Insecticide Resistance Action Committee

Sucking Pest WG

Imre Mezei & Colleagues,
51st IRAC International Meeting,
Philadelphia March 28-31, 2017

Antitrust Law Reminder
for all CropLife International meetings

"IRAC Committees and IRAC Members should be aware that while some activities among competitors are both legal and beneficial to the industry, **group activities of competitors are inherently suspect under the antitrust laws**.
Agreements or combinations between or among competitors need not be formal to raise questions under antitrust laws, but may include any kind of understanding, formal or informal, secretive or public, under which each of the participants can reasonably expect that another will follow a particular course of action.
All IRAC Members have a responsibility to see that topics, which may give an appearance of an agreement that would violate the antitrust laws, are not discussed during meetings, conference calls or in any other forum.
It is the responsibility of each member in the first instance to avoid raising improper subjects for discussion and the purpose of the Antitrust Guidelines is to assure that participants are aware of this obligation"
….

- **All IRAC meetings are held under anti-trust rules** and regulations.
- Regulations are developed under **guidance from CropLife** International
- All discussions should be **technical discussions and NOT commercial**.
- **Do not talk about individual products**, but active ingredient or mode of action only
- **Do not talk about prices**, marketing strategies, etc.
- **If you have any concerns – please stop the conversation** and consult with IRAC colleagues or CropLife International.
- A **copy of the anti-trust guidelines** is typically provided before each meeting/conference call.

Objective of the meeting

51st IRAC International Meeting, Philadelphia March 28-31, 2017

This was to make sure that IRAC members were aware of the past years activities early in the meeting and then be inspired to propose new impactful activities and projects for the coming year. The same format was followed in 2016, but we have attempted to shorten the time reflecting on past activities and focus on planning for the year ahead.
What do we would like to achieve as members of IRAC. What activities do we feel would be a benefit for the company and for global pest management.

1. **The development and communication of practical IRM guidelines.** We have made great progress in this area over the last few years and I understand that **IRAC's efforts to provide practical advice** have been appreciated by many who have in the past challenged IRAC's effectiveness. However, there are many agricultural, horticultural and urban environments which are challenged by insecticide resistance issues and many where our guidance would be valuable.

2. **Effective promotion of insecticide resistance management to growers and advisors**. Much of the criticism of IRAC in the past has been that its outputs have been technical in nature and focused away from growers/pesticide applicators. We have made **significant efforts to provide more grower centric materials** and we need to continue in this trend.

SP WG Activities: 2014 – 2016

Date	No. of participants	Meeting structure
17.-20.03.2014	10	F2F in RTP, USA
22.07.2014	8	Conference call
09.09.2014	9	Conference call
27.10.2014	10	Conference call
17.12.2014	7	Conference call
19.02.2015	10	Conference call
14.04.2015	9	Conference call
09.07.2015	10	Conference call
14.-17.09.2015	8 + 2	F2F Rothamsted, UK
25.11.2015	8	Conference call
23.03.2016	8	Conference call
07.04.2016	8 + 4	F2F Dublin, IRL
04.08.2016	6	Conference call
27.10.2016	7	Conference call

Participation had been constant for the past years, with active contribution from eight companies:

- ADAMA, BASF, Bayer, Cheminova, Dow, DuPont, Nufarm, Syngenta.

IRAC-Sucking Pest WG Team structure – 2016/2017

Names	Email Address	Company	Sucking Pests
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IRAC Sucking Pest WG Objectives 2016-17

Updated 7th March 2017

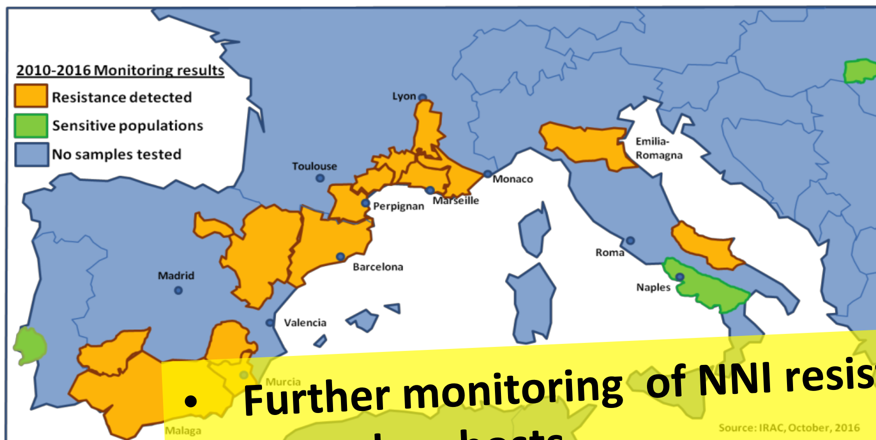
Goals	Objectives	Timeline	Status
Short term (“alert”) actions to minimise spread of resistant pests	• *Myzus persicae* Follow-up with “implementation” of IRM Guidelines in Southern EU	2016	Ongoing
	• *Bemisia tabaci* monitoring program (PROMIP/IRAC-BRA): how to design IRM strategies?	Q2 2016	Ongoing
	• update IRAC method #015	Q2 2016	Done
	• *Sitobium avenae* review last year’s alert for Mainland EU for PYR-resistance (in view of few MOAs)	2016	Done
	• *Aphis gossypii* (neonicotinoid target site resistance)	2016	Ongoing
	▪ Develop IRM recommendations for Korea as template for future use		
	▪ Finalize / review poster: globally & local Korean language version		
Prepare IRM guidelines for pests with, or at risk of developing resistance in the **mid term**	▪ *Euschistus heros*, check on MOA IRAC 01, 03, 04, with PROMIP/IRAC-BRA		
	▪ Follow up with monitoring efforts: how to design IRM strategies?	Q2 2016	Ongoing
	▪ Method validation and implementation (review vial test to IRAC approved methods)	Q3 2016	
	• *Bathycoelia distincta* Support research efforts in RSA (suspected PYR-resistance)	2016	Postponed
	• *Diaphorina citri*		
	• poster update with IRM recommendation	2016	Done
	• Validate & publish a Flush tube systemic test for IRAC Groups 23&28	Q2 2016	Ongoing
	• *Bactericera cockerelli* Activate monitoring, validate and publish a method, notably for IRAC 04	Q3 2016	Postponed
	• *Myzus persicae*		
	▪ updated IRM Guidelines for new cases (Andalusia, ESP)	2016	Done
	▪ the poster, incl. new MOA with IRAC ESP	2016	Done
	• *Bemisia tabaci (T. vaporariorum)* updated poster version, incl. new MOA	2016	Ongoing
	• Fruit fly species (pyrethroids-resistant olive fly suspected, Greece): 1. Summarize current resistance situations, 2. Exchange about methodology and 3. Pro-actively release recommendations (highlight value of current options / prevent use restrictions)	2016	Done
Prepare for future Sucking Pest problems **long term (avoidance)**	▪ *Tetranychus sp.* (mites), *Nilapavarta lugens*, bugs/stinkbugs *(Dichelops melacanthus)*		
	▪ Collect reports on monitoring studies and publications, follow up field failures	2016	Ongoing
	▪ *Aphis gossypii , Myzus persicae, M. nicotianae* (neonicotinoid target site resistance)		
	▪ Monitor complaints globally and report liaise with researchers	2016	Ongoing

