

Insecticidal and Acaricidal Activities of Domestic Plant Extracts against Five Major Arthropod Pests

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Abstract : Methanol extracts from 420 samples of 173 plant species in 58 families were tested at 5000 ppm for their insecticidal and acaricidal activities against five economically important arthropod pests by spray method. The responses varied with arthropod pest species, plant species and plant tissue sampled. In a test with *Nilaparvata lugens* Stal, extracts from *Zanthoxylum piperitum* barks, *Chamaecyparis obtusa* leaf and *Quercus salicina* leaf showed potent insecticidal activity. With *Plutella xylostella* L., potent larvicidal activity was observed from extracts of *Platycarya strobilacea* wood, *Meliosma myriantha* barks, *Sophora japonica* leaf, *Zanthoxylum piperitum* barks, and *Pinus thunbergii* wood. Methanol extracts of *Sophora japonica* leaf and *Zanthoxylum piperitum* barks showed high insecticidal activity against *Spodoptera litura*. In a test with *Tetranychus urticae* Koch, extract from *Carpinus coreana* leaf, *Firmiana simplex* barks, *Elaeagnus macrophylla* leaf, *Aralia elata* leaf, *Comus controversa* barks and *Chamaecyparis obtusa* leaf exhibited strong acaricidal activity. As a naturally occurring pest control agent, *Zanthoxylum piperitum* barks could be useful as new insecticidal and acaricidal products against various arthropod pests.(Received November 15, 2002; accepted December 13, 2002)

Key words : insecticidal activity, acaricidal activity, plant extracts.

Introduction

Over the several decades, various attempts to control arthropod pests have taken an effort toward effective eradication or prevention through the development of synthetic insecticides and acaricides. Although effective, their continued or repeated use has disrupted biological control by natural enemies and has led to outbreaks in arthropod pests, and widespread development of resistance to various types of insecticides and acaricides,

toxicity to nontarget organisms, and environmental and human health concerns (Georghiou and Saito, 1983; Hayes and Laws, 1991). Decreasing efficacy and increasing concern over adverse environmental effects of the earlier types of insecticides and acaricides have brought about the need for the development of new types of selective control alternatives or of methods of crop protection without, or with reduced, use of conventional pesticides.

Plants may provide potential alternatives to currently used insecticides and acaricides, because they virtually constitute a rich source of bioactive chemicals (Swain, 1977; Namba, 1986; Harborne, 1993; Wink, 1993). Since

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these are often active against a limited number of species including specific target arthropod pests, are biodegradable to nontoxic products, and potentially suitable for use of integrated pest management, they could lead to the development of new classes of possibly safer arthropod control agents. Therefore, much efforts have been focused on plant materials for potentially useful products as commercial insecticides and acaricides or as lead compounds (Balandrin *et al.*, 1985; Miyakado, 1986; Benner, 1993; Hedin *et al.*, 1997).

In the laboratory study described here, we assessed insecticidal and acaricidal activities of methanol extracts from 420 samples of 173 plant species against five important arthropod pests.

Materials and Methods

Insects

The susceptible strain of *Nilaparvata lugens* (Stål), *Myzus persicae* (Sulzer), *Plutella xylostella* (L.), and *Tetranychus urticae* (Koch) were reared on the rice plant (*Oryza sativa* L.) seedlings (5~7 days after germination), tobacco plant (*Nicotiana tabacum* L.), chinese radish (*Raphanus sativus* L.) seedlings (5~6 days after germination), and kidney bean (*Phaseolus vulgaris* var. *humilis* Alefeld) seedlings (2 weeks after germination) in acrylic cages, respectively. *Spodoptera litura* (L.) was reared on artificial diet (Im *et al.*, 1988) in plastic containers. They have been maintained in the laboratory without exposure to any insecticide at 24±2°C, 50~60% relative humidity (RH), and a photoregime of 16 : 8 (L : D) h.

Plant materials and sample preparation

Total 420 samples of 173 plant species in 58 families are anecdotally selected and listed in Table 1. Different tissues namely bark (118), leaf (157), wood (114), twig (19), fruit (2), bark+wood (2), leaf+twig (6), twig+wood (1) and leaf+wood (1) were collected during June-September in 1998~2000. The economic importance of these plants is described in detail

elsewhere (Lee, 1982; Namba, 1986; Kim, 1996). They were dried in an oven at 60°C for 2 d and finely powdered using a blender. Each sample (100 g) was extracted twice with 500 ml methanol at room temperature and filtered (Toyo filter paper No. 2, Toyo Roshi). The combined filtrate was concentrated *in vacuo* at 35°C using a rotary vacuum evaporator (EYELA autojack NAJ-160, Japan).

