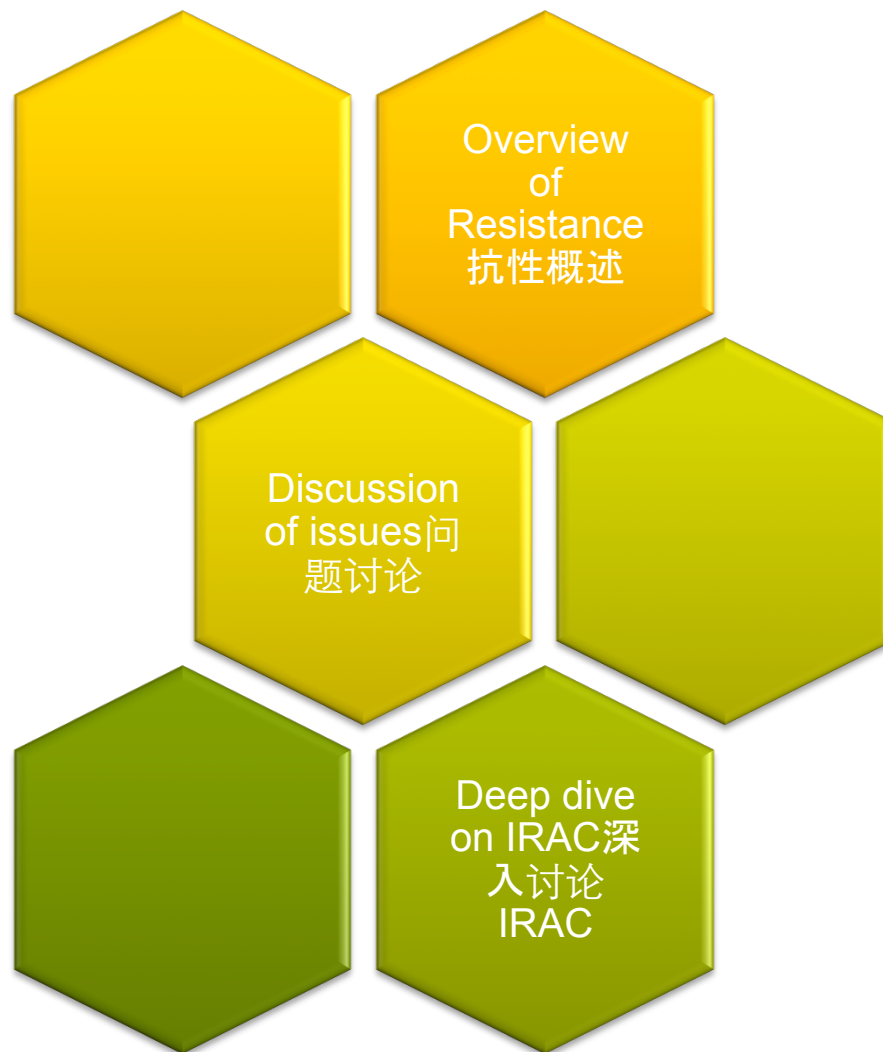


Resistance to Crop Protection Products

农化产品的抗性



The Syngenta logo is positioned on a dark green horizontal bar. It consists of the word "syngenta" in a white, lowercase, sans-serif font. A small green leaf icon is placed above the letter 'n'.

syngenta

Principles of resistance management

抗性管理的原则

ONE PERSON
CAN MAKE A
DIFFERENCE,
AND EVERYONE
SHOULD TRY
-JOHN F. KENNEDY-

每
人
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Understanding resistance 了解抗性

- Resistance occurs when an **organism is no longer controlled by a chemical** such as antibiotics and crop protection products that were previously effective.
当一个有机体不再受到以前有效的抗生素和农化产品的控制时，就会发生抗药性。
- **The organism is able to resist the effects of the chemical and can continue to reproduce and thrive.**
生物体能够抵御化学物质的影响，并能继续繁殖和繁衍。



Resistance in agriculture 农业中的抗性

- In agriculture, organisms can become **resistant to crop protection chemicals**. 在农业中，有机体对农化产品产生抗性。
- Resistance occurs when **the target pests, weeds or pathogens adapt and are no longer affected by the crop protection products** used to control them. 当目标害虫、杂草或病原体适应及其不受农化产品影响时，就会发生抗性。
- In **genetically modified (GM) crops**, the crops produce a chemical which is toxic to insect pests; in other words, they **contain an insect-resistant trait** (e.g. Bt). 在转基因作物中，作物产生一种对害虫有毒的化学物质，换句话说，它们含有抗虫性(如bt)。
 - **The insect pests may adapt and become able to resist the effects of the particular trait.** 昆虫可以适应并能够抵抗特定抗性基因的影响。

It is not the strongest of the species
that survive, nor the most intelligent,
but the one most responsive to
change.

