Biocontrol Technical Workshop Series 2022

Session 6: Botanical Pesticides

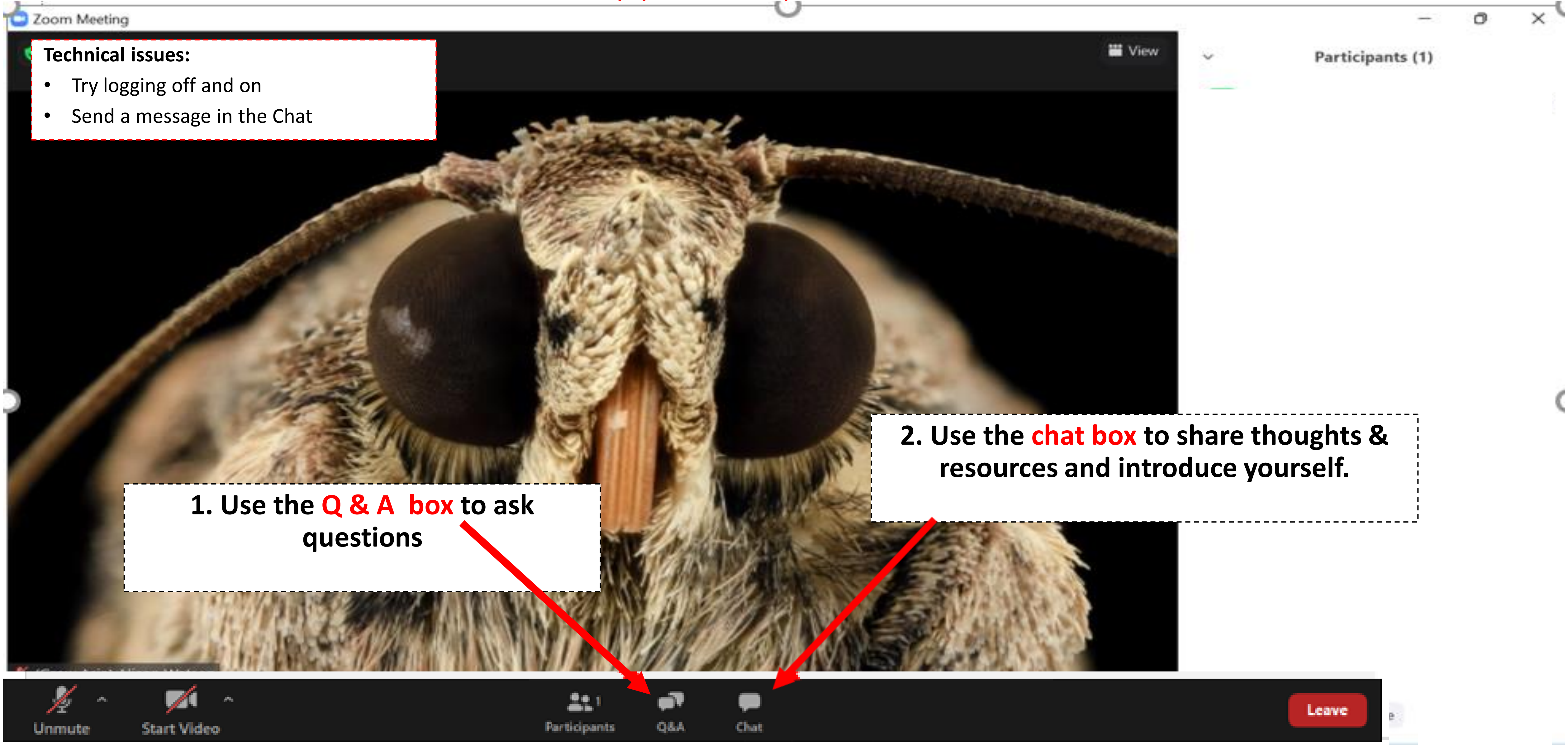
23 November 2022

CABI

ASEAN FAW ACTION PLAN

Supporting IPM Across Southeast Asia

The session will be recorded. A copy will be posted 1 week after this session.



Technical issues:

- Try logging off and on
- Send a message in the Chat

1. Use the Q & A box to ask questions

2. Use the chat box to share thoughts & resources and introduce yourself.

Biocontrol Workshop Schedule

1: Bt Biopesticides Part A
5 May 2022

30 June 2022
2: Bt Biopesticides Part B

3. New Frontiers
11 Aug. 2022

25 Aug. 2022
4. Baculoviruses

5. Nematodes and Fungi
29 Sep. 2022

23 Nov. 2022
6. Botanicals

7. Semiochemicals
13 Dec. 2022

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Speakers

Botanical insecticides: the disconnect between theory and practice
Dr Murray Isman, Professor of Entomology/ Toxicology, University of British Columbia

Status of botanical pesticides in Viet Nam
Dao Bach Khoa, Head of Division of Pesticide, Weed and Environment, PPRI, Vietnam

Prospects of botanical compounds and pesticides for FAW control
Patrick Maada Ngegba, Researcher, South China Agricultural University

POLL (anonymous)

1. **Have you worked with or researched botanicals for plant health and protection purposes?**

2. **Choose the statement that best suits your view:**

Statement 1: We need to spend more time on discovering new botanical insecticides

OR

Statement 2: We need to spend more time on developing botanical insecticides from a targeted number of plants already known to be suitable for producing botanical insecticides.

Botanical insecticides: the disconnect between theory and practice

Murray B. Isman

Faculty of Land and Food Systems

University of British Columbia, Vancouver, CANADA

ASEAN FAW Action Plan
Biocontrol Workshop Series 6: Botanicals
23 November 2022

ASEAN FAW ACTION PLAN
Supporting IPM Across Southeast Asia

THE UNIVERSITY OF BRITISH COLUMBIA
Land and Food Systems

Terrestrial plants are a rich source of novel chemistry; the majority of these plant “secondary” substances likely evolved as defenses against herbivores and pathogens

There are perhaps 100,000 or more “secondary plant metabolites”; many serve as natural chemical defenses for the plants producing them. *Thousands* (or more) have some <u>demonstrated bioactivity in insects</u> (at least in laboratory tests)

Bioactivities can be behavioral (repellence, feeding deterrence, oviposition deterrence) or physiological (acute toxicity, developmental disruption, growth inhibition)

Why are there so few botanical insecticides in actual use?

Long-established Botanical Insecticides

- **Pyrethrum** (*Tanacetum cinerariaefolium*)
- **Rotenone** (*Derris elliptica, Lonchocarpus* spp.)
- **Nicotine** (*Nicotiana* and *Anabasis* species)

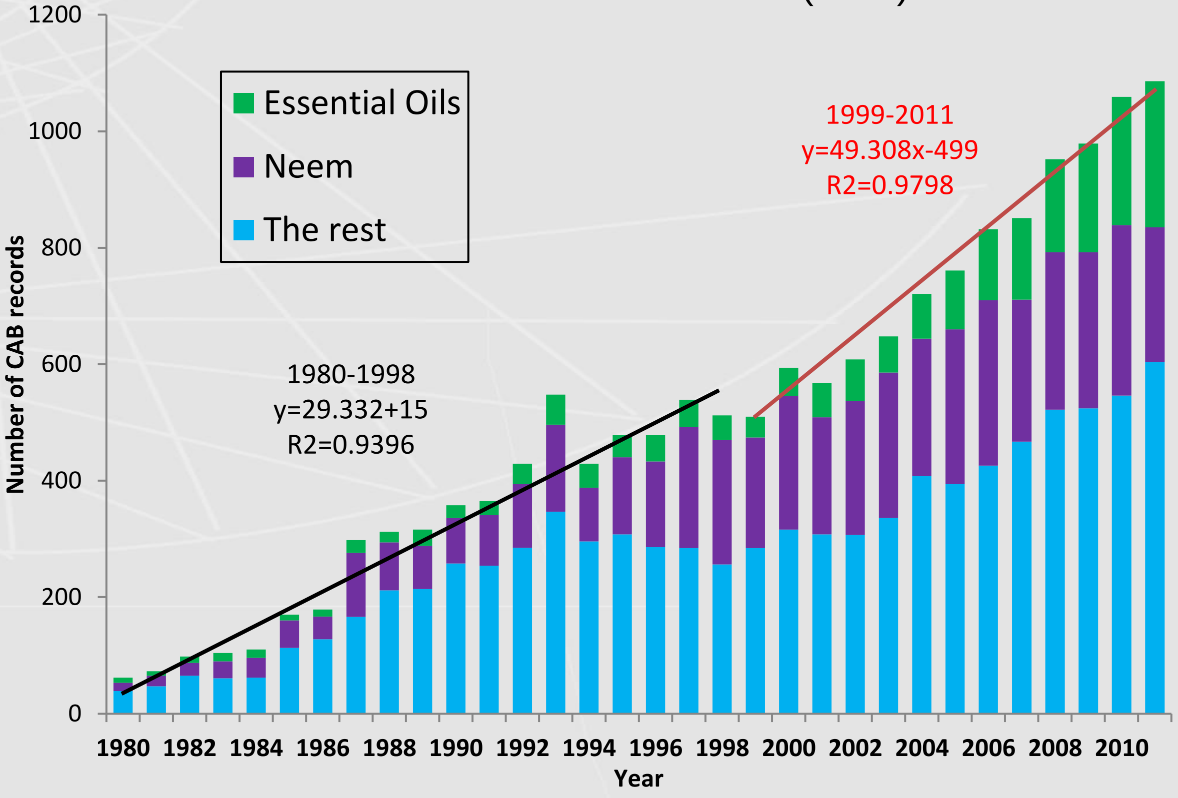
NB the use of rotenone and nicotine for insect control has been largely discontinued in most industrialized countries

Recently Introduced Botanical Insecticides

- **Neem** (*Azadirachta indica*)
- **Essential oils** (various including *Eugenia, Cymbopogon, Thymus, Cinnamomum, Citrus*)

Growth in Journal Papers on Botanical Insecticides: 1980-2011

Isman & Grieneisen (2014) *Trends in Plant Science* 19: 140-145.



