

# Registration process for new chemicals & opportunities for the mango industry



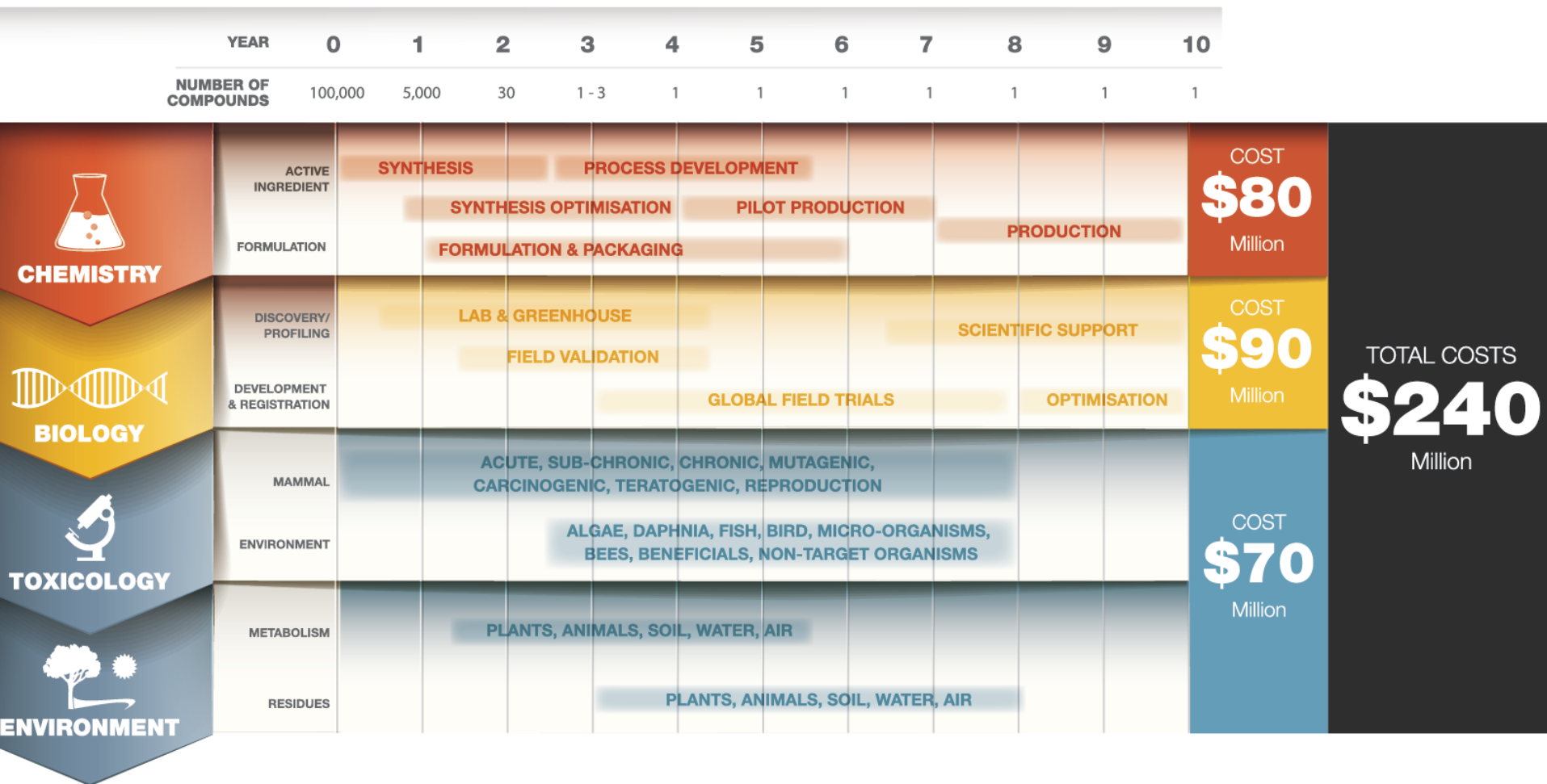


+

# MARTIN CLOUGH

Head of Global Product  
Biology, Syngenta

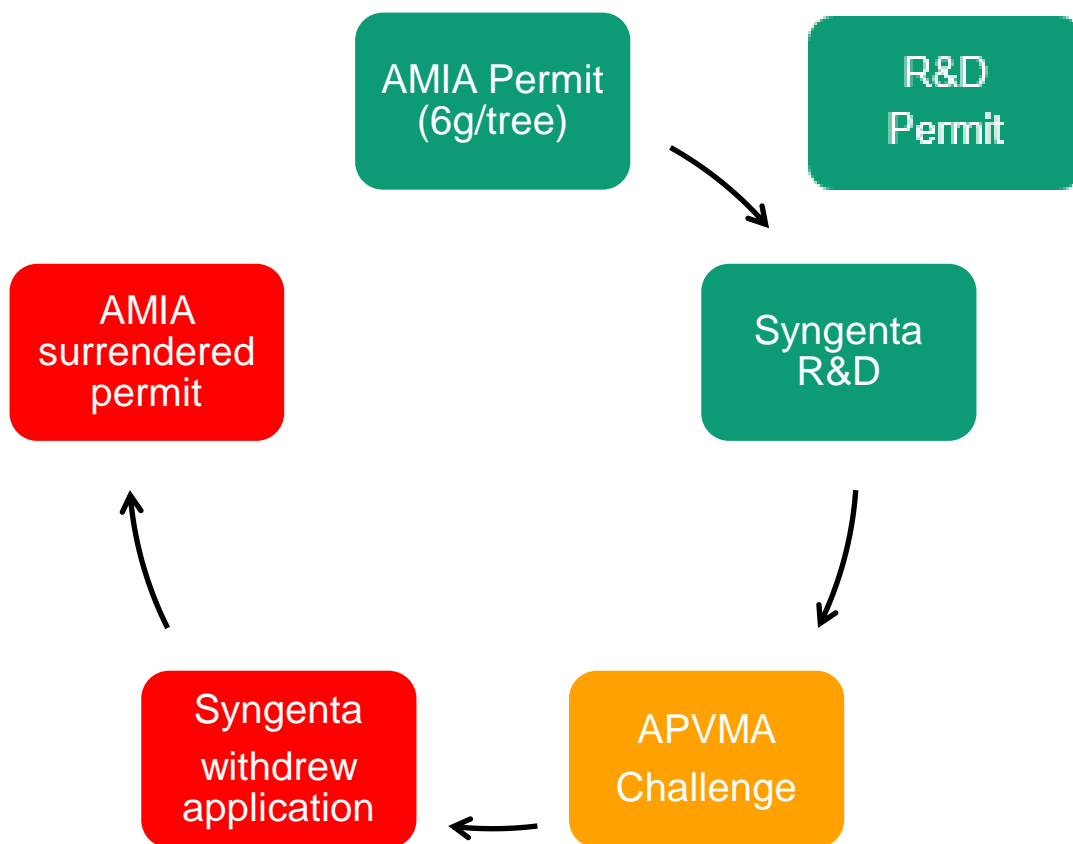
# Long path from molecule to product...