Charles Darwin

并不是最强壮和最聪明的
个体能存活下来，而是最
能适应改变的个体。

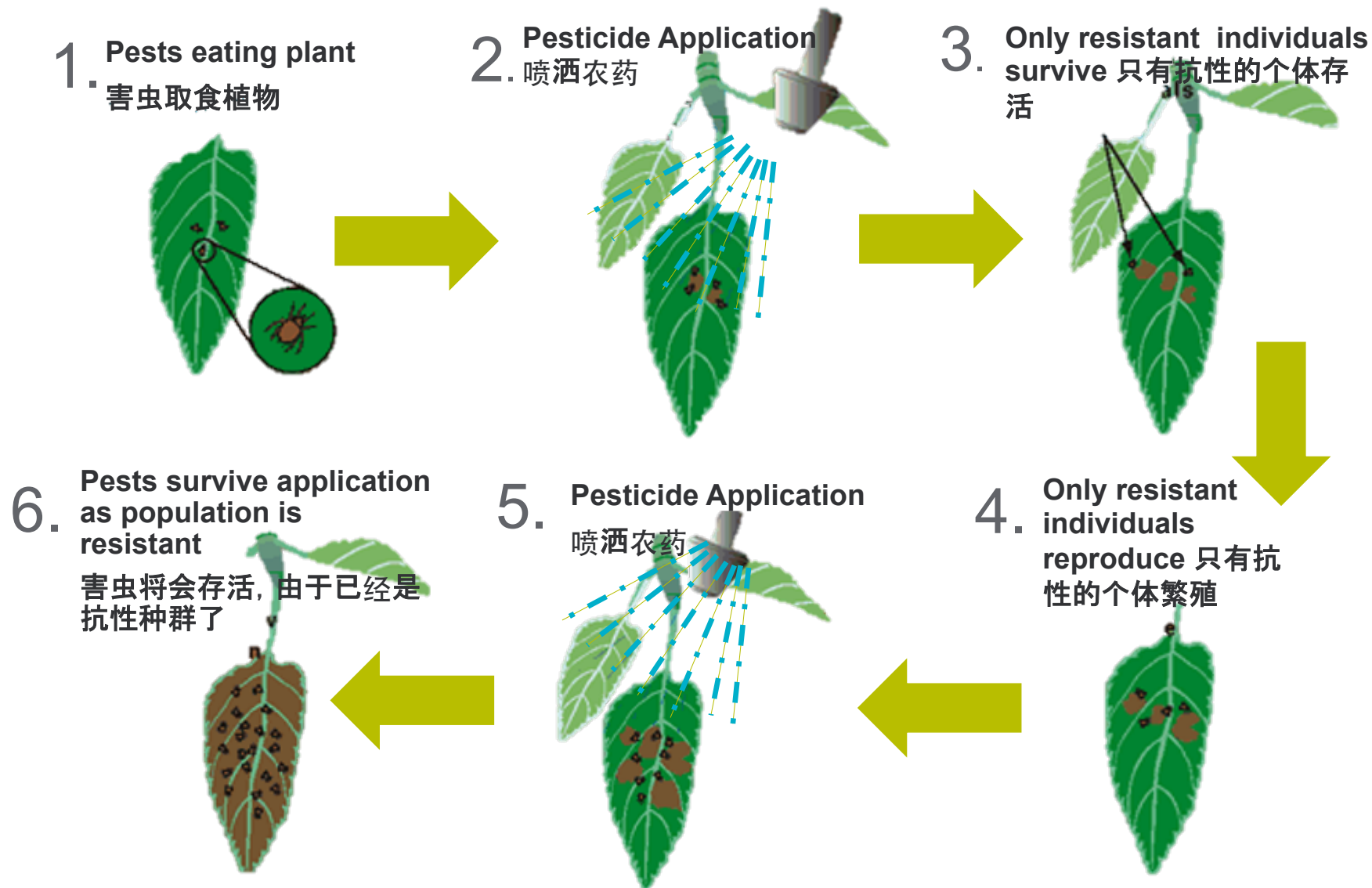
——达尔文



Evolution in action.....不断的进化

- Resistance is sometimes known as “**evolution in action**” because it can be considered a process of **natural selection**. 抗性有时候被称为“不断的进化”，因为它可以被认为是一个自然选择的过程。
- If chemicals are used to control a target organism (weed, insect, pathogen or mammal) over time **rare individuals with natural tolerance** will survive. 如果化学物质被用来控制目标有机体(杂草、昆虫、病原体或哺乳动物)，随着时间的推移，具有自然耐受能力的稀有个体将生存下来。
- The organisms which do not adapt or evolve eventually die, and only the resistant organisms can reproduce and keep the population alive. 那些不适应或进化的生物最终会死亡，只有有抵抗力的生物体才能繁殖并保持种群存活。
- After **long use of** these chemicals, **resistant populations** of the target organism will develop. 长期使用这些化学物质后，目标生物的抗性种群将发展。

