



Herbicide Resistance Action Committee Asia (HRAC Asia) helps to protect crop yields and quality in the global fight against herbicide resistant weeds.

Luis Camacho^{1*}, Ramisis Fulgencio¹, Le Duy², Sudakir³, Susan Knight⁴, Wu Ben⁴, Ya-Fei Pan⁵.

¹Bayer CS Asia Pacific Pte Ltd - Singapore / HRAC Asia; ²Corteva AgriSudakirscience-HCM Vietnam;

³BASF – Jakarta / HRAC Asia; ⁴Syngenta Asia Pacific Pte Ltd – Singapore / HRAC Asia; ⁵FMC Agro Singapore / HRAC Asia. *E-mail: Luis.camacho@bayer.com

Dec 7th, 2022



Agenda

- Highlights of reported herbicide resistance cases in Asia

- Introduction to the regional HRAC Asia organization and its priorities:
 1. Establishment of HRAC Asia countries governance and objectives
 2. Regional implementation of new Herbicide Mode of Action Classification and labelling.

- Q&A

Asia Pacific region at a glance



- APAC account for approximately 25% share of the global herbicides market.
- Large number of very small customers operating with a high degree of relative risk – applying incorrect doses, incorrect application timings and using illegal/counterfeit products in which the dose/efficacy is unknown.
- Lack of awareness about pesticide resistance.
- Confirmed cases of herbicide resistance has been reported.
- Lack of Mode of Action (MoA) labeling classification in many countries to manage resistance.





Highlights of reported herbicide resistance cases in Asia (1983 to 2022)

- Number of **reported cases**: 304
- Number of **species**: 121
- **Country**: Japan (37), S. Korea (15), China (44), India (5), Thailand (4), Malaysia (20), Indonesia (3), Philippines (2), Australia (153) and New Zealand (21).
- **Crops**: rice, cereal, sorghum, corn, canola, range land, sugar cane, soybean, orchard, oil palm
- Most reported **species**: *Lolium rigidum*, *Echinochloa* spp. *Leptochloa* spp., *Conyza* spp. *Eleusine indica*,
- Reported herbicide **MoA**: ACCase inhibitors (A/1), ALS inhibitors (B/2), Microtubule Assembly inhibitors (K1/3); Very Long-Chain Fatty Acid Synthesis inhibitors (K3/15); EPSP synthase inhibitors (G/9); Auxin Mimics (O/4); PSII (C1/5); PSI Electron Diverter (D/22).



Introduction to the Herbicide Resistance Action Committee Asia organization (HRAC Asia)

Who We Are ?

The HRAC Asia is an international body founded by the agrochemical industry, helps to protect crop yields and quality worldwide by supporting efforts in the fight against herbicide-resistant weeds.

Our Mission

Providing comprehensive information about herbicides and herbicide resistance and their management to our regional partners and local experts around the region.

Introduction to HRAC Asia Regional Leadership team

Our Companies Representatives	Our Staff
<p>BASF – Sudakir (Indonesia)</p> <p>Bayer Crop Science – Ramisis Fulgencio (Singapore)</p> <p>Corteva – Le Duy (Vietnam)</p> <p>FMC – Yafei Pan (Singapore)</p> <p>Syngenta – Susan Knight and Wu Ben (Singapore)</p>	<p>Chair Luis Camacho Bayer CS (Singapore)</p> <p>Crop Life Asia Stewardship Lead Delisa Jiang (Singapore)</p>

Geographic Scope: China, South Asian subcontinent, South-East Asia, Korea and Taiwan.

HRAC Asia is tightly collaborating with HRAC Global in order to develop and coordinate its actions with other regions worldwide.



HRAC Asia Priority:

1. Establishment of Asia countries HRAC governance to enable effective coordination of the network

Country HRAC governance to enable effective coordination of the regional network



HERBICIDE
RESISTANCE
ACTION
COMMITTEE

Crop Life member company colleagues that have accepted to represent HRAC in 10 countries of Asia

China

- Cong Co. FMC
- Peter Pan FMC
- Arthur Chen FMC
- Wu Chuanzhi SYN
- Wei Zheng BAYER
- Chun He Qu CORTEVA
- Biao Feng Sui BASF

Yafei

India

- Thippeswamy Ph FMC
- Manojit Ghosh, SYN
- Jitendra Kumar SYN
- **Mayank Yadav BAYER**
- Sunil Kumar CORTEVA
- Ashish Nema BASF