Bioassay

The plant samples were tested at a concentration of 0.5% by direct contact application as described by Ahn *et al.* (1992). 'Chucheongbyeo' rice plant seedlings (5-7 d after germination) for *N. lugens* female adults were used. Chinese cabbage leaf for 3rd larvae of each *P. xylostella* and *S. litura*, tobacco leaf for *M. persicae* adults, and kidney bean leaf (3 weeks after germination) for *T. urticae* adults were collected, and discs (5.5 cm diameter) were punctured from each leaf. Test samples (dissolved in 2 ml methanol) suspended in distilled water with Triton X-100 (Coseal Co., Seoul) added at the rate of 1 ml/liter were used. Control received methanol-Triton X-100 solution. Five rice seedlings and two leaf discs were dipped in test solution for 30 sec. After evaporation in a draft for 2 h, 20 individuals of test insects were separately placed onto the treated and the control leaf discs or rice seedlings in petri dishes or test tubes. Treated and control samples were held under the conditions as mentioned earlier. Insecticidal activity was evaluated 48 h after treatment. All treatment were replicated three times. Insecticidal and acaricidal activities were classified as previously described (Kwon *et al.*, 1994): strong activity +++, mortality >80%; moderate ++, mortality 61~80%; weak +, mortality 40-60%; and little or no activity -, mortality <40%.

Results

Insecticidal activity of extracts from domestic plants at 5,000 ppm against agricultural pests is shown in Table 2. Potent activity against *N. lugens* was observed in extracts of *Zanthoxylum piperitum* (bark), *Chamaecyparis*

obtusa (leaf) and *Quercus salicina* (leaf). Methanol extract of *Albizzia julibrissin* (leaf) showed moderate activity. The other plant extracts exhibited weak or no insecticidal activity.

Extracts of *Platycarya strobilacea* (wood), *Meliosma myriantha* (bark), *Sophora japonica* (leaf), *Zanthoxylum piperitum* (bark) and *Pinus thunbergii* (wood) showed strong insecticidal activity against *P. xylostella*. Moderate activity was observed in extracts of *Vitis amurensis* (twig), *Meliosma oldhamii* (bark, leaf), *Styrax japonica* (leaf, wood), *Lindera erythrocarpa* (bark, wood), *Rhododendron schlippenbachii* (leaf), *Parthenocissus tricuspidata* (leaf), *Thuja orientalis* (bark) and *Stewartia koreana* (bark). The other plant extracts showed weak or no insecticidal activity.

Acaricidal activity of the test samples against *T. urticae* is also shown in table 2. Strong insecticidal activity was observed from extracts of *Carpinus coreana* (leaf), *Firmiana simplex* (bark), *Elaeagnus macrophylla* (leaf), *Aralia elata* (leaf), *Comus controversa* (bark) and *Chamaecyparis obtusa* (leaf). Moderate activity was observed in extract of *Albizzia julibrissin* (leaf), *Euonymus oxyphyllus* (bark), *Lindera erythrocarpa* (wood), *Symplocos chinensis* (leaf), *Elaeagnus umbellata* (leaf), *Quercus aliena* (leaf), *Abies holophylla* (bark), *Paulownia coreana* (bark), *Eurya japonica* (leaf), *Machilus thunbergii* (leaf), *Quercus glauca* (bark), *Hovenia dulcis* (wood), *Securinega suffruticosa* (leaf + twig), *Euonymus fortunei* (leaf), *Castanopsis cuspidata* (leaf), *Zanthoxylum piperitum* (bark), *Aster glehni* var. *hondoensis* (leaf), *Quercus salicina* (leaf), *Vaccinium bracteatum* (leaf) and *Lindera erythrocarpa* (leaf). The other plant extracts showed little or no acaricidal activity.

