Aerial application of agrochemicals in a sugarcane field.

Insecticide Resistance Action Committee

Insecticide resistance is a long standing and expanding problem for pest control worldwide. Consequently, effective insecticide resistance management (IRM) is essential in order to preserve the efficacy of modern low environmental impact insecticides. The Insecticide Resistance Action Committee (IRAC) is an international association of crop protection companies established in 1984. A key function of IRAC has been the development of the Mode of Action (MoA) classification scheme, which provides up-to-date information on the modes of action of both new and older insecticides. This scheme serves as a point of departure in developing appropriate IRM strategies for crop protection. The IRAC MoA classification scheme covers more than 25 different MoAs. Diversity of chemical use is the spice of resistance management (www.irac-online.org).

Since 2006, the sugar industry has relied on one MoA for eldana control (pyrethroid - group 3). Adequate eldana control requires up to eight repeated applications at two-weekly intervals. Given that any insect population may contain individuals with natural resistance, with repeated use of only one MoA, resistant populations might be expected to develop. However, evidence for the development of pyrethroid resistance by eldana is at present anecdotal. The possibility that eldana is in the process of developing resistance to pyrethroids will be tested under controlled conditions.

Recently two new MoAs have been registered for eldana control, oxadiazines (group 22) and diamides (group 28) in the forms of indoxacarb and rynaxypyr (also known as chlorantraniliprole) respectively. Both of these offer superior eldana control with longer residual periods.

On the down side, the diamides appear particularly prone to the development of resistance in target pests. Worldwide, the most rapid development of resistance occurred just 18 months after diamide deployment. Such is the concern over loss of this highly effective MoA that the IRAC Diamide Working Group was created in 2007 to prevent or delay the development of insect resistance to diamides.

Diamides have exhibited extremely high efficacy against many lepidopteran insect pests since this chemistry became commercially available. This insecticide class has the added benefit of very low toxicity to beneficial insects from other insect families, as well as faunal groups. Diamide insecticides function via a completely new novel mode of action by activating the ryanodine receptors in lepidopteran muscles, causing hyper-contraction and paralysis. Rynaxypyr has proven particularly effective against eldana when applied over moth peaks as it is thought that sub-lethal paralysis of moths prevents the formation of male moth aggregations (leks) and their calling to females, so providing control through mating disruption for up to two months following application. In addition to the effects on adults and larvae, the diamide and oxadiazine groups

also exhibit ovo-larvicidal activity, the ability to control neonates through the consumption of the egg case as the neonate emerges.

With the availability of three MoAs for eldana control, the sugar industry is in a position to prevent the loss of any one MoA, by following IRAC guidelines. Currently registered products are Ampligo® (diamide + pyrethroid); Steward® (oxadiazine); Coragen® (diamide) and Fastac® (pyrethroid).

TO DELAY THE DEVELOPMENT OF RESISTANCE FOUR BASIC CONDITIONS SHOULD BE ADHERED TO:

- Avoid exclusive repeated use of insecticides from the same chemical group, (indicated by the IRAC MoA Group number).
- Multiple successive applications of chemicals from the same group are acceptable if they are used to treat a single insect generation i.e. within a defined window of 60 days.
  - » Coragen®: has 60-days residual + a 60-day window = minimum four months between diamide applications. These applications can be targeted to moth peaks when greatest efficacy is expected;
  - » Ampligo® and Steward® both have 30-days residuals and can be re-applied 30-days after the first application since both applications and their residuals would then occur within the same 60 day window. Thereafter a 60-day window of diamide or oxadiazine non-use would apply.
- If a diamide was used in the final treatment before cutting a crop, a diamide should not be used for the first treatment on the next crop i.e. use an alternative in August.
- Combine with other control methods (e.g. cultural, biological, habitat management) into a full Integrated Pest Management Programme. For example, the use of refuges of genetic variation. Evolutionary theory tells us how we can slow the rate at which genes for pesticide resistance spread by providing refuges where non-resistant insects thrive. Delaying insecticide resistance is one of the additional benefits of the 'push-pull' habitat management approach to eldana control. The establishment of wetland sedges (pull plants) can serve to slow the development of resistance to insecticides in eldana. The few survivors of insecticidal treatment are more likely to mate with non-resistant moths from nearby unsprayed sedges. These matings would be more likely to take place in the sedges when the 'push' plant Melinis grass is placed in cane breaks.