Luis

Indonesia

- Ade Mahendra FMC
- **Ari Budiawan SYN**
- Febi Aryana BAYER
- dwi priyo Prabowo CORTEVA
- Rokhani Widodo BASF
- Adhisunu Harimurti BASF

Sudakir

S. Korea

- Albert Kim FMC
- **InKon Park SYN**
- SungMin Kim BAYER
- Jee Hwan Yi CORTEVA

Susan

Malaysia

- Mohammad Irfan Abd Quddus FMC
- Erny Nazri SYN
- Febi Aryana BAYER
- Aiman Hanis Jasmi CORTEVA
- **Ooi Kok Eng Crop Life Malaysia**

Sudakir

Pakistan

- **Muhammad Amir Bashir Malik FMC**
- Saeed-Ur Rehman BAYER
- Tariq Mushtaq, BAYER
- Muhammad Nadeem SYN
- Naveed Akhter BASF
- Rashid Ahmad Crop Life Pakistan

Luis

Philippines

- Nhover Bamacha FMC
- Jennifer Tuiza SYN
- Edward Limon BAYER
- Rene Ray CORTEVA
- Alvin Dolores BASF
- **Jay Lupongo SINOCHEM**
- Jenina Deleon UPL
- Bamzingan JARDINE

Ram

Taiwan

- **Staffan Hu FMC**
- Ted Huang SYN
- We Zheng BAYER
- Yi-Hsiou Huang CORTEVA
- Sandra Chang (Crop Life Taiwan)

Susan

Thailand

- Udomdej Nakprasert FMC
- Techin Teerawudtitorn SYN
- **Amorn Chernchaivachirakul BAYER**
- Sripeangchan Mongkol CORTEVA

Duy

Vietnam

- Phan Quang Huang FMC
- Duong Hoang Tu SYN
- Son Nguyen Hoang BAYER
- Thanh Dien Nguyen CORTEVA
- **Le Duy CORTEVA**

Duy



Crop Life Asia
National Associations



Companies Members

FMC – Nhover Barnacha

Corteva AgriScience – Rene Ray Bacosa / Jenina Signabon

Bayer Crop Science – Edward Limon / Rhobert Ona

Syngenta – Jennifer Tuiza-Minguez / Jemil Cambel

BASF – Alvin Dolores/ Edelyn Vicencio

CBAI – Charo Pagdonsolan/ Leo Valdez

Jardine – Fernando Tagalog/ Philina Amurao

Aldiz – Francis Dizon IV/ Manolo Basingan

Officers

Chair

Nhover Barnacha (FMC)

Vice-Chair

Jenina Signabon (Corteva)

HRAC Philippines Actions 2022

Herbicide Resistance Management Webinar Series

July 2022

Activity	Schedule	Status	Participants
Session1: Rice Herbicide Resistance Management	February 22 (9 to 11AM)	Completed	225
Session2: Corn Herbicide Resistance Management	March 29 (10 to 11AM)	Completed	387
Session3: Plantation (Banana & Pineapple) Herbicide Resistance Management	June 09 (9 to 11AM)	Completed	1,193
Session4: Fruits & Veg + Sugarcane Herbicide Resistance Management	July 29 (9 to 11AM)	Completed	467
Session5: Herbicide Mode of Action	August 19 (9 to 11AM)	Completed	462

Attendees include Farmers, Students from Agricultural Colleges & Univ), FPA & its regional offices, Pesticide retailers, Academe, Pesticide Industry, Dept. of Agriculture



HRAC Philippines Actions 2022



HERBICIDE
RESISTANCE
ACTION
COMMITTEE

Development, production & dissemination of Herbicide Resistance Management materials (brochures, posters)

Oct – Nov 2022 (released)

Ano ba ang Herbicide Resistance at paano ito nag-uumpisa?

Ang Herbicide Resistance ay ang naipapamanang kakayahang ng damo na mabuhay at hindi tablan ng isang uri ng herbisidyo na kaya namang mag-control ng ibang kauring damo nito.

Nakadepende sa paggamit nang magkakatulad na herbisidyo ang pagdami ng resistant na damo.