In a test with *S. litura*, strong insecticidal activity was observed in extracts of *Sophora japonica* (leaf), and *Zanthoxylum piperitum* (bark). Extracts of *Platycarya strobilacea* (wood), *Styrax japonica* (leaf), *Securinega suffruticosa* (leaf + twig) and *Lindera erythrocarpa* (leaf) showed moderate activity. The other plant extracts showed little or no activity. Extracts of *Smilax china* (leaf) and *Hovenia dulcis* (wood) revealed moderate

insecticidal activity against *M. persicae*, and other plant extracts showed weak or no activity.

Discussion

In the laboratory study with 420 samples against five economically important arthropod pests, the responses varied with arthropod pest species, plant species and plant part sampled. Strong insecticidal activity was produced from the plants belonging to the families Araliaceae, Betulaceae, Cornaceae, Cupressaceae, Elaeagnaceae, Juglandaceae, Leguminosae, Pinaceae, Rutaceae, Sabiaceae, and Sterculiaceae. Jacobson (1989) pointed out that the most promising botanicals as sources of novel plant-based insecticides for use at the present and in the future are species of the families, Meliaceae, Rutaceae, Asteraceae, Annonaceae, Labiatae, and Canellaceae.

It has been well acknowledged that many of plant-derived extracts and phytochemicals such as alkaloids, phenolics and terpenoids are potential alternatives to synthetic insecticides (Jacobson and Crosby, 1971; Elliott, 1977; Arnason *et al.*, 1989a). They have selectivity towards the natural enemies of pests, act in many ways on various types of pest complex, and may be applied to the plant in the same way as other agricultural chemicals. Derivatives of neem (*Azadirachta indica* A. JUSS) belonging to the family Meliaceae are found to have a variety of biological activities against nearly 200 species of insects (Saxena, 1989). Although certain plant-derived materials alone are ineffective against insect species, they enhance insecticidal activity of conventional insecticides. For example, mixture of *Thujopsis*-derived carvacrol and organophosphorus insecticide phosphamidon revealed much more potent larvicidal activity to *Thecodiplosis japonensis* than phosphamidon alone in spite of little or no larvicidal activity of carvacrol alone when implanted into the pine trunk, indicating an involvement of synergistic effect and good potential for the control of field populations of *T. japonensis* with reduced use of phosphamidon (Lee *et al.*, 1997). Additionally,