Myzus persicae:
Neonicotinoid resistance management guidelines

Myzus persicae neonicotinoid resistance management guidelines for Stone Fruits in Southern Europe, IRAC SPWG, 2016

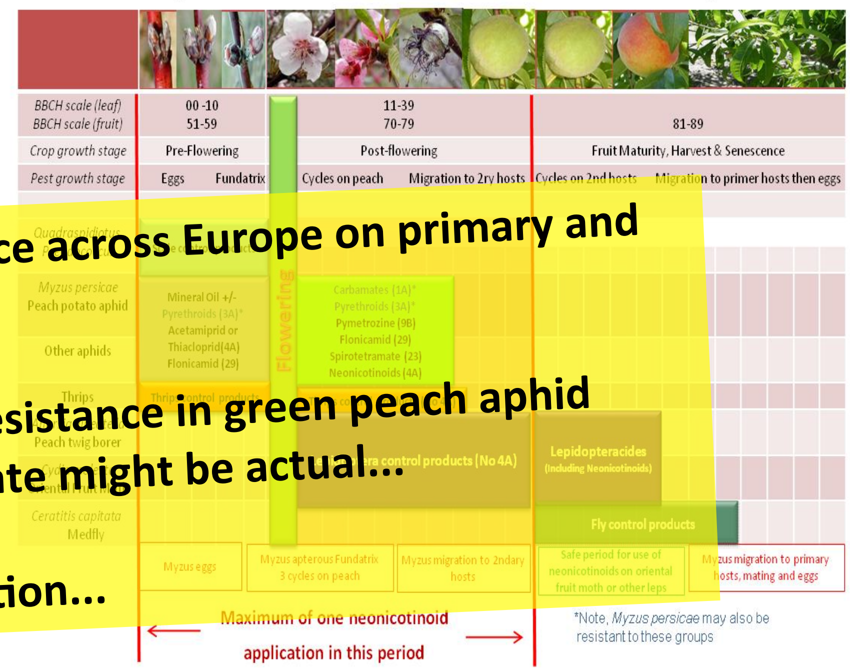
This is an update of the resistance alert and management recommendations issued in January 2013 by the IRAC Sucking Pest Working Group. The resistance is based on a target-site mutation which strongly affects neonicotinoid efficacy[1,2]. The results of surveys from 2010 to 2016 confirmed the spread and presence of neonicotinoid-resistant aphids in many of the stone fruit orchards of Southern France, Spain and Italy [3,4]. Recent findings proved the resistance also in Andalusia, Spain where the R81T mutation was found also in several vegetable crops.

Map of the region showing areas where target site resistance to neonicotinoids was detected in *Myzus persicae* collected from stone fruit orchards from 2010 to 2016.



- High interest and activity
- Guidelines are well perceived
- Spain issued their own alert and poster on MYZUPE resitance approved by IRAC SP WG and also an educational presentation

IRAC resistance management recommendations for the control of *Myzus persicae*: Example 2016: Peaches and Nectarines in Southern Europe



- **Further monitoring of NNI resistance across Europe on primary and secondary hosts...**
- **Major mechanisms of insecticide resistance in green peach aphid**
  Myzus persicae poster (2014) update might be actual...
- **Link website for 3rd party information...**

IRAC have worked with local agricultural ministry officials, and entomological experts from Spain, France, Italy and the UK, to provide the following advice for the impacted stone fruits pruducers:

