocasia antiquorum var. *esculenta*	Araceae	500	150.0	1.6
Cucurbita moschata	Cucurbitaceae	500	29.4	3.4
Cucurbita moschata (Seed)	Cucurbitaceae	500	18.7	1.9
Cucumis sativus	Cucurbitaceae	500	51.3	2.6
Daucus carota	Umbelliferaeceae	500	90.4	6.5
Helianthus annuus (Seed)	Compositae	500	35.9	5.2
Helianthus annuus (Leaf)	Compositae	500	25.6	4.7
Helianthus annuus (Flower)	Compositae	347	28.8	3.3
Ipomoea batatas	Convolvulaceae	500	206.0	6.7
Lactuca sativa	Compositae	500	25.0	2.0
Lactuca sativa var. *capitata*	Compositae	500	85.1	4.7
Lycopersicon esculentum	Solanaceae	500	16.9	5.5
Lycopersicon esculentum var. *cerasiforme*	Solanaceae	500	38.9	6.4
Malva verticillata	Malvaceae	500	43.2	3.7
Nelumbo nucifera	Nymphaeaceae	500	157.9	2.1
Oenanthe javanica	Umbelliferaeceae	500	26.9	2.0
Perilla frutescens	Labiatae	500	66.7	1.9
Petroselinum crispum	Umbelliferaeceae	500	50.0	8.7
Pimpinella brachycarpa	Umbelliferaeceae	500	132.1	3.8
Raphanus sativus	Brassicaceae	500	68.8	5.0
Rubus coreanus	Rosaceae	268	94.3	5.0
Salanum tuberosum	Solanaceae	500	195.3	6.1
Sedum sarmentosum	Crassulaceae	500	12.5	1.9
Solanum melongena	Solanaceae	500	94.6	1.9
Spinacia oleracea	Chenopodiaceae	500	26.3	2.4
Ulva lactuca	Ulvaceae	500	29.4	3.2
Zea mays (Seed)	Gramineae	500	51.4	6.7
Zea mays (Leaf)	Gramineae	500	43.2	4.6
Zingiber officinale	Zingiberaceae	500	27.5	1.2

[a](Dried weight of ethanol extract/dried weight of the sample vegetable) × 100.

podiaceae (1), Compositae (6), Convolvulaceae (1), Crassulaceae (1), Cucurbitaceae (3), Gramineae (1), Labiatae (1), Liliaceae (5), Malvaceae (1), Nymphaeaceae (1), Rosaceae (1), Solanaceae (6), Umbelliferaeceae (4), Ulvaceae (1), Zingiberaceae (1) were tested against five insect pests and four stored-product insect pests.

Insecticidal activities of the test samples against five agricultural insect pests are shown at 5,000 ppm in Table 2. The responses varied with vegetable species and agricultural insect pests used. When treated with 5,000 ppm of each sample, ethanol extracts of *Nelumbo nucifera* and *Ulva lactuca* gave over 90% mortality (++++) on *M. persicae,* and moderate activities (++) were obtained in extracts of *Zea mays* and *Z. mays*

Table 2. Insecticidal activity of vegetable extracts against five insect pests at 5,000 ppm under greenhouse

Sample Name	Insecticidal activity against				
	BPH[a)]	GPA	DBM	TCW	TSSM
A. arguta	-[b)]	-	-	++	++
A. cepa	-	-	++	-	++
A. fistulosum	-	-	-	-	-
A. monanthum	-	-	-	++	++
A. sativum	-	-	-	-	-
A. tuberosum	-	-	-	-	-
A. mangostanus	-	-	-	-	-
A. glehni	+	-	-	-	-
B. campestris subsp. napus var. *pekinensis*	-	-	-	-	-
B. campestris var. *chinensis*	-	-	-	-	-
C. bursapastoris	-	-	-	-	-
C. annuum	-	-	-	-	++
C. frutescens	-	-	-	-	-
C. coronarium var. *spatiosum*	-	-	-	-	++
C. intybus	-	-	-	-	-
C. vulgaris	-	-	-	-	-
C. vulgaris (Seed)	+	-	++++	-	++++
C. antiquorum var. *esculenta*	-	-	-	-	-
C. moschata	-	-	-	-	++
C. moschata (Seed)	-	-	-	-	++
C. sativus	-	-	-	-	-
D. carota	-	-	-	-	+++
H. annuus (Seed)	-	-	-	-	-
H. annuus (Leaf)	-	-	-	-	+++
H. annuus (Flower)	-	-	-	-	++++
I. batatas	-	-	-	-	++
L. sativa	-	-	-	-	+++
L. sativa var. *capitata*	-	-	-	-	-
L. esculentum	-	-	-	-	++
L. esculentum var. *cerasiforme*	-	-	-	-	-
M. verticillata	-	-	-	-	-
N. nucifera	++++	-	-	++++	+
O. javanica	-	-	-	-	-
P. frutescens	-	-	-	-	-
P. crispum	-	-	-	-	-
P. brachycarpa	-	-	-	-	-
R. sativus	-	-	-	-	-
R. coreanus	-	-	-	-	-
S. tuberosum	-	-	-	-	-
S. sarmentosum	-	-	-	-	-
S. melongena	-	-	-	-	-
S. oleracea	-	-	-	-	-
U. lactuca	++++	-	++++	-	-
Z. mays (Seed)	++	++++	-	++++	-
Z. mays (Leaf)	++	+++	-	++++	-
Z. officinale	-	-	-	-	+++

