CIPAC SYMPOSIUM 2026
Krabi, Thailand 16 June 2026

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Capacity Building of Pesticide Formulation Sciences under the Circumstances of the Hazardous Substances Act B.E. 2535 and the Department of Agriculture, THAILAND.

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- **Thailand's perspectives** of pesticide management
- Overall **JMPM-JMPS-JMPR** Guidelines and regulations for adoption of pesticides registration
- **Adoption of ICC-PM/PS Guidance** on data requirements for the registration of pesticides
- **Local capacity** building of **pesticides registration** for pesticide business operators (PBOs)
- **AMARC's** activities
- **Some challenges in Pesticide Industries and pesticide sciences** to combat the pests and efficacy
- **Conclusions**

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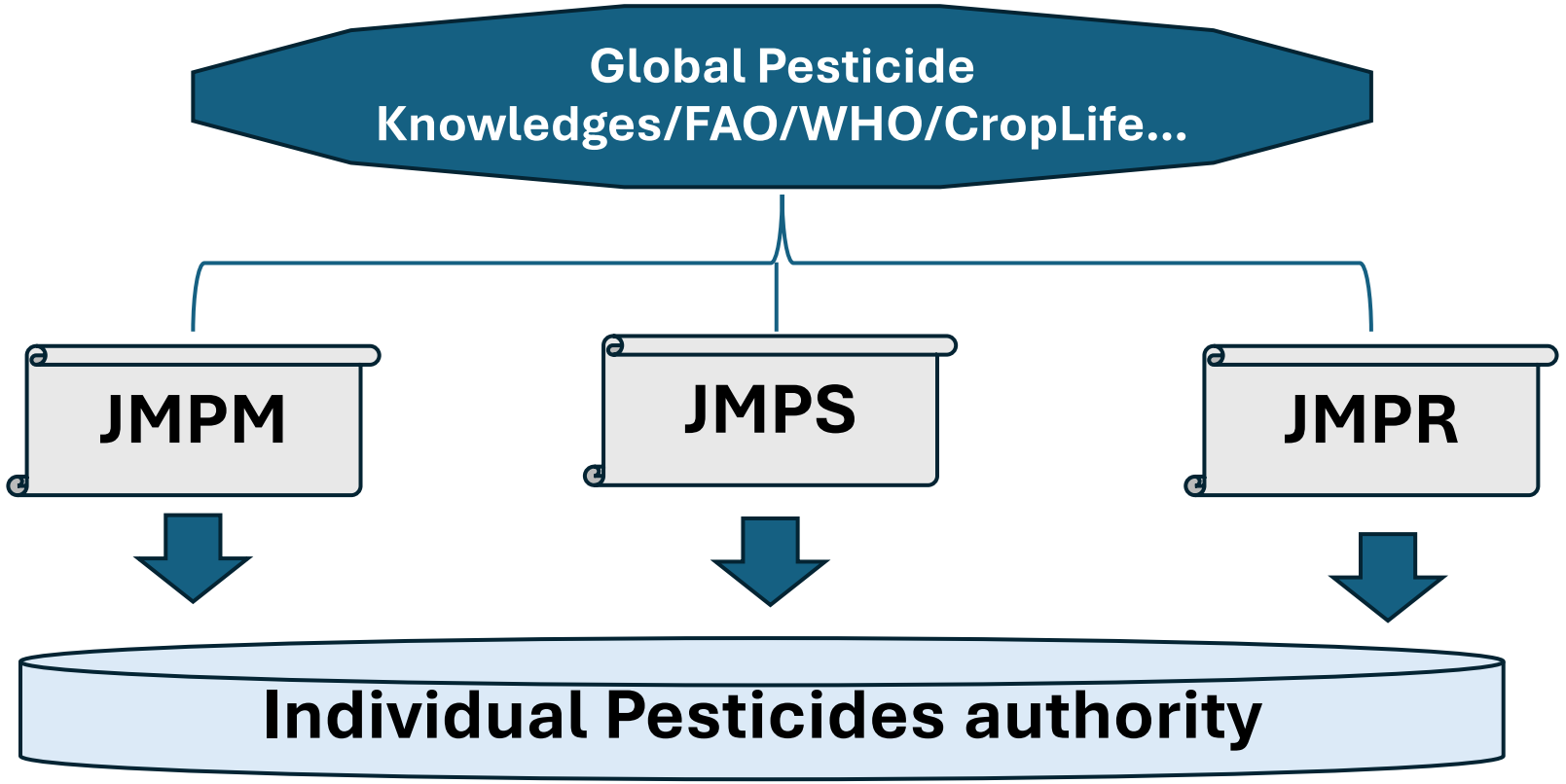
❑ Thailand's perspectives of pesticide management

- **Agriculture** is an important aspect of Thailand's **GDP** and development.
- The country ranked as the **No.** 1 **agricultural exporter in the ASEAN region** and is consistently ranked among the **top** 10 **global agricultural exporters**.(2024).
- Thailand's approach to pesticide management represents a continuous **tug-of-war** between **public health**, **economic trade pressures**, **GAP protocols** and **farming livelihoods**.
- The **quantity and quality** of agricultural-inputs is needed for the production.
- The **Maximum Residue Limits** (MRLs) of pesticides are always updated to align with **global** and **imported countries** standards, and play **important roles** in exportation.
- **The government** as well as **PBOs** and **NGOs** have to navigate the **never-ending pesticide debate** by attempting to balance sustainable farming agendas and strict consumer health demands.

❑ Overall JMPM-JMPS-JMPR Guidelines and regulations for adoption of pesticides registration

Pesticides are some of the most sensitive tested, monitoring and regulated products in the world.



The 3 JMP's activities

are to promote global standards and good practices with the overall goals of protecting human health, the environment and promoting agriculture development.