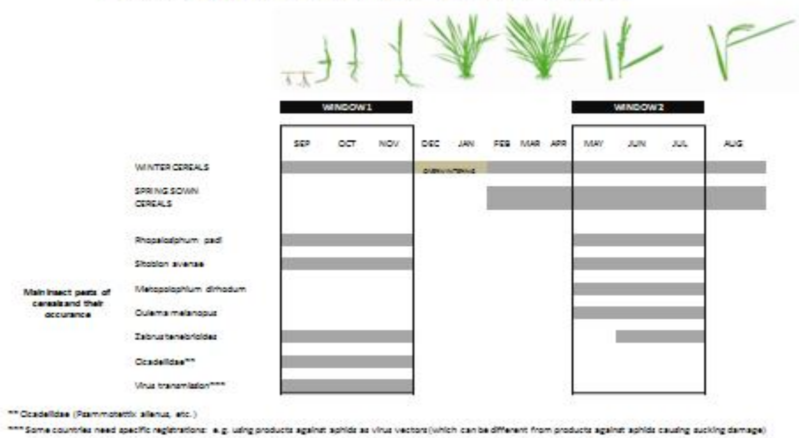
Where no loss of performance to neonicotinoids has been experienced, [illegible] one neonicotinoid application [illegible] against *Myzus persicae* to minimise the further spread and intensification of the resistance and maintain effectiveness of the neonicotinoids. Depending [illegible] and local guidelines, this single [illegible] post-flowering, but not during flowering, to fit with local IPM recommendations. (Note: Following restrictions to the neonicotinoids imidacloprid, thiamethoxam and clothianidin announced in 2013 by the European Commission, the recommended rotation programme has been modified accordingly to comply with these restrictions. See attached rotation scheme).

If a decline in neonicotinoid efficacy against *Myzus persicae* was observed during the previous seasons, it is recommended not to use this group of insecticides to prevent escalation or development of resistance. It is recommended to use insecticides with other modes of action, according to local registrations, such as products from groups 1A, 3A, 9, 23 and 29[5] as well as mineral oil to control *Myzus persicae*[6]. IRAC supports the use of any other IPM measures locally recommended, and may assist with the characterisation of resistance mechanisms in local *Myzus* populations[7].

Sitobion avenae:
IRM recommendation is available in 4 languages in EU

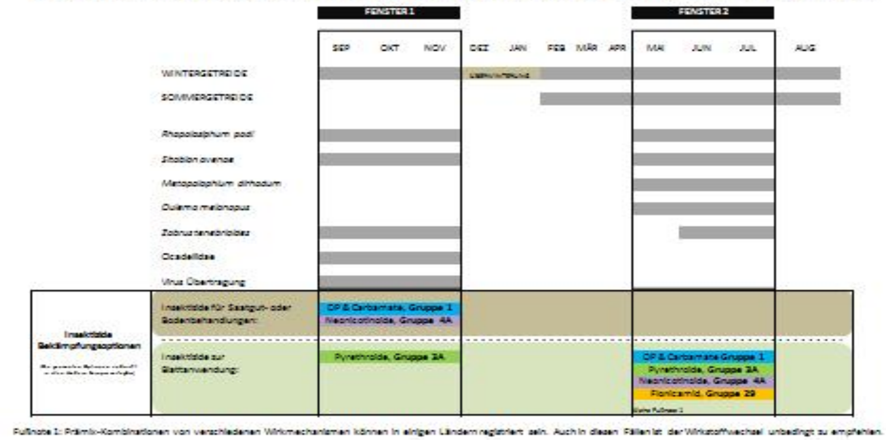
IRAC Insecticide resistance management recommendations for insect pests of cereals in Europe

Two main periods when insect pests of cereals may require insecticide treatment:
Window 1: Autumn-Winter = Protection of early growth stages of winter cereals
Window 2: Spring-Summer = Protection of mature plants and grains



IRAC Strategien und Empfehlungen zur Vermeidung von Insektizid-resistenten Schädlingen in Getreide in Europa

Es stehen nur wenige Insektizide mit unterschiedlichen Wirkungsmechanismen für die Bekämpfung von Getreideblattläusen zur Verfügung (Saatgut- oder Blattbehandlungen), mit dem Risiko, dass die gleichen Wirkstoffe hintereinander gegen die gleichen Schädlinge eingesetzt werden = Resistenzrisiko.



IRAC Recommandations de gestion de la résistance des insectes ravageurs des céréales aux insecticides en Europe

FENÊTRE 1 : Automne-Hiver

- Si un pyréthrinoïde a été utilisé durant l'été précédent pour lutter contre les pucerons, il faut si possible éviter d'employer à nouveau ...

FENÊTRE 2 : Printemps-été

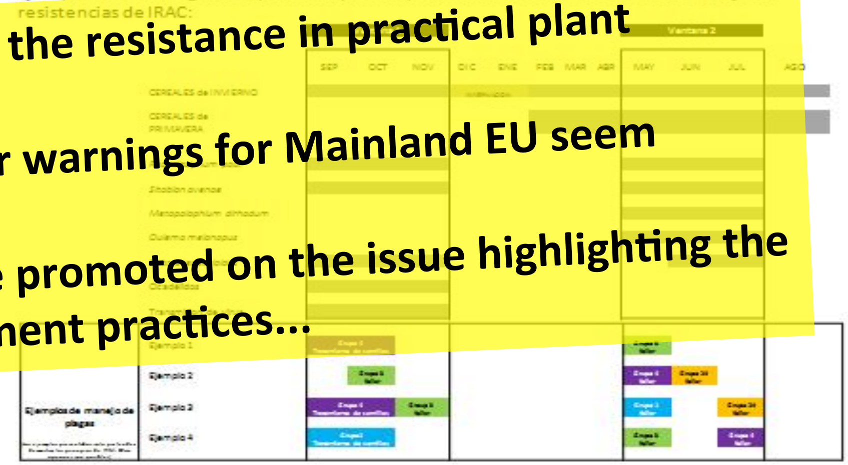
- Si plus d'un traitement insecticide est nécessaire, ne pas utiliser le même mode d'action de façon consécutive.
- Si des coléoptères phytophages sont couramment présents dans votre région, il est recommandé de réserver les traitements à base de pyréthrinoïdes contre ces ravageurs et d'utiliser des produits ... pour lutter contre les pucerons.