Table 1. Plant species tested

Plant species	Family name	Part ^{a)} collected	Plant species	Family name	Part collected
<i>Acer ginnala</i>	Aceraceae	B, L, W	<i>Vaccinium bracteatum</i>	Ericaceae	B, L, W
<i>Acer triflorum</i>	Aceraceae	B, L, W	<i>Vaccinium oldhami</i>	Ericaceae	B, L, W
<i>Actinidia arguta</i>	Actinidiaceae	L	<i>Eucommia ulmoides</i>	Eucommiaceae	B, L, W
<i>Rhus chinensis</i>	Anacardiaceae	B, L, W	<i>Daphniphyllum macropodum</i>	Euphorbiaceae	B, L, W
<i>Trachelospermum asiaticum</i>	Apocynaceae	L+T	<i>Mallotus japonicus</i>	Euphorbiaceae	B, L, W
<i>Ilex cornuta</i>	Aquifoliaceae	B, L, W	<i>Sapium japonicum</i>	Euphorbiaceae	B, W
<i>Ilex crenata</i>	Aquifoliaceae	L, T, W	<i>Sapium sebiferum</i>	Euphorbiaceae	B, L, W
<i>Ilex integra</i>	Aquifoliaceae	B, L, W	<i>Securinega suffruticosa</i>	Euphorbiaceae	T, L+T
<i>Ilex macropoda</i>	Aquifoliaceae	B, W	<i>Castanopsis cuspidata</i> var. <i>sieboldii</i>	Fagaceae	L, W
<i>Ilex rotunda</i>	Aquifoliaceae	B, L, W	<i>Castanopsis cuspidata</i>	Fagaceae	B, L, W
<i>Aralia elata</i>	Araliaceae	B, L, W	<i>Quercus acuta</i>	Fagaceae	B, L, W
<i>Dendropanax morbifera</i>	Araliaceae	B, L, W	<i>Quercus aliena</i>	Fagaceae	B, L, W
<i>Fatsia japonica</i>	Araliaceae	B, L, W	<i>Quercus glauca</i>	Fagaceae	B, L, W
<i>Hedera rhombea</i>	Araliaceae	L, T	<i>Quercus myrsinaefolia</i>	Fagaceae	B, L, W
<i>Kalopanax pictus</i>	Araliaceae	B, L, W	<i>Quercus salicina</i>	Fagaceae	B, L, W
<i>Betula platyphylla</i>	Betulaceae	B, L, W	<i>Idesia polycarpa</i>	Flacourtiaceae	B, L, W
<i>Carpinus cordata</i>	Betulaceae	B, L, W	<i>Corylopsis coreana</i>	Hamamelidaceae	B, L, W
<i>Carpinus coreana</i>	Betulaceae	B, L, W	<i>Distylium racemosum</i>	Hamamelidaceae	L, W
<i>Carpinus laxiflora</i>	Betulaceae	B, L, W	<i>Illicium religiosum</i>	Illiciaceae	B, L, W
<i>Ostrya japonica</i>	Betulaceae	B, L, W	<i>Platycarya strobilacea</i>	Juglandaceae	B, L, W
<i>Adenophora triphylla</i>	Campanulaceae	L	<i>Rabdosia inflexa</i>	Labiatae	L
<i>Sambucus williamsii</i>	Caprifoliaceae	B, L	<i>Akebia quinata</i>	Lardizabalaceae	T
<i>Viburnum awabuki</i>	Caprifoliaceae	B, L, W	<i>Stauntonia hexaphylla</i>	Lardizabalaceae	L, T
<i>Celastrus flagellaris</i>	Celastraceae	L, T	<i>Cinnamomum camphora</i>	Lauraceae	B, L, W
<i>Celastrus orbiculatus</i>	Celastraceae	L+T	<i>Cinnamomum japonicum</i>	Lauraceae	B, L, W
<i>Euonymus alatus</i>	Celastraceae	L	<i>Cinnamomum loureirii</i>	Lauraceae	B, L, W
<i>Euonymus chibi</i>	Celastraceae	L	<i>Lindera erythrocarpa</i>	Lauraceae	B, L, W
<i>Euonymus fortunei</i>	Celastraceae	B, L	<i>Lindera glauca</i>	Lauraceae	B, L, W
<i>Euonymus oxyphyllus</i>	Celastraceae	B, L, W	<i>Lindera obtusiloba</i>	Lauraceae	B, L
<i>Tripterygium regelii</i>	Celastraceae	L	<i>Lisea aciculata</i>	Lauraceae	B, L, W
<i>Cephalotaxus harringtonia</i>	Cephalotaxaceae	B, L, W	<i>Lozoste lancifolia</i>	Lauraceae	B, L, W
<i>Cercidiphyllum japonicum</i>	Cercidiphyllaceae	B, L, W	<i>Machilus japonica</i>	Lauraceae	B, L, W
<i>Allium victorialis</i>	Compositae	L	<i>Machilus thunbergii</i>	Lauraceae	B, L, W
<i>Aster glehni</i> var. <i>hondoensis</i>	Compositae	L	<i>Neolitsea aciculata</i>	Lauraceae	B, L, W
<i>Aster scaber</i>	Compositae	L	<i>Viburnum dilatatum</i>	Lauraceae	B, L, W
<i>Erigeron annuus</i>	Compositae	L	<i>Albizzia julibrissin</i>	Leguminosae	B, L, W
<i>Solidago virgaurea</i>	Compositae	L	<i>Amorpha fruticosa</i>	Leguminosae	L
<i>Sunurus palmatopinnatifidus</i>	Compositae	L	<i>Caesalpinia japonica</i>	Leguminosae	B, L, W
<i>Taraxacum mongolicum</i>	Compositae	L	<i>Maackia amurensis</i>	Leguminosae	B, L, W
<i>Cornus controversa</i>	Cornaceae	B, L, W	<i>Pueraria thunbergiana</i>	Leguminosae	L+T
<i>Cornus kousa</i>	Cornaceae	B, L, W	<i>Sophora japonica</i>	Leguminosae	B, L, W
<i>Cornus macrophylla</i>	Cornaceae	B, L, W	<i>Allium tuberosum</i>	Liliaceae	L

^{a)}B ; bark, L ; leaf, F ; fruit, T ; twig, W ; wood.

