SIXTH FRAMEWORK PROGRAMME

THEMATIC PRIORITY 5

FOOD QUALITY AND SAFETY

ResistVir

Co-ordination of Research on genetic resistance to plant Pathogenic Virus, and their Vectors in European Crops

Project number: FOOD-CT-2005-006961

Co-ordination Action

Deliverable 22 - Report from expert group 5: Interference with vector transmission

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PU public	**PU**
PP Restricted to other programme participants (including the Commission Services)	
RE Restricted to a group specified by the consortium (including the Commission services)	
CO Confidential, only for members of the consortium (including the Commission services)	

Meeting: Helsinki, Friday 7th July 2006

Attendants:

Juan Jose Lopez-Moya (chair)	IBMB-CSIC, Spain	jlmgmy@ibmb.csic.es
Claude Bragard (representing also Henri Maraite)	UCL, Belgium	maraite@fymy.ucl.ac.be, bragard@fymy.ucl.ac.be
Piero Caciagli	CNR, Italy	p.caciagli@ivv.cnr.it
Artur Kryszczuk	IHAR, Poland	a.kryszczuk@ihar.edu.pl
Ioannis Manoussopoulos	NAGREF, Greece	inmiz@nagref.gr
Thomas Thieme	BTL, Germany	tt@biotestlab.de
Lesley Torrance	SCRI, UK	ltorra@scri.ac.uk

The group meeting also included the presence of several observers from the ResistVir consortium.

- **Goals and activities of the Expert Group on "Interference with vector transmission"**

According to the Technical annex of the project, the Expert Groups (EGs) are intended to discuss 'hot topics' in research towards developing control strategies (especially resistance) for plant pathogenic viruses/vectors.

The description of the proposed main goals includes the following points:

- Identification of gaps in the current research

- Discussion and exchange of information and know-how

To achieve these goals, the following activities have been considered in the project:

- Decission of subject of discussion in February 2006 at Alicante.

- Discuss and progress assessment in July 2006 at Helsinki

These activities will produce a Deliverable, described as:

D22 Report from expert groups deliberations (Task 3.2, Month 20, Responsible partner: **IHAR**).

The present document has been drafted after fulfilling the two mentioned activities, with participation of all EG-5 members, and hence constitutes the corresponding deliverable.

Report of ResistVir Expert Group 5 deliverations on the topic "Interference with vector transmission"

Date of preparation: July 2006

Authors (alphabetic order): Bragard, C., Caciagli, P., Kryszczuk, A., Lopez-Moya, J.J., Manoussopoulos, I., Maraite, H., Thieme, T., Torrance, L.

▪ Introduction

The members of the ResistVir project Expert Group 5 (see technical annex) have meet formally twice: the first time in Alicante, Spain (February 2006), and the second time in Helsinki, Finland (July 2006). During these activities, as well as through e-mail contacts, they have fulfilled the goals intended in the project, which includes the identification of gaps in the current research, and the discussion and exchange of information and know-how on the topic "Interference with vector transmission".

▪ Antecedents and State of the Art

Viruses are important plant pathogens which in most cases require vector organisms to surpass host defense barriers and spread in Nature. A vector of a plant virus is an organism able to acquire the virus from an infected host and deliver it to a different host plant where the virus can iniciate a new infection. This process is known as vector transmission, and it depends on specific features of the virus, the vector and the host involved. Occasionally the vectors are considered pests or pathogenic organisms, although in many cases their importance is due to their vectoring capacities to disseminate viral diseases.

The main groups of plant virus vectors can be classified as follows:

1.- Arthropods

- 1.1.- Aphids
- 1.2.- Whiteflies
- 1.3.- Leafhoppers
- 1.4.- Others: thrips, beetles, mites…

2.- Soil-borne virus diseases

- 2.1.- Nematodes
- 2.2.- Plasmodiophorids
- 2.3.- Others

▪ Current control strategies

Since vector organisms are essential for dissemination of most virus-caused diseases, considerable efforts have been pursued to control their ability to transmit viruses.

The following list mentions the most used strategies currently in use:

1.- Cultural practices

- 1.1.- Modification of crop periods (sowing dates...). When possible, it is useful to uncouple crop presence in field from peak periods of vectors activity.
- 1.2.- Confinment measures, applicable mainly for protected crops in greenhouses, plastic covers...
- 1.3.- Others: photoselective barriers of UV-absorbing films, trap crops...

2.- Agrochemicals.

- 2.1.- Insecticides and other pesticides. Direct action aimed to kill vector organisms. There is a clear tendency to limit their abusive use.
- 2.2.- Desinfection of soil and substrates. In many cases, highly toxic products are required, for instance methyl bromide. Regulations also tend to reduce their use to diminish impact on the enviroment.
- 2.3.- Repelents and others.

3.- Integrated pest management strategies:

- 3.1.- Bio-control strategies (natural enemies, parasitoids...)
- 3.2.- Monitoring for vectors and forecasting

4.- Breeding resistance traits against vectors/transmission.