RECOMMANDATIONS GÉNÉRALES

- Si des pucerons des céréales résistants aux pyréthrinoïdes (*Sitobion avenae*) sont susceptibles d'être présents dans la parcelle, il est ... d'insecticides de type pyr... (Groupe 3).
- Il est recommandé de détruire les repousses de céréale (labour, désherbage) pour casser le "relais vert" qu'elles représentent entre les céréales en été et les nouveaux semis à l'automne.

IRAC Recomendaciones para Manejo de resistencias a insecticidas en plagas de cereales en Europa

Ejemplos de estrategias de aplicación que cumplen con las recomendaciones de manejo de resistencias de IRAC:



- **Re-evaluate the importance of the resistance in practical plant protection...**
- **Renewal and release of further warnings for Mainland EU seem appropriate:**
  Local farmer paper articles are promoted on the issue highlighting the IRAC recommended mamagement practices...

Aphis gossypii in Asia:
action: extending the local IRM-activities

<u>It is really difficult to get a clear insights how resistance is handled locally as no formal IRAC country teams are available...</u>

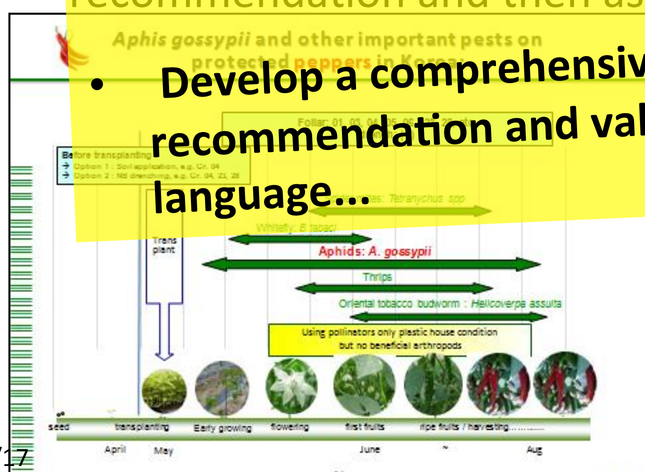
<u>Step-wise approach:</u>

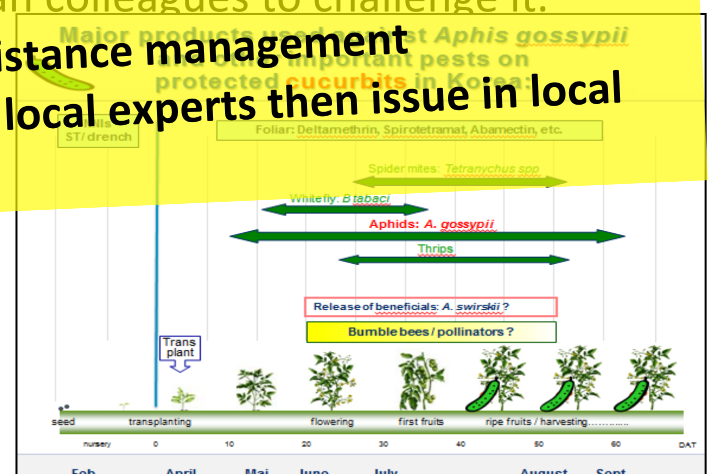
1. <u>Intensify</u> local Lepidopteran/Diamide team and <u>extent</u> to other companies

2. Focus on a most critical crops to develop IRM recommendations
   - 2 crop programs were developped but should be updated with local annual cropping and pestcycles and available pest control options.

3. With this information, we update current posters to an official IRM recommendation and then ask the Korean colleagues to challenge it.

- **Further monitoring of NNI resistance across South-East Asia is suggested...**
- **Develop a comprehensive IRAC resistance management recommendation and validate with local experts then issue in local language...**





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***Bemesia tabaci*:**
monitor susceptibility and design IRM strategies

<u>Monitoring in 2016 in Brasil:</u>

- Field monitoring in 2016 continued on adults and nymphs on 6 soyabean and 5 tomato populations. Buprofezin, pyriproxyfen, imidacloprid, spiromesifen, ciantraniliprole and thiametoxam were tested and some adult tests showed clear efficacy decrease for NNIs.

<u>Method comparison and outputs:</u>

- IRAC accepted the PROMIB best practice and adjusted IRAC method #015 => using 25 C temperature and 72 h for Group 4, and 120 h for Group 9 and 29 products incubation time.

