IRAC

Insecticide Resistance Action Committee

eConnection

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www.irac-online.org

About This Issue

Welcome to another IRAC eConnection Newsletter. As always we try to bring you interesting and informative articles about the work of IRAC and insecticide resistance news from around the world.

In this issue we have an overview of the European Resistance Action Groups (RAGs) and their role in resistance risk assessment as part of the EU registration process. The make-up of the groups and objectives are different to that of IRAC although there is close cooperation between the teams. We also have an update on the resistance alert and IRM recommendations issued in January 2013 by the IRAC Sucking Pest Working Group. It concerns specifically neonicotinoid resistance in green peach aphid (*Myzus persicae*) in Southern Europe. Finally our key article in this edition is an overview of the activities of the IRAC Diamide Working Group outlining the work underway to delay the onset of resistance and the steps taken to monitor and report on cases identified. The article outlines the current resistance status with details of areas and pests where resistance has been confirmed.

Remember, if you have any news or resistance topics of interest, please let us know us so that we can inform others in the IRAC Network. We hope you enjoy the issue.

Pest Information by Crop now available on the IRAC website

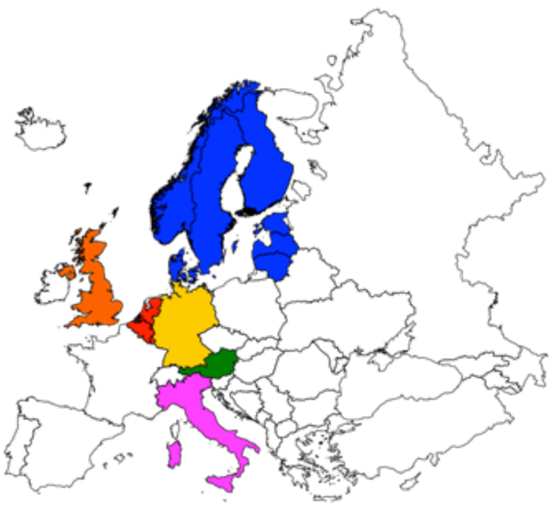
Key crops and crop groups are listed with links back to the individual Pest Profiles relevant to that crop. The area is still under development and more content will be added over time. Crop Pages can be found at: http://www.irac-online.org/crops/

National and Regional Resistance Action Groups (RAGs) in Europe

The pesticide legislation procedure in Europe includes the mandatory submission of a resistance risk assessment for registration as well as re-registration purposes. Such an assessment is considered a continuous process, i.e. starting during product development by establishing baseline susceptibility measures for resistance monitoring purposes, and continuing with the definition of appropriate (regional) resistance management strategies and the implementation of monitoring programs throughout the commercial use of an active ingredient. Guidance on the entire process is provided by a Standard (PP 1/213(3)) developed by the European and Mediterranean Plant Protection Organisation (EPPO) in collaboration with all stakeholders in 1999. The standard describes how the resistance risk to crop protection products should be assessed in the context of official (re)registration of such products. The last revision of the Standard PP 1/213(3) was published in 2012 (www.eppo.int).

After the introduction of the Standard several Resistance Action Groups (RAGs) were established in many countries and regions (Figure 1), covering fungicide, herbicide and insecticide resistance either within single (e.g. NORBARAG) or even separate groups (e.g. IRAG UK). These RAGs are usually not chaired by technical industry representatives but regulatory authorities and/or university advisors with a strong technical background in insecticide resistance. However, RAG members include governmental and registration authorities, university researchers, advisors and industry representatives. Six different Insecticide RAGs covering 14 European countries have been established over the past years.

The RAGs provide an independent forum for the exchange and interpretation of information on insecticide resistance.



National/Regional Resistance Action Groups (RAGs) in Europe

- Nordics Baltics RAG (NORBARAG)
- German RAG (ECPR-I)
- BeNeLux RAG
- UK RAG (Insecticide RAG UK)
- Austrian RAG
- Italian RAG (GIRIF)