JMPM

Join Meeting on Pesticide Management

JMPM's activities

- Advisory body for **the lifecycle management of pesticides** in agriculture and public health.
  - Develops technical guidelines, advises on policies,
  - Aligns its work with the *International Code of Conduct on Pesticide Management*

- Guidance on **aerial application of pesticides**,√
- Guidance on reducing risks during **phase out of pesticides,**
- Guidance note on **illegal trade of pesticides** √
- Guidance note on **online sales of pesticides**. √

- *Guidelines on a Developing a Reporting System for Health* and *Environmental Incidents Resulting* ***from Exposure to Pesticides***
- *Guidelines on Management Options for Empty Pesticide Containers (2008).*

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JMPS

(Join Meeting on Pesticide Specifications)

)

- **to regulate global pesticide standards** by produce recommendations to FAO and/or WHO on the adoption, extension, modification or withdrawal of **specifications**
- to **develop guidance** and procedures in establishing **pesticide specifications** and **equivalence** determination which has also its relevance to the registration and quality control of pesticide in national or regional authorities.
- **As a GL quality for the buying and selling of pesticides**

assistance in the official approval and acceptance of pesticides

protection for responsible vendors against inferior products

a link **between biological efficacy and specification** requirements

an international point of reference;

- is an expert ad hoc body by FAO and WHO, composed of scientists collectively possessing expert knowledge of the development of specifications.
- Their opinions and recommendations to FAO/WHO are provided in **their individual expert capacities**, not as representatives of their countries or organizations.

JMPR

Join Meeting on Pesticide Residue

Independent expert ad hoc body comprised of two distinct panels

- Evaluates the **safety** of pesticide residues in food.
- Reviewing toxicological data to establish **Acceptable Daily Intakes (ADIs),**
- **Estimating Maximum Residue Limits** (**MRLs**) in international trade,
- Assessing **dietary exposure to protect consumer**

EVALUATING RESIDUE DATA (FAO PANEL): USE PATTERNS, SUPERVISED FIELD TRIALS, ENVIRONMENTAL FATE DATA, TO ESTIMATE THE HIGHEST RESIDUE LEVELS GOOD AGRICULTURAL PRACTICE (GAP).

TOXICOLOGICAL RISK ASSESSMENT (WHO CORE ASSESSMENT GROUP): SETTING ADIS AND ACUTE REFERENCE DOSES (ARFDS) TO ESTABLISH SAFE LIMITS FOR HUMAN CONSUMPTION.

DIETARY INTAKE CALCULATIONS: JMPR UTILIZES REGIONAL DIETS (ESTABLISHED BY GEMS/FOOD) TO CALCULATE BOTH LONG- AND SHORT-TERM DIETARY INTAKES, ENSURING HUMAN EXPOSURE DOES NOT EXCEED THE SAFE REFERENCE DOSES.

CODEX SUPPORT & RECOMMENDATIONS: MAXIMUM RESIDUE LEVELS ARE RECOMMENDED TO THE CODEX COMMITTEE ON PESTICIDE RESIDUES (CCPR) SO THEY CAN BE ADOPTED AS CODEX MAXIMUM RESIDUE LIMITS (CODEX MRLS) FOR FOOD COMMODITIES CIRCULATING IN GLOBAL TRADE.

❑ Adoption of ICC-PM/PS Guidance on data requirements for the registration of pesticides

Guidance on data requirements for the registration of pesticides

Second edition

World Health Organization

Food and Agriculture Organization of the United Nations

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International Code of Conduct on Pesticide Management/the combination of the codes;

- Inter-Organization Programme for the Sound Management of Chemicals (**IOMC**), United Nations.
- Food and Agriculture Organization of the United Nations **(FAO)**, the International Labour Organization **(ILO)**, the Organisation for Economic Co-operation and Development (**OECD**), the United Nations Environment Programme (**UNEP**), the United Nations Industrial Development Organization (**UNIDO**), the United Nations Institute for Training and Research (**UNITAR**), the World Health Organization (**WHO**), the World Bank, and the United Nations Development Programme (**UNDP**)

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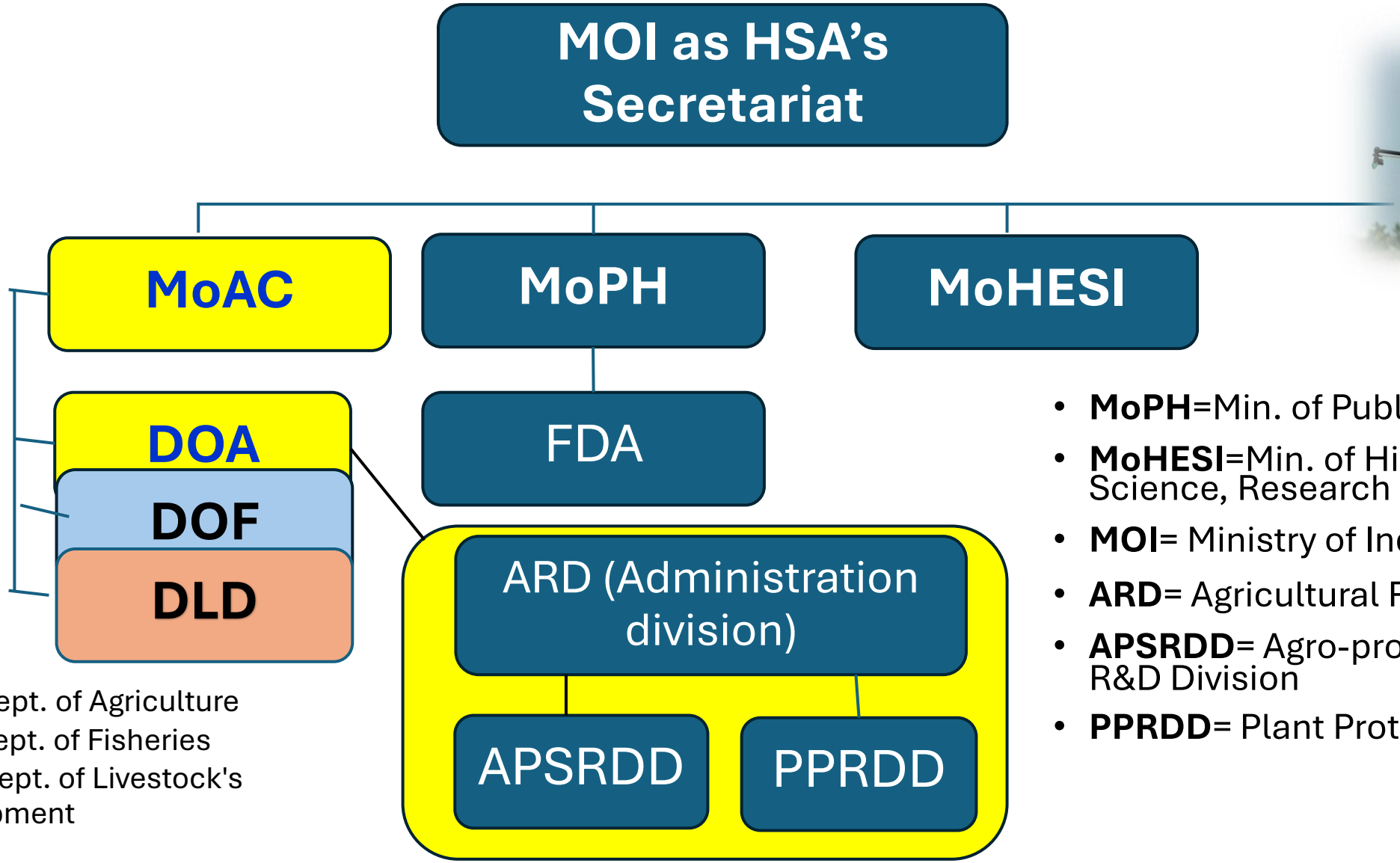
❑ Local capacity building of pesticides registration for Pesticide Business Operators (PBOs)