Halimbawa:

Resistant Biotypes
- Mga damong matibay o hindi namamatay kahit na-spray/in ng herbisidyo - to ay namamama

Susceptible Biotypes
- Mga damong madaling mamatay kapag na-spray/in ng herbisidyo

Sa mga unang taon, lilan lang ang resistant na damo sa sakahan.

Kadalasan ay hindi nasusunod ang nakasaad sa label ng herbisidyo at paulit-ulit ang paggamit ng parehong produkto (Herbicide X) sa sakahan sa loob nang maraming taon.

Sa umpisa, epektibo ang pag-control ng damo pero sa kalaunan, mapapansin na mas duamdami na ang mga "Resistant" na damo. Ito ay dahil ang napapayamanang resistant na damo ay nagpaparami ng seeds sa lupa hanggang sa kalaunan ay ang mga ito na ang dominante.

CropLife PHILIPPINES

Unit 5E Mapfre Bldg. Acacia Ave. Madrigal Business Park, Ayala, Alabang, Muntinlupa City 1780, Philippines

Tel. +63 7255-4972 | secretariat@croplife.org.ph

[@croplifephilippines](https://www.facebook.com/croplifephilippines)
[CropLife Philippines](https://www.youtube.com/channel/UC...)
[CropLife Philippines](https://www.instagram.com/croplifephilippines)
www.croplife.org.ph

Webinars on Herbicide Resistance Management

Herbicide Resistance Management Brochure

Webinars: [Agriculture](#), [CropLife](#), [FMC](#), [Syngenta](#), [LPL](#)

Herbicide Resistance Management Brochure: [Agriculture](#), [CropLife](#), [FMC](#), [Syngenta](#), [LPL](#)

RICE HERBICIDE RESISTANCE MANAGEMENT

Ano ba ang Herbicide Resistance Management at Paano Ito Nag-uumpisa?

Tatlong Uri ng Herbicide Resistance

Mga Paraan para Mapebagal ang Pagkakaroon ng Herbicide Resistance

Tatlong Uri ng Herbicide Resistance:

- Single Herbicide Resistance - ang damo ay resistant lamang sa iisang herbicide
- Cross Herbicide Resistance - ang damo ay resistant sa dalawa o mahigit pang uri ng herbicide na may parehong mode of action
- Multiple Herbicide Resistance - ang damo ay resistant sa dalawa o higit pang herbicide na magkaiba ang mode of action

MGA PARAAN PARA MAPABAGAL ANG WEED RESISTANCE:

1 PAGSUNOD SA LABEL
Mga dapat alamin at sundin:

Standard Format	(Name of Active Ingredient)	Group	Mode of Action	Type of Herbicide
Example 1	ACTIVE INGREDIENT GROUP	GROUP	MODE OF ACTION	HERBICIDE
Example 2	ACTIVE INGREDIENT GROUP	GROUP	MODE OF ACTION	HERBICIDE

Uri ng damo na kayang kontrolin
(ex. Grasses, Sedges, Broadleaves)

Timpla kada ektarya
(ex 1.0 Liter/ha)

Spray volume kada ektarya
(ex: 10-12 tank loads/ha)

Timing ng pag-spray
(ex: PRE (0-3 DAP); 0-1 LS*), Post (10-14 DAP; 3-4 LS*)

Level ng tubig sa araw ng pag-spray
(ex: saturated)

Sunod na patubig mula sa pagkatapos mag-spray
(ex: 1-3 days after spray)

2 PAGSUNOD SA MGA IMPORMASYONG NAKASAAD SA LABEL UKOL SA TAMANG PAGGAMIT NG PRODUKTO

- Paggamit ng tama at maayos na spray equipment
 - * Malinis na tangke at nozzle (ex: fan type nozzle)
 - * Tamang uri ng nozzle
- Pagsasagawa ng calibration bago ang pag-spray
 - * Siguraduhing maayos ang spray coverage para walang weed escapes

Paalala: Ang bawat herbicide ay maaaring may pagkakaiba sa angkop na paraan ng pag-apply nito. Sundin ang rekomendadong paraan ayon sa impormasyong nakasaad sa label.

3 Paggamit ng Herbisidyo na Magkakaiba ang MoA Group kada Panahon ng Taniman

Kung maaari, gumamit ng herbisidyo na mayroong magkaibang Mode of Action (MoA) sa magkasunod na planting season

Halimbawa:

1ST SEASON	2ND SEASON	1ST SEASON	2ND SEASON
USE MoA #99	USE MoA #99	USE MoA #99	USE MoA #100

Para sa karagdagang impormasyon bisitahin ang pahina gamit ang link sa itaas o i-scan ang QR code.