Note:
1. in 2011, more papers on essential oils (251) than on neem (231)
2. overall, twice as many papers on neem (4,997) than essential oils (2,180)
3. over half of all papers on essential oils (1,111) published in 2007-2011

The problem statement

- Published research on botanical insecticides is heavily skewed (>80%) toward the *discovery* end of the R&D spectrum (e.g., "extract or oil of plant species X kills or repels pest species Y under laboratory conditions")
- In the absence of much applied research, this wealth of knowledge is NOT being translated to practice (i.e., put in the hands of farmers)

Challenges for the *commercial* development of new botanical insecticides

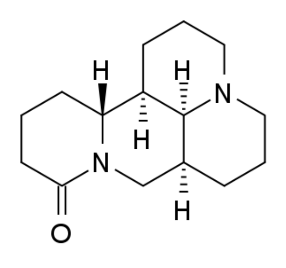
- **Resource availability/sustainability**
  - Wild-crafting vs. propagation/cultivation
- **Stability, standardization and quality control**
  - Chemical characterization; formulation
- **Regulatory approval (toxicology)**
  - Data requirements, data waivers, exemptions

Botanical insecticides commercialized since 2000

Common name	Plant species	Active ingredient(s)	Country of manufacture	Commerical product(s)
Matrine	*Sophora flavescens*	Matrine and related quinolizidine alkaloids	PR China	Matrine 0.3% EC
Black false hellebore	*Veratrum nigrum*	Cevadine-type alkaloids	PR China, USA	Veratrine 0.5% SL, Veratran D
Staff vine	*Celastrus angulatus*	Celangulin and related sesquiterpenes	PR China, USA	Celastrus 1% EW, Celan-X SL
Annona, sweetsop	*Annona squamosa*	Annonin and related acetogenins	India	Anosom, Biorakshak
Karanjin	*Derris indica (syn. Pongamia glabra)*	Karanjin (a furanoflavonol)	India	Biocawach
Hot pepper	*Capsicum annuum*	Capsicum oleoresin, capsaicin	Colombia, USA	EcofloraAgro, Captiva
Butterfly pea	*Clitoria ternatea*	cyclotides	Australia	Sero-X

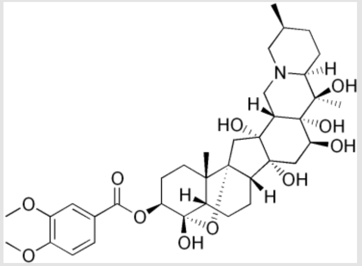
PR China

Matrine 0.3% EC



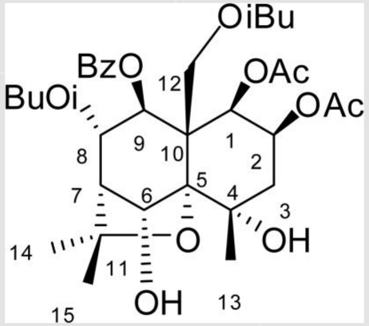
Sophora flavescens

Veratrine 0.5% SL



Veratrum nigrum

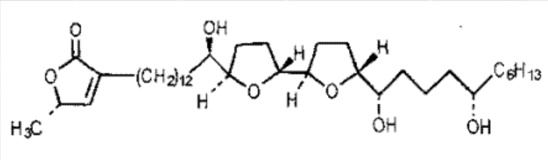
Celan-X SL

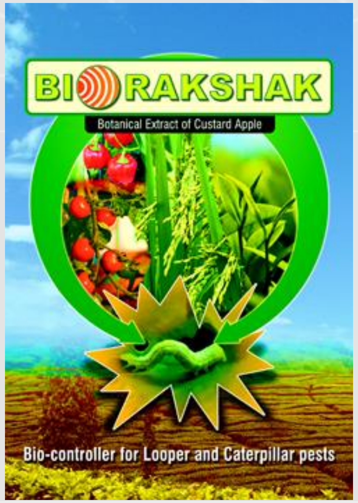


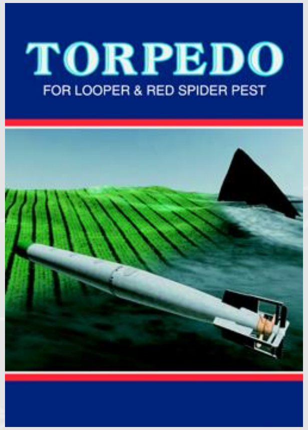
Celastrus angulatus

India

Annona squamosa and *A. reticulata* (1% squamosin)







Sophora

Stemona

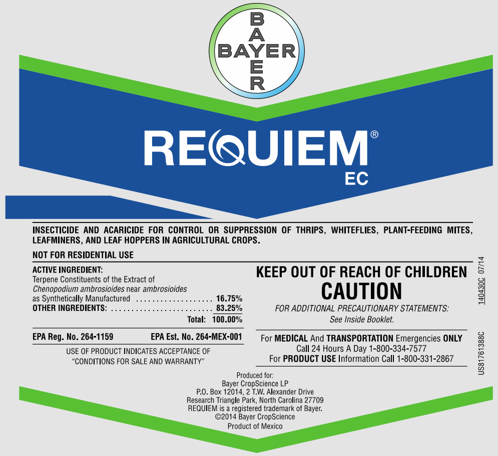
Millettia

Plant essential oils as active ingredients of some commercial botanical insecticides

Common name	Plant species	Major constituent(s)	Country of manufacture	Commercial product(s)
Rosemary	*Salvia rosmarinus (syn. Rosmarinus officinalis)*	1,8-cineole (=eucalyptol), camphor	USA	Ecotrol, TetraCURB
Thyme	*Thymus vulgaris*	Thymol, carvacrol	USA, Italy	Avenger Plus, Promax, Api Life VAR
Orange	*Citrus sinensis*	*d*-limonene	RSA, USA	Prev-AM, XT-2000
"Chenopodium"	Synthetic blend of terpenes based on *Chenopodium*	α-terpinene, *p*-cymene, *d*-limonene	USA	Requiem EC
Mint	*Mentha* spp.	Menthol, carvone	USA	EcoSMART

Active ingredients:
10% Rosemary oil
2% Peppermint oil

Active ingredient:
5% orange oil



Active ingredients:
16.75% monoterpenes

Captiva Prime
INSECT REPELLENT / INSECTICIDE

Active ingredients:
7.6% Capsicum oleoresin extract
23.4% Garlic oil
55.0% Canola oil

Akabrown
bioagricert inputs
PRODUCTO ORGANICO

Active ingredients:

Cinnamon oil	1.25%
Oil of Oregano	0.25%
Peppermint oil	1.00%
Clove oil	0.50%
Neem oil	4.00%
Olive oil	21.00%
Soybean oil	2.00%

Control of tomato pests using botanical insecticides - 2017

Visalia, California, August 2017

Treatment	Sweetpotato whitefly nymphs/5 leaves	Green peach aphids/5 leaves	Beet armyworms/plot
Ecotec (0.25%)	4.75 a	8.25 a	1.75 a
Pyganic (0.13%)(pyrethrins)	4.25 a	7.75 a	1.25 a
Untreated control	22.75 b	50.25 b	9.0 b

Insect counts taken 1 week after 2nd application; data courtesy of Brandt Consolidated

BRANDT

Myzus persicae

Bemisia tabaci

Spodoptera exigua

France - control of western flower thrips on cucumber - 2018

Treatment (L/ha x applications)	Thrips larvae/shoot (@ 3 weeks)
KeyPlex 063 (5.0 x 4)	138
Oikos (azadirachtin)(1.5 x 4)	180
Decis (deltamethrin)(0.83 x 3)	125
Untreated control	960

Western flower thrips
Frankliniella occidentalis

KeyPlex

A question of scale…

Commodity-based mechanized agriculture (domestic and for export) versus smallholder food production for local consumption