- **PBOs** are individual people or group of peoples or as juristic person or legal entities that have business works related to pesticides, namely:
  - Thai Agricultural Business Association (**TABA**)
  - Thai Crop Protection Association (**TCPA**)
  - Thai Fertilizers and Agricultural Supplies Association (**TFASA**)
  - Thai Agricultural Innovation Trade Association (**TAITA**)
  - The **Agrochemical Application Controller:** a person who has been licensed or trained by the DOA to control the use of hazardous substances, including the operation of agricultural **unmanned aerial vehicles** (UAV/drones) and the safe and legal spraying of chemicals.

❑ Local Capacity Building of pesticides registration for Pesticides Business Operators (PBOs)



DOA=Dept. of Agriculture
DOF=Dept. of Fisheries
DLD= Dept. of Livestock's Development

- **MoPH**=Min. of Public Health
- **MoHESI**=Min. of Higher Education, Science, Research and Innovation
- **MOI**= Ministry of Industry
- **ARD**= Agricultural Regulatory Division
- **APSRDD**= Agro-production Science R&D Division
- **PPRDD**= Plant Protection R&D Division

Thailand perspectives on Agri-pesticide management: History of HS control

- **Brief history** of pesticide control in Thailand was under 2 ACTs;
  - **Toxic Substances Act** B.E. 2510 (1967)(**TSA-1967**)
  - **Hazardous Substances Act** B.E. 2535 (1992) (**HSA-1992**), up to present, there are 3 amendments in 2001, 2008 and 2019.
- **Ministry of Industry** is the secretariat of the **HSA** Act, the other ministries such as **MoAC** (DOA, DOF and DLD), **MoPH** (FDA) and **MoHESI** would ask for authority to utilize the law for their own regulatory responsibilities.
- Under the **HSA**, there are **Ministerial Regulation**, **Notifications of the Ministry**, and several relevant **Guidelines** based on **FAO-ICCPM (**the *International Code of Conduct on Pesticide Management)*
- **Registration age** is 6 years, and renewal should be started before ended age.

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Advantages and Limitation of implementing JMPS protocol;

- **Advantages**; JMPS …
  - Provides **standardized scientific data** to establish product quality, chemical equivalence, and ensure safety.
  - It enables **regulators and buyers** to distinguish between good- and bad-quality products while minimizing redundant animal.
  - Governments can enforce **strict quality control** and protects farmers from purchasing substandard or counterfeit products.
  - Ensures pesticides meet **specific limits for hazardous impurities (usually patented)** and storage stability, supporting human health protection and environmental safety.
  - Establishes **clear equivalence criteria (usually, confidential)**, which allows regulatory authorities to easily evaluate and approve generic or alternative pesticide formulations without requiring costly, time-consuming testing.
  - **Global Trade Harmonization**

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Advantages and Limitation of implementing JMPS protocol; Cont'.

- **Some limitation: on inplementing of specifications;**
- **Compliance** with the specifications **does not** constitute an endorsement or warranty of the fitness of a particular pesticide for a particular purpose, including its suitability for the control of any given pest, or its suitability for use in a particular area.

- The **suitability of pesticides** for a particular purpose and the content of the labelling instructions must be decided at the **national or provincial level.**

- **Protocols** are not exempted from any safety regulation or other legal or administrative provision applicable to their manufacture, sale, transportation, storage, handling, preparation and/or use.

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Advantages and Limitation of using JMPS protocol; Cont'.

- **More disclaims**;
- **Improper** storage, handling, preparation and/or use of pesticides can result in either a lowering or complete loss of safety and/or efficacy.
- **Regulators** must respond any liability, for the testing of pesticides for compliance with the specifications, nor for any methods recommended and/or used for testing compliance.
- As a result, **FAO and WHO do not** in any way warrant or represent that any pesticides claimed to comply with a FAO or WHO specification does so.

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Pesticide management revisions in 2026

- Presently, the **Re-registration protocols (2026) for PBOs** are under the revision; however, the main requirements did not change but these revisions will be benefit to registrants to get certificate faster than the past when all necessary dossiers are complete before submitted. (now On-going process)
- **By this changes, three committees** have been setup as follow;
  - 1) **Toxicity of pesticides** evaluation, **pesticide product analysis, equivalency**, together with **FAO specification compliances** as well as **pesticide residue (s) decline study**,
  - 2) **Efficacy trials** of pesticide on target pests, plants and
  - 3) **Regulatory certification committee** for licensing.

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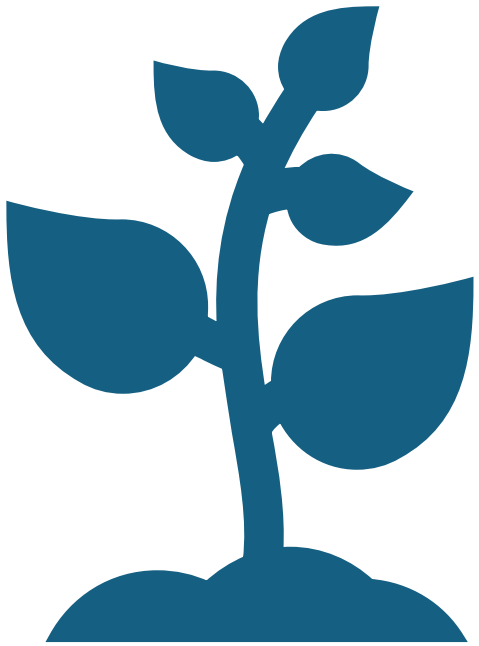

Pesticide management revisions in 2026 (Cont.)