<u>2017 Plan:</u>

- Keep monitoring
- Design a comprehensive IRM recommendation
- Establish a communication program
- Field trial program

IRM for sustainable whitefly control with special reference to *Bemisia tabaci*

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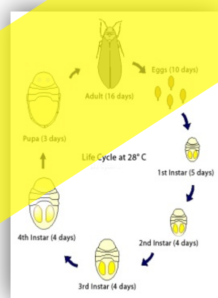
Introduction and background

Whiteflies (Homoptera: Aleyrodidae) globally comprises approx. 1500 species, but only a few of them are known and described as serious sucking pests in numerous agricultural and horticultural settings. Among them the cotton whitefly, *Bemisia tabaci* is by far the most important one, followed by the greenhouse whitefly, *Trialeurodes vaporariorum*. *B. tabaci* is known for its genetic diversity resulting in morphologically indistinguishable species rather than biotypes. The two most important phylogenetic groups of *B. tabaci* from an agricultural perspective are MEAM1 (Middle East-Asia Minor 1; also commonly known as biotype B) and MED (Mediterranean; including the commonly known biotype Q among others). *B. tabaci* causes damage to a diverse range of host plants by symplastic feeding, transmission of numerous plant viruses and indirectly by the excretion of honeydew as a substrate for sooty mold.

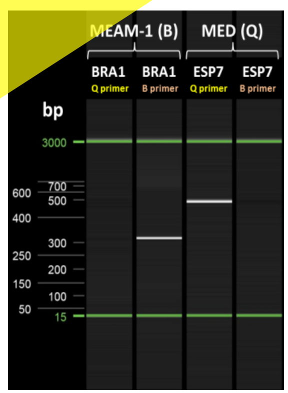
In order to keep crop infestations by *B. tabaci* under economic damage thresholds insecticide treatments are quite common, so that insecticide resistance developed against many chemical classes of insecticides. However there are also a number of biological control methods available these days which are preferably successful under greenhouse conditions rather than open field situations.

Life cycle *Bemisia tabaci*



Bemisia tabaci adults on cotton

You want to know who I am?
Please follow the procedure outlined below!



Rapid discrimination of biotypes B (MEAM-1) and Q (MED) by *mtCOI* PCR using primers specific for the B and Q biotypes of *B. tabaci*.[1]

Strain BRA1: Brazilian B-type
- PCR product only with primers specific for B type mtCOI (lane 2)

Strain ESP7: Spanish Q type
- PCR product only with primers specific for Q type mtCOI (lane 3)

Resistance mechanisms

Target-site resistance

Reduced or even no binding of the insecticide to its target-site due to mutations evolved by continuous selection[2], e.g.

- ➢ Knock-down resistance (kdr) → Pyrethroids
- ➢ Modified acetylcholinesterase → OP´s, carbamates

Metabolic resistance

Detoxification (degradation) of insecticides due to the over-expression of metabolic enzymes[3], e.g.

- ➢ Cytochrome P450 CYP6CM1 → Neonicotinoids,& pymetrozine

IRAC Group	Mode of action	Subgroup	Chemical class
1	Acetylcholinesterase inhibitors	A	Carbamates
		B	Organophosphates
3	Sodium channel modulators	A	Pyrethroids
4	nAChR competitive modulators	A	Neonicotinoids
		C	Sulfoxaflor
		D	Flupyradifurone
7	Juvenile hormone mimics	C	Pyriproxyfen
9	Effectors of chordotonal organs	B	Pymetrozine
		D	Afidopyropen
12	Inhibitors of mitochondrial ATP synthase	A	Diafenthiuron
15	Inhibitors of chitin biosynthesis, type 0	None	Benzoylureas
16	Inhibitors of chitin biosynthesis, type 1	None	Buprofezin
21	Mitochondrial complex I inhibitors	A	METI´s
23	Inhibitors of acetyl-CoA carboxylase	None	Spirotetramat
28	Ryanodine receptor modulators	None	Cyantraniliprole
29	Chord. organ modulators, undefined	None	Flonicamid
UN	Compounds of unknown MoA	None	Azadirachtin

DRAFT

Designed & produced by IRAC Sucking Pest WG, March 2017, Poster Ver. 1.0

For further information visit the IRAC website:
www.irac-online.org

Euschistus heros: Monitoring in 2016

Stink Bugs Work Group Brazil:

- It was decided to run just vial tests in 2016 season
- 12 populations were collected and tests realized
- Imidacloprid, acephate, beta-cyfluthrin, lambda-cyhalothrin and thiametoxam were tested.
- a slight shift in sensitivity for piretroids, OPs and NNIs in some populations were observed.

2017 Plan:

- Keep monitoring
- Design a comprehensive IRM recommendation
- Establish a communication program
- Plan to run field trials in the area/site where vial tests are conduct ?

Diaphorina citri Asian Citrus Psyllid – Methodology and IRM recommendation

IRM recommendation for Huanglongbing - vector control ACP was updated and the poster upload to website

Flush tube systemic method was updated and sent to field validation to Brasil

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The Asian citrus psyllid, *Diaphorina citri*: 'Insecticide Resistance Management' is the Basis of a Successful IPM Program

www.irac-online.org

Introduction and Biology

The Asian citrus psyllid (ACP), *Diaphorina citri* Kuwayama (Fig. 1a.), is the insect vector associated with the bacteria *Candidatus* Liberobacter asiaticus and *C.* L. americanus. These bacteria are suspected to be the causal agents of Huanglongbing (HLB) in Asia and America. Trees infected with the bacterial pathogen begin to show symptoms such as early fruit drop and mottled leaves anywhere from 5 months to 3 years after infection. Even during this asymptomatic period, plants can also be source of inoculum, hence the need to manage the vector even if the trees are not showing symptoms (Fig. 1b). Once the trees are infected, their production rapidly declines rendering the infected trees unproductive in a few years.