One solution

- Choose a select number of plants from among the many already known to be suitable for producing botanical insecticides

- Focus more research/development on:
  - Methods for propagation and cultivation
  - Simple methods for extraction
  - Simple methods to validate bioactivity
  - Field trials/demonstrations to optimize efficacy

Some plant extracts used for crop protection

Thailand

Brazil

Azadirachta indica (Neem)
Derris spp. (timbó)(Rotenone)
Chrysanthemum cinerariaefolium (Piretro)(Pyrethrum)
Piper nigrum (Pimenta do reino)(Black pepper)
Allium sativum (Alho)(Garlic)
Allamanda nobilis (Alamanda)
Melia azedarach (Cinamomo)(Chinaberry)
Pongamia glabra (Karanja)
Capsicum frutescens (Pimenta Malagueta)(Hot pepper)
Artemisia absynthium (Artemisia)(Absynthe)
Bixa orellana (Annato)

Well known insecticidal plants – Asia, Americas

Sophora flavescens
(MB Isman)

Piper retrofractum
(Berbagi Sedikit Informasi)

Eucalyptus globulus
(Forest & Kim Starr, Wikipedia)

Tagetes minuta
(H. Tolosa, Flora Bonaerense)

Annona squamosa
(I. Maguire, Pine Island Nursery)

Well known insecticidal plants in Africa

Tephrosia vogelii (MB Isman)

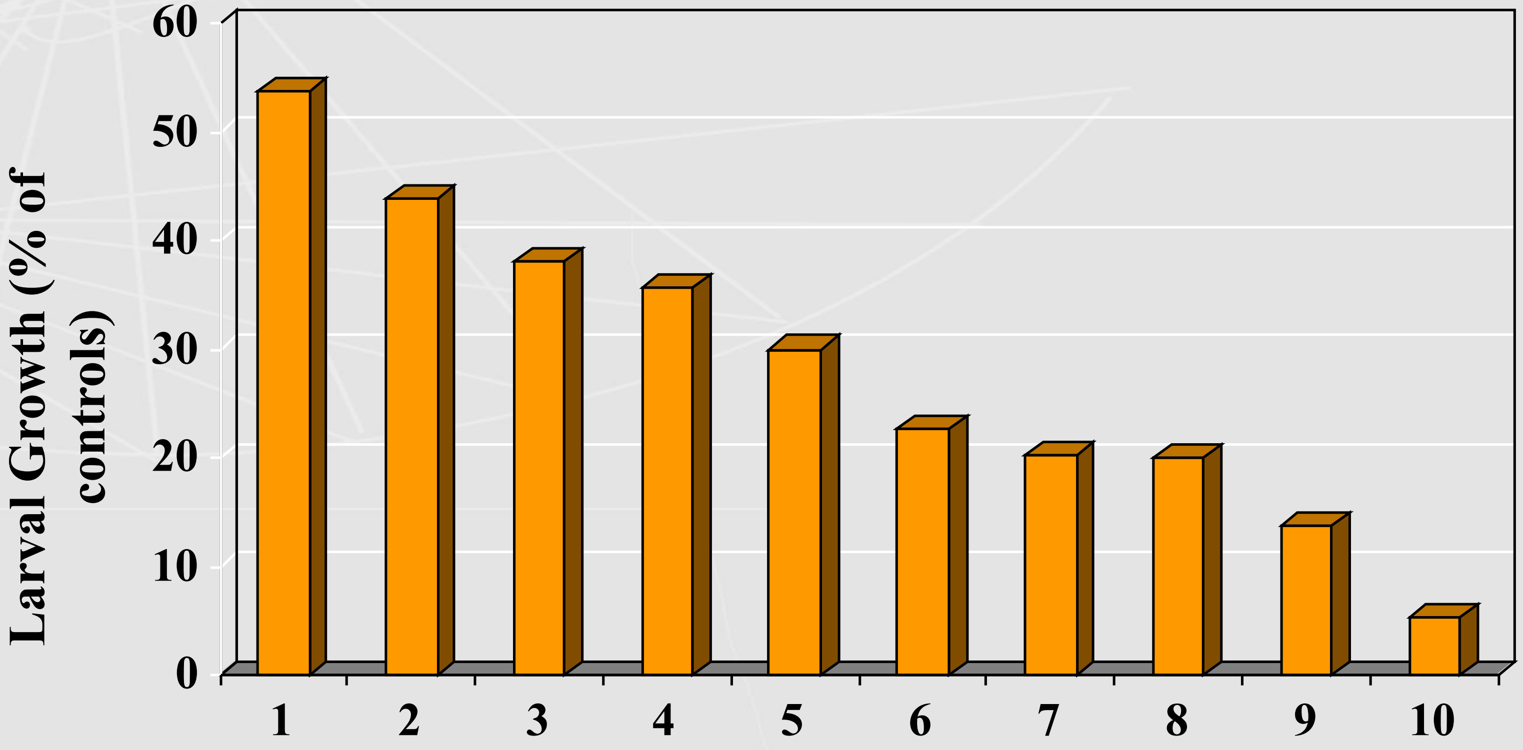
Ocimum gratissimum
(Onlyfoods.net)

Lippia javanica
(PlantzAfrica.com)

Tithonia diversifolia
(PlantzAfrica.com)

Geographic variation in potency of *Annona squamosa* seed extracts to *Spodoptera litura*

(Leatemia & Isman, *Phytoparasitica 32: 30-37,* 2004)

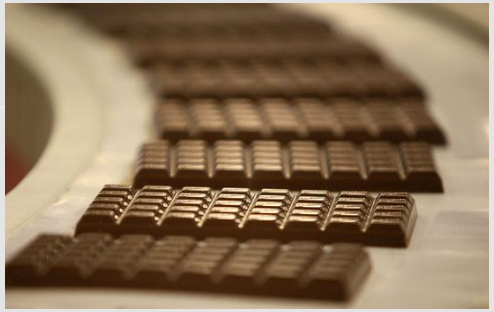


1 Negeri Lama 2 Batugantung-a 3 Semarang 4 Tantui
5 Batugantung-b 6 Blora 7 Latuhalat 8 Kudamati
9 Kate-Kate 10 Namlea (all seeds collected 1996)

Problem: Chemical variation in plants

Solution: *Blending* to achieve consistency

Cocoa: beans to chocolate



Coffee: beans to beverage

Wine: grapes to beverage

Summary

- a vast (and growing) scientific literature indicates that hundreds (possibly thousands) of terrestrial plants contain natural constituents that are toxic or deterrent to insects
- In contrast, only a handful of botanical insecticides have been commercialized in the past 20 years, because the barriers to commercialization are primarily technical, financial and legal rather than biological
- The disconnect between the theory (research) and practice (utilization) for botanical insecticides is a result of too much research on "discovery" and too little research on "application"
- More focus should be placed on the practical utilization of insecticidal plants that are already well known globally

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THE REPUBLIC OF SIERRA LEONE

SIERRA LEONE AGRICULTURAL RESEARCH INSTITUTE

Prospects of botanical compounds and pesticides as sustainable management strategies against *Spodoptera frugiperda*

Speaker : Patrick Maada Ngegba
PhD in Pesticide Science (In view)
M. Agriculture in Crop Protection
B.Sc (Hons) Crop Protection

2022 BIOCONTROL WORKSHOP SERIES
Workshop 6
23/11/2022

PRESENTATION OUTLINE

1. Current status of FAW
2. Prospects of botanical pesticides in management FAW
3. Some commercial botanical pesticides
4. Impact of botanical pesticides on FAW and its yield potential
5. Challenges of botanical pesticides usage
6. Conclusions and Recommendations

Current status

Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae) is an economically important agricultural pest that poses a serious threat to food security globally (Hui-ru et al., 2021; Qi et al., 2021)

It is native to tropical and subtropical regions of the Americas, and has rapidly spread to most parts of the world (Lira *et al*., 2020; Wang et al., 2020)

Highly polyphagous and has a wide host range of 353 plant species from 76 families, including maize (Zea mays L.), sorghum (Sorghum bicolor (L.) Moench), cotton (Gossypium sp. L.), and rice (Oryza sativa L.) (Montezano et al., 2018; Guo et al., 2020; Lv et al., 2021)

A serious transboundary pest, can fly long distances, and breeds prolifically under suitable environmental conditions (Baudron et al., 2019)

Photo credit: Desiree Van Heerden from Sygenta

Current status

- Globally, the application of synthetic pesticides is the most widely utilized control measure against *S. frugiperda* (Arias *et al*., 2019; Tambo *et al*., 2019)

- Commonly used insecticides include carbamate organophosphates, pyrethroids, and diamides (Gutiérrez-Moreno et al., 2019; Boaventura et al., 2020).

- Chemical pesticides pose adverse health risks to farmers and consumers, can build up resistance, cause toxicity to beneficial insects and natural enemies, and lead to environmental contamination (Day et al., 2017).