- **Ministry of Agriculture and Cooperatives** is responsible for Agri-pesticides and DOA is responsible agency for registration for plants/pests.
- **Number of pesticides registered** with the DOA from AD 2011-2026 = 29,924 products. (Up to Feb. 2026)
- Most of pesticides used in the country **are imported** from **China**, **Malaysia, Japan, EU** and **US.**
- About **250-320** compounds/formulations are imported each year.
- About **20-30 %** of the imported formulations are **mixed active ingredients** (2-3 active ingredients) in formulation.
- There are also some **inhouse mixed formulations** with their specifications are based on individual spect. and the **overall specification would depend on registry?**

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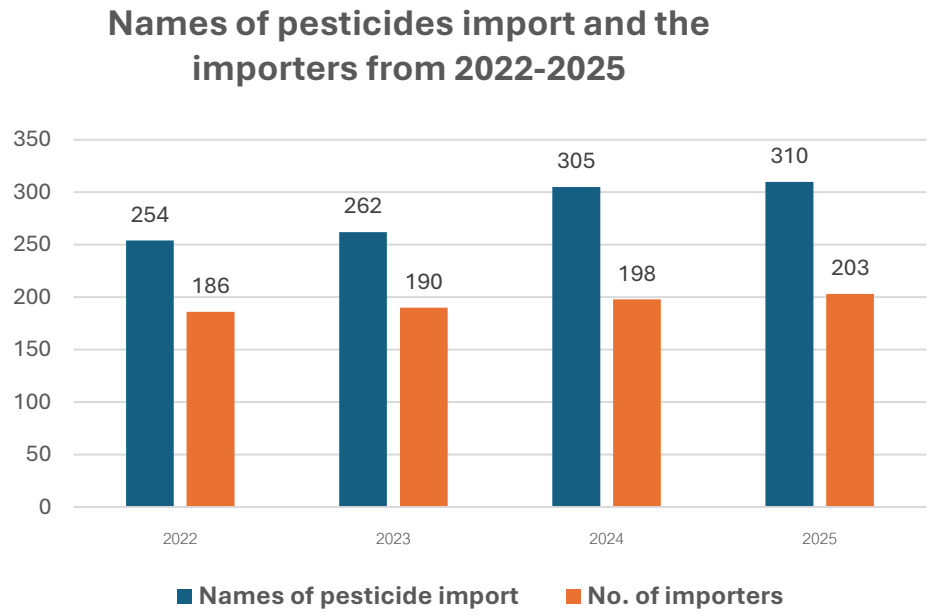
Pesticide management revisions in 2026 (Cont.) on importation



- Name's list of imported pesticides/formulations and number of the importers in 2023-2025.

Ranking of the ten imported pesticides in 2025 where Herbicides are priority..

- Glufosinate ammonium/H*
- **Glyphosate IPA/H***
- 2,4-D diaamonium/**H***
- **Diquat dibromide/H**
- Atrazine/H*
- **Abamectin/In??**
- Ametryn/H*
- Emamectin benzoate/In
- Ethephon/PGR
- Diuron/H*

Source: Processes from https://www.doa.go.th/ard

***products import champion**

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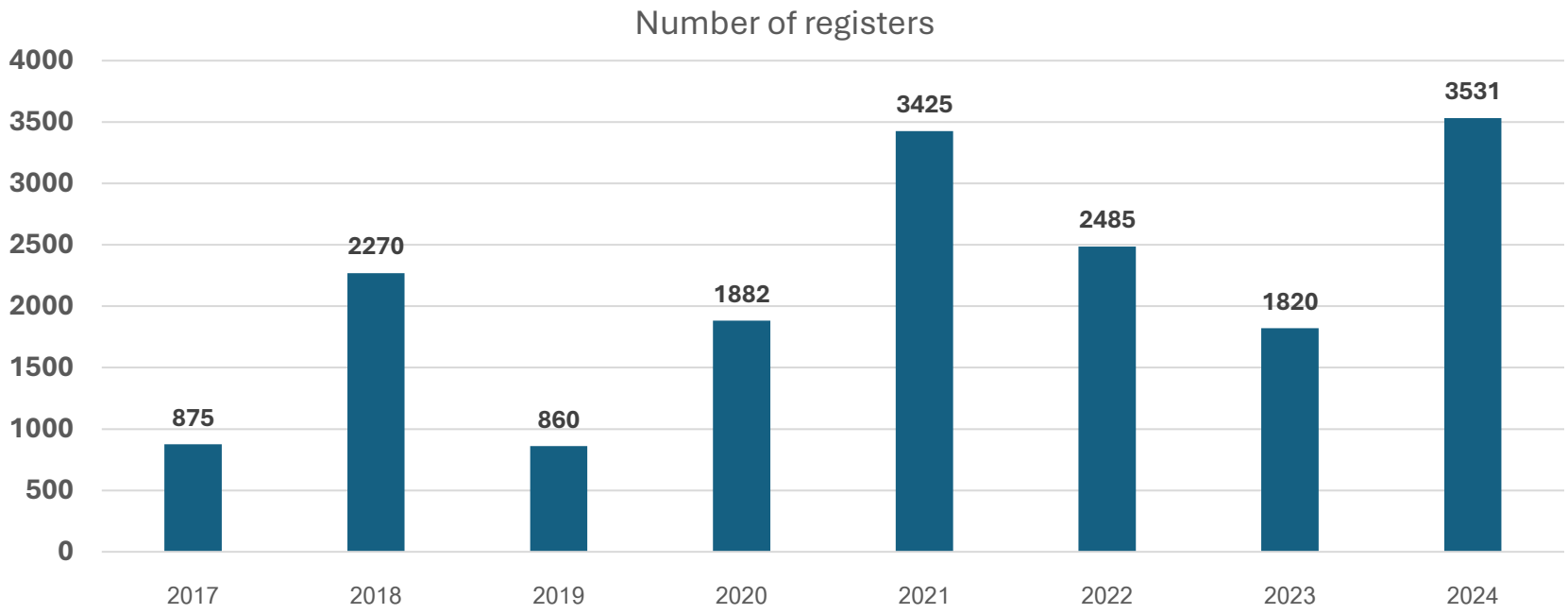
Pesticide management revisions in 2026 (Cont.) registration age and reregistration