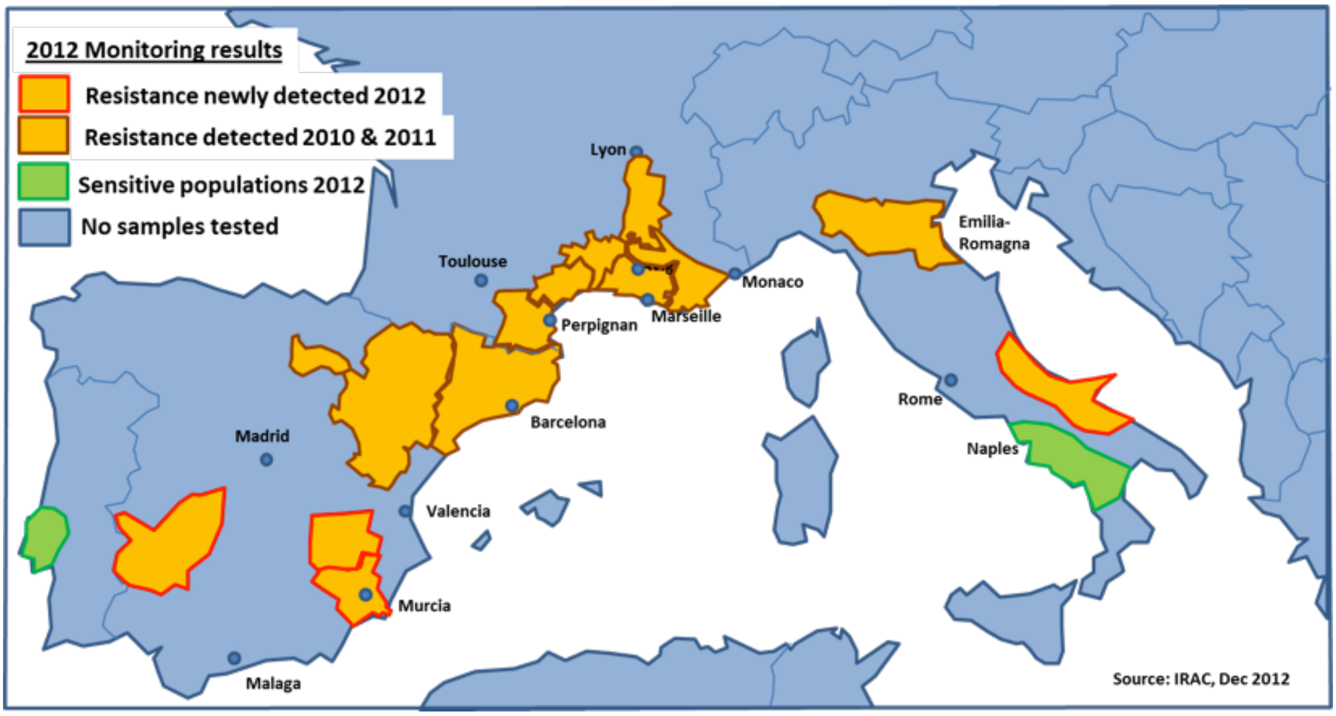
Figure 1: European RAG landscape

Most of the RAGs have developed their own website including lots of information regarding their objectives and scope. Most of the websites can be accessed via the EPPO website at http://www.eppo.int/PPPRODUCTS/resistance/resistance.htm.

Myzus Persicae Neonicotinoid Resistance Management Guidelines for Stone Fruits in Southern Europe, IRAC Sucking Pest Working Groups, 2014

This is an update of the resistance alert and management recommendations issued in January 2013 by the IRAC Sucking Pest Working Group. It concerns specifically the appearance of neonicotinoid resistance in green peach aphid (*Myzus persicae*) in the peach orchards of southern France and north-eastern Spain and Northern Italy in 2010. The resistance is based on a target-site mutation which strongly affects neonicotinoid efficacy[1,2]. The results of surveys from 2010 to 2012 confirmed the spread and presence of neonicotinoid-resistant aphids in many of the stone fruit orchards of southern France, Spain and Italy [3,4].

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 2012. No reports from new regions have been received to date in 2013.



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 2014 season in stone fruits, notably peaches:

Where no loss of performance to neonicotinoids has been experienced, it is recommended to use a maximum of one neonicotinoid application per crop cycle against *Myzus persicae* to minimise the further spread and intensification of the resistance and maintain effectiveness of the neonicotinoids. Depending on crop and country and local guidelines, this single spray may be pre-flowering or post-flowering, to fit with local label 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)

It is recommended that growers that have experienced a decline in activity to neonicotinoids in past seasons do not continue to use this group of insecticides as a preventative measure to halt the spread of resistance, and use insecticides with other modes of action, according to local registrations, such as products from groups 1A, 3A, 9B, 9C, 23 [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].

Acknowledgements:

Many thanks to representatives of Rothamsted Research International, Università Cattolica del Sacro Cuore - Piacenza campus, Italy, University of Cartagena, Spain, Chamber of Agriculture in Catalunya and Aragon in Spain and the IRAC Spain Sucking Pest Working Group for inputs into these IRM recommendations.