- How might botanical pesticides help in farmers manage FAW and what are the benefits and challenges

Prospects of botanical pesticides in management of FAW

- Botanical pesticides
  - efficacy
  - biodegradability
  - varied modes of action
  - low toxicity
  - easy usage
  - affordability
  - availability
  - minimal adverse effects on agroecosystems
  - human health (Shu et al., 2019; Jia et al., 2020)

Prospects of botanical pesticides in management of FAW

Botanical pesticides induce behavioral and physiological effects such as:

- repellence
- oviposition
- feeding deterrence
- acute toxicity
- developmental disruption
- growth suppression

Some plants utilized as botanical insecticides and their effects on *S. frugiperda*

Scientific Name (s)	Common Name (s)	Part used	Effect on Life Cycle	Study Area	Reference
Dysphania ambrosioides	Jesuit's tea, Mexican-tea	Leaf, Seed	High mortality, pupal weight loss	Laboratory/greenhouse/field	(Trindade et al., 2015; Sisay et al., 2019)
Tagetes erecta	African marigold	Leaf	Antifeedant, larval and pupal mortality, weight reduction	Laboratory	(Salinas-Sánchez et al., 2012)
Cymbopogon winterrianus	Citronella (Java Type)	Leaf	Alteration to the biochemical profile of larval, impaired reproduction	Laboratory/Greenhouse	(Silva et al. 2015)

Some plants utilized as botanical insecticides and their effects on *S. frugiperda* Cont'd

Scientific Name (s)	Common Name (s)	Part used	Effect on Life Cycle	Study Area	Reference
Carica papaya	Pawpaw	Seed	Reduced larval weight, prolonged pupation emergence time, high mortality	Laboratory/Greenhouse	(Perez-Gutierrez et al., 2011; Figueroa-Brito et al. 2013)
Euphorbia pulcherrima	Poinsettia	Leaf	Larval mortality, larval or pupal weight loss, prolonged larval stage, reduced egg viability	Laboratory	(Almeida et al. 2017)
Moringa oleifera	Moringa, Horse radish tree		Antifeedant activity, high mortality	Laboratory	(Kamel 2010)

Some plants utilized as botanical insecticides and their effects on *S. frugiperda* Cont'd



Scientific Name (s)	Common Name (s)	Part used	Effect on Life Cycle	Study Area	Reference
Jatropha gossypiifolia	Bellyache bush, Cotton-leaf physic nut	Leaf	Antifeedant	Laboratory	(Bullangpoti et al., 2012)
Azadirachta indica	Neem	Seed	Growth inhibition, antifeedant, larval mortality, low oviposition, prolonged development rate.	Laboratory/ greenhouse/field	(Sisay et al., 2019)
Argemone ochroleuca	Pale Mexican prickly poppy	Leaf, seed, flower	Larval mortality, antifeedant, delayed larval growth	Laboratory	(Martínez et al., 2017)

Some plants utilized as botanical insecticides and their effects on *S. frugiperda* Cont'd

Scientific Name (s)	Common Name (s)	Part used	Effect on Life Cycle	Study Area	Reference
Cymbopogon flexuosus	Cochin grass, Malabar grass	Leaf	Insecticidal activity	Laboratory	(Oliveira et al., 2018)
Lantana camara	Lantana	Seed	Larval mortality	Laboratory/ greenhouse/field	(Sisay et al., 2019)
Ocimum basilicum	Ho-ra-pa, Sweet-basil, basil	Leaf	Induced toxicity, nonpreference, knockdown	Laboratory/ greenhouse/field	(Phambala et al., 2020)

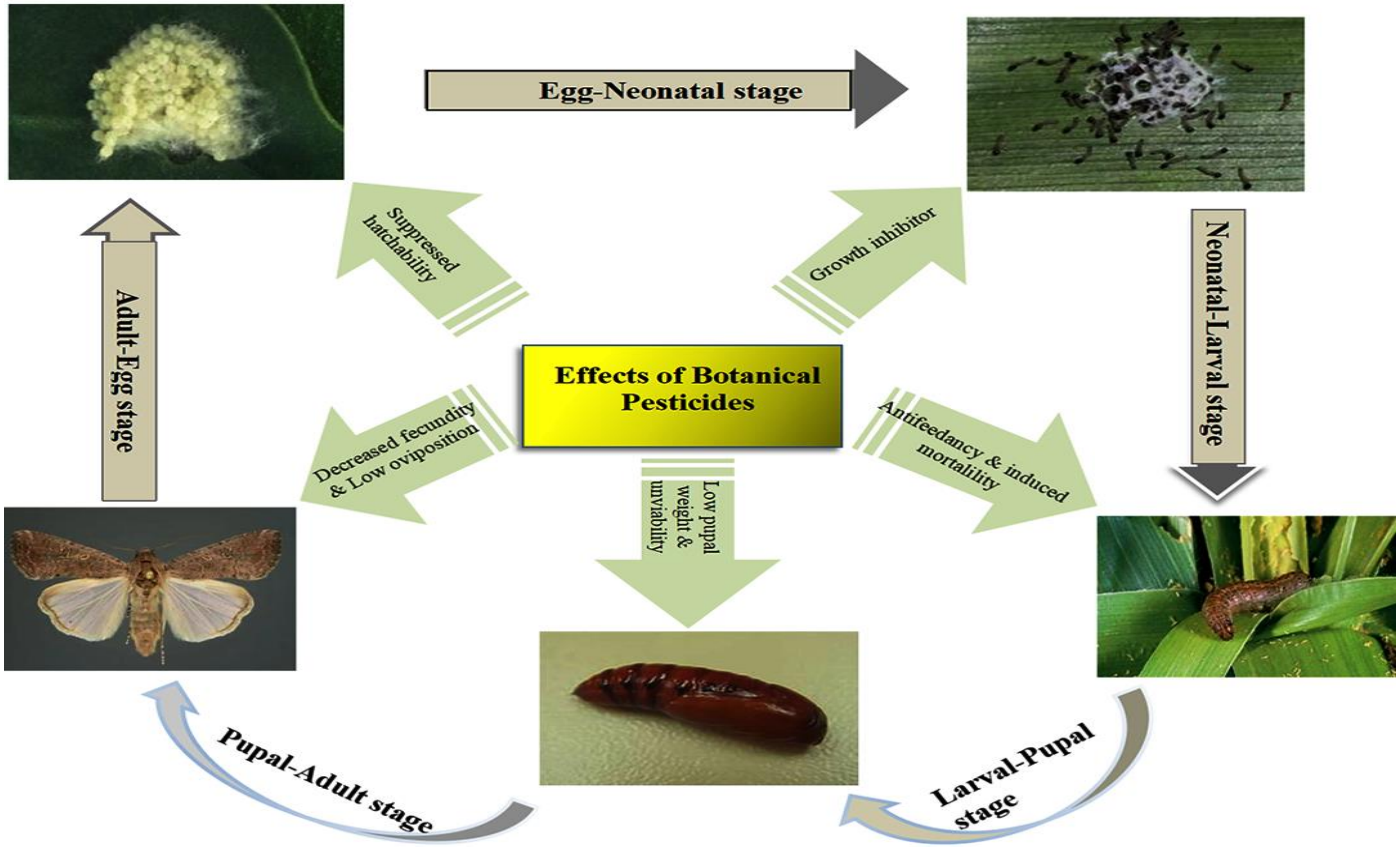


Illustration of effects of botanical pesticides on the life stages of *S. frugiperda* (Ngegba et al., 2022).

Some commercial botanical pesticides

Scientific Name (s)	Product common Name (s)	Trade Name
Cymbopogon nardus, C.citratus, Cymbopogon flexuosus (D.C)	Lemongrass essential oil	GreenMatch EX™
Azadirachta indica	Neem	Ecozin, Azatrol EC, Agroneem, Trilogy™
Cassia tora (L.), *Cassia obtusifolia* (L.)	Cinnamaldehyde	Vertigo™, Cinnacure™
Syzygium aromaticum (L.) *Eugenia caryophyllus* (Spreng)	Clove essential oil	Matran EC, Burnout II, Biooganic Lawn.
Tanacetum cinerariaefolium (Trevisan) Schultz-Bip.	Pyrethrum	Pyganic, DiatectSeed.

Some commercial botanical pesticides

Scientific Name (s)	Product common Name (s)	Trade Name
Derris spp., Lonchocarpus spp., and Tephrosia spp	Rotenone	Bonide, Rotenone
Ryania spp. (Ryania speciose Vahl)	Ryania	Natur-Gro R-50, Natur-Gro Triple Plus, Ryan 50.
Schoenocaulon spp. (S. officinale)	Sabadilla	Veratran, RedDevil, Natural Guard.
Thymus vulgaris L. Thymus spp	Thyme essential oil	Proud 3, OrganicYard Insect Killer, Promax™

Impact of botanical pesticides on FAW and yield potential

Neem extracts inhibited *S. frugiperda* infestation and recorded highest maize yield of 4.9 t ha^{-1}, followed by cypermethrin + Chinaberry with 4.7 t ha^{-1} and a garlic yield of 4.3 t·ha^{-1} respectively (Siazemo and Simfukwe, 2020).