How resistance develops 抗性是如何发展的



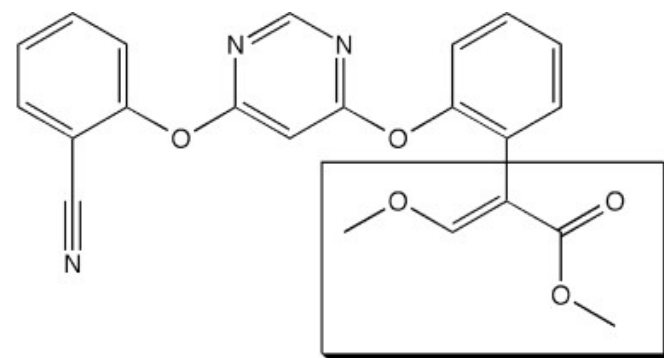
Mode-of-action and cross-resistance 作用机理和交互抗性

- Crop protection products and GM traits work by stopping an essential process in the organism 农化产品和转基因的抗性基因通过组织有机体的一个基本过程起作用

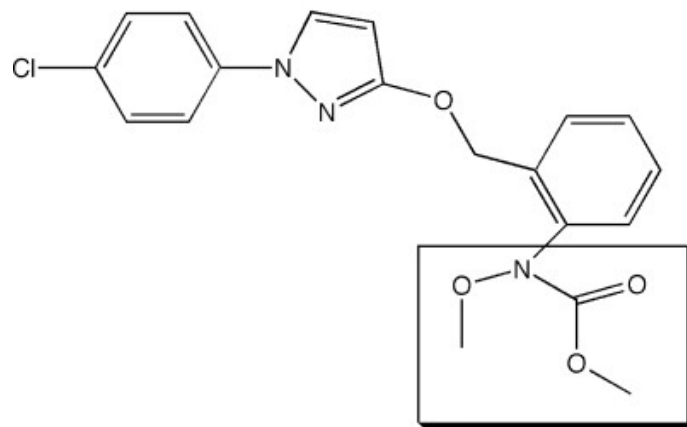
- Crop protection products or traits which affect the same process are said to have the same **mode-of-action (MoA)** 农化产品或者抗性基因影响同一个过程被认为是具有相同的作用方式
- Crop protection products with the same mode of action often have similar chemical structures (but not always) 具有相同作用方式的作物保护产品通常具有相似的化学结构（但并非总是如此）。

- Example: azoxystrobin and pyraclostrobin

- 例如：嘧菌酯、吡唑醚菌酯



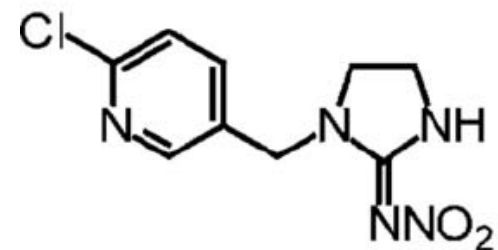
Azoxystrobin



Pyraclostrobin

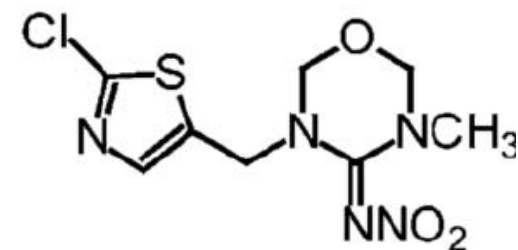
Mode-of-action and cross-resistance 作用机理和交互抗性

- Generally, an organism that develops resistance to one crop protection product will also be resistant to other crop protection products that have the same mode of action. 一般来说, 对一种农化产品产生抗性的有机体也会对其他具有相同作用方式的农化产品产生抗性。
 - This is termed **cross-resistance** 这叫做交互抗性
- Cross-resistance may also occur between **unrelated crop protection products**. This is most frequent in herbicides. 在不相关的农化产品之间也可能发生交叉抗性。这是除草剂中最常见的。



imidacloprid

吡虫啉



thiamethoxam

噻虫嗪

Game time 游戏时间

What factors influence the risk of resistance? 抗性风险受哪些因子的影响？



What factors influence the risk of resistance? 抗性风险受哪些因子的影响？

There are three factors that impact the likelihood of resistance:
抗性风险可能受这三个因素影响

1. Biochemical mode of action (target site) and mechanism of resistance 生化作用方式(靶标位点)和抗性机制
 - Resistance develops more quickly to some crop protection products, compared with others 有些农化产品的抗性产生比其他的产品快很多
2. The biology of the target organism 靶标的生物学
 - E.g. resistance develops more quickly in organisms with multiple generations and large populations 如，一年多代，数量大的有机体更容易产生抗性
3. The local environment and farmer practices 环境和农民操作
 - Resistance develops more quickly if there is intensive use of crop protection products 如果密集的使用农化产品，抗性更容易产生



