IRAC

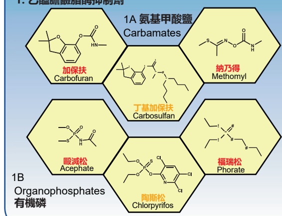
Insecticide Resistance Action Committee

Mode of Action Classification

主要生理標靶
Key to Targeted Physiology

- 神經/肌肉 Nerve & Muscle
- 生長發育 Growth & Development
- 呼吸 Respiration
- 中腸 Midgut
- 未知/非專一 Unknown or Non-specific

Group 1: Acetylcholinesterase (AChE) inhibitors
(Only representatives actives of the groups are shown)
1. 乙醯膽鹼脂酶抑制劑



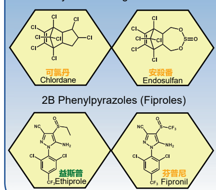
1A 氨基甲酸鹽 Carbamates

1B Organophosphates 有機磷

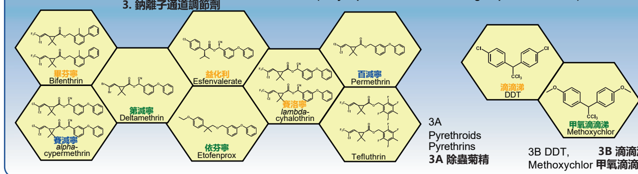
Group 2: GABA-gated chloride channel antagonists
2. GABA氯離子通道拮抗劑

2A Cyclodiene Organochlorines

2B Phenylpyrazoles (Fiproles)



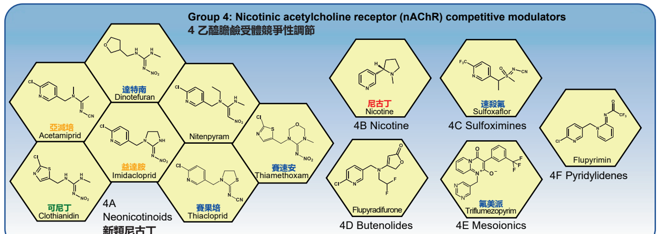
Group 3: Sodium channel modulators (Only representative actives of group 3A are shown)
3. 鈉離子通道調節劑



3A Pyrethroids Pyrethrins
3A 除蟲菊精

3B DDT, Methoxychlor
3B 滴滴涕 甲氧滴滴涕

Group 4: Nicotinic acetylcholine receptor (nAChR) competitive modulators
4 乙醯膽鹼受體競爭性調節



4A Neonicotinoids 新類尼古丁

4B Nicotine

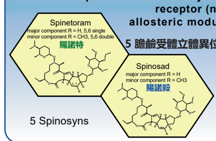
4C Sulfoximines

4D Butenolides

4E Mesoionics

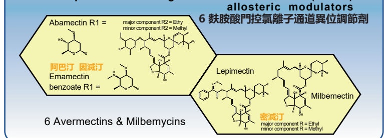
4F Pyridylidenes

Group 5: Nicotinic acetylcholine receptor (nAChR) allosteric modulators site I
5 膽鹼受體立體異位調節劑 位點 I



5 Spinosyns

Group 6: Glutamate-gated chloride channel (GluCl) allosteric modulators
6 麩胺酸閂控氯離子通道異位調節劑



6 Avermectins & Milbemycins

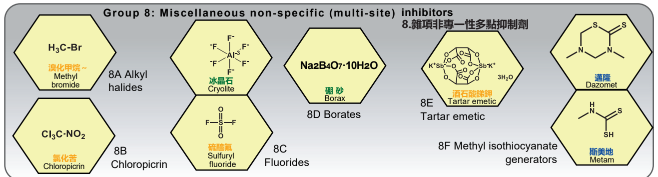
Group 7: Juvenile hormone mimics
7.仿保幼激素類

7A Juvenile hormone analogues
保幼激素類似物

7B Fenoxycarb

7C Pyriproxyfen

Group 8: Miscellaneous non-specific (multi-site) inhibitors
8.雜項非專一性多點抑制劑



8A Alkyl halides

8B Chloropicrin

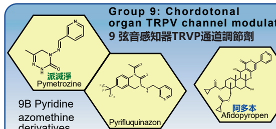
8C Fluorides

8D Borates

8E Tartar emetic

8F Methyl isothiocyanate generators

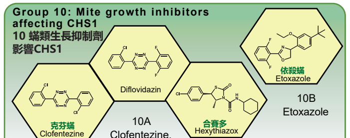
Group 9: Chordotonal organ TRPV channel modulators
9 弦音感知器TRVP通道調節劑



9B Pyridine azomethine derivatives

9D Pyropenes

Group 10: Mite growth inhibitors affecting CHS1
10 蟎類生長抑制劑 影響CHS1



10A Clofentezine, Diflovidazin,Hexythiazox

10B Etoxazole

Group 11: Microbial disruptors of insect midgut membranes
11 微生物中腸膜破壞劑

Includes transgenic crops expressing Bacillus thuringiensis toxins (however, specific guidance for resistance management of transgenic crops is not based on rotation of modes of action)

Rotation between certain specific B.t. microbial products may provide resistance management benefits for some pests. Consult product-specific recommendations.