Extracts from **West African black pepper** at different concentrations **induced *S. frugiperda* mortality and decreased the larval population** (Tanyi et al., 2020).

Reducing plant damage at both the vegetative and reproductive stages and leading to more crop growth and photosynthesis that accounted for maize yields ranging from 2.2 to 6.3 t ha^{-1} compared to control (Tanyi et al., 2020).

Impact of botanical pesticides on FAW and its yield potential cont'd

Some botanical extracts suppressed *S. frugiperda* damage in maize fields, and azadirachtin had the highest grain yield of 2,580 kg·ha^{-1}, followed by neem seed kernel with 2,446 kg ha^{-1} (Dhobi et al., 2020)

Green chili induced the lowest grain yield (2,051 kg ha^{-1}) compared to *Lantana camara* (2,089 kg ha−1) and tobacco decoction 2,198 kg ha^{-1} (Dhobi et al., 2020).

Challenges of botanical pesticides usage

Botanical pesticide effectiveness in the field is extremely contingent on prevailing environmental and weather conditions as they are **easily degradable** (Isman and Grieneisen, 2014; Campos et al., 2018).

It is often **challenging to standardize botanical pesticide dosages** due to variance growth habitations, varietal differences, harvest duration, extraction methods, and storage conditions (Shiberu and Getu, 2016).

Appropriate formulation is very challenging because multiple bioactive constituents are evident in one plant species that differ in chemical properties (Kumar and Singh, 2015).

Challenges of botanical pesticides usage Cont'l

Botanical pesticides commercialization has major challenges, such as

(a) limited supply of botanical raw materials

(b) poor standardization and quality control of the required active ingredients

(c) issues with regulatory approval, i.e., costly toxicological evaluation of the candidate botanical pesticide (Isman and Paluch, 2011; Fischer et al., 2013)

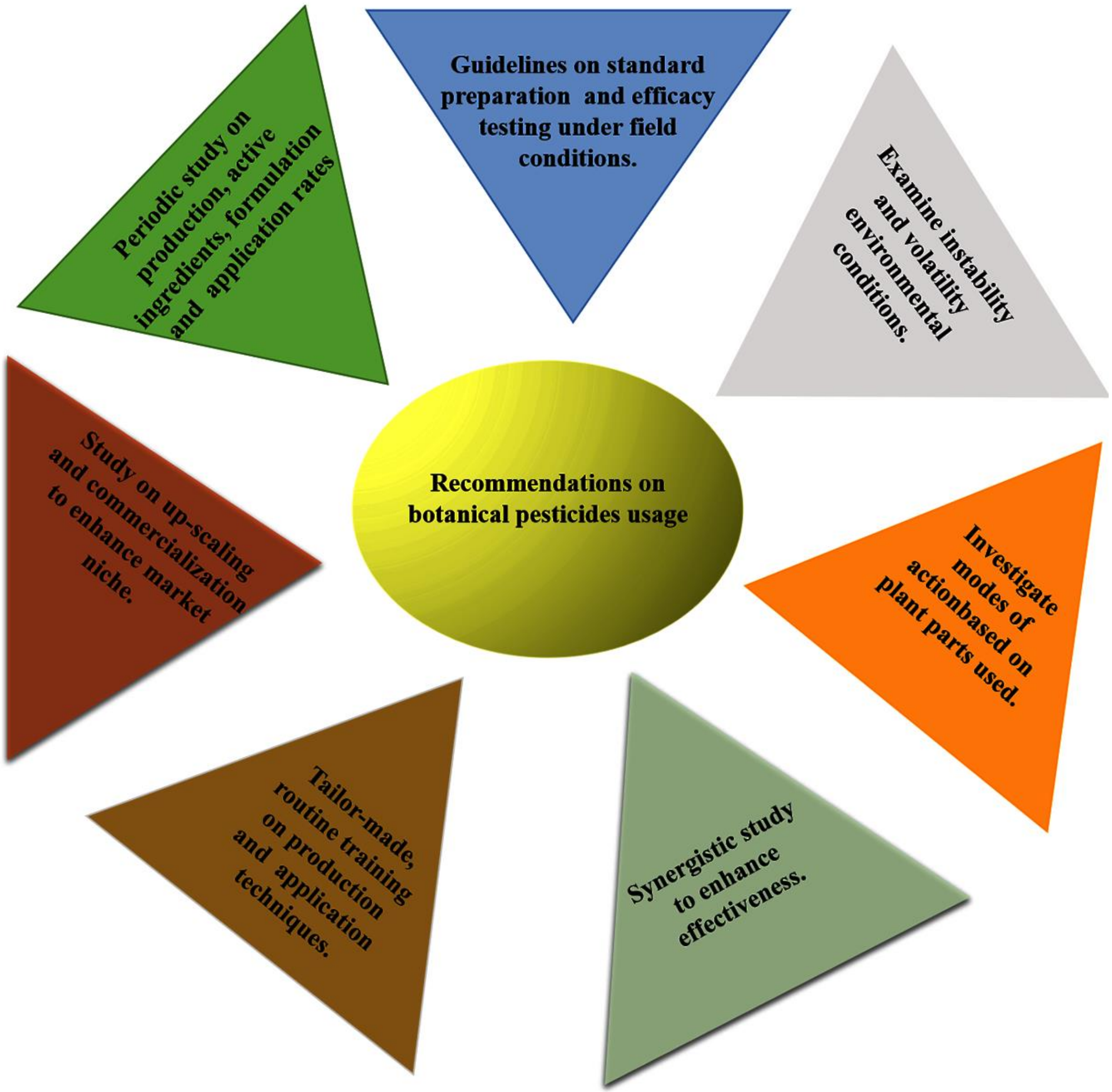
Conclusions and Recommendations

Significant concerns related to human health, environmental safety, and negative impacts on beneficiary organisms from the use of conventional chemical pesticides along with increasing global demand for pesticide residue-free products can help drive increasing demand for botanical pesticides as sustainable alternatives in managing *S. frugiperda*.

Botanical pesticides can cause low egg viability, reductions in larval growth, prolong development periods, increase mortality, and lower fertility and fecundity of adults of *S. frugiperda*, providing benefits related to environmental safety and food safe for human consumption.

Considering the benefits of botanical pesticides in helping to control FAW we recommend…

Recommendations to enhance the utilization of botanical pesticides to manage *S. frugiperda* (Ngegba et al., 2022)



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I am particularly grateful to the organizers for singling out our work to be shared with the wilder stakeholders in the agricultural sector.

Selected Citations

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Review

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Review

Prospects of Botanical Compounds and Pesticides as Sustainable Management Strategies Against *Spodoptera frugiperda*

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Abstract

Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae) (fall armyworm) is an extremely destructive insect pest that causes crop losses, especially cereal production across the world. Its management is challenged by its high migratory ability, polyphagous nature, high fecundity level, and short life cycle. It has become a serious threat across the globe that requires proactive and coordinated regional and global interventions. Although synthetic insecticides have been widely utilized to control the pest, there are numerous inherent challenges associated with the overreliance and overuse of these chemicals, e.g., toxicity to humans, destruction of natural pest enemies and pollinators, environmental and food contamination, pest resurgence, secondary pest outbreaks, and resistance development. Plant-derived pesticides such as *Azadirachta indica, Eucalyptus globulus, Jatropha curcas, Lantana camara, Phytolacca dodecandra,* and *Piper guineense* have been evaluated under laboratory, greenhouse, and field conditions to control *S. frugiperda*. We are certain that the substantial potential of these plants under field conditions could be enhanced and promoted together with existing plant-based products (registered) for use against *S. frugiperda* as an alternative in integrated pest management schemes. Therefore, this review highlights challenges and prospects that will help refocus and increase research attention on the development and application of botanical pesticides under field conditions rather than only under laboratory and control conditions to increase the commercialization and adoption rate of this technology across the globe.

Key words: *Spodoptera frugiperda*, botanical pesticide, challenge and prospect, commercialization, adoption

Spodoptera frugiperda (J.E. Smith) (Lepidoptera: Noctuidae) is an economically important agricultural pest that poses a serious threat to food security globally (Dumas et al. 2015, Zacarias 2020, Hui-ru et al. 2021, Qi et al. 2021). Moreover, it is native to tropical and subtropical regions of the Americas, and this deleterious pest has rapidly spread to most parts of the world since 2015 (Baloch et al. 2020, Lira et al. 2020, Wang et al. 2020). *S. frugiperda* was first detected outside its native range in Central and West Africa (Benin, Nigeria, Sao Tome and Principe, and Togo) in 2016 and caused immense devastation to maize in several countries (Goergen et al. 2016, FAO 2018). In less than three years, it spread to 44 African countries (Feldmann et al. 2019), as well as several Asian countries (Guo et al. 2018, Shylesha et al. 2018, CABI 2019). The first report of the invasion of *S. frugiperda* into China was in January 2019 in Yunnan Province (Guo et al. 2019, Zhang et al. 2019). Then, it rapidly spread to 26 provinces across the country and became extremely destructive to maize and other crops (Jiang et al. 2019). The average corn yield losses due to infestation by *S. frugiperda* range from 20% to 50% in Africa, South Asia, and Southeast Asia (Day et al. 2017, FAO 2018). In Central Mexico, crops have experienced considerable yield losses estimated at 17.7 million tons (Jaraleño-Teniente et al. 2020).