Table 1 (continued)

Plant species	Family name	Part ^a collected	Plant species	Family name	Part collected
<i>Cornus walteri</i>	Cornaceae	B, W	<i>Smilax china</i>	Liliaceae	L, T
<i>Chamaecyparis obtusa</i>	Cupressaceae	B, L, W	<i>Kadsura japonica</i>	Magnoliaceae	L+T
<i>Juniperus chinensis</i>	Cupressaceae	L	<i>Liriodendron tulipifera</i>	Magnoliaceae	B, L
<i>Thuja orientalis</i>	Cupressaceae	B, L	<i>Magnolia grandiflora</i>	Magnoliaceae	B, L, W
<i>Diospyros kaki</i>	Ebenaceae	B, L, W	<i>Magnolia kobus</i>	Magnoliaceae	B, L, W
<i>Diospyros lotus</i>	Ebenaceae	L, T	<i>Schizandra chinensis</i>	Magnoliaceae	L
<i>Elaeagnus glabra</i>	Elaeagnaceae	L, T	<i>Melia azedarach</i>	Meliaceae	B, L, W
<i>Elaeagnus macrophylla</i>	Elaeagnaceae	B, L	<i>Boehmeria nivea</i>	Moraceae	L, T
<i>Elaeagnus umbellata</i>	Elaeagnaceae	L, T	<i>Cudrania tricuspidata</i>	Moraceae	B, L, W
<i>Rhododendron mucronulatum</i>	Ericaceae	F, T	<i>Ficus nipponica</i>	Moraceae	L, T
<i>Rhododendron schlippenbachii</i>	Ericaceae	B, L, W	<i>Ficus stipulata</i>	Moraceae	L, T
<i>Myrica rubra</i>	Myricaceae	B, L, W	<i>Paederia scandens</i>	Rubiaceae	L+W, L+T
<i>Forsythia koreana</i>	Oleaceae	F, T	<i>Serissa japonica</i>	Rubiaceae	L+T
<i>Fraxinus rhynchophylla</i>	Oleaceae	B, L, W	<i>Phellodendron amurense</i>	Rutaceae	L
<i>Fraxinus sieboldiana</i>	Oleaceae	B, L, W	<i>Poncirus trifoliata</i>	Rutaceae	L
<i>Ligustrum japonicum</i>	Oleaceae	B, L, W	<i>Zanthoxylum piperitum</i>	Rutaceae	B, W
<i>Osmanthus fortunei</i>	Oleaceae	B, L, W	<i>Zanthoxylum planispinum</i>	Rutaceae	B, L, W
<i>Abies holophylla</i>	Pinaceae	B, L, W	<i>Zanthoxylum schinifolium</i>	Rutaceae	L
<i>Abies koreana</i>	Pinaceae	B, L, W	<i>Meliosma myriantha</i>	Sabiaceae	B, L, W
<i>Abies nephrolepis</i>	Pinaceae	B, L	<i>Meliosma oldhamii</i>	Sabiaceae	B, L, W
<i>Larix leptolepis</i>	Pinaceae	B, L, W	<i>Koelreuteria paniculata</i>	Sapindaceae	B, L, W
<i>Picea koraiensis</i>	Pinaceae	B, L, W	<i>Paulownia coreana</i>	Scrophulariaceae	B, L, W
<i>Pinus banksiana</i>	Pinaceae	B, L, W	<i>Euscaphis japonica</i>	Staphyleaceae	B, L, W
<i>Pinus densiflora</i>	Pinaceae	B, L, W	<i>Firmiana simplex</i>	Sterculiaceae	B, L, W
<i>Pinus koraiensis</i>	Pinaceae	B, L, W	<i>Styrax japonica</i>	Styracaceae	B, L, W
<i>Pinus rigida</i>	Pinaceae	B, L, W	<i>Symplocos chinensis</i>	Symplocaceae	B, L
<i>Pinus thunbergii</i>	Pinaceae	B, L, W	<i>Texus cuspidata</i>	Taxaceae	L
<i>Pittosporum tobira</i>	Pittosporaceae	B, L, W	<i>Torreya nucifera</i>	Taxaceae	B, L, W
<i>Platanus orientalis</i>	Platanaceae	B, L	<i>Cryptomeria japonica</i>	Taxodiaceae	B, L, W
<i>Portulaca oleracea</i>	Portulacaceae	L	<i>Camellia japonica</i>	Theaceae	B, L, W
<i>Clematis apiifolia</i>	Ranunculaceae	L, T	<i>Cleyera japonica</i>	Theaceae	B, L, W
<i>Hovenia dulcis</i>	Rhamnaceae	W	<i>Eurya japonica</i>	Theaceae	B, L, W
<i>Rhamnella franguloides</i>	Rhamnaceae	B, L, W	<i>Stewartia koreana</i>	Theaceae	B, W
<i>Rhamnus davurica</i>	Rhamnaceae	B, L, W	<i>Aphananthe aspera</i>	Ulmaceae	B, L, W
<i>Sageretia theezans</i>	Rhamnaceae	L, T, W	<i>Celtis biondii</i>	Ulmaceae	B, L, W
<i>Zizyphus jujuba</i>	Rhamnaceae	B, L, W	<i>Celtis sinensis</i>	Ulmaceae	B, L, W
<i>Chaenomeles sinensis</i>	Rosaceae	B, L, W	<i>Ulmus davidiana var. japonica</i>	Ulmaceae	B, L, W
<i>Eriobotrya japonica</i>	Rosaceae	B, L, W	<i>Ulmus parvifolia</i>	Ulmaceae	B, L, W
<i>Photinia glabra</i>	Rosaceae	B, L, W	<i>Zelkova serrata</i>	Ulmaceae	B, L, W
<i>Pourthiae villosa</i>	Rosaceae	B, L, W	<i>Anthriscus sylvestris</i>	Umbelliferae	L
<i>Prunus leveilleana var. pendula</i>	Rosaceae	B, L, W	<i>Callicarpa mollis</i>	Verbenaceae	L, T+W
<i>Prunus sargentii</i>	Rosaceae	B, L, W	<i>Amoelopsis brevipedunculata</i>	Vitaceae	L
<i>Pyrus pyrifolia</i>	Rosaceae	B, L, W	<i>Parthenocissus tricuspidata</i>	Vitaceae	B+W, L
<i>Raphiolepis umbellata</i>	Rosaceae	L, T	<i>Vitis amurensis</i>	Vitaceae	L, T
<i>Rubus coreanus</i>	Rosaceae	B+W, L			