# Actara<sup>®</sup>

## GROUP 4A



Mango seed weevil



*Bringing plant potential to life*

Trademark



# INNOVATION



Inspiration



Creativity



Analysis



Technology



Development



Teamwork



Success



Pydiflumetofen (7)



Azoxystrobin (11)  
Fludioxonil (12)



Emamectin (6)



NEW ACTIVES

CO-FORMULATIONS

FORMULATION  
EXTENSIONS

LABEL  
EXTENSIONS



# INNOVATION



Inspiration



Creativity



Analysis



Technology



Development



Teamwork



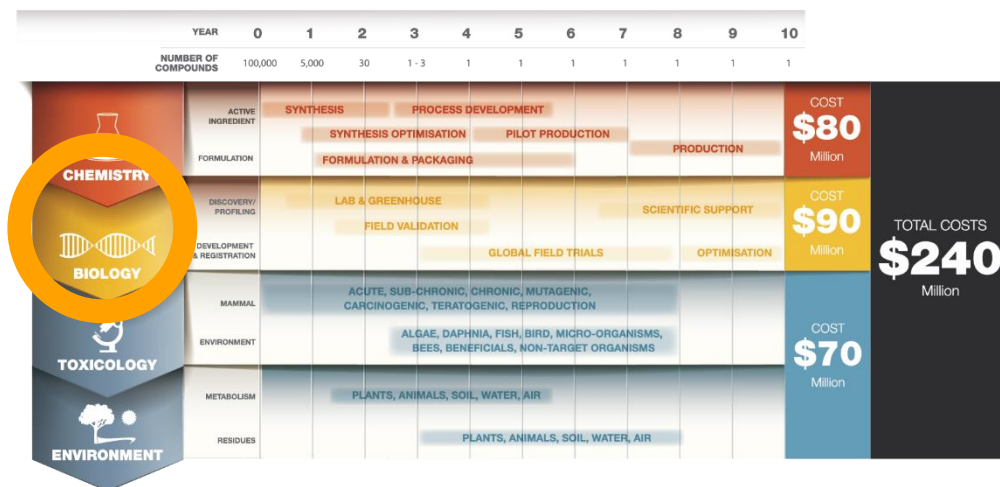
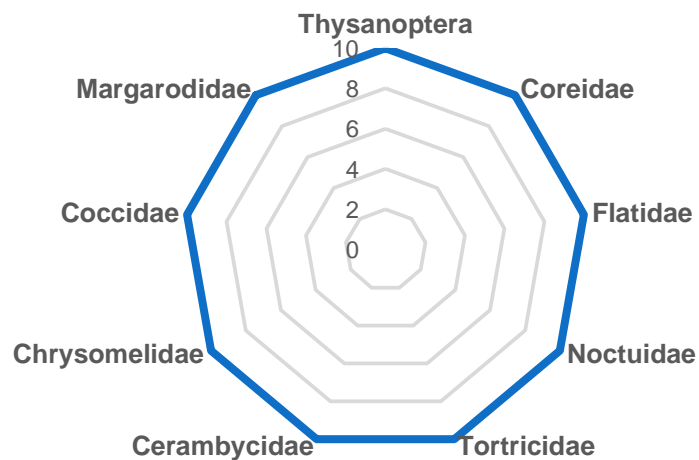
Success