Fig. 1: (a.) Adult of *D. citri* feeding on a young orange leave. (b.) HLB-infected trees: asymptomatic (left) and symptomatic (right). Notice fruits on the ground, leaf coloration, and dieback are more prominent on the symptomatic plant.

Citrus psyllids lay their eggs on the inner-side of unfolding leaves which protect the eggs and early nymphs from adequate insecticide contact, rendering applications of non-systemic insecticides inefficient to manage nymphs. Psyllids develop through 5 nymphal instars, taking between 15 and 47 days to become adults, depending on environmental conditions. Nymphs acquire the bacteria, and the adults vector the disease to uninfected plants and to plants that are already infected. Re-infestation increases the bacterial titer in already diseased plants. Adults are considered to be the preferred target for foliar insecticide applications since they vector the bacteria. Systemic soil insecticide target nymphs and adults for the first 2 years after planting, after that period, trees are too big for the current chemistries to be effective.

Resistance to Insecticides

Various levels of insecticide susceptibility have been reported in Florida, USA (Table 1). Although the resistance ratios are not high in comparison to those of other pests, it is important to be vigilant to prevent the onset of resistance for this pest. The results in table 1 are correlated with elevated levels of detoxifying enzymes in both adults and nymphs collected in the field. However, ACP carrying HLB were shown to be more sensitive to insecticides than non-infected psyllids. In Brazil, no tolerance has been reported

Table 1: Highest Resistance Ratio 50 (RR_{50}) values observed on various wild population of *D. citri* in Florida in 2010. (Tiwari et al. 2011)

	imidacloprid	chlorpyrifos	thiamethoxam	malathion	carbaryl	spinetoram
RR_{50} adults	35X	18X	15X	5X	3X	2X
RR_{50} nymphs	4X	3X	No tested	No tested	3X	6X

Integrated ACP Management Guidelines

- Protect nursery plants under netting and use only stock that is certified as HLB-free.
- Transport infected nursery stock according to government regulations.
- Protect young and non-bearing trees with rotation of soil applied systemic insecticides (MoA 4 and MoA 28). In older trees, soil applied systemic insecticides may not work.
- Rotate soil-applied insecticides with foliar sprays of other modes of action. Rotation of different modes of action is key to resistance management.
- Management of adults during dormant season is key to maintain low populations for the rest of the year.
- Use locally defined monitoring methods and intervention thresholds to make spray decisions. Notify manufacturers of any product performance failures immediately.
- Use and protection of bio-control agents is encouraged as part of the IPM programs and to reduce the risk of insecticide resistance development.

Management Plan Example, US-related

Figure 2: Management plan example derived from USA-FL and opportunities for MoA rotation used for citrus psyllid based on plant phenology. The rotation uses various MoA which are registered and labeled for control of citrus psyllids. The rotations and number of MoA might vary according to the number of products registered in each country.

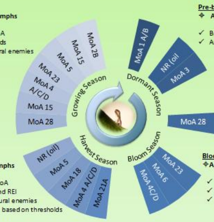


Table2: Modes of action registered for ACP management. Pest and Resistance management should be based on an appropriate rotation of these MoA

Modes of action registered for ACP management (NR: Horticultural oils)			
1 A&B: AChE Inhibitors	4: nAChR agonist	7C: Juvenile hormone analogues	21A: Mitochondrial complex 1 electron transport inhib.
2B: GABA antagonists	5: nAChR allosteric activators	15: Inhibitors of chitin biosynthesis type 0	23: Inhibitor of aCoA carboxylase
3: Sodium Channel modulator	6: Chloride channel activator	18: Ecdysone receptor agonist	28: Ryanodine receptor modulators

Relevant Literature

Poltronieri, A.S. 2013. Bases para o manejo da resistência de *Diaphorina citri* (Hemiptera: Liviidae) ao inseticida neonicotinoide imidacloprid em pomares de citros. PhD thesis. Escola Superior de Agricultura Luiz de Queiroz. Universidade de São Paulo. http://www.teses.usp.br/teses/disponiveis/11/11146/tde-16052013-162931/pt-br.php

Rogers, M.E., P.A. Stansly, L.L. Stelinski. 2012. 2012 Florida Citrus Pest Management Guide: Asian Citrus Psyllid and Citrus Leaf Miner. IFAS –University of Florida. ENY-734. http://edis.ifas.ufl.edu/in686

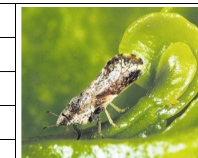
*Tiwari, S., R.S. Mann, M.E. Rogers, L.L. Stelinski. 2011. Insecticide Resistance in Field Populations of Asian Citrus Psillid in Florida. Pest Management Science 67: 1258-1268

Vanaclocha. P., H. A. Arevalo, A.B. Fraulo, G. Snyder, and P. A. Stansly. 2011. Citrus Greening Bibliographical Database. University of Florida. http://swfrec.ifas.ufl.edu/programs/entomology/hlb_db.php

* Provisional method used by IRAC to evaluate insecticide susceptibility by Asian citrus psyllid

Details:

Method:	No: xxx
Status:	Draft
Species:	*Diaphorina citri*
Species Stage	Adults/3rd instar nymphs
Product Class:	Diamides and Tetronic and Tetramic acid derivatives
Comments:	



Photograph by D. G. Hall

Description:

Materials:
Aspirators, sweep nets, vials, and coolers for insect collection; Petri dishes (9-cm and/or 14-cm. diameter); Eppendorf tubes (1.5 ml); razor blades or scalpels; Parafilm membrane; small forceps; camel hair brushes; beakers or glass jars (ca. 100-ml capacity) for test liquids; pipette for liquid or weighing balance for solid products; maximum/minimum thermometer; fine-tip (flame drawn) glass Pasteur pipette; handling cage (e.g. Fig. 1); fume hood.