Table 2. Insecticidal activity^{a)} of domestic plants against five major pests

Plant species	Insecticidal activity				
	BPH ^{b)}	GPA	DBM	TCW	TSSM
<i>Albizia julibrissin</i> (L)	++ ^{c)}	-	-	-	++
<i>Smilax china</i> (L)	+	++	-	-	-
<i>Platycarya strobilacea</i> (W)	-	-	+++	++	-
<i>Vitis amurensis</i> (T)	-	-	++	-	-
<i>Meliosma myriantha</i> (B)	-	-	+++	-	-
<i>Meliosma oldhamii</i> (B)	-	-	++	-	-
<i>Meliosma oldhamii</i> (L)	-	-	++	-	-
<i>Sophora japonica</i> (L)	-	-	+++	+++	-
<i>Styrax japonica</i> (L)	-	-	++	++	-
<i>Styrax japonica</i> (W)	-	-	++	-	-
<i>Euonymus oxyphyllus</i> (B)	-	-	+	-	++
<i>Lindera erythrocarpa</i> (B)	-	-	++	-	+
<i>Lindera erythrocarpa</i> (W)	-	-	++	-	++
<i>Rhododendron schlippenbachii</i> (L)	-	-	++	-	-
<i>Parthenocissus tricuspidata</i> (L)	-	-	++	+	-
<i>Juniperus chinensis</i> (L)	-	-	+	-	-
<i>Symplocos chinensis</i> (L)	-	-	-	-	++
<i>Elaeagnus umbellata</i> (L)	-	-	-	-	++
<i>Quercus aliena</i> (L)	-	-	-	-	++
<i>Carpinus coreana</i> (L)	-	-	-	-	+++
<i>Firmiana simplex</i> (B)	-	-	-	-	+++
<i>Thuja orientalis</i> (B)	-	-	++	-	-
<i>Abies holophylla</i> (B)	-	-	-	-	++
<i>Magnolia kobus</i> (W)	-	-	-	-	+
<i>Paulownia coreana</i> (B)	-	-	-	-	++
<i>Elaeagnus macrophylla</i> (L)	-	-	-	-	+++
<i>Eurya japonica</i> (L)	-	-	-	-	++
<i>Machilus thunbergii</i> (L)	-	-	-	-	++
<i>Quercus glauca</i> (B)	-	-	-	-	++
<i>Hovenia dulcis</i> (W)	-	++	-	-	++
<i>Neolitsea sericea</i> (W)	-	-	-	-	+
<i>Securinega suffruticosa</i> (L + T)	-	-	-	++	++
<i>Kalopanax pictus</i> (W)	-	-	-	-	+
<i>Euonymus fortunei</i> (L)	-	-	-	-	++
<i>Castanopsis cuspidata</i> (L)	-	-	-	-	++
<i>Aralia elata</i> (L)	-	-	+	-	+++
<i>Zanthoxylum piperitum</i> (B)	+++	-	+++	+++	++
<i>Comus controversa</i> (B)	-	-	-	-	+++
<i>Chamaecyparis obtusa</i> (L)	+++	+	+	+	+++
<i>Aster glehni</i> var. <i>hondoensis</i> (L)	-	-	-	-	++
<i>Quercus salicina</i> (L)	+++	-	-	-	++
<i>Vaccinium bracteatum</i> (L)	-	-	-	-	++
<i>Lindera erythrocarpa</i> (L)	-	-	-	++	++
<i>Stewartia koreans</i> (B)	-	-	++	-	-
<i>Pinus thunbergii</i> (W)	-	-	+++	-	-