Spodoptera frugiperda is highly polyphagous and has a wide host range of 353 plant species from 76 families, including maize

Prospects of botanical compounds and pesticides as sustainable management strategies against Spodoptera frugiperda

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CURRENT STATUS OF USING BOTANICAL PESTICIDES IN VIETNAM

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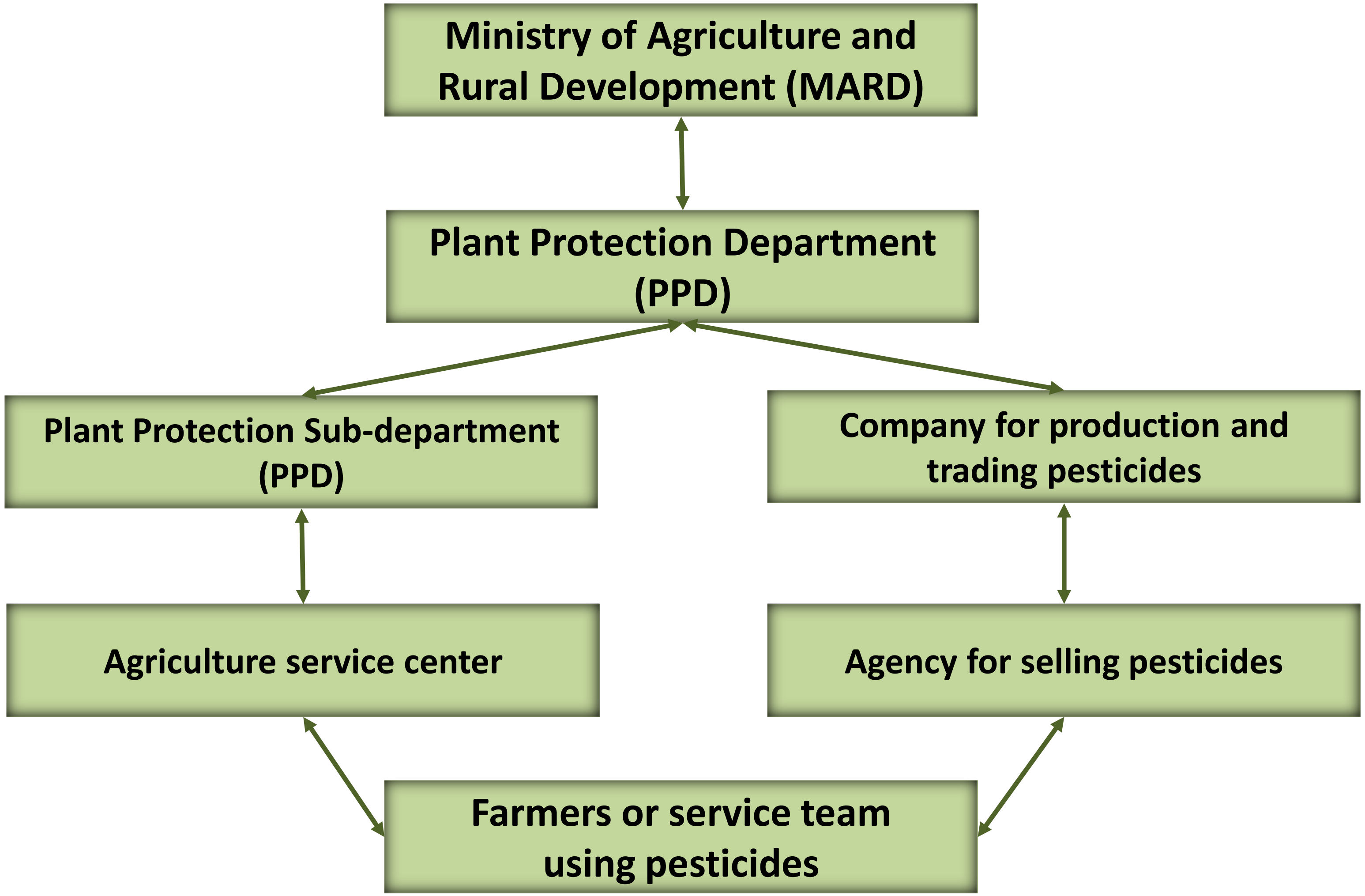
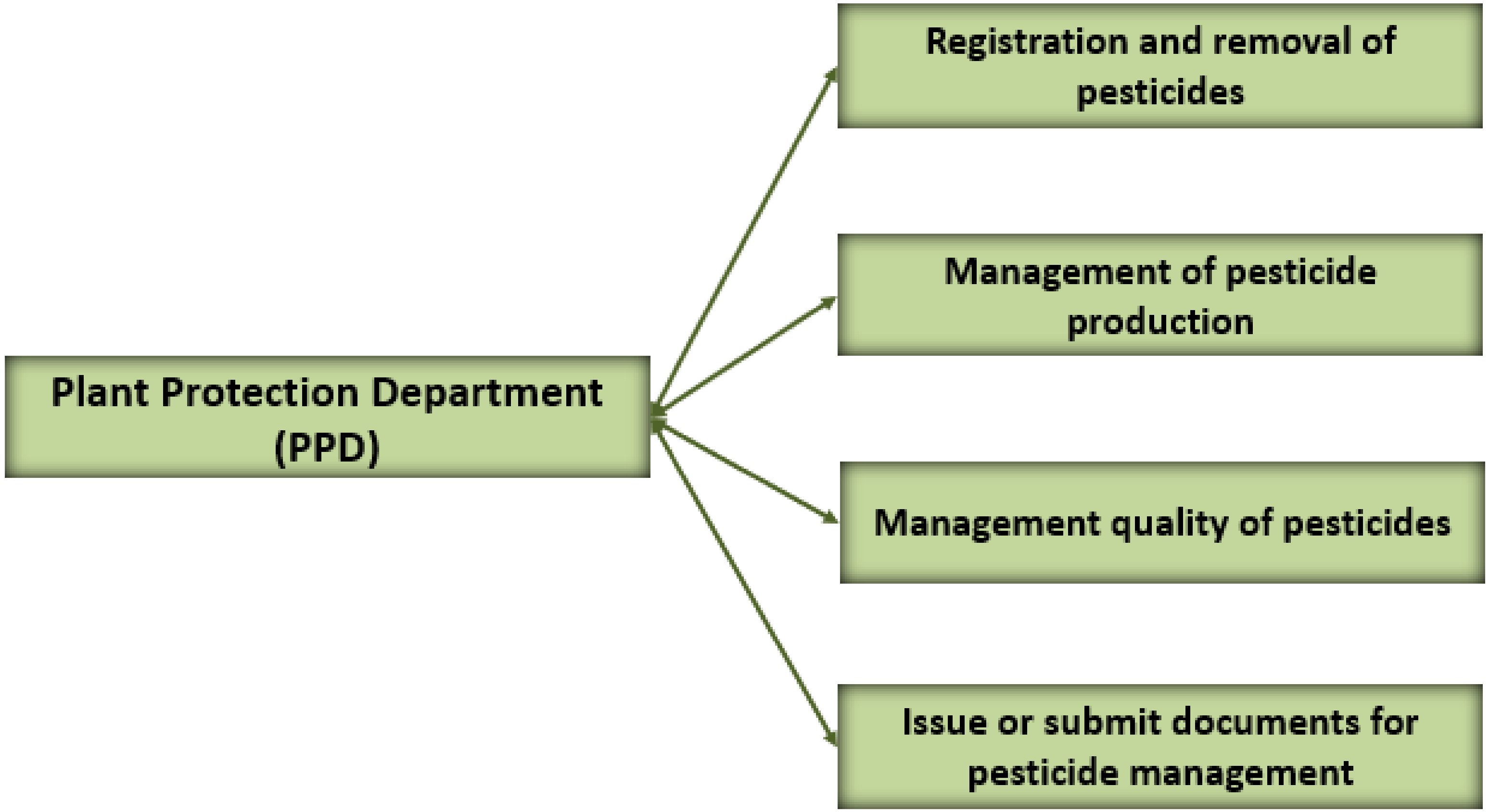
Hanoi-2022