References:

[1] Bass et al. BMC Neuroscience 2011, 12:51 Mutation of a nicotinic acetylcholine receptor beta subunit is associated with resistance to neonicotinoid insecticides in the aphid *Myzus persicae*

[2] Puinean et al Pest Manag Sci (2012), Society of Chemical Industry, Development of a high-throughput real-time PCR assay for the detection of the R81T mutation in the nicotinic acetylcholine receptor of neonicotinoid-resistant *Myzus persicae*.

[3] Slater et al, Pest Manag Sci 2012; 68: 634–638, Society of Chemical Industry, Identifying the presence of neonicotinoid resistant peach-potato aphid (Myzus persicae) in the peach-growing regions of southern France and northern Spain

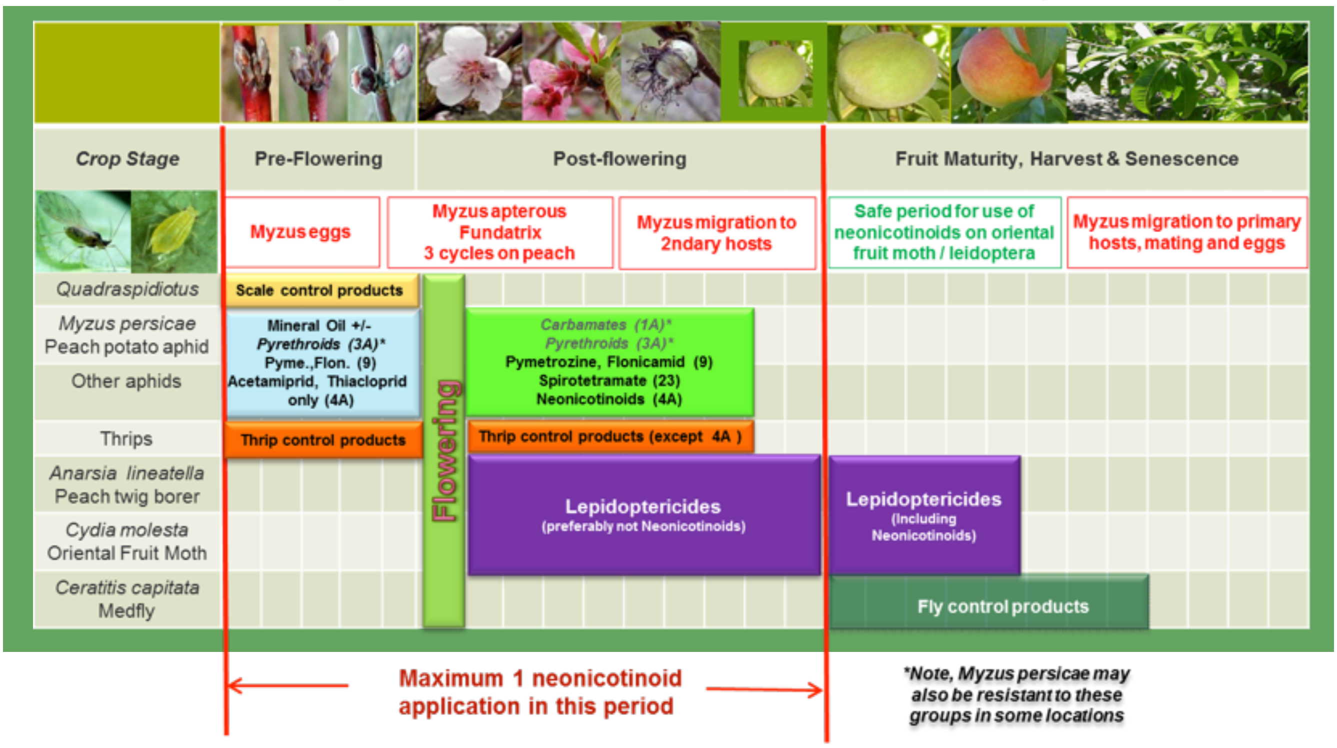
[4] Panini et al, Pest Manag Sci (2013), Society of Chemical Industry, Detecting the presence of target-site resistance to neonicotinoids and pyrethroids in Italian populations of Myzus persicae

[5] See IRAC guidelines on *Myzus persicae* resistance management on the IRAC website

[6] Consult local advisors for advice on which aphicides are affected by resistance in your locality.