# Insecticide case study



# Global R&D Results

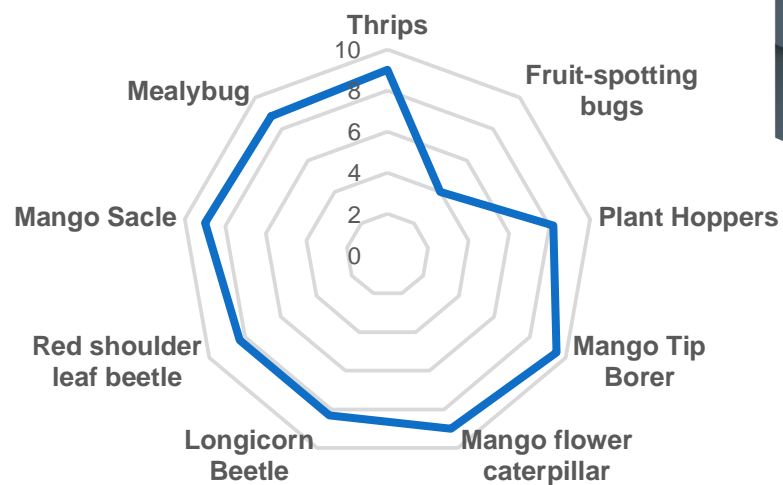
# Hypothetical



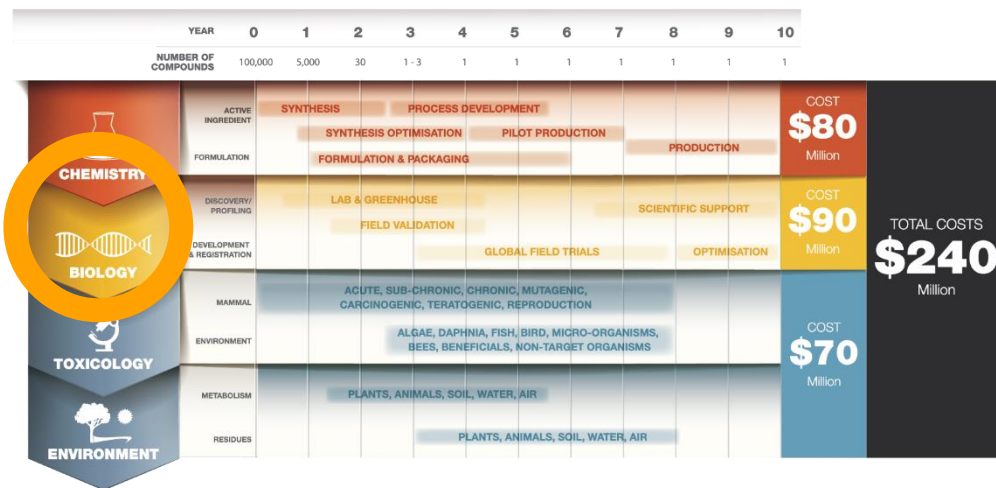
# Global R&D Results

# Hypothetical

## Broad spectrum



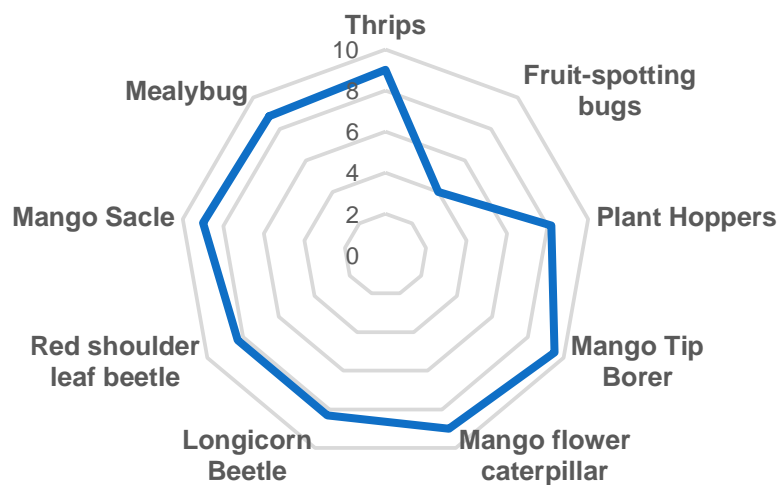
10 = 100% control



## Global R&D Results

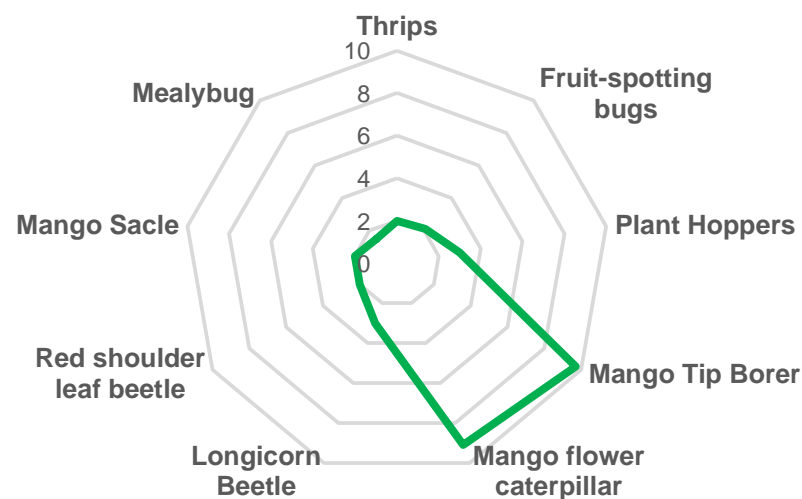
# Hypothetical

### Broad spectrum



10 = 100% control

### Selective



# How insecticides work

**Contact**

**Translaminar**

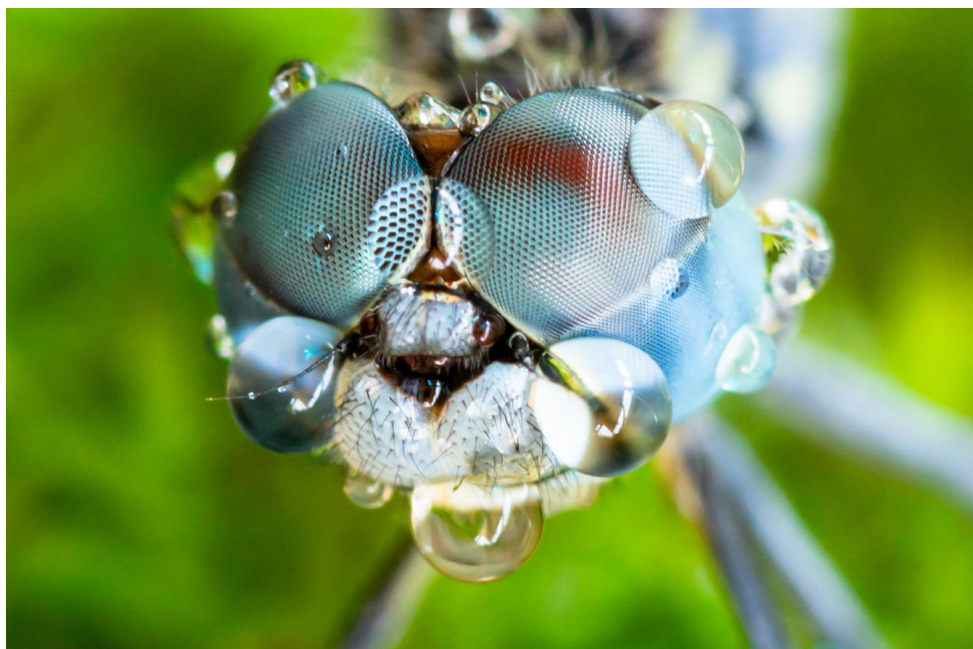
**Systemic**

# How insecticides work

**Contact**

**Translaminar**

**Systemic**



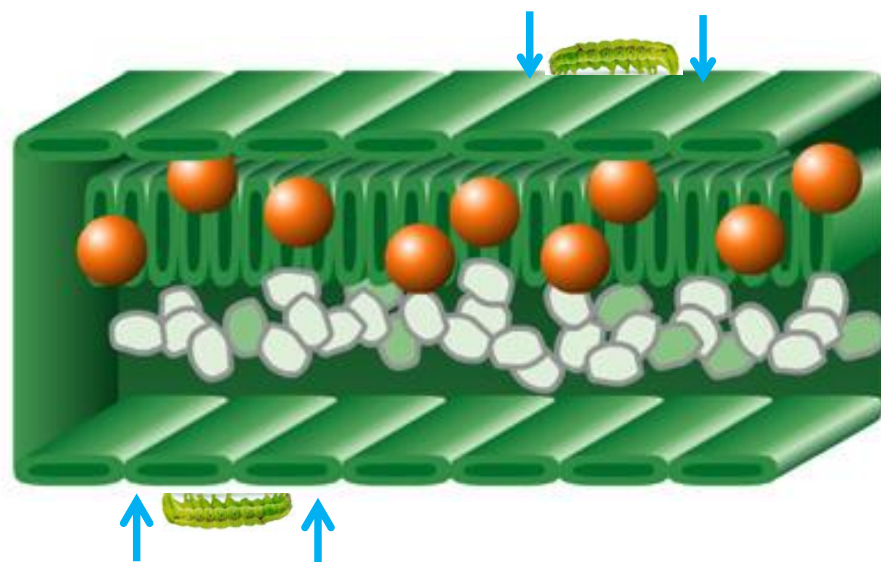
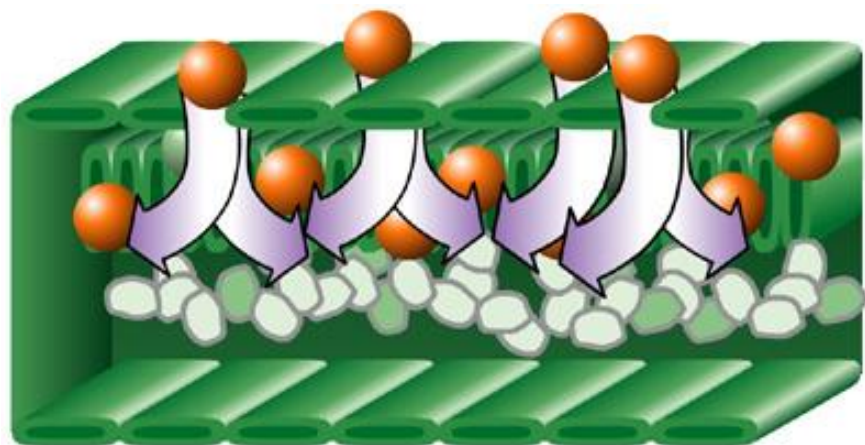
- Direct contact
  - Spray
- Indirect contact
  - Residues
  - Better on mobile pests