No. of registered pesticides each year from 2017-2024 with 6 years of expiration

Registers	Expire age
2017	2023
2018	2024
2019	2025
2020	2026
2021	2027*
2022	2028
2023	2029
2024	2030*



Source: Processes from https://www.doa.go.th/ard/?page_id=386

Overall Quality systems related laboratory compliance in Thailand

List No.	Quality systems applied	Accreditation Bodies (ABs)	No. of Acc. Lab, Labs
1	ISO/IEC 17025 Testing lab	**BLQS, TISI, BLA**	1,171
2	ISO/IEC 17025 Calibration lab	**TISI** (Thailand Industrial Standards Institute)	305
3	ISO/IEC 17043 PT providers	Bureau of Laboratory Accreditation (**BLA**)	13
4	ISO/IEC 17034 CRM providers	**BLA**	4
5	OECD GLP compliance	**BLQS**	9

AMARC's Activities

AMARC's Activities

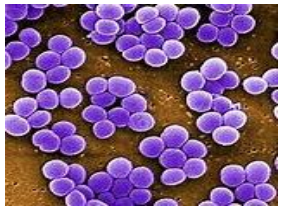
Testing | Calibration

Inspection & Certification

- *Be part of **Thailand's National Quality Infrastructure (NQI)***
- *Contribute to **consumers' safety and quality of life***
- *Create **business opportunities** through trust at international level*

ONE-STOP TIC SERVICES

for the Agriculture, Food and Pharmaceutical industries




Agricultural & Food
: Chemical Lab
: Microbiology &
Filth/Physical Lab
Efficacy Test and
Pesticide Residue
Decline Study
Pesticide
Formulation
Product Analysis
Fertilizer Quality
Analysis
Pharmaceutical Lab
Drug/BA/BE
Calibration
Lab
Inspection and
Certification
Service
Structure
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ASIA MEDICAL AND
AGRICULTURAL LABORATORY
AND RESEARCH CENTER
Served for
ASEAN Economic Community

AMARC LAB RESOURCES

MAJOR INSTREUMENTS & EQUIPMENTS

Scientific instruments	Numbers (Unit)
LC-MS/MS	11
GC-MS/MS	8
GC-FID,HEAD SPACE/FPD/micro ECD	7
Conventional HPLCs	15
ICP-MS	2
ICP-OES	5
Ultra Wave (Microwave digestion)	5

AMARC' S PERSONNEL

TESTING LABORATORY

(156 PERSONS)

INSPECTION & CERTIFICATION DIVISION

IN DIFFERENT ISOS

(21 PERSONS)

CALIBRATION LAB

(24 PERSONS)

SUPPORT TEAM

(132 **PERSONS**)

› 200 Scientists

TOTAL ACADEMIA

333 PERSONS

Q-Factory

The Q-plan for strengthen the Control the Agricultural-inputs by DOA and PBOs

- With **this plan**, PBOs must register to DOA and follow the strict regulation, for ensuring the quality, safety, legality, and effectiveness of agricultural inputs—such as pesticides and fertilizers—from the **manufacturing plant all the way to the farmer**.
  - **Q shops** to ensures farmers have access to standard, safe, and lawful agricultural inputs.
  - **Q factory** to ensures that production processes comply strictly with the Hazardous Substance and guarantees that manufacturing adheres to high safety, health, and environmental standards.
- The other **voluntary measures** to support Quality, with the **3-ISOs** namely: **ISO 9001, ISO 14001 (for factories)** and **ISO/IEC 17025 (Pesticide Formulation Laboratory)**.

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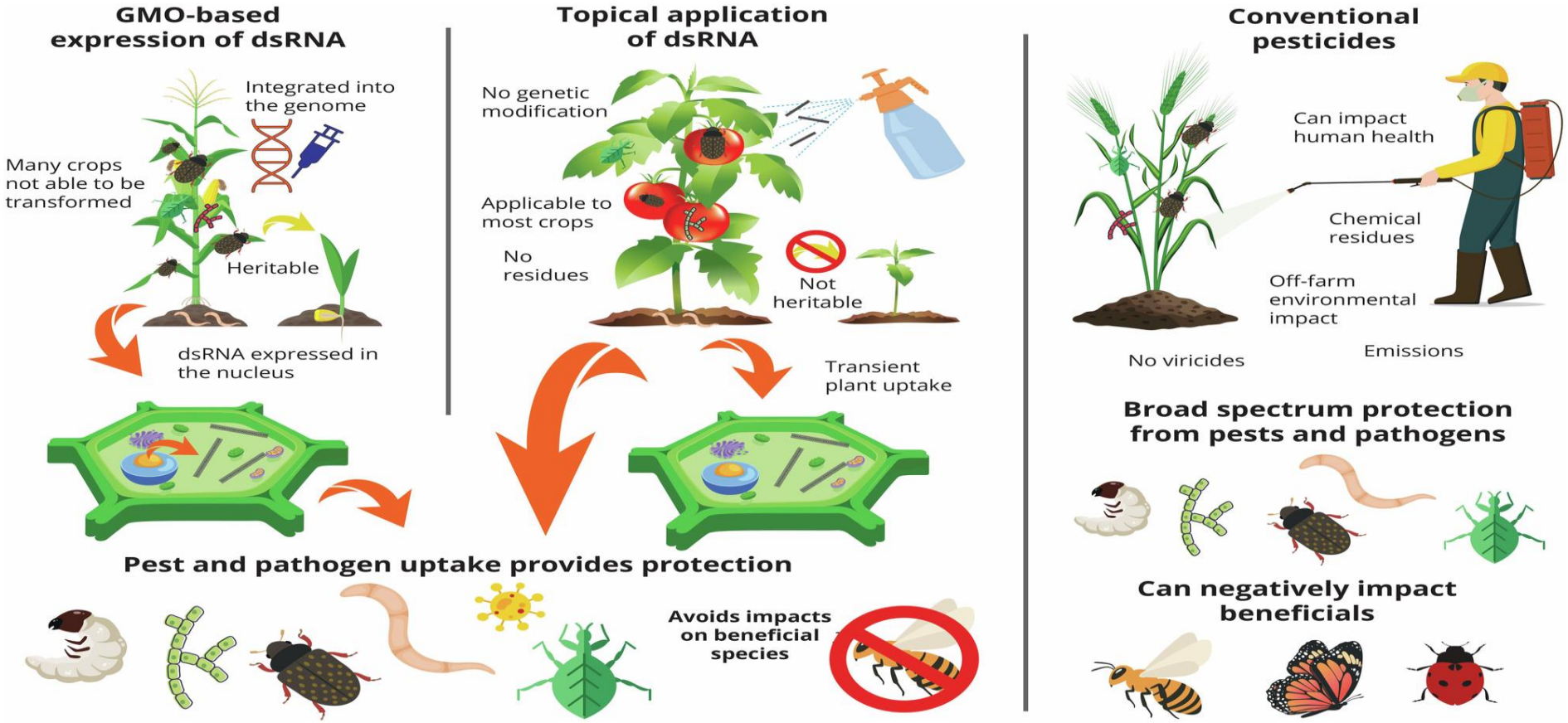
Alternatives to use of biopesticide formulation : RNA-based biopesticides