4 GUMAMIT NG PRODUKTONG "PRE-MIXED" O PAG-TANK-MIX NG MGA HERBISIDYO NA MAGKAIBA ANG MOA GROUP

PREMIX **TANK MIX**

Paalala: Bago magsagawa ng tank-mixing suriin kung compatible ang bawat herbicide na paghahalin. Siguraduhin GAMITIN ANG RECOMMENDED LABEL RATES ng bawat produktong pang-tank mix.

Siguraduhing i-triple rinse o hugasan ng 3 beses ang basyo ng herbisidyo bago itapon sa tamang lagayan.

5 MAKAKATULONG DIN ANG PAGGAMIT NG IBA PANG PARAAN NANG PAG-MANAGE NG MGA DAMO TULAD NG "ROUING" O PAG-AALIS NG DAMONG LUMUSOT

Ang pag-aalis ng mga damong lumusot bago ito makapamalaklak ay makatutulong upang hindi na ito makapaghaisik ng mga buto sa lupa.



Other successful HRAC Asia actions in 2022



- Weed management challenges: The difficulties of herbicide resistance management and the high cost of new products development. **Vietnam**
Partnership with Vietnam government, local companies, WSSV, Can Tho University and VN HRAC (+ international participants from Crop Life Companies). Offline at Can Tho City and an online meeting platform. June 2022



- Weed Resistance Management Workshop, **Malaysia**.
Partnership with the Malaysian Plant Protection Society (MAPPS) and an important number of industry players, academic and plantations together with participant of the Department of Agriculture (see attached report). July 2022



- Herbicide Resistance Action Committee Asia (HRAC Asia) helps to protect crop yields and quality in the global fight against herbicide-resistant weeds. **Indonesia**.
Partnership with Indonesia Weed Science Society. Seminar 6-8 October 2022



HRAC Asia activities planned for 2023

- Enhance accountability through activation of more HRACs in individual countries (ex China, India, Taiwan, S Korea...)
- Continued awareness on HR, capacity building and workshops
- Lead MoA advocacy strategy planning and implementation in countries (advance India position paper sent to Indian government)
- Implement MoA labelling at grower level



HRAC Asia Priority:

2. Regional implementation of new Herbicide Mode of Action Classification and labelling

HRAC Mode of Action Classification 2022

The infographic is divided into three main sections:

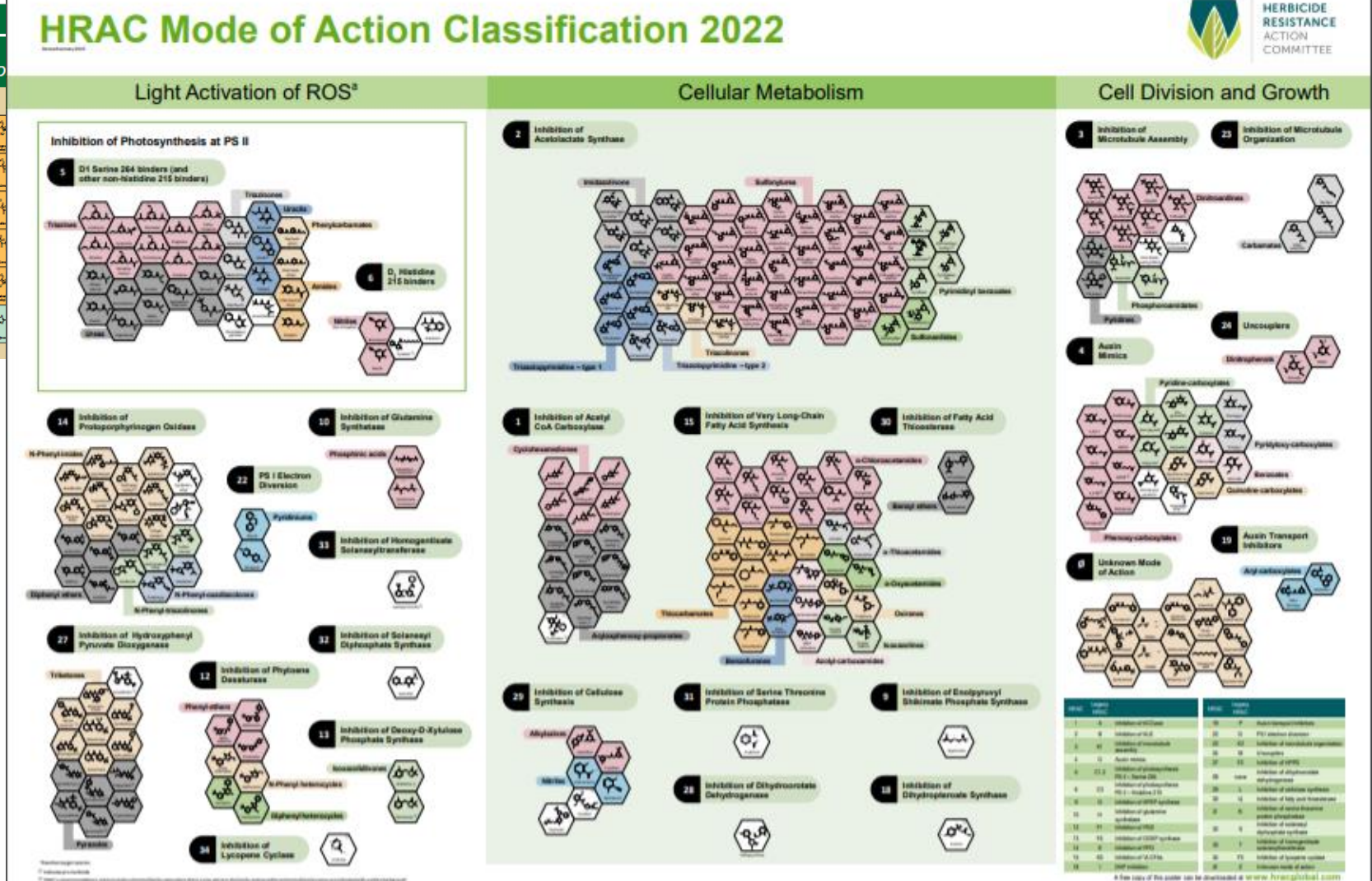
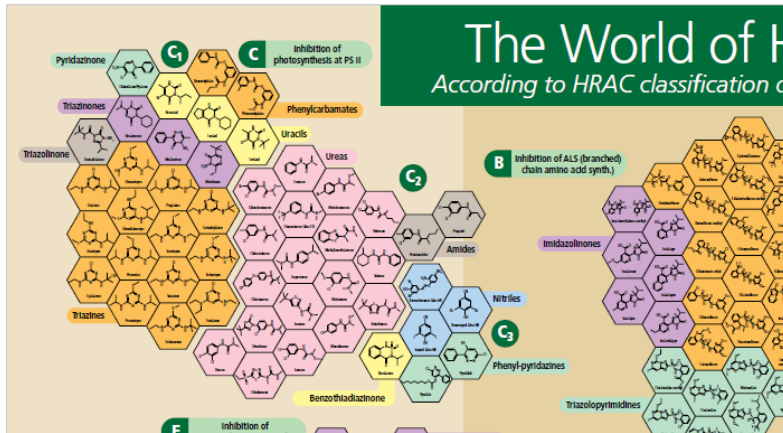
- Light Activation of ROS³**
 - 5** Inhibition of Photosynthesis at PS II: D1 Serine 264 binders (and other non-herbicide 215 binders), D1 Histidine 215 binders.
 - 14** Inhibition of Protochlorophyllin Oxidase: N-Phenylacetamide, Acetylacetone, Acetylacetone derivatives.
 - 16** Inhibition of Hydroxyphenyl Pyruvate Dioxygenase: Trioxazole.
 - 17** Inhibition of Phytyl Squalene Synthase: Phosphonate.
 - 18** Inhibition of Geranyl Diphosphate Synthase: Nucleoside, Nucleoside derivative.
 - 21** Inhibition of Lycopene Cyclase: Quinoline.
 - 22** PS I Electron Donor: Pyridazine.
 - 23** Inhibition of Homogentisate Selenocysteine Synthase: Pyridazine.
 - 24** Inhibition of Salicylate Synthase: Quinoline.
 - 25** Inhibition of Serine Threonine Phosphate Synthase: Quinoline.
 - 26** Inhibition of Decoy D-Ribulose: Nucleoside, Nucleoside derivative.
 - 27** Inhibition of Glyoxylate Synthase: Nucleoside, Nucleoside derivative.
 - 28** Inhibition of Lycopene Synthase: Quinoline.
- Cellular Metabolism**
 - 1** Inhibition of Acetyl CoA Carboxylase: Cyanoacetamide.
 - 2** Inhibition of Acetoacetyl Synthase: Nucleoside, Nucleoside derivative.
 - 3** Inhibition of Acetyl CoA Synthase: Cyanoacetamide.
 - 4** Inhibition of Very Long-Chain Fatty Acid Synthase: Cyanoacetamide.
 - 5** Inhibition of Fatty Acid Thiokinase: Cyanoacetamide.
 - 6** Inhibition of Cellulose Synthase: Nucleoside, Nucleoside derivative.
 - 7** Inhibition of Serine Threonine Protein Phosphatase: Quinoline.
 - 8** Inhibition of Enolpyruvate Shikimate Phosphate Synthase: Quinoline.
 - 9** Inhibition of Dihydroxycinnate Dehydrogenase: Nucleoside, Nucleoside derivative.
 - 10** Inhibition of Dihydroflavone Synthase: Quinoline.
- Cell Division and Growth**
 - 11** Inhibition of Microtubule Assembly: Benzimidazole, Benzimidazole derivative.
 - 12** Inhibition of Microtubule Organization: Benzimidazole, Benzimidazole derivative.
 - 13** Auxin Mimic: Benzimidazole, Benzimidazole derivative.
 - 14** Unknown Mode of Action: Nucleoside, Nucleoside derivative.
 - 15** Auxin Transport Inhibitors: Acylacetamide, Acylacetamide derivative.