# How insecticides work

Contact

Translaminar

Systemic



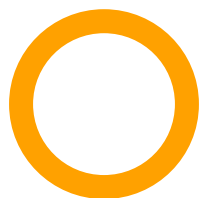
Good on hidden pests

# How insecticides work

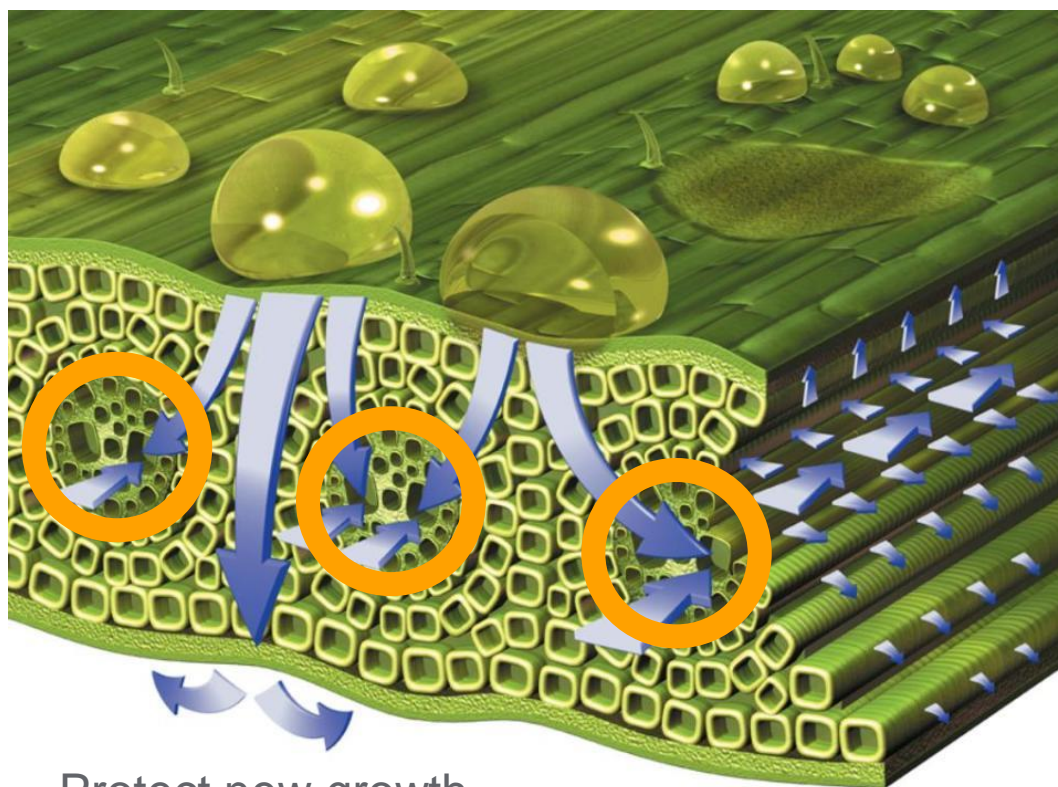
Contact

Translaminar

Systemic



Vascular  
bundle



Protect new growth

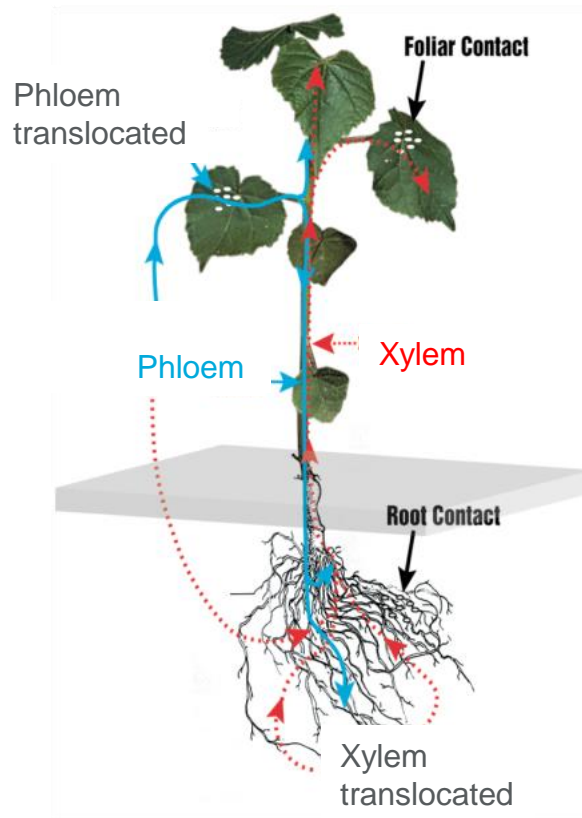
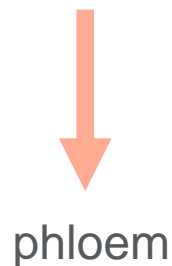
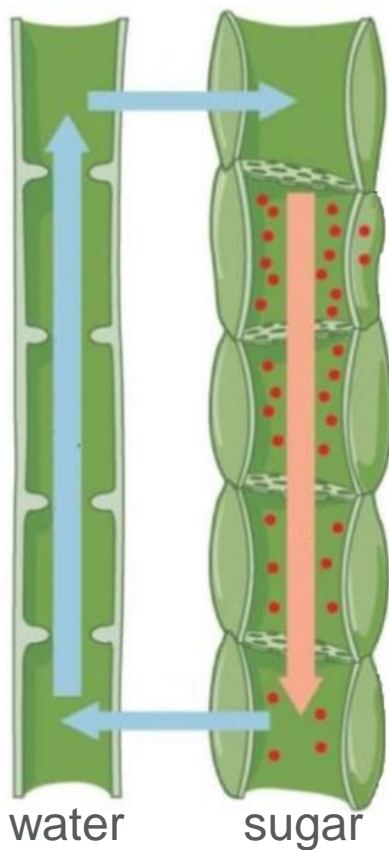
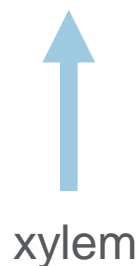
# How insecticides work