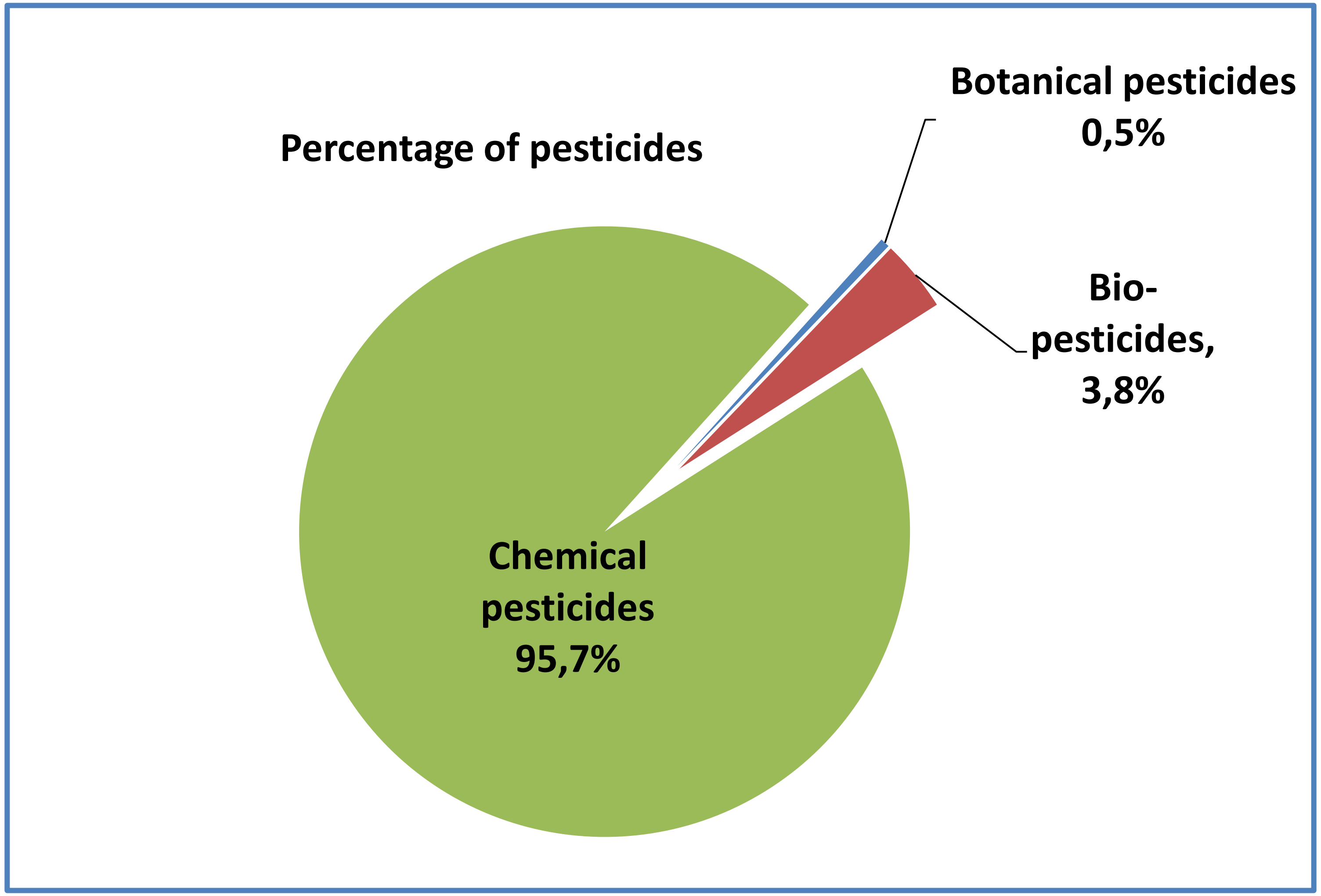
Vietnam: System for management and use of pesticides



Vietnam: System for management, production and use of pesticides



Comparison of botanical pesticides with bio-pesticides and chemical pesticides



List of botanical pesticides registered in Vietnam

BCATYPE_ KEY	Active Ingredient	Trade name	BCA_CONCENTRATION	Registered Pest
Botanical	Azadirachtin	Agiaza 0.03 EC, 4.5EC	0.03EC, 4.5EC	diamond back moth, Thrips, Aphid, Red spider mite, Bollworm, Green aphids
		Altivi	0.3EC	diamond back moth, Red spider mite, Sheath borer, Green aphids
		A-Z annong	0.03EC, 0.15EC, 0.3EC, 0.6EC, 0.9EC	diamond back moth, Thrips, BPH, Aphid, Red spider mite, Green aphids, Rice Leafroller
		Aza	0.15EC	diamond back moth
		Boaza	0.3EC, 0.6EC	diamond back moth
		Cittioke	0.6EC, 0.9EC	diamond back moth, Thrips, BPH, Rice Leafroller
		Goldgun	0.3EC, 0.6EC, 0.9EC	diamond back moth, Thrips, BPH, Aphid, Red spider mite, Green aphids, Rice Leafroller
		Hoaneem	0.03EC, 0.15EC, 0.3EC	diamond back moth, Red spider mite, Rice Leafroller, Leafminer
		Jasper	0.3EC	diamond back moth, Aphid, Red spider mite, Green aphids, Rice Leafroller
		Kozomi	0.15EC, 0.3EC, 1EC	diamond back moth, BPH, Aphid, Red spider mite, Bollworm, Green aphids, Rice Leafroller
		Minup	0.3EC, 0.6EC, 0.9EC	diamond back moth, Thrips, BPH, Red spider mite, Green aphids
		Misec	1.0EC	diamond back moth
		Mothian	0.35EC	diamond back moth, Aphid, Red spider mite, Bollworm
		Neem Nim Xoan Xanh green	0.15EC, 0.3EC	diamond back moth
		Sarkozy	0.3EC, 1EC, 1WP	diamond back moth, Thrips, Red spider mite, Sheath borer, Green aphids, Rice Leafroller, Leafminer
		Sokotin	0.3EC	diamond back moth, BPH, Red spider mite, Green aphids, Rice Leafroller
		Super Fitoc	3EC, 5EC, 10EC	diamond back moth, Thrips, BPH, Aphid, Red spider mite, Green aphids
		Trutat	0.32EC	diamond back moth, Aphid, Red spider mite, Bollworm, Rice Leafroller
		Vineem	1500EC	Thrips, Aphid, Red spider mite, Green aphids
		Dau nim xoan xanh xanh	0.15EC	Leafminer, Mealybug, aphid, Diamond Back moth
	Celastrus angulatas	Emnus	1EC	diamond back moth, Thrips, Cutworm, Silk worms (Vietn.) syn. Diamondback moth, Green aphids, Rice Leafroller
	Celastrus angulatus	Agilatus 1EC	1EC	diamond back moth, Thrips, Cutworm, Red spider mite, Bollworm, Rice Leafroller
	Citrus oil	MAP Green	3SL, 6SL, 8SL, 10SL	diamond back moth, Thrips, Red spider mite, Mold, Rot, Anthracnose, Rice Leafroller
	Corn oil + Cottonseed oil + Garlic oil	GC - 3	83SL:Corn oil30% + Cottonseed oil30% + Garlic oil23%	Powdery mildew
	Esters of botanic oil	Subain	99SL	Surfactant
	Eucalyptol	Pesta	2SL: Eucalyptol (min 70%)	diamond back moth, Cutworm, BPH, Rice Leafroller
	Garlic juice	Bralic - Toi Toi	1.25SL, 10SL	Mealybugs
	Matrine (gentian extract)	Agri-one 1SL	1SL	diamond back moth, Thrips, Aphid, Red spider mite