Excised leaf method (Ammar et al. 2013a, 2013b, 2015):

(a) Collect Asian citrus psyllid (ACP) adults by using a sweep net or a stem-tap sample along the rows of the grove selected for sampling. [http://edis.ifas.ufl.edu/pdffiles/IN/IN86700.pdf]. The insects collected can be aspirated from a sweep net or the tap sampling tray into a vial. ACP nymphs can be collected by cutting off an entire infested flush shoot. The collected insects or plant materials are transported in an ice cooler to the laboratory. Adults should be released on citrus plants in a cage until assayed. Flush with nymphs can be maintained for several days by placing stems in water until the nymphs are assayed.

(b) Prepare appropriate number of test dilutions of products in water and then add 0.2% mineral oil (for better coverage). For lethal concentration calculation (e.g. LC_{50} or LC_{90}), at least 5-6 concentrations (including an untreated control) are required. Each concentration (and control) should be replicated 4-5 times.

(c) It is recommended that a set of healthy citrus seedlings (4-6 inch tall) be available in the laboratory for conducting baseline/monitoring studies. Top leaves with an intact petiole are excised at the bottom end of the petiole with a diagonal cut using a sharp razor blade or scalpel under water.

(d) Agitate test liquids and then dip each excised leaf for 30 s, at least 3 leaves (replications) per treatment. For 'untreated' control, dip 3 leaves in water contains only 0.2% mineral oil.

(e) Allow surface water on the leaves to dry in a fume hood before placing each leaf petiole in an Eppendorf tube (1.5 ml) filled with water; seal the top of the tube around the petiole with Parafilm membrane to reduce evaporation and prevent insects from drowning in the water.

(f) Place each leaf in Eppendorf tube in a plastic Petri dish. Attach the Eppendorf tube to the bottom half of the Petri dish, so the cut leaf is positioned in the middle of the dish (Figure 2). Younger/smaller leaves can be placed in regular size Petri dishes (9 cm diam.), whereas older/larger leaves (for adults) can be placed in larger Petri dishes (14 cm diam.) (Figure 2).

(g) Infest each dish with 20-25 adults or nymphs (but not the mix of the two) using a camel hair brush or an aspirator, and then seal the Petri dish with Parafilm. To facilitate the transfer of adults onto the treated leaves in Petri dishes, refrigerate the adults or briefly anesthetize them with carbon dioxide. Third instar nymphs should be carefully transferred using fine camel brush onto the treated leaves. Label each Petri dish with treatment, replicate number. etc.

(h) Use a handling cage (as in Fig. 1 or similar design) when adding ACP adults to the Petri dishes or when examining adults daily, so that any adult that escapes can be retrieved from inside the cage. Handling ACP nymphs does not require a handling cage (nymphs are much less agile than adults).

(i) After the insects settle to start feeding on the leaf, place the Petri dishes vertically in racks to allow insect access to either side of the leaf (Fig. 2). Adults during feeding assume a typical posture with head

Stinkbug – PYR resistance in South Africa: follow-up: progress report

Research efforts for two-spotted stinkbug *Bathycoelia distincta* in macadamia (suspected PYR-resistance) are funded by IRAC for 1st year: 2015. The contract has been finalized and signed, incl. remarks made by the SP-team.

- The sucking pest team as well as IRAC South Africa keeps an eye on the progress of the project aiming at developing IRM recommendations together with the UFS based on available information.

- In 2016 no significant progress was achieved due to drought and logistic problems.

- The contract was prolonged to 2017 with no additional budget.

- The research will be led by Devilliers Fourie, in Bloemfontein,
  window persons for IRAC are:
  - Tanya Zais & Andrew Bennett (both IRAC-RSA
  - Jan van Vuuren (established local contacts),
  - Russell Slater/Imre Mezei (IRAC /SP WG).

Olive Fruit Fly:
What's up in fruit flies?

Information collection on olive fruit flie *(Dacus oleae)* piretroid resistance was targeted in 2016 and a survey was done in major olive producing countries...

It is considered an issue only in Greece so far in Europe or even in the Globe and in the other countries there are no reports of resistance in Dacus oleae towards pyrethroids.

A paper will be published soon on this topic by Roditakis *et al* .

Next steps ???

Other topics

Potato psyllid (*Bactericera cockerelli*) methods were created (one for systemic compounds one for non-systemic compounds **) and sent for validation**

Establish cooperation between SP WG and IRAC India and IRAC Korea.

Update our pest resistance priority list...