RESISTANCE MANAGEMENT GUIDELINES

Incorporate IPM practices into your pest control programme.

Monitor pests. Scouting is one of the key activities in the implementation of an insecticide resistance management strategy. Monitor insect population development in fields to determine if and when control measures are warranted. After treatment, continue monitoring to assess pest populations and their control.

Focus on economic thresholds. Insecticides should be used only if insects are numerous enough to cause economic losses that exceed the cost of the insecticide plus application.

Do not reduce rates. Follow recommended timing of applications and spray volumes.

Rotate insecticide MoA groups

Avoid treating two consecutive insect generations with the same MoA (the average generation time for eldana is 60 days).

Multiple successive applications of the same MoA are acceptable if they are used to treat a single insect generation within a defined window of 60 days.

Stuart Rutherford
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SPRAY PROGRAMME

MOTH PEAK — MOTH PEAK

MONTH	AUGUST				SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH				APRIL
WEEKS	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	Harvest
PRODUCT	Fastac 200 SC		Fastac 200 SC		Coragen 200 SC								Steward 150 EC				Steward 150 EC								Coragen 200 SC								
RATE	200 ml/ha		200 ml/ha		250 ml/ha								350 ml/ha				350 ml/ha								250 ml/ha								
IRAC COMMENTS	The application of multiple sprays of the same MOA within a 60 day window is IRAC compliant.												Scout carefully through this period: The second Steward application should only be made if counts are above thresholds. The application of two sprays of the same MOA within a 60 day window is IRAC compliant.																				

MOTH PEAK — MOTH PEAK

MONTH	AUGUST				SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH				APRIL				MAY
WEEKS	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	Harvest
PRODUCT			Steward 150 EC				Ampligo 150 CS				Ampligo 150 CS				Steward 150 EC														Coragen 200 SC								
RATE			350 ml/ha				150 ml/ha				150 ml/ha				350 ml/ha														250 ml/ha								
IRAC COMMENTS							The application of multiple sprays of the same MOA within a 60 day window is IRAC compliant.								A 60 day window between the residual of the August Steward application and the November Steward application is IRAC compliant. This application could be delayed to February.																						

MOTH PEAK — MOTH PEAK

MONTH	AUGUST				SEPTEMBER				OCTOBER				NOVEMBER				DECEMBER				JANUARY				FEBRUARY				MARCH				APRIL				MAY				JUNE
WEEKS	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	Harvest
PRODUCT	Fastac 200 SC		Fastac 200 SC		Steward 150 EC				Coragen 200 SC								Steward 150 EC												Steward 150 EC				Ampligo 150 CS				Ampligo 150 CS				
RATE	200 ml/ha		200 ml/ha		350 ml/ha				250 ml/ha								350 ml/ha												350 ml/ha				150 ml/ha				150 ml/ha				
IRAC COMMENTS	The application of multiple sprays of the same MOA within a 60 day window is IRAC compliant.								A 60 day window between the residual of the September Steward application and the December Steward application is IRAC compliant.								Scout carefully through this period: The Steward application should only be made if counts are above thresholds.				A 60 day window between the residual of the December Steward application and the March Steward application is IRAC compliant.								The application of multiple sprays of the same MOA within a 60 day window is IRAC compliant.								
GENERAL COMMENTS	• Beneficial insect populations will be low, therefore low risk from pyrethroid. • Pyrethroids are more effective during cooler conditions.				• Steward has good knockdown, and effective on all stages of pest cycle. • Is a pro-insecticide - must be activated by insect esterase enzymes. Likely to counter esterase based resistance to pyrethroids.				**Moth flight peak.** The diamides in Ampligo and Coragen exert a mating disruption effect best targetted to moth peaks."				• Summer is the period in which to encourage populations of beneficials to flourish. Pyrethroids should be avoided. Steward and Coragen are less damaging to beneficials than pyrethroids. • Coragen is the most Lepidoptera-specific product of those available. Coragen and Steward are more effective in high temperature conditions. • The Steward application in December will give growers peace of mind over the Christmas shut-down. However the need for it should be established by scouting.												**Moth flight peak.** • The diamides in Ampligo and Coragen exert a mating disruption effect best targetted to moth peaks. • Ampligo could be preferred during April and May due to lower temperatures increasing the effectiveness of the pyrethroid component.								