How important is resistance management to agriculture? 抗性管理对农业有多重要呢？

- The UNEP has listed pesticide resistance as the **third most serious threat to global agriculture** behind soil erosion and water pollution. 环境署把农药抗性列为突然污染和水污染之后对全球农业的第三大严重威胁
- In an extreme case of resistance, **farmers are unable to control pests and entire crops are at risk of being decimated**, impacting: 在抗性的极端情况下, 农民无法控制虫害, 整个农作物面临被摧毁的危险:
 - Income and livelihood 收入和生活
 - Food security 食品安全
- When resistance starts to develop; growers will often **apply products more frequently and apply more product** than is recommended on the label or revert to **using older and more toxic chemistry**. 当抗药性刚刚发生时候, 种植者往往会喷施比标签上推荐的更多的产品, 或者使用老的, 毒性更高的化学物质。
- On a large scale, this has the potential to harm the environment. 在很大的程度上, 这有可能损害环境。



Four principles of good resistance management

好的抗性管理的4条理论

1

Assessing the resistance risk for a new active ingredient or trait
评估新活性成分或者抗性基因的抗药性风险

2

Creating **best practice guidelines** for managing the risk of resistance
创建最佳实践指南来管理抵抗风险

3

Communicating guidelines to growers, channel and stakeholders and driving implementation
与种植者、渠道和利益相关者沟通指导并推动实施

4

Monitoring the target organization population for changes in sensitivity to the product
监控靶标对产品的敏感性变化

1

Assessing the resistance risk 抗药性风险评估

- Laboratory studies 试验室研究
- Baseline sensitivity monitoring (“mapping”) 敏感基线监测(“测绘”)
- Assumption-setting 假设设定
- Market analysis 市场分析
- Computer modeling 计算机建模



2

Best practice guidelines 最好的实施指导

**Prevention is much more
effective than cure.
预防比治疗要更有效**

2

Best practice guidelines: Crop protection products 最好的实施指导：农化产品

- ✓ Using good agronomic practices such as crop rotation and integrated pest management (IPM) 使用好的农艺措施，如作物轮换和综合防治
- ✓ Applying the chemicals only when needed 需要的时候才喷施化合物
- ✓ Applying the chemicals according to the instructions on the label 按照标签的说明来喷洒化合物
- ✓ Know the product chemical class (or “Mode of Action”) 知道产品的化学类别（或者作用机理）
- ✓ Rotate between pesticides with different chemical classes or mix pesticides from different chemical classes – either as a pre-formulated product or tank mixture 轮换不同化学类别的农药，或使用不同的化学类别的混合农药——预混剂或桶混。

3

Communicating the guidelines to growers 与种植者沟通指导并推动实施

- Discussion 讨论

4

Monitoring the target population 监控靶标

- Resistance monitoring is crucial to understanding what changes may be taking place in the pest population 抗性监测对于了解害虫种群中可能发生的变化是至关重要的。
 - Sampling the pests in the field and evaluating their sensitivity 田间害虫抽样调查及其敏感性评价
 - Followed up by analyzing the pests' DNA to see if they have mutations 接着通过分析害虫的DNA来判断它们是否有突变。

Industry collaborations 行业合作

- Specialist technical groups of CropLife International: 植保协会国际有特别的技术合作组
 - HRAC (Herbicides Resistance Action Committee) 除草剂行动委员会
 - FRAC (Fungicides Resistance Action Committee) 杀菌剂行动委员会
 - IRAC (Insecticides Resistance Action Committee) 杀虫剂行动委员会
 - RRAC (Rodenticides Resistance Action Committee) 杀鼠剂行动委员会
- The role is to **promote sustainable resistance management activities**, including stewardship guidelines 其作用是促进可持续的抗药性管理活动，包括管理指导方针。
- Local cross-industry groups discuss **specific guidelines for local markets** 当地的跨行业集团讨论当地市场的具体指导方针。
 - Well-established in some countries 一些国家建立的很好
 - Currently being strengthened via CropLife Asia 目前是通过植保协会亚洲 (Asia HRAC, FRAC, IRAC being formed) (亚洲的HRAC等正在建立)

Resistance management can be an opportunity

抗性管理也可能是一个机会

- **It's not all bad news!** 都不全是坏消息
- **Effective resistance management can prolong the life of crop protection products.** 有效的抗性管理可以延长农化产品的使用寿命。
- **New products** can also play an important role in resistance management
新产品在抗性管理方面也能起到重要作用。