RNA-based biopesticides with specificity and biodegradability features resonate with sustainable crop protection, reducing health and environmental risks associated with pesticide exposure during application and consumption of treated produce.



Source:

npj Sustainable Agriculture **volume 3,** Article number: 15 (2025)

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Formulation Lab (FL) help to solve some the resistance/resurgent of mixed pesticides

FRAC Code List©* 2024: Fungal control agents sorted by cross-resistance pattern and mode of action

CropLife International and the RACs make every effort to present accurate and reliable information in the guidelines,

- RAC Code Lists is based on scientific evaluation of their **modes of action.**
- Each country must not be interpreted as approval for use of a compound in a given country.

More about ‘FRAC Code’

- If field- **resistance** is known to one member of the Group, it is most likely but not exclusively valid that cross-resistance to other group members will be present.
- **Numbers and letters** are used to distinguish the fungicide groups according to their cross-resistance behavior.
- P = host plant defence inducers, M = chemical multi-site inhibitors, U = unknown mode of action and unknown resistance risk, and BM = biologicals with multiple modes of action.

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FL for RESIDENT AND BYSTANDER EXPOSURE

Spray drift (at the time of application)

Vapour (may occur after the PPP has been applied) sometime REI must be notified.

Surface deposits

Entry into treated crops

AOEL: (Acceptable operator effective level)

REI: Re-entering Interval

FL and Water Quality and Pesticide Performance

Extreme pH levels in the spray mixture can also cause some pesticides to break down prematurely.

At pH > 7, organophosphate insecticides can breakdown in a matter of hours or minutes

Sulfonyl urea (SU) herbicides (Escort, Ally) tend to break down more rapidly where the pH is < 7 (acidic).

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Hardness and soft water applied for some pesticide dilution

* **At a low pH, 2,4-D is an uncharged molecule**
* **At a high pH, 2,4-D becomes anionic or negatively charged**

At high pH, 2,4-D tends to become more negatively charged.

- This can slow its absorption into plants.
- **Check pesticide labels for restrictions on hard water or pH levels.**

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Using of Manual on Development and Use of FAO and WHO Specifications for Chemical pesticides in **FL**

Case study: Cypermethrin

Purity >900 mg/kg (**1995**), Old specification

2.3 *Cis*- isomer (332/TC/M/3.2, CIPAC 1C, p.2052)

The *cis*- isomer content shall be declared and shall be between 40% minimum and 60% maximum of the declared cypermethrin content.

The permitted tolerance shall be ± 10% of the declared *cis*- isomer content.

Purity >930 mg/kg (**2025**), New specification

2.3 Cypermethrin isomer ratio (332/TC/M/3.3, CIPAC Handbook 1C, p. 2052, 1985)

The cypermethrin *cis* isomer content shall be declared and, when determined, shall be between 40% and 60% of the total cypermethrin content as measured under 2.2.

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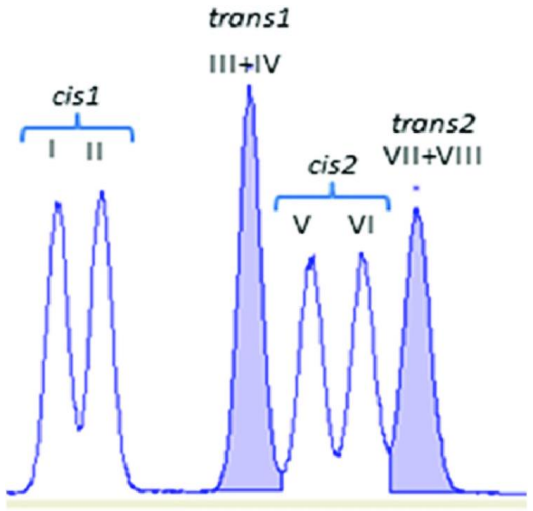
Cypermethrin enantiomers, racemic and right isomers?

The **improper use of racemic mixtures** can actively contribute to the development of insecticide resistance?

The Inactive "Dead Weight": When a racemic mixture is applied, the inactive enantiomer still enters the insect's system. Because it is non-toxic, it gives the insect an opportunity to adapt and develop Phase I and Phase II metabolic detoxification processes (such as Cytochrome P450 monooxygenases or esterases).

Compound	CAS
Cypermethrin	52315-07-8
Alpha-Cypermethrin	67375-30-8
Beta-Cypermethrin	86753-92-6
Zeta -Cypermethrin	1315501-18-8
Theta -Cypermethrin	71697-59-1



Cyp	*not available*
Alpha-Cyp	racemic mix of "*cis*-II" components
Beta-Cyp	2:3-mix of "*cis*-II" and "*trans*-II" comp.
Zeta-Cyp	~ 1:1-mix. of *cis*:*trans*: 1S *cis* αS (of *cis*-I)+1R *cis* αS (of *cis*-II) : 1S *trans* αS (of *trans*-I)+ 1R *trans* αS (of trans-II)

Theta: racemic mixture of "trans-II" comp.