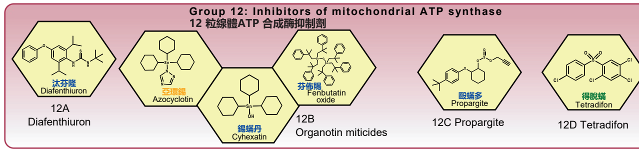
Bacillus thuringiensis and the insecticidal proteins produced
B.t. israelensis, B.t. aitzawai, B.t. kurstaki, B.t. tenebrionis
蘇力菌與毒蛋白

11A Bacillus thuringiensis

Bacillus sphaericus
球形芽孢桿菌

11B Bacillus sphaericus

Group 12: Inhibitors of mitochondrial ATP synthase
12 粒線體ATP 合成酶抑制劑



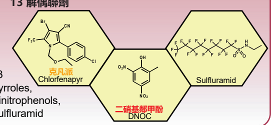
12A Diafenthiuron

12B Organotin miticides

12C Propargite

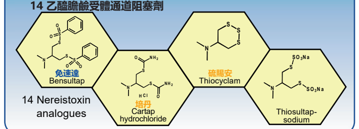
12D Tetradifon

Group 13: Uncouplers of oxidative phosphorylation via disruption of proton gradient
13 解偶聯劑



13 Pyrroles, Dinitrophenols, Sulfluramid

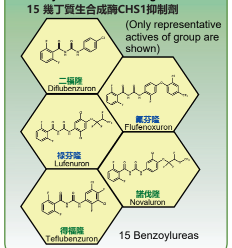
Group 14: Nicotinic acetylcholine receptor (nAChR) channel blockers
14 乙醯膽鹼受體通道阻塞劑



14 Nereistoxin analogues

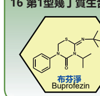
Group 15: Inhibitors of chitin biosynthesis affecting CHS1
15 幾丁質生合成酶CHS1抑制劑

(Only representative actives of group are shown)



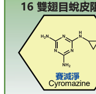
15 Benzoylureas

Group 16: Inhibitors of chitin biosynthesis, type 1
16 第1型幾丁質生合成酶抑制劑



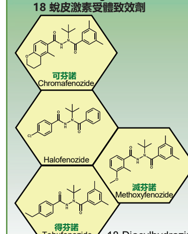
16 Buprofezin

Group 17: Moulting disruptors, Dipteran
16 雙翅目蛻皮阻斷劑



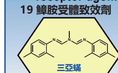
17 Cyromazine

Group 18: Ecdysone receptor agonists
18 蛻皮激素受體致效劑



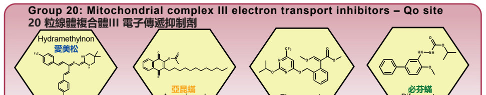
18 Diacylhydrazines

Group 19: Octopamine receptor agonists
19 章胺受體致效劑



19 Amitraz

Group 20: Mitochondrial complex III electron transport inhibitors – Qo site
20 粒線體複合體III 電子傳遞抑制劑



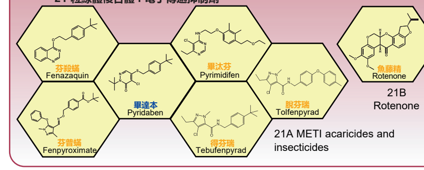
20A Hydramethylnon

20B Acequinocy

20C Fluacrypyrim

20D Bifenazate

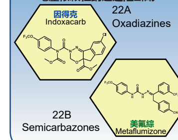
Group 21: Mitochondrial complex I electron transport inhibitors
21 粒線體複合體 I 電子傳遞抑制劑



21A METI acaricides and insecticides

21B Rotenone

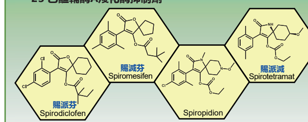
Group 22: Voltage-dependent sodium channel blockers
22 電壓依賴性鈉通道阻斷劑



22A Oxadiazines

22B Semicarbazones

Group 23: Inhibitors of acetyl CoA carboxylase
23 乙醯輔酶A羧化酶抑制劑



23 Tetronic & Tetramic acid derivatives

Group 24: Mitochondrial complex IV electron transport inhibitors
24 粒線體複合體IV電子傳遞抑制劑

AlP 磷化鋁 Aluminium phosphide

PH3 磷化氫 Phosphine

Ca3P2 磷化鈣 Calcium phosphide

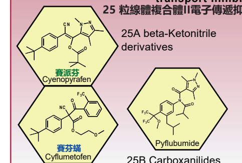
Zn3P2 磷化鋅 Zinc phosphide

CN- 氰化物 Cyanide salts

24A Phosphides

24B Cyanides

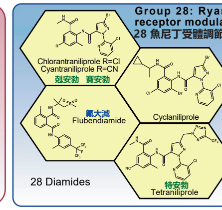
Group 25: Mitochondrial complex II electron transport inhibitors
25 粒線體複合體II電子傳遞抑制劑