List of botanical pesticides registered in Vietnam

Matrine (gentian extract)	Agri-one 1SL	1SL	diamond back moth, Thrips, Aphid, Red spider mite
	Ajisuper	0.5SL, 1SL, 1EC, 1WP	diamond back moth, Thrips, Red spider mite, Sheath borer, Green aphids
	Aphophis	5EC, 10EC	diamond back moth, Thrips, BPH, Aphid, Green aphids
	Asin	0.5EC, 0.5SL	diamond back moth, Aphid
	Ema 5EC	5EC	diamond back moth, Thrips, Cutworm, BPH, Mealybugs, Rice Leafroller
	Faini	0.288EC, 0.3SL	diamond back moth, BPH, Rice Leafroller
	Kobisuper	1SL	Thrips, Red spider mite, Bollworm
	Ly 0.26SL	0.26SL	Aphid, Diamond back moth
	Marigold	0.36SL	diamond back moth, Thrips, Red spider mite, Bollworm, Mold, Green aphids, Rot
	Sakumec	0.36EC, 0.5SL	diamond back moth, Thrips, Red spider mite, Green aphids
	Sokonec	0.36SL	diamond back moth, BPH, Red spider mite, Bollworm, Green aphids
	Sokupi 0.36SL, 0.5SL		Diamond back moth, worm, rice bug, leafolder
	Wotac	5EC, 10EC, 16EC	diamond back moth, Thrips, Cutworm, BPH, Rice Leafroller
Oligo-alginate	M.A Maral	10SL, 10WP	Growth stimulation
Polyphenols extracted from Gleditsia, Siegesbeckia, Bidens and Parthenium	Anisaf SH-01	2SL	diamond back moth, Cutworm
Polyphenols extracted from Mangifera indica L	Plastimula	1SL	Growth stimulation
Polyphenols extracted from Sophora japonica L. Schott	Lacasoto	4SP	Growth stimulation
Pyrethrins	Bopy	14EC, 50EC	diamond back moth, Red spider mite
	Mativex	1.5EW	Aphid
	Nixatop	3.0CS	diamond back moth, Thrips, BPH, Aphid, Sheath borer, Green aphids, Rice Leafroller
Rotenone	Bin 10EC, 25EC	10EC, 25EC	diamond back moth, Rice Leafroller
	Dibaroten	5WP, 5SL, 5GR	diamond back moth, Aphid, Red spider mite, Green aphids
	Fortenone	5WP	diamond back moth
	Limater	7.5EC	diamond back moth, Thrips, Cutworm, Aphid, Red spider mite, Bollworm, Green aphids
	Newfatoc	50WP, 50SL, 75SL, 75WP	Thrips, BPH, Aphid, Red spider mite, Green aphids, Leafminer
	Rinup	50EC, 50WP	diamond back moth, Thrips, Aphid, Red spider mite, Green aphids
	Rotecide 2SL	2SL	diamond back moth, BPH
	Trusach	2.5EC	diamond back moth, Thrips, Aphid, Red spider mite, Bollworm, Rice Leafroller, Leafminer
	Vironone	2EC	diamond back moth
Saponin	Abuna 15 GR	15GR	Snail, Slug
	Dibonin super	5WP, 15WP	Snail, Slug
	Map Lisa 230 SL	230SL	diamond back moth
	Oc tieu		Snail, Slug

List of botanical pesticides registered in Vietnam

Product Mix	Azadirachtin + Matrine	Biomax	1EC:Azadirachtin 0.6% + Matrine 0.4%	diamond back moth, BPH, Rice Leafroller
		Golmec	9EC, 15EC, 20EC:Azadirachtin 5(7.5/10)g/L+Matrine 4(7.5/10)g/L	diamond back moth, Cutworm, Rice Leafroller, Rice borer
		Lambada 5EC	5EC:Azadirachtin 3 g/l + Matrine 2 g/l	diamond back moth, Cutworm, Rice Leafroller
	Botanic oil + potash	Thuốc sâu sinh học Thiên Nông 1 SL	1 SL	diamond back moth
	Cafein + Nicotine Sulfate + Azadirachtin	Tob	1.25GR, 1.88GR	Snail
	Chaetomium sp. + Trichoderma sp.	Mocabi SL	Chaeto.sp1.5x10^6 cfu/ml+ Trichod.sp1.2x10^4 cfu/ml	Root rot, Wilt, Rot
	Chitosan + Polyoxin	Starone	20WP, 50WP:Chitosan 19g/kg (49g/kg) + Polyoxin 1g/kg (1g/kg)	Rot, Blast
	Chitosan 2% + Oligo - Alginate 10%	2S Sea & See 12WP, 12SL	12WP, 12SL	Black rot
	Cottonseed oil + clove oil + Garlic oil	GC - Mite	70SL:Cottonseed oil 40%+clove oil 20%+garlic oil10%	Mealybugs, Rice Leafroller
	Cucuminoid + Gingerol	Stifano	5SL: Cucuminoid 5% + Gingerol 0.5%	Late blight, Root rot, Wilt, Leaf spot, Rot, Bacterial spot, downy mildew, Leaf blight
	Matrine + Oxymatrine	Disrex	0.6SL:Matrine 0.5% + Oxymatrine 0.1%	diamond back moth
	Pyrethrins + Rotenone	Biosun	3EW:Pyrethrins 2.5% + Rotenone 0.5%	diamond back moth, Thrips, Red spider mite, Green aphids
	Rotenone + Saponin	Dibonin	5WP, 5SL, 5GR: Rotenone 2.5% + Saponin 2.5%	diamond back moth, Aphid, Red spider mite, Green aphids
		Ritenon	150BR, 150GR: Rotenone 2g/kg + Saponin 148g/kg	Nematode
		Sitto-nin	15EC, 15BR:Rotenone 50g/kg (g/l) + Saponin 2.5% 145g/kg (g/l)	Nematode
	Saponin + Cafein + Azadirachtin	Dietoc	5.6GR:Saponin 5%+ Cafein 0.5% + Azadirachtin 0.1%	Snail
		Ovadan	37GR:Saponin 30 g/kg + Cafein 6g/kg + Azadirachtin 1g/kg	Snail
	Saponozit + saponic acid	TP - Than Dien 78SL	78SL:Saponozit 46% + Saponin acid 32%	Thrips, Red spider mite, Mealybugs
	Polyoxin complex	Polyoxin AL	(blank)	Leaf spot

List of botanical pesticides registered in Vietnam

Product Mix	Azadirachtin + Matrine	Biomax	1EC:Azadirachtin 0.6% + Matrine 0.4%	diamond back moth, BPH, Rice Leafroller
		Golmec	9EC, 15EC, 20EC:Azadirachtin 5(7.5/10)g/L+Matrine 4(7.5/10)g/L	diamond back moth, Cutworm, Rice Leafroller, Rice borer
		Lambada 5EC	5EC:Azadirachtin 3 g/l + Matrine 2 g/l	diamond back moth, Cutworm, Rice Leafroller
	Botanic oil + potash	Thuốc sâu sinh học Thiên Nông 1 SL	1 SL	diamond back moth
	Cafein + Nicotine Sulfate + Azadirachtin	Tob	1.25GR, 1.88GR	Snail
	Chaetomium sp. + Trichoderma sp.	Mocabi SL	Chaeto.sp1.5x10^6 cfu/ml+ Trichod.sp1.2x10^4 cfu/ml	Root rot, Wilt, Rot
	Chitosan + Polyoxin	Starone	20WP, 50WP:Chitosan 19g/kg (49g/kg) + Polyoxin 1g/kg (1g/kg)	Rot, Blast
	Chitosan 2% + Oligo - Alginate 10%	2S Sea & See 12WP, 12SL	12WP, 12SL	Black rot
	Cottonseed oil + clove oil + Garlic oil	GC - Mite	70SL:Cottonseed oil 40%+clove oil 20%+garlic oil10%	Mealybugs, Rice Leafroller
	Cucuminoid + Gingerol	Stifano	5SL: Cucuminoid 5% + Gingerol 0.5%	Late blight, Root rot, Wilt, Leaf spot, Rot, Bacterial spot, downy mildew, Leaf blight
	Matrine + Oxymatrine	Disrex	0.6SL:Matrine 0.5% + Oxymatrine 0.1%	diamond back moth
	Pyrethrins + Rotenone	Biosun	3EW:Pyrethrins 2.5% + Rotenone 0.5%	diamond back moth, Thrips, Red spider mite, Green aphids
	Rotenone + Saponin	Dibonin	5WP, 5SL, 5GR: Rotenone 2.5% + Saponin 2.5%	diamond back moth, Aphid, Red spider mite, Green aphids
		Ritenon	150BR, 150GR: Rotenone 2g/kg + Saponin 148g/kg	Nematode
		Sitto-nin	15EC, 15BR:Rotenone 50g/kg (g/l) + Saponin 2.5% 145g/kg (g/l)	Nematode
	Saponin + Cafein + Azadirachtin	Dietoc	5.6GR:Saponin 5%+ Cafein 0.5% + Azadirachtin 0.1%	Snail
		Ovadan	37GR:Saponin 30 g/kg + Cafein 6g/kg + Azadirachtin 1g/kg	Snail
	Saponozit + saponic acid	TP - Than Dien 78SL	78SL:Saponozit 46% + Saponin acid 32%	Thrips, Red spider mite, Mealybugs
	Polyoxin complex	Polyoxin AL	(blank)	Leaf spot

Advantages in the production and use of botanical pesticides in Vietnam

- ❖ Diversity of topography and tropical monsoon climate permit many plants to grow that are good materials for botanical pesticide production.

- ❖ Government supports research and development of botanical pesticides in particular, and bio-pesticides in general.

- ❖ Consumers are gradually understanding and receptive to organic agriculture products.

Disadvantages in the production and using botanical pesticides in Vietnam

- ❖ Biological efficacy and economic efficiency are lower to compare with chemical pesticides.

- ❖ Botanical pesticides are normally difficult storage and using.

- ❖ It is very difficult to change farmer's habits about using chemical pesticides.

- ❖ It is very difficult to register new botanical pesticides in the list.

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THANK YOU

Dr. Dao Bach Khoa

Summary

Biocontrol Technical Workshop Series 2022

Session 6: Botanical Pesticides




23 November 2022

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ASEAN FAW ACTION PLAN
Supporting IPM Across Southeast Asia




ASEAN Action Plan on Fall Armyworm

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ASEAN FAW ACTION PLAN
Supporting IPM Across Southeast Asia