Insecticide & Acaricide Resistance Monitoring

Harmonisation and Coordination of Susceptibility Bioassay Methods

Insecticide Resistance Action Committee

www.irac-online.org

Importance of Susceptibility Testing

One of the important factors governing the management of insecticide and acaricide use is the availability of sound baseline and monitoring data on the susceptibility of the target pest to the toxicant. Baseline data can be defined as data obtained from a strain with no selection history by the toxicant or toxicants with the same or related site of action showing cross resistance.

Currently a wide range of bioassay and biochemical tests are employed but unfortunately the results from different methods may not be comparable since they measure different parameters which can lead to difficulties over the interpretation of monitoring data.

IRAC has addressed this issue by establishing a Methods Working Group which evaluates and recommends a range of bioassay techniques for pest species of economic importance.

The goals of the team are:

- To establish a single contact point for researchers to gain information on how to conduct insecticide resistance bioassays
- To provide IRAC approved methods, so that data generated by independent researchers can be directly compared

To be able to continue providing additional methods we would like to encourage you to submit your testing methods to us.

Choice of Method & Limitations

Changes in insect and mite susceptibility to toxicants can take various forms, which often influences the sensitivity of given bioassay techniques. Because tests may measure different parameters, a single test method is unlikely to provide a complete picture of the susceptibility of a given population.

The IRAC recommended bioassays were chosen as being:

- Reliable and reproducible under field usage allowing data comparisons
- Simple and easy to perform using a minimum of resources
- Consistent in distinguishing between susceptible and resistant phenotypes
- Relevant as far as possible to field performance of products
- Useful where possible for a range of toxicant groups.

The tests are specific to particular life-history stages and can only detect changes in susceptibility expressed in that stage. They can only be used with confidence for toxicants which have been validated in the development of the methodology. As susceptibility testing often involves rearing the insect pest for one or more generations in laboratory or glasshouse conditions, results from the tests may vary with the generation of pest tested, the sex/age/condition (including disease) of these organisms and the test holding conditions. These should be standardized as far as possible.

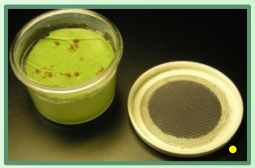
Sampling, Test Design & Analysis

Sampling Procedures

It is important that samples used in the tests are truly representative of the population, thus sampling bias must be rigorously avoided. Consideration should be given to the crop or host plant sampled, the time and frequency of sampling, the crop-treatment history, the number, age, sex and life stage of organisms collected and the number, size and location of sampling areas. It must be ensured that test organisms are not the offspring of only one or a few females which can often be a problem with laboratory rearing.

Experimental Design & Analysis

- The choice of a susceptible baseline strain is critical in obtaining meaningful data as many laboratory strains are artificially susceptible compared with field populations.
- Generally, the use of commercial formulation of the test compound is preferred to the use of technical material.
- The choice between using a single discriminating dose or a range of doses depends on the objective of the test:
  - → If the objective is to detect a large change in susceptibility in a small portion of the population, then a single discriminating dose is more appropriate. This should be selected as a dose which gives complete kill or high mortality of a susceptible population but zero or low mortality of a homogeneous resistant population.
  - → If small changes in susceptibility are suspected or there is a range of resistance phenotypes already present in the population, the use of more than one dose is preferred. The choice of doses will depend on the range of resistance factors expressed. However, it is important to remember that probit analysis (LC/LD) may be invalid if the model indicates a significant heterogeneity (Chi-square test).
  - → Results should be recorded in terms of percentage mortality and corrected for mortality in the untreated control using Abbott's formula. A standard form is available on the IRAC website.
- Results from susceptibility tests will not always relate directly to field performance due to complex interaction of factors including environmental conditions, application equipment and pest pressure, in addition to the susceptibility of the population to be controlled. Results from the tests do, however, give an indication of the potential for field control failure due to a change in susceptibility of the pest.



IRAC Recommended Methods

No	Species	Stage
001	*Myzus persicae*	A
002	*Psylla spp.*	All
003	*Panonychus ulmi* *Tetranychus spp.*	E
004	*Panonychus ulmi* *Tetranychus spp.*	A
005	*Nilaparvata lugens* *Nephotettix cincticeps*	A
006	Stored Product Beetles	All
007	Leaf eating Coleoptera & Lepidoptera	L
008	*Bemisia tabaci*	A
009	*Leucoptera scitella* *Lithocolletis blancardella*	E+L
010	*Frankliniella occidentalis*	A
011	*Meligethes aenus*	A
012	*Panonychus ulmi*	A
013	*Panonychus ulmi*	A

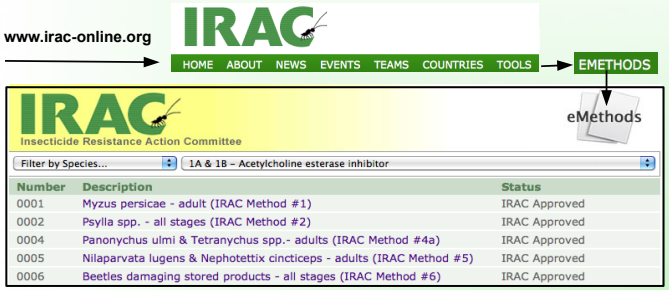
No	Species	Stage
013	*Panonychus ulmi*	A
014	*Frankliniella occidentalis*	L
015	*Trialeurodes vaporariorum* *Bemisia tabaci*	A
016	*Trialeurodes vaporariorum* *Bemisia tabaci*	E+N
017	*Cydia pomonella*	L
018	*Plutella xylostella*	L
019	Aphid	A+N
020	*Spodoptera, Helicoverpa,* *Heliothis spp.*	L
021	*Meligethes aenus*	A
022	*Tuta absoluta*	L
023	*Myzus persicae*	N
024	*Aphis gosypii*	N
025	*Meligethes aenus*	A
026	*Musca domestica*	A

Life Stages: A – Adult, L – Larvae, N – Nymph, E – Eggs

Note: Biotech Method 1 is available for susceptability testing on maize feeding Lepidoptera reared on artificial diets

IRAC eMethods Database

IRAC eMethods is a database, searchable by species and MoA, of IRAC recommended methods and those described by researchers but not evaluated or approved by IRAC. The example below is an extract from a search by MoA.



Designed & produced by the IRAC Methods Working Group. June 2011, Version 1
For further information visit the IRAC website: www.irac-online.org
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