[a)]BPH, *Nilaparvata lugens;* GPA, *Myzus persicae;* DBM, *Plutella xylostella;* TCW, *Spodoptera litura* and TSSM, *Tetranychus urticae.*

[b)]++++, >90%; +++, 80~90%; ++, 61~80%; +, 40~60%; and -, <40%.

Table 3. Insecticidal activity of various vegetable extracts against five insect pests at 2,500 ppm under greenhouse

Sample Name	Insecticidal activity against				
	BPH[a)]	GPA	DBM	TCW	TSSM
A. arguta	-[b)]	-	-	+	+
A. cepa	-	-	++	-	+
A. monanthum	-	-	-	+	-
C. annuum	-	-	-	-	+
C. coronarium var. *spatiosum*	-	-	-	-	-
C. vulgaris (Seed)	-	-	+++	-	+++
C. moschata	-	-	-	-	+
C. moschata (Seed)	-	-	-	-	+
D. carota	-	-	-	-	-
H. annuus (Leaf)	-	-	-	-	++
H. annuus (Flower)	-	-	-	-	+++
I. batatas	-	-	-	-	+
L. sativa	-	-	-	-	+++
L. esculentum	-	-	-	-	-
N. nucifera	+++	-	-	++++	-
U. lactuca	++++	-	++++	-	-
Z. mays (Seed)	+	+++	-	+++	-
Z. mays (Leaf)	+	+	-	+	-
Z. officinale	-	-	-	-	++

a)BPH, *Nilaparvata lugens*; GPA, *Myzus persicae*; DBM, *Plutella xylostella*; TCW, *Spodoptera litura* and TSSM, *Tetranychus urticae*.
b)++++, >90%; +++, 80~90%; ++, 61~80%; +, 40~60%; and -, <40%.

(leaf), whereas weak and no activities were observed in the extracts of remaining samples. In the test with *N. lugens*, potent insecticidal activities over 80% mortality were produced from extracts of *Z. mays* and *Z. mays* (leaf), but other test extracts had no insecticidal activities. For *P. xylostella*, extracts of *Citrullus vulgaris* (seed) and *U. lactuca* had potent insecticidal activities over 90% mortality, and extract of *Allium cepa* had a moderate activity. Extracts of *N. nucifera*, *Z. mays*, and *Z. mays* (leaf) exhibited potent activities against *S. litura*, but moderate activities were produced in extracts of *Actinidia arguta* and *Allium monanthum*. In the test with *T. urticae*, strong insecticidal activities over 80% mortality were observed in extracts of *C. vulgaris* (seed), *Daucus carota*, *Helianthus annuus* (leaf), *H. annuus* (flower), *Lactuca sativa*, and *Zingiber officinale*. Furthermore, moderate activities were observed in extracts of 9 vegetables.

When treated with 2,500 ppm, extracts of *N. nucifera* and *U. lactuca* gave over 80% mortality on *M. persicae*, but *Z. mays* and *Z. mays* (leaf) revealed weak activities (Table 3). Extract of *Z. mays* revealed potent insecticidal activities over 80% mortality against *N. lugens*. For *P. xylostella*, strong insecticidal activities over 80% mortality were observed in extracts of *C. vulgaris* (seed) and *U. lactuca* at 2,500 ppm. Extracts of *N. nucifera* and *Z. mays* exhibited strong insecticidal activities against *S. litura*. In the test with *T. urticae* at 2,500 ppm, strong insecticidal activities over 80% mortality were observed in extracts of *C. vulgaris* (seed), *H. annuus* (flower), and *L. sativa*.