JMPR 2008 [11]

Consists of 8 isomers,
four *cis* and four *trans*.

- **JMPS 2025**
- 2.3 Cypermethrin **isomer ratio** (332/TC/M/3.3, CIPAC Handbook 1C, p. 2052, 1985) The cypermethrin **cis-isomer content shall be declared** and, when determined, shall be between **40% and 60%** of the total cypermethrin content as measured under 2.2.
- **930 g/kg, with a cis/trans isomer ratio of 40:60 to 60:40**
- **Is it enough to maintain its effectiveness as well as prevent insect resistance?**

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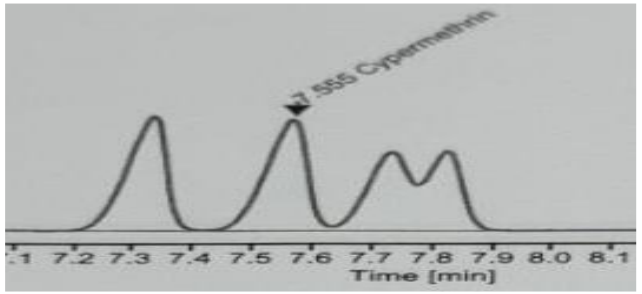
Cypermethrin enantiomers, racemic and right isomers? From 1995 to 2025.

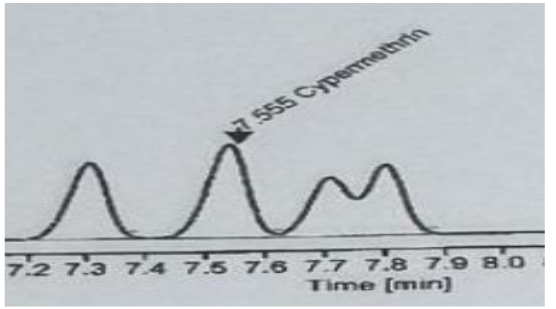
(i) The FAO specifications for cypermethrin TC, TK, WP, EC and UL developed under the "old procedure" should be withdrawn;

(ii) The specification for cypermethrin TC, proposed by Hemani Industries Ltd, and as amended, should be adopted by FAO and WHO.

Declared minimum cypermethrin content	930 g/kg
cis-isomer content (as a proportion of total cypermethrin)	400-600 g/kg

The content of permethrin and *m*-phenoxyphenylacetonitrile in cypermethrin TC is determined by HPLC-UV.





Total chromatographic area of Cypermethrin

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Abamectin/Avermectin

No FAO Specification and the latest version is 2024;

CIPAC/5384/m Abamectin
(May, 2024)

ISO Common Name	Abamectin
Chemical Name	Mixture of Avermectin B_{1a} (at least 80%) and Avermectin B_{1b} (CA)

The CRM manufacture declaration

Batch Information

Water Content: 2.03% (g/g) by Karl-Fischer-Titration (U(exp) = 0.16% (g/g)).
Storage under argon.
Mixture of congeners. RT 6.58 min: B1a (about 94.7 %, Sum formula C48H72O14, Mol weight 873.09).
RT 6.15 min: B1b (about 3.1 %, Sum formula C47H70O14, Mol weight 859.06).

CERTIFIED	CERTIFIED
Purity 95.69% (g/g)	Expanded Uncertainty (U) 0.30% (g/g)

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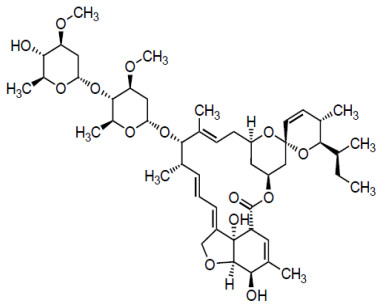
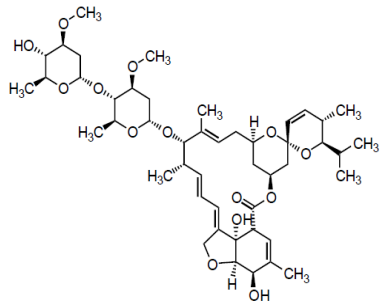
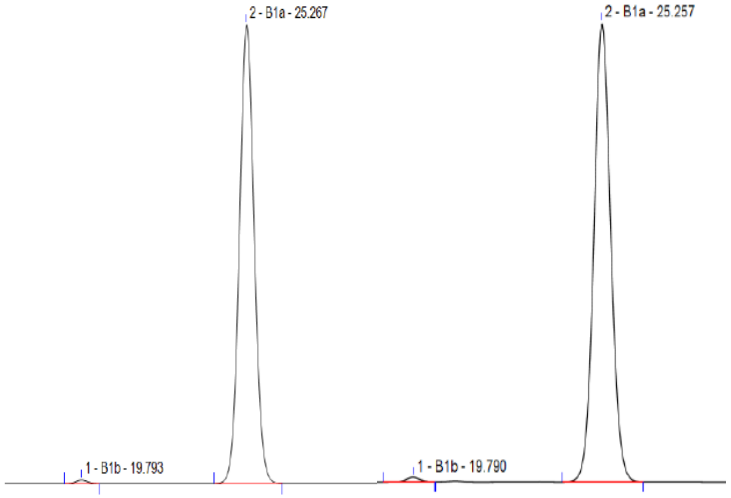
Case study: Abamectin-Avermectin analysis



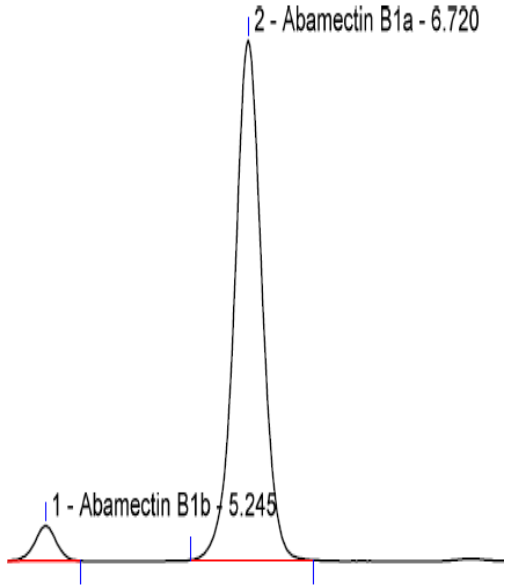
avermectin B_{1a}



avermectin B_{1b}



CIPAC/5384/m Abamectin
(May, 2024)