## Contact

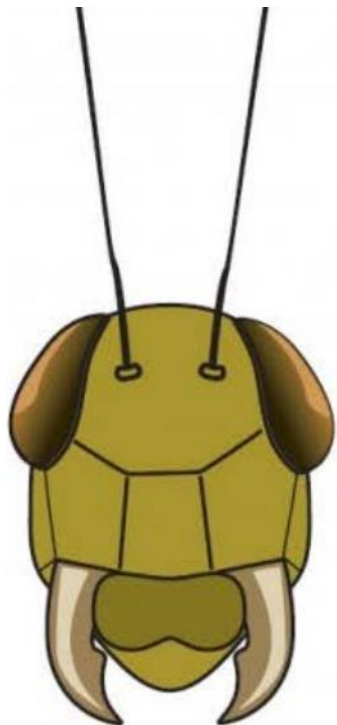
## Translaminar

## Systemic

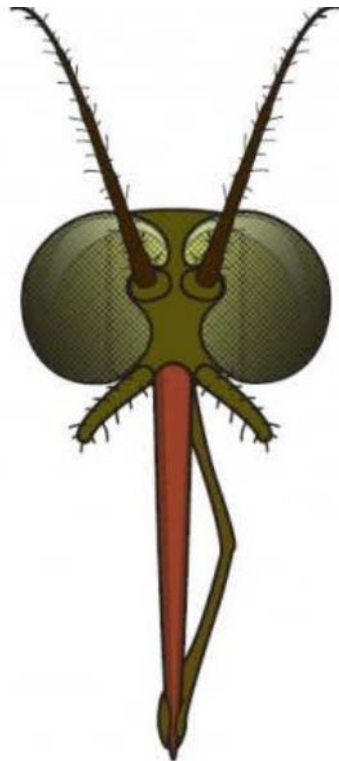
Systemic insecticides 'hitch' a ride in the xylem



# Insect feeding behaviour



**Chewing**



**Piercing-sucking**



**Siphoning**



**Sponging**

# FIELD GUIDE



## Pests, Beneficials, Diseases and Disorders of Mangoes



Fruit-spotting bugs

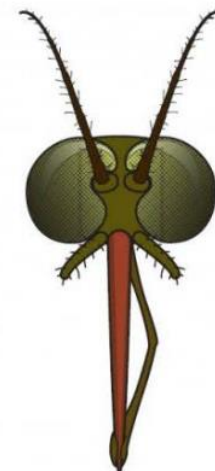


Plant hoppers



- Mobile
  - Contact
- Sap suckers
  - Translaminar & systemic

Bugs



Tea mosquito bugs

Mango shoot caterpillar

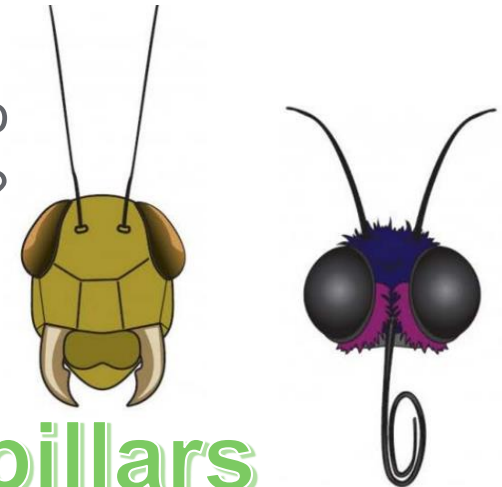


Flower caterpillar



- What's the go to product?

Caterpillars



Mango fruit borer

Longicorn beetle

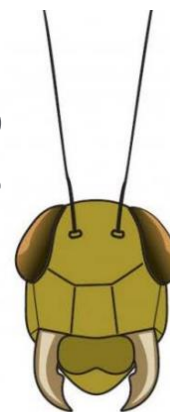


Swarming beetle



Red shouldered leaf beetle

- What's the go to product?



Beetles

Mango bud mite

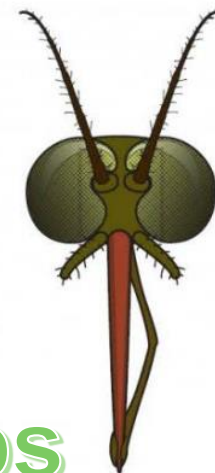


Mango leaf coating mite



Flower thrips

- What's the go to product?



Mites, thrips

Mealybugs

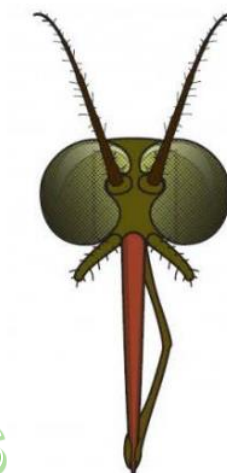


Fluted scale



- What's the go to product?

Scale  
Mealybugs



Mango scale

# Bringing it all together

Effective



Beneficial insects



Resistance management

**Your options**

# Registered insecticides

ACTIVES	GROUP	Number of registered products	Insects controlled
BUPROFEZIN	16	6	Scale
CARBARYL	1A	5	Scale, leafhopper, planthopper
CHLORPRYIFOS	1B	38	Scale
DIMETHOATE	1B	20	Fruit fly
METHIDITHION	1B	2	Scale, Mango tip borer, leafminer, Mango Seed weevil
PARAFINIC OIL	-	3	Scale, planthopper
PETROLEUM OIL	-	3	Scale
SPINETORAM	5	1	Flower eating caterpillar, Mango tip borer
SPIROTETRAMAT	23	1	Scale