[7] Contact IRAC Sucking Pest Working Group or IRAC Spain on www.irac-online.org

IRAC management recommendations for neonicotinoid resistant Myzus persicae: Example 2014: Peaches, Nectarines in Southern Europe



Diamide Insecticide Resistance Update: February, 2014

The IRAC Diamide Working Group promotes sustainable use of all insecticides through industry education and implementation of IRM disciplines and strategies. The main objective of the Diamide team is to maintain the longevity of all crop protection products available to growers by preventing or delaying the development of resistance to insect pests. The IRAC Diamide team has developed IRM strategies for the key diamide markets that are implemented by country inter-company teams working with key industry influencers. Tracking and understanding the susceptibility of insect pest populations to diamides is critical for pest control communications, IRM training, and implementation of optimal rotational strategies. This is done through the coordination of susceptibility monitoring assays in crop markets where diamide use is high as well as follow-up on communications from company field reps, industry personnel, and growers.

Comments, reports, and complaints of unsatisfactory field performance for any crop protection product are common. However, determining that the cause is due to growing insect tolerance is best determined by conducting laboratory-based susceptibility bioassays. One of the first indicators of early onset of insect resistance to diamide products is reduced residual control. Communications of this type, which sometimes are not associated with resistance, as well as more serious performance complaints are generally still considered by the Diamide Working Group as a “yellow flag” until further investigated. The documentation of an insect population resistant to diamide chemistry most often occurs when laboratory insect bioassay data aligns with field performance failures. Bioassay data from the suspicious population are compared to existing baseline data and diagnostic dose thresholds. If neither is available, then field or laboratory development data is used for comparison. The results of these relative comparisons are combined with the collective experiences and observations from company field experts to render a decision. In addition, there may be situations where field failures are so extensive and insect control by diamide products so dramatically poor that diamide resistance can be claimed with no bioassay or previously acquired comparative baseline data. Regardless of the process, diamide resistant cases are differentiated as “red flags” requiring immediate grower and industry communication.

All diamide products in the market today represent numerous solo and pre-mixture formulations containing the active ingredients flubendiamide, chlorantraniliprole, and cyantraniliprole. Flubendiamide, the first diamide insecticidal compound, was discovered by Nihon Nohyaku and co-developed with Bayer and other distributors is a phthalic diamide and became available for large scale crop protection use in approximately 2008. DuPont discovered chlorantraniliprole and cyantraniliprole and partnered with Syngenta to commercialise both products in 2009 and 2013 respectively. These two actives share very similar chemistry and are called anthranilic diamides. Testing to date indicates that insect populations resistant to any one of the diamide products are cross-resistant to all the other diamide actives. The level of relative activity by resistant individuals may vary among the three actives but ultimately the result is inadequate insect control. With the forecast of additional manufacturers competitively selling multiple brands of different diamide actives over the next five to seven years, collaboration among diamide companies, industry influencers, and growers is imperative to protect this valuable chemistry.

Table 1 below shows the current status of insect populations resistant to diamide chemistry around the world based on the most up-to-date information available to the IRAC Global Diamide Working Group. Most obvious is how quickly and broadly diamondback moth (DBM) populations in the tropics responded to repeated applications of diamides. Most crucifer producers in Asia Pacific have few effective rotation partners to control lepidopteran pests. The paucity of DBM control products combined with the very effective diamides created a scenario often seen in agriculture where growers significantly overused a single mode of action chemistry. The result was rapid development of resistant DBM populations in 11 countries. DBM resistance to diamides occurred within 18 months after launch of flubendiamide in Bang Bua Thong, Thailand, 2009. The following year, DBM resistance to all diamides was observed in Cebu, Philippines. In 2011 it was reported in Taiwan, India, and in the Guangzhou vegetable production area of Southeast China. During the following years DBM resistance spread throughout other parts of Asia and has also been documented in Brazil and the United States (Mississippi).