25A beta-Ketonitrile derivatives

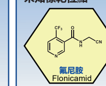
25B Carboxanilides

Group 28: Ryanodine receptor modulators
28 魚尼丁受體調節劑



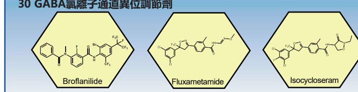
28 Diamides

29: Chordotonal organ modulators – undefined target site
29 弦音感知器調節劑 未知標靶位點



29 Flonicamid

Group 30: GABA-gated chloride channel allosteric modulators
30 GABA氯離子通道異位調節劑



間二醯胺/異噁唑啉類
30 Meta-diamides & Isoxazolines

Group 31: Baculoviruses
31.桿狀病毒

Cydia pomonella GV
Thaumatotibia leucotreta GV

Anticarsia gemmatalis MNPV
Helicoverpa armigera NPV

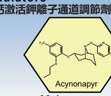
顆粒體病毒和核多角體病毒
31 Granuloviruses & Nucleopolyhedroviruses

Group 32: Nicotinic acetylcholine receptor (nAChR) allosteric modulators site II
32 nAChR異位調節劑 位點 II

GS-omega/kappa HXTX-Hv1a peptide
毒蜘蛛蛋白

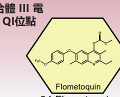
32 GS-omega/kappa HXTX-Hv1a peptide

Group 33: Calcium-activated potassium channel (KCa2) modulators
33 鈣激活鉀離子通道調節劑



33 Acynonapyr

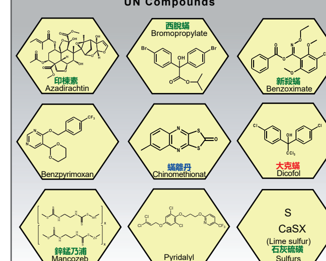
Group 34: Mitochondrial complex III electron transport inhibitors – Qi site
34 粒線體複合體 III 電子傳遞抑制劑 QI位點



34 Flometoquin

Unknown or uncertain mode of action
UN 作用機制未知或尚未確定

UN Compounds



細菌製劑
UNB
Bacterial agents (non-Bt)

Burkholderia spp, Wolbachia pipientis (Zap)

真菌製劑
UNF
Fungal agents

Beauveria bassiana strains
Metarhizium anisopliae strain F52,
Paecilomyces fumosoroseus
Apopka strain 97

Chenopodium ambrosioides near ambrosioides extract
Fatty acid monoesters with glycerol or propanediol
Neem oil

植物性精油
UNE
Botanical essence including synthetic, extracts and unrefined oils

Diatomaceous earth
Mineral oi

非專一性機械/物理破壞
UNM
Non-specific mechanical and physical disruptors

Use of Groups:

- Alternations, sequences or rotations of compounds between MoA groups reduce selection for target site resistance.
- Applications are arranged into MoA spray windows defined by crop growth stage and pest biology. Several sprays of a compound may be possible within each spray window, but successive generations of a pest should not be treated with compounds from the same MoA group. Local expert advice on spray windows and timings should always be followed.
- Groups in the classification whose members do not act at a common target site are exempt from the proscription against rotation within the group (Group 8, 13 and all UN groups: UN, UNB, UNE, UNF, UNM, UNP & UNV).

Use of Sub-Groups:

- Sub-groups represent distinct structural classes which are believed to have the same mode of action.
- Sub-groups provide differentiation between compounds that may bind at the same target site but are structurally different enough that risk of metabolic cross-resistance is lower than for close chemical analogs.
- Cross-resistance potential between sub-groups is higher than between groups, so rotation between sub-groups should be considered only when there are no alternatives, and only if cross resistance does not exist, following consultation with local expert advice. These exceptions are not sustainable, and alternative options should be sought.

Poster Notes:

- Sub-group 3B: DDT is no longer used in agriculture and therefore this is only applicable for the control of insect vectors of human disease, such as mosquitoes, because of a lack of alternatives.
- Sub-group10A: Hexythiazox is grouped with Clofentezine because they exhibit cross-resistance even though they are structurally distinct. Diflovidazin has been added to this group because it is a close analogue of Clofentezine and is expected to have the same mode of action.
- Group 20: While there is strong evidence that Bifenazate acts on the Qo site of Mitochondrial Complex III and some Bifenazate resistance mutations confer cross-resistance to Acequinocyl, the sites of action of Fluacrypyrim and Hydramethylnon have not been determined.
- Groups 26 and 27 are unassigned.
- In some cases, only representative actives are shown.
- Please visit www.irac-online.org for the complete IRAC classification.

Poster Edition 8.2, Aug. 2022. Based on the MoA Classification Version 10.3

CropLife 作物永續發展協會 台灣分會

財團法人植物保護科技基金會
Plant Protection Science And Technology Foundation