© 2022 HRAC Asia. All rights reserved. For more information, visit www.hracsites.com.

HRAC Herbicide MoA Classification Update

Poster 2010

Poster 2022



- transition to **numerical codes**
- aligned with WSSA & Australian HRAC achieving **one global system**
- **realigned** some groups, **created** new ones and **eliminated** one
- new **poster**
- lookup tools **online** and **app**

www.hracglobal.com

What is the HRAC Mode of Action (MoA) Classification System & why is it important?

- The MoA labelling provides a clear and simple method to inform, pesticide retailers and users, the type of pesticide and its mode of action group.
- The MoA groups can be used to identify products with the same mode of action, they should not be used repetitively. The more frequently farmers use the same mode of action, the more likely resistance will occur.
- Rotating and mixing pesticides with different modes of action is therefore one way to delay or avoid resistance.

www.hracglobal.com

GROUP 15 | 27 HERBICIDES

OR

GROUP 5 HERBICIDE



Progress in driving mode-of-action labelling in Asia 2022

Country	Is MOA labeling voluntary or mandatory?
Bangladesh	Voluntary
Cambodia	Voluntary
China	Voluntary
India	Voluntary
Indonesia	Mandatory (HRAC code transition in progress)
Japan	Voluntary
Korea	Mandatory
Malaysia	Mandatory (HRAC code transition in progress)
Myanmar	Voluntary
Pakistan	Voluntary
Philippines	Mandatory (HRAC code transition in progress)
Taiwan	Mandatory
Thailand	Mandatory
Vietnam	Voluntary
Australia	Mandatory (agreed to adopt HRAC numerical codes)
New Zealand	Mandatory

Source: Asia HRAC, IRAC, FRAC regional coordination

Key take home message on MoA labelling

- Currently, mode of action labelling is only a legal requirement in a handful of countries, including Australia, Indonesia, Korea, ML, Th, Ph
- HRAC developed brochures, infographics, and presentations to help you deliver this message, visit www.hracglobal.com
- **We are calling on regulators to help farmers tackle resistance by making mode of action labelling mandatory.**

The entire agricultural community must make an effort to understand herbicide resistance, learn to identify it early, and implement management tactics to reduce the evolution of herbicide-resistant weeds.

Connect with us at www.hracglobal.com and visit us at our booth

Gracias.

Thank you.

Grazie.

Vielen Dank.

謝謝你。(Xièxiè nǐ.)

धन्यवाद। (Dhanyavaad.)

Terima kasih.

ありがとうございました。(Arigatōgozaimashita.)

ขอขอบคุณ。(Khx khxbkhun.)

Obrigado.



HERBICIDE
RESISTANCE
ACTION
COMMITTEE