Table 1: Diamide Resistance Status and Chronology: February, 2014

Country	Location	Insect	Crop	Date Confirmed/ Observed
Sites where resistance was confirmed by bioassay				
Philippines	Cebu	Plutella xylostella	Crucifers	2009
Thailand	BangBuaThong	Plutella xylostella	Crucifers	2009
Brazil	NE Brazil, Ceara	Plutella xylostella	Crucifers	2011
China	Guangdong	Plutella xylostella	Crucifers	2011
India	Bangalore	Plutella xylostella	Cabbage	2011
Indonesia	East Java, Brebes	Spodoptera exigua	Shallots	2011
Taiwan	Puyen & Xihu, Changhwa	Plutella xylostella	Crucifers	2011
Indonesia	West Java	Scirpophaga incertulus	Rice	2012
Mexico	Tamaulipas State	Liriomyza spp.	Pepper	2012
USA	Florida, Immokalee	Liromyza trifolli	Tomato	2012
China	Hubei	Chilo supressalis	Rice	2013
Japan	Kyushu	Plutella xylostella	Crucifers	2013
USA	Washington State	Choristoneura rosaceana	Apple	2013
USA	Mississippi	Plutella xylostella	Crucifers	2013
Sites where observations were made that diamide products were not effective				
India	Meerut, Undra Pradesh	Leucinodes sp.	Eggplant	2011
Malaysia	Cameroon Highlands, Jahore	Plutella xylostella	Crucifers	2011
Philippines	Luzon	Leucinodes spp.	Eggplant	2011
Indonesia	Pergalengan, Sulawesi	Plutella xylostella	Crucifers	2012
Vietnam	Hanoi	Plutella xylostella	Crucifers	2012

By 2012, additional species of insects other than DBM began developing resistance. Controlling *Spodoptera exigua* in shallots requires multiple sprays per season and diamide overuse resulted in resistance in Indonesia. Rice production in Indonesia and China is highly dependent on rice stem borer control. Over-dependence on diamides has produced resistant *Scirpophaga* (yellow stem borer) and *Chilo* (striped stem borer) populations. Certainly, rice stem borer populations in other rice producing Asian countries are also at risk. Chlorantraniliprole-based products are very effective on *Liriomyza* leafminers. Lack of rotation partners caused wide-spread resistance in the pepper production area of Tamaulipas, Mexico and misuse in Florida, USA tomato production has revealed very early signs of impending tolerance. Eggplant production in the Philippines and India is normally a long growing season which requires many sprays to control the *Leucinodes* fruit borer. Inadequate product rotation and over-dependence on diamide chemistry produced diamide resistant populations at these sites in 2011.

Despite the list of locations shown in Table 1, resistant populations in most countries are localised and many crop production areas still maintain susceptible populations. Significant resistant management efforts by IRAC and industry experts continue in major insecticide markets around the world. Preventing resistance still remains a less daunting task vs managing resistance. Insect monitoring, early detection of diamide tolerance, and continued training of growers on proper rotation of different mode of action chemistries remain critical objectives of IRAC and the representative companies. The IRAC team requests your help in communicating to them observations of perceived diamide resistance or inappropriate IRM recommendations by company or trade experts. Insect resistance affects everyone in the industry, thus insecticide resistance management must be practiced by everyone in the industry.

IRAC News Snippets

★ Some changes in the leadership of the IRAC WGs. Frank Wessels (Dow Agroscience) takes over from Tatjana Sikuljak (BASF) as the new leader of the IRAC Methods WG and Gérald Huart (Makhteshim Agan) takes over the leadership of the Coleoptera WG from Russell Slater (Syngenta).

★ The next IRAC International meeting will be held at Research Triangle Park, North Carolina, March 17-20, 2014. The meeting is open to all IRAC company members. IRAC was formed in 1984 and 2014 sees the group celebrate 30 years of working in the field of insecticide resistance.

Conferences & Symposia (2014)

★ 4th Intl. Conference on Advances in Biotechnology, Dubai, March 10-11

★ 5th World Congress on Biotechnology, Valencia, Spain June 25-27

★ 7th Intl. Symposium Molecular Insect Science, Amsterdam, July 13-16

★ 8th Intl. Conference on Urban Pests, Zurich, Switzerland, July 20-23

★ 10th European Congress of Entomology, University of York, UK, August 3-8

★ 13th IUPAC Intl. Congress Pesticide Chemistry, San Francisco, August 10-14

★ Entomology 2014, 62nd ESA Annual Meeting, Portland, Oregon, Nov. 16-19

Links to the websites for the conferences and symposia can be found on the IRAC Events Page at http://www.irac-online.org/events/

Feedback

The eConnection is prepared by the IRAC International Communication & Education Working Group and supported by the 13 member companies of the IRAC Executive. If you have information for inclusion in the next issue of eConnection or feedback on this issue please email aporter@intraspin.com

Disclaimer

The Insecticide Resistance Action Committee (IRAC) is a specialist technical group of CropLife. Information presented in this newsletter is accurate to the best of our knowledge but IRAC and 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.

FURTHER INFORMATION

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