- 4.1.- Use of available genes: Vat (resistance to aphid transmission in melon), Mi (resistance to aphids, nematodes and whiteflies in tomato), AKR (resistance to aphids in Medicago truncatula)
- 4.2.- Other less characterized resistances

Although effectiveness is highly variable, in general terms the available strategies are considered insuficient. Commonly a combinations of control measures is required, rising costs to levels that might compromise the viability of the crop. Despite the intensive use of agrochemical, in most ocassions they are not totally effective to avoid virus spread, and even can result counterproductive because treatments might boost mobility of vectors, a fact that can also apply to resistance and other strategies.

To summarize, there is a clear need of innovative control measures, effective and more environmental friendly.

▪ Gaps

Research on vectors of plant viruses shows an important numbers of gaps and deficiencies. Here we mention some of the most important drawbacks and failings affecting the discipline:

1.- Basic knowledge is still required in many aspects, such as:

- Mechanisms of transmission
- Dinamics of virus appeareance-disappereance (epidemiology)
- Identification of vectors, with updated/accessible knowledge on taxonomical issues
- Development of general methods of quantification of transmission efficiency and characterization of other aspects of the transmission processes.

2.- Effects of climate changes (global warming) and other alterations of the current situation regarding vector populations and virus problems. Emerging virus diseases spread by (new/old) vectors in a changing enviroment are frequently reported. The impact of migrations of vectors and other modifications of the environment are rarely studied.

3.- Unexpected and unforesen problems lack scientific views on effects caused by modification of control strategies or application of new measures. Careful considerations of epidemiological aspects of virus dissemination caused by vectors would be required before implementation of control strategies. Modelling on changing scenarios is missing.

4.- General strategies for identification of resistance genes acting on transmission have not been defined, with only one case reported of a genetic trait directly involved in the transmission process (Vat gene).

5.- Availability of effective and allowed agrochemicals, and defining their optimal use in practise. Rational strategies and combined control measures need to be defined.

▪ Outcome expected from EG5 work

The identified gaps in the current research should drive to corrective efforts in the form of specific research projects dealing with these issues and aiming to fill the blanks. A comprehensible review on the topic, not focused only in specific topics but aiming to show the big picture, will be timely. This review should address the influence of changing management practices and climate change in . Recomendations for future research directions to increase awareness of the importance of the issue are expected.

This review must reflect expertises of the current EG members, and gather also cooperations from other colleagues to complete the picture.

The authors of the present report intend to dedicate effort to complete such review in the next six months and establish contact with peer-reviewed journals in the field to publish this piece of work.

- **Summary of conclusions and main suggestions for the uture, derived from the deliberations of Expert Group 5 (EG5) on "*Interferente with vector transmisión*"**

(July, 2008. Compiled by J.J. Lopez-Moya, EG5 leader)

Vector organisms are responsible of the dissemination of many plant viruses, including a large number of arthropod-transmitted viruses and also some soil-borne viral pathogens. Vectors may establish specific relationships with the viruses they transmit, and the mechanisms governing the processes operating during transmission are only partially understood. The importance of vector transmission in epidemiological terms is beyond any doubt.

The **conclusions** of EG5 deliberations can be summarized as follows:

- The currently available strategies for control of vectors are insuficient. Despite promising cultural approaches (as illustrated for instance by the use of UV-absorbing film covers), or initial bio-control methods, still the use of agrochemicals is the main system of fight against vectors. That creates an environmentally unacceptable situation.

- Although plant resistances against vectors (example: Mi gene), or even against transmission (Vat gene) have been described, their characterization is still incomplete, and there are intrinsic difficulties in the identification of new sources. In general, very few genes in a rather limited number of species are known. As a consequence, management of resistance has a limited application in integrated strategies for vector control.

- Several gaps and deficiencies have been identified, ranging form a low knowledge of the processes involved, to insufficient modelling and prediction capable to take into account changes in the enviroment (climatic) as well as in the conditions of agricultural production that might result in new vector and virus problems.

- There is a need of innovative control measures, effective and more environmental friendly, that could be applied to a large number of crops and in different situations.

Suggestions for the future.

The current research on these topics is starting to deal with some of the deficiencies identifyed, but clearly an effort to pursue in these lines will be timely.

Identification of new sources of resistance in plants, as well as further studies with the already known resistance genes, are a first point that deserves attention. Potentiation of general defence mechanisms in plants, considering that most vectors are also pests, is an attractive possibility that should be explored in depth. Transgenic strategies with potential effects on transmission should be also considered.

Modification of vectors is also feasible with the available technology, and examples in other viral pathosystems (i.e. mosquitos and human/animal viruses) are promising. Interdisciplinary broad sense approaches, dealing with transmission of viral diseases affecting different hosts might provide clues to understand the processes in other hosts. Linked to this, new technologies ('omics') capable to deal with complex problems are likely to provide new opportunities to unravel the mechanims of virus transmission and provide innovative strategies of control. As an example, the availability of complete genomes of several organisms closely related to certain

vectors (nematodes, fungi, insects), together with the underway sequencing efforts on important vectors of plant viruses (such as aphids and whiteflies), is providing resources and post-genomic tools highly desirable for functional analysis. All thesemethodologies could be exploited to deepen our unstanding of the mechanism operating and eventually could lead to new control strategies, for instance through blocking or interfering with essential interactions during transmission.

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