Insecticidal activities of vegetable samples against four stored-product insect pests are shown at 50 ppm in Table 4. The responses varied with vegetable species and stored-product insect pests used. Extracts of *C. vulgaris* (seed) and *Cucurbita moschata* (seed) revealed potent activities over 90% mortality against *S. oryzae* (Table 4). For *P. interpunctella*, strong activities over 80% mortality were produced from extracts of *C. vulgaris* (seed), *H. annuus* (seed), and *Z. officinale*, whereas remaining samples revealed no activity. In tests with *C. chinensis* and *L. serricorne*, extracts of all vegetables tested exhibited weak and no activity.

Discussion

In this study with 70% ethanol extracts from 46 vegetables belonging to the family Actinidiaceae, Amaranthaceae, Araceae, Brassicaceae, Chenopodiaceae, Compositae, Convolvulaceae, Crassulaceae, Cucurbitaceae, Gramineae, Labiatae, Liliaceae, Malvaceae, Nymphaeaceae, Rosaceae, Solanaceae, Umbelliferaeceae, Ulvaceae, and Zingiberaceae, many of them showed potent insecticidal activity against the economically important insect pests and stored-product insect pests. Insecticidal activity varied with both the vegetable species and agricultural insects/stored-product insects tested. In the test with agricultural insect pests, *T. urticae* was inhibited more effectively by the application of ethanol extracts of various vegetables than *M. persicae, N. lugens, P. xylostella,* and *S. litura,* and, when tested with four stored-product insects, *S. oryzae* and *P. interpunctella* were controlled more effectively by the application of ethanol extracts of

Table 4. Insecticidal activity of vegetable extracts against stored-product insect pests at 50 ppm by direct contact application.

Sample Name	Insecticidal activity against			
	S. oryzae	*C. chinensis*	*L. serricorne*	*P. interpunctella*
A. arguta	-[a]	-	-	-
A. cepa	-	+	-	-
A. fistulosum	-	-	-	-
A. monanthum	-	-	+	-
A. sativum	-	-	-	-
A. tuberosum	-	-	-	-
A. mangostanus	-	-	-	-
A. glehni	-	-	-	-
B. campestris subsp. napus var. *pekinensis*	-	-	-	-
B. campestris var. *chinensis*	-	-	-	-
C. bursapastoris	-	-	-	-
C. annuum	-	-	-	-
C. frutescens	-	-	-	-
C. coronarium var. *spatiosum*	-	-	-	-
C. intybus	-	+	-	-
C. vulgaris	-	-	-	-
C. vulgaris (Seed)	++++	-	-	+++
C. antiquorum var. *esculenta*	-	-	-	-
C. moschata	-	-	-	-
C. moschata (Seed)	++++	-	-	-
C. sativus	-	-	-	-
D. carota	-	-	-	-
H. annuus (Seed)	-	-	-	++++
H. annuus (Leaf)	-	-	-	-
H. annuus (Flower)	-	-	-	-
I. batatas	-	-	-	-
L. sativa	-	-	-	-
L. sativa var. *capitata*	-	-	-	-
L. esculentum	-	-	-	-
L. esculentum var. *cerasiforme*	-	-	-	-
M. verticillata	-	-	-	-
N. nucifera	-	-	-	-
O. javanica	-	-	-	-
P. frutescens	-	-	-	-
P. crispum	-	-	-	-
P. brachycarpa	-	-	-	-
R. sativus	-	-	-	-
R. coreanus	-	-	-	-
S. tuberosum	-	-	-	-
S. sarmentosum	-	-	-	-
S. melongena	-	-	-	-
S. oleracea	-	-	-	-
U. lactuca	-	-	-	-
Z. mays (Seed)	-	-	-	-
Z. mays (Leaf)	-	-	-	-
Z. officinale	-	-	-	++++

[a]++++, >90%; +++, 80~90%; ++, 61~80%; +, 40~60%; and -, <40%.