7 out 9 registered actives control scale

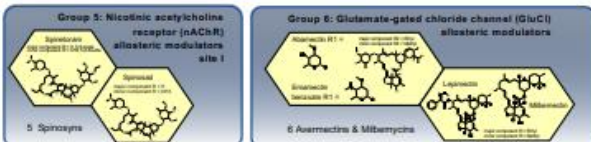
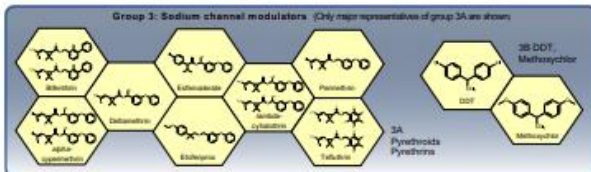
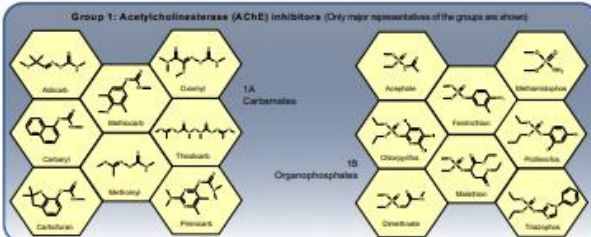
# PERMITS

ACTIVES	GROUP	Expires	Insects controlled
FIPRONIL	2B	Mar-23	Termite
SULFOXAFLO	4C	Mar-23	Fruit-spotting bug
METHOMYL	1A	Nov-20	Thrips
CLOTHINIDIN	4A	Aug-19	Mango seed weevil (S)
MALDASON	1B	Aug-22	Fruit fly
CLOTHINIDIN	4A	Nov-20	Fruit fly
BETA-CYFLUTHRIN	3A	Aug-22	Fruit-spotting bug, Rhino beetle, Monolepta, longicorn beetle, tip borer, planthopper, green vegetable bug, stink bugs, yellow peach moth
CARBARYL	1A	Jun-20	Leafhopper
TRICHLORFON	1B	Jun-20	Fruit-spotting bug (S), green vegetable bug (S), Lychee stink bug (S) planthopper, flower feeding caterpillar, yellow peach moth



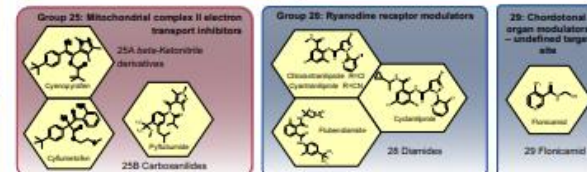
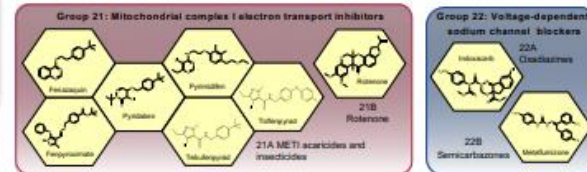
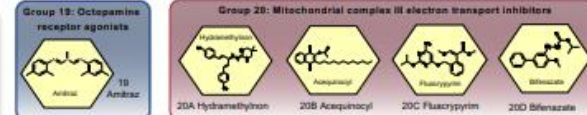
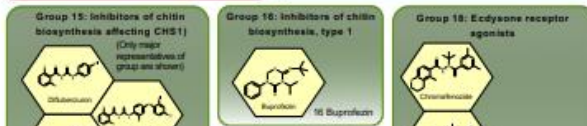
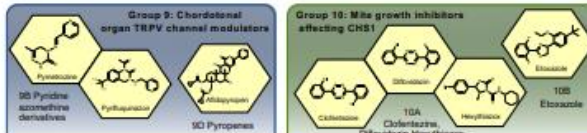
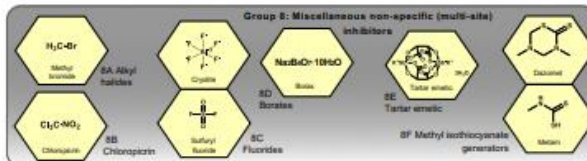
Insecticide Resistance Action Committee

## Mode of Action Classification



**Use of Groups and Sub-Groups:**

- Alterations, 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 should always be followed with regard to spray windows and timing.
- Groups in the classification whose members do not act at a common target site are exempt from the prescription against rotation within the group. These are, Group 8, Group 13 and all the UN groups: UN, UNS, UNE, UNM, UNP & UNV.
- 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 analogues.
- 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.
- 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-group 15A: Hexythiazox is grouped with chlorfenvinphos because they exhibit cross-resistance even though they are structurally distinct. Chlorfenvinphos has been added to this group because it is a close analogue of hexythiazox and is expected to have the same mode of action.



**Key to Targeted Physiology**

■ Nerve & Muscle ■ Growth & Development ■ Respiration ■ Midgut ■ Unknown or Non-specific

**Poster Notes:**

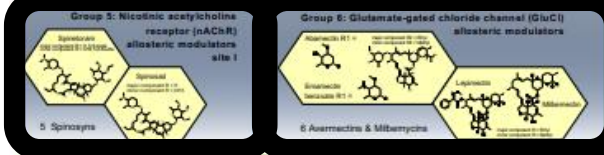
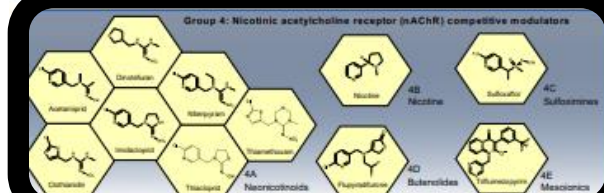
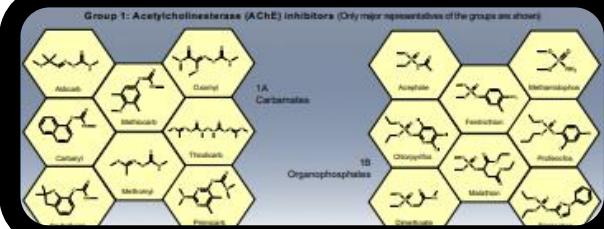
- Groups 26 and 27 are unassigned.
- The poster is for educational purposes only. Information presented is accurate to the best of our knowledge at the time of publication, but IRAC or its member companies cannot accept responsibility for how this information is used or interpreted. Advice should always be sought from local experts or advisors, and health and safety recommendations followed.
- In some cases only representative compounds in Groups are shown where indicated.
- Please visit [www.irc-online.org](http://www.irc-online.org) for the complete IRAC classification.