Key resistance risks/issues affecting sap feeding pests across the Globe

Pest Species (group)	Major Crop	Major resistance issues to focus	Region/Country to focus	Global Importance
Myzus persicae	stones (veggies)	NNIs (piretroids, OPs, carbamates)	South Europe, Australia	1
Bemisia tabaci	Cotton, veggies, soybean	NNIs (piretroids, OPs, etc.)	Worldwide	1
Frankliniella occidentalis	Veggies, ornamentals, fruits	Piretroids, OPs, spinosyns, etc	US, Brazil, S. Cone, China (Worldwide)	1
Nilapavarta lugens	Rice	NNIs (pyretroids, OPs); buprofezin, pymetrozine, fiproles	Asia Pacific	2
Aphis gossypii	Cotton, veggies	NNIs (piretroids, OPs, carbamates)	Korea, US	2
Diaphorina citri	citrus	NNIs (OPs)	US, Brazil, Asia	2
Euschistus heros	Soybean	NNIs (piretroids, OPs, etc.)	Brazil, S. Cone	2
Dichelopis melacanthus	Corn	NNIs (piretroids, OPs, etc.)	Brazil, S. Cone	3
Tetranychus urticae	Cotton, veggies, ornamentals	abamectin, spiromesifen, etc.	Brazil	3
Mahanarva fimbriolata	Sugar Cane	NNIs (piretroids, OPs, etc.)	Brazil, S. Cone	3
Sitobion avenae	cereals	piretroids	North Europe	4
Stinkbugs (various spp including Nezaria)	Macadamia	pyrethroids	Southern Africa	4
Amrasca biguttula biguttula	Cotton	NNI's	India	4
Frankliniella fusca	Vegetables	NNI's	Southern US	4

IRAC Sucking Pest WG Objectives 2017-18

Updated 7th March 2017

Goals	Objectives	Timeline

Hot issues management
Actions to minimise spread of resistant pests , monitoring resistance issues
	• *Myzus persicae* Follow-up with "implementation" of IRM Guidelines across Europe
	  • Monitor vegetable crops and new areas in Europe
	  • Monitor complaints globally and report liaise with researchers
	• *Bemisia tabaci* monitoring program (PROMIP/IRAC-BRA): Design IRM strategy in Brasil.
	• *Bemisia tabaci (T. vaporariorum)* updated poster version, incl. new MOAs
	• *Sitobium avenae* Follow-up with "implementation" of IRM Guidelines across Europe
	  • Write local warnings in farmer papers
	• *Aphis gossypii* (neonicotinoid target site resistance)
	  ▪ Monitor complaints globally and report liaise with researchers
	  ▪ Develop IRM recommendations for Korea as template for future use
	  ▪ Finalize / review poster: globally & local Korean language version
		Ongoing
		
		2017
		Q2 2017
		
		Ongoing ?
		
		Ongoing
		2017

Mid term issue managemnt
Prepare IRM guidelines and test methods for pests with, or at risk of developing resistance
	▪ *Euschistus heros*, check on MOA IRAC 01, 03, 04, with PROMIP/IRAC-BRA
	  ▪ Follow up with monitoring efforts; Design IRM strategy
	  ▪ Method validation and implementation (review vial test to IRAC approved methods)
	• *Bathycoelia distincta* Support research efforts in RSA (suspected PYR-resistance)
	• *Diaphorina citri* Validate & publish a Flush tube systemic test for IRAC Groups 23&28
	• *Bactericera cockerelli* Activate monitoring, validate and publish a method, notably for IRAC 04
	• Fruit fly species (pyrethroids-resistant olive fly suspected, Greece): Exchange about methodology and Pro-actively release recommendations (highlight value of current options / prevent use restrictions)
	  • Decide on future poster needs (Liriomyza)
		
		2017
		Q3 2017 ?
		2017
		2017
		2017
		Observer ?

Prepare for future Sucking Pest problems **long term (avoidance)**	▪ *Establish a list of future problematic sucking pests, identify new tragets for IRAC SP WG work*
	  ▪ Collect reports on monitoring studies and publications, follow up field failures
	  ▪ Create educational materials, test methods, IRM recommendations if needed
	▪ *Follow the monitoring of high risk species such as Frankliniella occidenttalis* (thrips), *Tetranychus sp.* (mites), *Nilapavarta lugens* (stinkbugs)
	  ▪ Collect reports on monitoring studies and publications, follow up field failures
		Q2 2017
		Ongoing
		Ongoing
		Ongoing ?

IRAC

Sucking Pest WG Session program (Conf. call available) in "Adams", Thursday, 30th March 2017

<u>11:00-12:00:</u>

- Welcome, introduction, reminder of antitrust guidelines
- Team structure 2017, scheduling tel cons in 2017
- *Myzus persicae* – New results across Europe (Ralf)
- *Aphis gossypii* - IRM recommendation (Russel)
- *Bemisia tabaci* – Update and new poster (Ralf)
- *Bemisia tabaci* and *Euschistus heros* IRM findings and recommendations in Brazil (Pavan)

<u>12:00-12:30:</u>

-Review of new problematic pests and identify available and missing IRAC materials useful being in IRAC-web pages. List and prioritize the key resistance risks/issues and then identify if IRAC actions.

-Finalize SP WG SMART Objectives 2017

<u>13:30-15:00: Further discussion topics (if needed, otherwise members join to other WG sessions)</u>

--*Sitobion avenae* – Pyrethroid resistance in EU

--Olive fruit fly resistance to pyrethroids actions, further fruit fly species

-- RSA – Stinkbugs – PYR resistance

-- *Diaphorina citri,* Asian Citrus Psyllid – method validation news

-- *Bactericera cockerelli* – monitoring, methodology

-- Other pest issues/any other business; spider mites?, Lygus?, rice plant hoppers?
(These themes will be discussed in later webex meetings if insufficient time here)

Insecticide Resistance Action Committee

Many Thanks for Sucking Pest WG Members and Supporters

Questions or Comments ?

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