various vegetables than *C. chinensis* and *L. serricorne.* Jacobson (1989) pointed out that the most promising botanicals as sources of novel plant-based insecticides at present and in the future are species of the families Meliaceae, Rutaceae, Asteraceae, Annonaceae, Labiatae, and Canellaceae. It has been also reported that Annonaceous plant species can be employed as safe, effective, economical, and environmentally friendly insecticides on the home garden, ornamental, and greenhouse (Hostettman and Potterat, 1997). Various compounds including phenolics, terpenoids and alkaloids exist in vegetables (Swain, 1977; Wink, 1993). These compounds jointly or independently contribute to generation of biological activities. About 18,000 secondary plant metabolites have been chemically identified so far (Swain, 1977). Since these plant-derived extracts and phytochemicals act on various types of complex induced by insect pests, and may be applied to the plant in the same way as other agricultural chemicals, they are being considered as potential alternatives for synthetic insecticides (Hostettman and Potterat, 1997; Hedin, 1982), or lead compounds for new classes of synthetic insecticides such as podoblastin produced from *Podophyllum peltatum* (Miyakado, 1986; Hostettman and Potterat, 1997). However, little information is available for insecticidal activity of plants such as vegetables. Lee et al. (1998) already reported that leguminous seed extracts have fungicidal and insecticidal activities against phytopathogenic fungi and insect pests.

In this study, significant insecticidal activity over 80% mortality at 2,500 ppm was observed in extracts of *N. nucifera* and *U. lactuca* against *M. persicae*, *Z. mays* against *N. lugens*, *C. vulgaris* (seed) and *U. lactuca* against *P. xylostella*, *N. nucifera* and *Z. mays* against *S. litura*, and *C. vulgaris* (seed), *H. annuus* (flower), and *L. sativa* against *T. urticae*, although remaining samples tested were ineffective to *M. persicae*, *N. lugens*, *P. xylostella*, *S. litura*, and *T. urticae*. Furthermore, when treated with stored-product insect pests, strong insecticidal activity exhibited from extracts of *C. vulgaris* (seed) against *S. oryzae* and *P. interpunctella*, *C. moschata* (seed) against *S. oryzae*, *H. annuus* (seed), and *Z. officinale* against *P. interpunctella*, whereas all vegetable extracts revealed weak or no inhibition against *C. chinensis* and *L. serricorne*. The vegetables above indicated confirm their superiority and usefulness as a potent insecticide. These vegetables might give a new clue for managing insect pests and stored-product insect pests in field ecosystem, although their effects on non-target organisms or environment remain unknown. It has been reported that many of 21 grain extracts at 2,500 ppm were very effective against *T. urticae* but exhibited no insecticidal activity against *P. xylostella* and *S. litura* (Lee et al., 2000).

In conclusion, the vegetable-derived materials might be useful for developing new types of insecticides, and biorational management agents for controlling insect pests and stored-product insect pests on crops at same time, although their effects on natural enemies, vegetable qualities, or environment has not been fully clarified.

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다양한 채소 추출물의 농업해충 및 저장물해충에 대한 살충활성

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요약 : 46종 채소류의 에탄올 추출물을 대상으로 5종의 주요 농업해충 및 4종의 저장물 해충에 대한 살충효과를 조사한 효과는 채소류의 종류 및 해충의 종류에 따라 커다란 차이를 보였다. 5종의 농업해충에 대한 살충효과는 5,000 ppm의 농도로 처리할 때 연근 및 파래는 복숭아혹진딧물, 옥수수 및 옥수수 잎은 벼멸구, 수박씨 및 파래는 배추좀나방, 연근, 옥수수 및 옥수수 잎은 담배거세미나방, 수박씨, 당근, 해바라기 잎과 꽃, 상추 및 생강은 점박이응애에 대하여 80% 이상의 살충효과를 나타냈다. 2,500 ppm의 농도로 처리할 때는 연근 및 파래는 복숭아혹진딧물, 옥수수는 벼멸구, 수박씨 및 파래는 배추좀나방, 연근 및 옥수수는 담배거세미나방, 수박씨, 해바라기 꽃 및 상추는 점박이응애에 대하여 80% 이상의 살충효과를 나타냈다. 4종의 저장물해충에 대한 살충효과는 50 ppm의 농도로 처리할 때 수박씨 및 호박씨는 쌀바구미, 수박씨, 해바라기씨 및 생강은 화랑곡나방에 대하여 80% 이상의 살충효과를 나타냈다. 팥바구미와 권련벌레에 대하여는 사용된 채소류의 추출물이 활성을 나타내지 않았다. 이상의 결과로부터 복숭아혹진딧물, 벼멸구, 배추좀나방, 담배거세미나방 및 점박이응애에 높은 방제효과를 보인 상기 채소류 추출물들은 농업해충 방제제로서 사용 가능성이 예상되었으며, 또한 쌀바구미와 화랑곡나방에 강한 살충효과를 보인 추출물은 저장물해충방제에 이용할 수 있을 것으로 기대되었다.

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