^{a)}Evaluated with 5000 ppm. ^{b)}BPH, *Nilaparvata lugens*; GPA, *Myzus persicae*; DBM, *Plutella xylostella*; TCW, *Spodoptera litura*; TSSM, *Tetranychus urticae*. ^{c)}+++; > 80%, ++; 80-50%, +; 50-30%, -; < 30%

plant-derived materials are found to be highly effective against insecticide-resistant insect pests (Arnason *et al.*, 1989b; Schmutterer, 1992; Verkerk and Wright, 1993; Kwon *et al.*, 1996; Ahn *et al.*, 1997). For example, derivatives of *Ginkgo biloba* L. (Ginkgoaceae) leaf had potent insecticidal activity towards three strains of *N. lugens* resistant to carbofuran, fenobucarb, and diazinon, respectively (Kwon *et al.*, 1996; Ahn *et al.*, 1997).

The plant species described confirm their superiority and usefulness as potent insect control agents. They might form a new source for managing this insect pest in agroecosystem, although their effects on natural enemies remains unknown. However, many of plant-derived materials often have been shown to be selective towards natural enemies, e.g., neem derivatives are found to have no any adverse effects on most non-target organisms (Saxena, 1989; Lowery and Isman, 1995).

Based upon our data and these earlier findings, some plants described might be useful products for developing new types of insecticides or biorational management agents for controlling the arthropod pest populations on crops, although their effects on natural enemies, vegetable qualities, or environment has not been fully investigated.

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국내산 식물체 추출물의 다섯 가지 주요 해충에 대한 살충 및 살비 활성

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요약 : 173종 국내산 식물체의 메탄올 추출물을 대상으로 5 종의 주요 농업해충에 대해 살충 및 살비 효과를 조사한 결과 식물의 종류 및 채집부위에 따라 커다란 차이를 보였다. 173종 420 샘플을 5,000ppm 농도로 처리하였을 때 벼멸구에 강한 살충 효과를 나타낸 식물체는 초피나무 수피, 편백나무 잎과 참가시나무 잎이었다. 배추좀나방 유충에 대해서는 굴피나무 목부, 나도밤나무 수피, 회화나무 잎, 초피나무 수피, 그리고 해송 목부 추출물이 강한 살충활성을 나타내었고 회화나무 잎 및 초피 수피 추출물은 담배거세미나방 유충에 강한 살충활성을 나타내었다. 점박이응애에 대해 강한 살충활성을 나타낸 식물체는 소사나무 잎, 벽오동 수피, 보리밤나무 잎, 두릅나무 잎, 쟁쟁나무 수피, 그리고 편백 잎이었다. 특히 초피나무 수피 추출물은 여러 해충에 대하여 강한 살충효과를 나타내어 해충 방제에 크게 이용할 수 있을 것으로 기대되었다.

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