Global HRAC Mode of Action (MoA) Classification Working Group Report
Version: December 2025

Executive Summary

The Global Herbicide Resistance Action Committee (HRAC), supported by regional HRACs around the world and the Mode of Action Working Group completed its update to the mode of action classification system of 2024 to come up with the revised version 2026. The Mode of Action Working group held ten meetings in the period 2024-2025 to discuss content as well as changes relevant for the Mode of Action Classification of herbicides.

Global HRAC followed earlier decisions since 2017 to focus on:

1) Review and update the list of active ingredients (a.i.s) – including adding new ones, taking off non relevant ones
2) Update/revise MOA designations
3) Update/revise chemical classes
4) Recommend changes to the MOA classification code
5) Devise process for annual review and updates

Global HRAC will keep the numerical code system introduced in 2020 now and in the future as we are convinced that it is more globally relevant and sustainable compared to English/Latin letters. In geographies where the Latin alphabet is not used and/or where literacy rates are low, most everyone understands Hindu-Arabic numerals (including China).

Working Group results 2024-2025:

With this update, Global HRAC fosters the review of actives further as based on new knowledge on the site of action and sales data across three databases to assess the importance for resistance management as a core mission of the HRAC mode of action classification.

The following main results could be achieved:

1. A new updated visual design poster 2026 based on the layout of the 2024 version.

2. The addition of 5 new actives according to the guidelines for new actives:

Metproxybicyclone – HRAC Group 1
Dimesulfazet – HRAC Group 15
Icafolin-methyl – HRAC Group 23
Iptriazopyrid – HRAC Group 15
Rimisoxafen – HRAC Group 12 / 32

Ten company requests to add active ingredients to the poster were not accepted due to missing data, e.g., evidence of the mode of action and other data requirements.

3. Active ingredients decided to be off the HRAC Mode of Action Classification 2026

The Mode of Action Working Group used three different databases to understand the global sales values of each of the 266 actives. 49 compounds with low sales data were analyzed in more detail as based on 2022-2024 sales data and threshold criteria have been defined to take off compounds of the poster:

- Actives with no sales data
- All actives below 2 mio € global sales in all three databases with decreasing sales from 2022-2024, with no importance for resistance management.
- Actives below 0,5 mio € sales in three databases with marginal resistance management value

HRAC regional chairs were consulted early 2025 followed by a further review in September as based on 2024 sales data again.

As a result of the analysis 41 actives were decided to be taken off the poster as shown below. All affected compounds will be kept in the xls-herbicide mastersheet list available at the HRAC website.

Group 0 (Unknown): Pyributicarb, DSMA, Fosamine, Naproanilide, Etobenzanid
Group 1 (ACCase) Tepraloxydim, Diclofop, Fenthiaprop
Group 2 (ALS) Imazethabenz, Imazaquin, Primisulfuron, Metosulam
Group 3 (MT Assembly): Oryzalin, Thiazopyr, DMPA
Group 4 (Auxin Mimics): 2,4,5-T, Chloramben, Clomeprop,
Group 5 (PSII): Prometon, Monuron, Chloranocryl, Methabenzthiazuron
Group 10 (GS): Bialophos
Group 14 (PPO): Cinidon-ethyl, Butafenacil
Group 15 (VLCFA): Thenylchlor, Propachlor, Cycloate, Dimepiperate, Vernolate, Orbencarb, Piperophos, Indanofan, Tridiphane
Group 19 (Auxin Transport): Naptalam
Group 23 (MT Organization): Barban
Group 24 (Uncouplers) DNOC, Dinoseb
Group 27 (HPPD): Pyrazoxyfen
Group 29 (CS): Chlorthiamid
Group 31 (STPP): Endothall

The modes of action group 24 (uncouplers) and group 23 (Serine-Threonine Protein Phosphatase) are taken off the poster completely as the actives in these groups are also taken off the poster.

The chemical class “oxiranes” in group 15 was taken off the poster as both actives in this chemical class were taken of the poster.

Also, the modes of action and chemical class names will be kept in the herbicide xls-mastersheet list.

4. Reclassification of actives and new group names

The MoA Classification Working Group carried out a detailed literature review on all active ingredients within Group 3 (Inhibition of Microtubule Assembly) and Group 23 (Inhibition of Microtubule Organization), including mode of action aspects (biochemistry, cell biology, cell biology and more). The working group considered the latest knowledge on observed resistance and cross resistance. The active ingredient propyzamide does not exhibit cross-resistance to alpha-tubulin target-site mutations. Furthermore, studies using Chlamydomonas reinhardtii mutants suggest beta-tubulin as the possible target site for propyzamide, although this has yet to be confirmed. The same studies were conducted with the new active ingredient icafolin-methyl, which has been classified as a Group 23 inhibitor.

As a result of this review, the team decided to rename:

Group 3 from “*Inhibition of Microtubule Assembly*” to “*Inhibition of Microtubule Assembly – alpha-tubulin*”.

Group 23 from “*Inhibition of Microtubule Organization*” to “*Microtubule Interference – Unclear Site of Action*”, as the exact target remains unknown and may differ from proteins involved in microtubule organization.

The team aims to publish a peer-reviewed article on these findings in 2026.

Background

Working Group Members 2025
Jens Lerchl, Matthias Witschel, Bianca Martins, Gael Le Goupil, Roland Beffa, Jens Frackenpohl, Hudson Takano, Jeffrey Epp, James Morris

Bernd Laber, Hubert Menne and Caio Rossi left the MoA Working Group while Bianca Martins newly joined the team in the beginning of 2024.

The starting point for the list of herbicide active ingredients was changed previously with the poster release in 2022. It was originally provided by Ian Heap (Administrator of the herbicide resistance website weedscience.org) which was cross-referenced with the Pesticide Manual (BCPC), WSSA Herbicide Handbook and third-party reports such as Phillips McDougall/AgbioInvestor for gaps and new market introductions. Evidence of commercialization was required for inclusion on the list. The final Master List includes all referenced herbicide a.i.s. The updated 2026 HRAC MOA poster is a subset of the Master List and includes 230 actives including new ones.