Mixture of Avermectin B_{1a} (at least 80%) and Avermectin B_{1b} (CA)

Abamectin: 71751-41-2
Avermectin B_{1a}: 65195-55-3
Avermectin B_{1b}: 65195-56-4

$$f_i = \frac{s \times P}{H_s}$$

$$\text{Content of abamectin} = \frac{H_w \times f}{w} \text{ (g/kg)}$$

where:
fi = individual response factor
f = mean response factor
H_s = peak area of abamectin (peak B_{1b}+B_{1a}) in the calibration solution
H_w = peak area of abamectin (peak B_{1b}+B_{1a}) in the sample solution
s = mass of abamectin reference standard in the calibration solution (mg)
w = mass of sample taken (mg)
P = purity of the abamectin reference standard (g/kg)

Calculate the ratio of B_{1a} to B_{1b} of avermectin in the sample:

$$\alpha(B_{1a}/B_{1b}) = \frac{H_{W_{B1a}}}{H_{W_{B1b}}}$$

Test results: should be reported as **Avermectin isomer/or abamectin formulation?**

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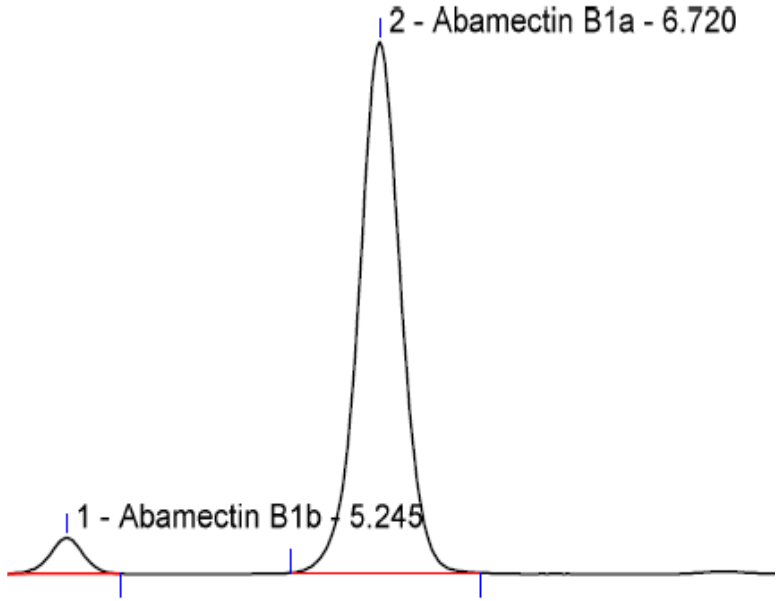
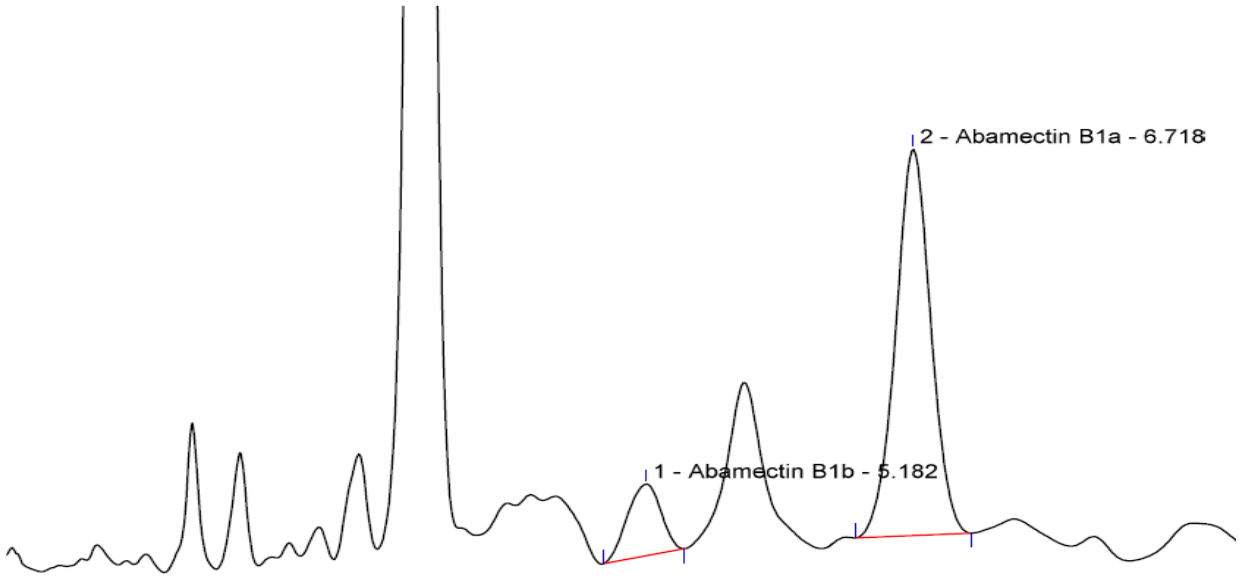
True chromatograms of sample Abamectin/avermectin by HPLC, taken from market



Ref. std. Abamectin



True abamectin sample taken from market

Codex Residue definition: For compliance with the MRL and for dietary risk assessment for plant and animal commodities: **Avermectin B1a**.

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Conclusions

1

We encourage and support the JMPS committee to move forward for quality of pesticide specification for all developing countries to get pesticide at reasonable price.

2

The movement of 2 important herbicides in the future: **Glyphosate** (complete FAO spec.) and **glufosinate** ammonium (No FAO spec.) herbicides in global situation.

3

The movement of **FAO-spec.** would be depended on the complete submission of manufacturer's document where off-patent pesticides must add more research but less benefit.

4

The related government agencies have to observe the changing of the up-to-date spec. of pesticides that affect to the critical properties.