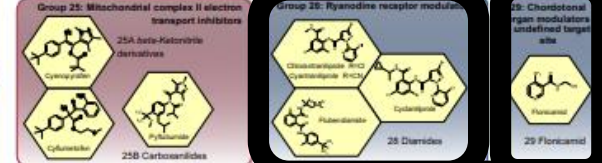
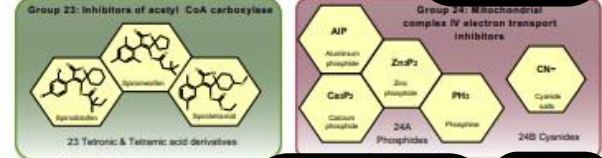
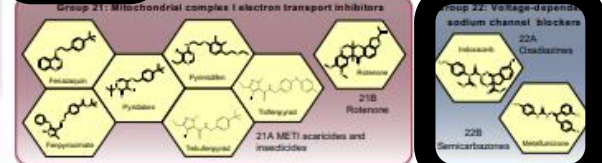
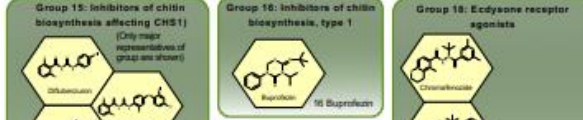
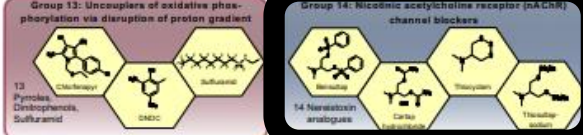
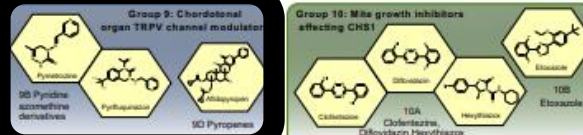
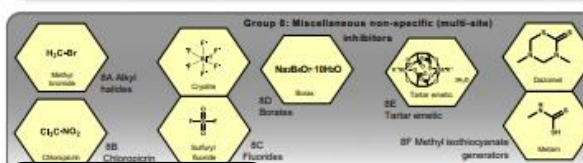
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- Local expert advice should always be followed with regard to spray windows and timing.
- Groups in the same MoA group are subdivided into sub-groups (e.g. from the insecticide group according to general resistance within the group, these are, Group 6, Group 13 and all the UN group: UN1, UN2, UN3, UN4, UN5, UN6, UN7, UN8, UN9, UN10, UN11, UN12, UN13, UN14, UN15, UN16, UN17, UN18, UN19, UN20, UN21, UN22, UN23, UN24, UN25, UN26, UN27, UN28, UN29, UN30, UN31, UN32, UN33, UN34, UN35, UN36, UN37, UN38, UN39, UN40, UN41, UN42, UN43, UN44, UN45, UN46, UN47, UN48, UN49, UN50, UN51, UN52, UN53, UN54, UN55, UN56, UN57, UN58, UN59, UN60, UN61, UN62, UN63, UN64, UN65, UN66, UN67, UN68, UN69, UN70, UN71, UN72, UN73, UN74, UN75, UN76, UN77, UN78, UN79, UN80, UN81, UN82, UN83, UN84, UN85, UN86, UN87, UN88, UN89, UN90, UN91, UN92, UN93, UN94, UN95, UN96, UN97, UN98, UN99, UN100, UN101, UN102, UN103, UN104, UN105, UN106, UN107, UN108, UN109, UN110, UN111, UN112, UN113, UN114, UN115, UN116, UN117, UN118, UN119, UN120, UN121, UN122, UN123, UN124, UN125, UN126, UN127, UN128, UN129, UN130, 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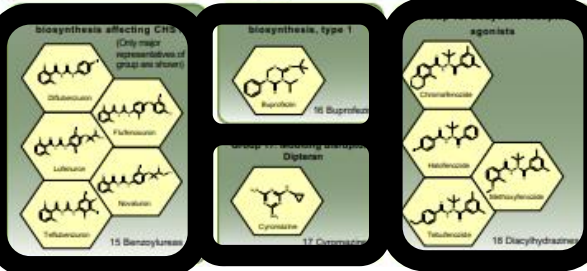
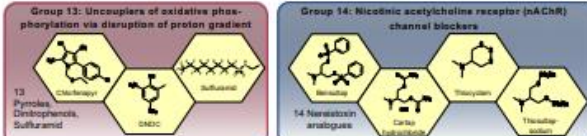
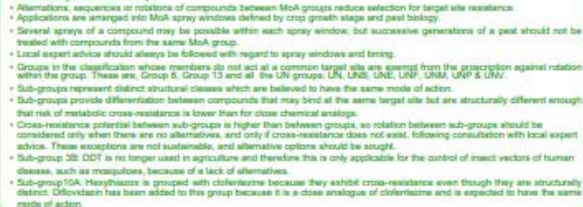
**Key to Targeted Physiology**

- Nerve & Muscle ■ Growth & Development ■ Respiration ■ Metabolism ■ Unknown or Non-specific

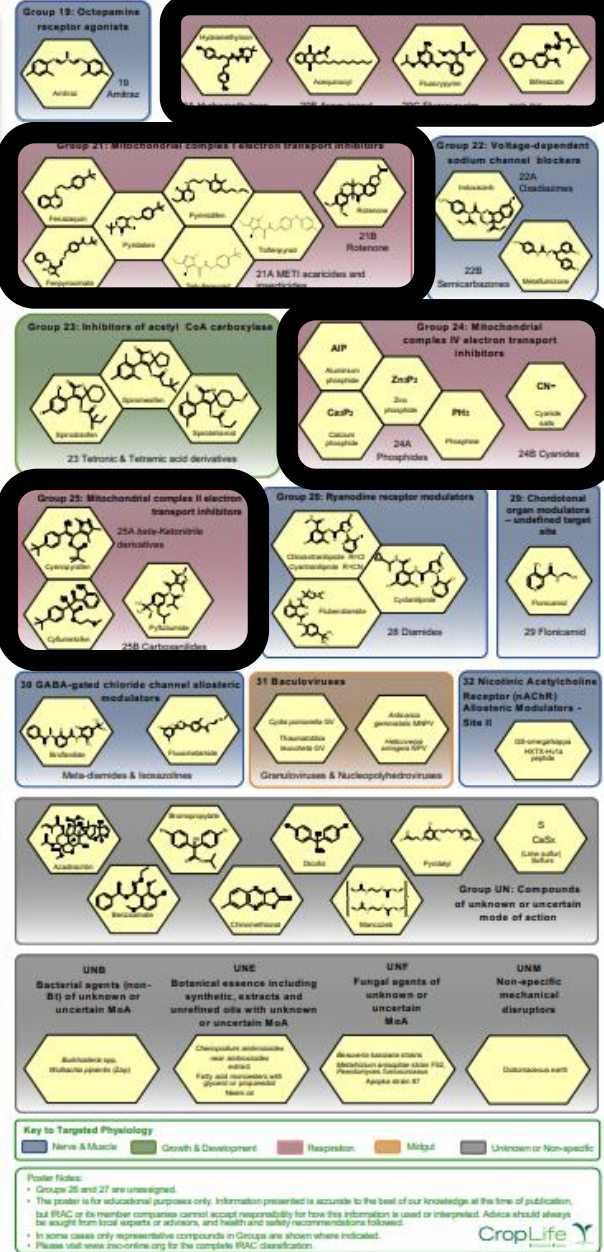
Protein Folding:

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  - In some cases only representative compounds in Groups are shown where indicated.
- CropLife Y

### Mode of Action Classification



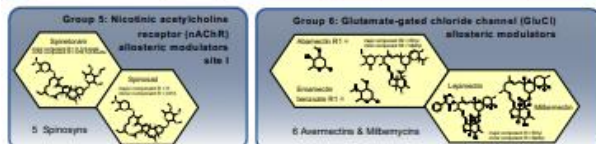
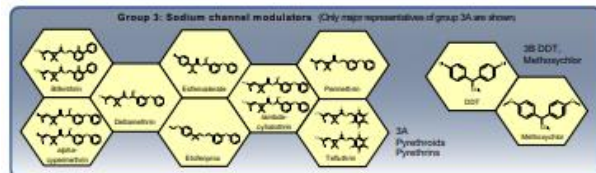
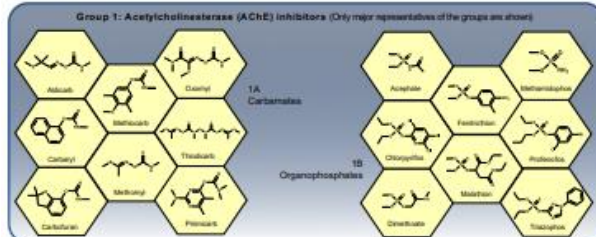
### Mode of Action Classification





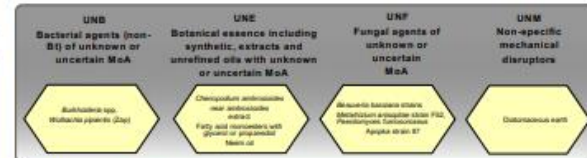
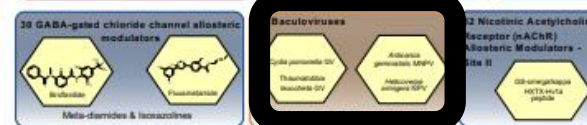
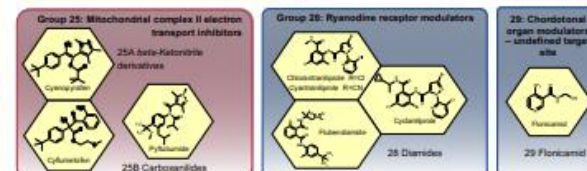
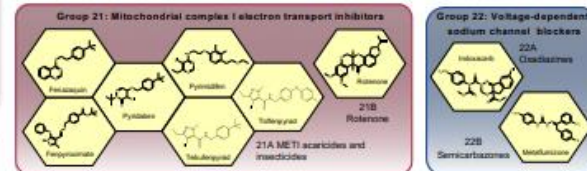
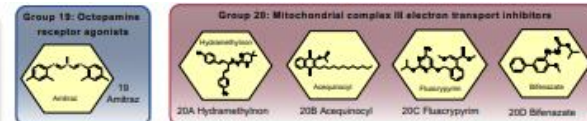
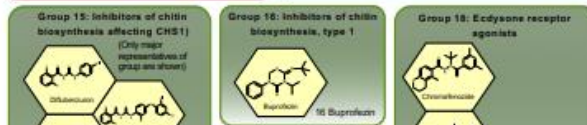
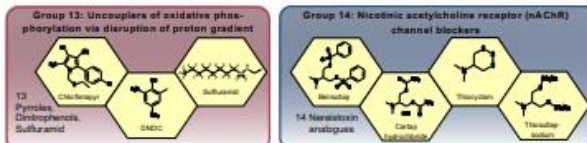
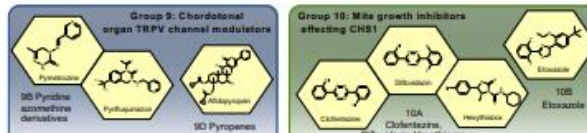
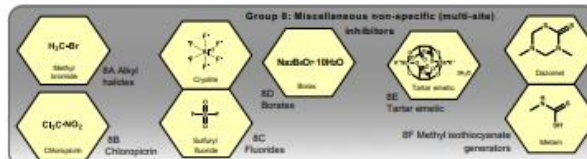
Insecticide Resistance Action Committee

### Mode of Action Classification



### Use of Groups and Sub-Groups:

- Alternations, sequences or not 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 can be made over the season after each spray window, but successive generations of a pest should not be treated with compounds from the same MoA group.
- Local expert advice should always be followed with regard to spray windows and timing.
- Insects in the same MoA group have different modes of action, from the insecticide against rotation to the repellent.
- Within the group, there are, Group 6, Group 13 and all the UN-Groups: UNL, UNLS, UNLP, UNLN, UNLP, UNLA, UNL & UN/L.
- Sub-groups represent distinct structural classes which are believed to have the same mode of action.
- Some sub-groups may be considered as alternative options if the main targeted active has been 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 relation between sub-group should be determined only when they are used in combination with other products and/or crops.
- Following consultation with local experts, some exceptions are not sustainable, and alternative options should be sought.
- Sub-group 28: DDT is no longer used in agriculture and therefore it is only applicable for the control of insect vectors of human diseases.
- Sub-group 15A: Hexachlorine is grouped with chlorfenvinphos because they exhibit cross-resistance even though they are structurally distinct. Chlorfenvinphos has been added to this group because it is a close analogue of chlorfenvinphos and is expected to have the same effect.



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- 

1A (2)

1B (5)



IRAC

Insecticide Resistance Action Committee

Mode of Action Classification

[illegible]

3A (1)

4A (1)

4C (1)

5 (1)

16 (1)



1,5-Diphenylhexane



1,3-Diphenylhexane



1,6-Diphenylhexane

23 (1)

[illegible]

1A (2)

1B (5)

3A (1)

60%  
Carbamate  
Organophosphates  
Pyrethroids

4A (1)

4C (1)

5 (1)

Caterpillars

60%

Bugs / weevils

16 (1)

23 (1)

Scale

Scale

Fruit-spotting bugs



Plant hoppers



Mango shoot caterpillar



Flower caterpillar



Longicorn beetle



Swarming beetle



Tea mosquito bugs

- Mobile
- Contact
- Sap suckers
- Translaminar & systemic



Bugs



Mango fruit borer



Caterpillars



Red shouldered leaf beetle



Beetles

27

syngenta.

28

syngenta.

31

syngenta.

Mealybugs



Fluted scale



Mango bud mite



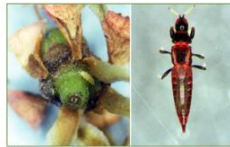
Mango leaf coating mite



Mango scale



Scale  
Mealybugs



Flower thrips



Mites, thrips

35

syngenta.

33

syngenta.

# Are there any gaps?

