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## RCIM - Récepteurs et Canaux Ioniques membranaires

Rapport Hcéres

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# HCERES

High Council for the Evaluation of Research  
and Higher Education

Research units

HCERES report on research unit:

Récepteurs et Canaux Ioniques Membranaires

RCIM

Under the supervision of the following  
institutions and research bodies:

Université d'Angers - UA

Institut National de la Recherche Agronomique - INRA

# HCERES

High Council for the Evaluation of Research  
and Higher Education

Research units

*In the name of HCERES,<sup>1</sup>*

Michel Cosnard, president

*In the name of the experts committee,<sup>2</sup>*

Luc Belzunces, chairman of the committee

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Under the decree No.2014-1365 dated 14 november 2014,

<sup>1</sup> The president of HCERES "countersigns the evaluation reports set up by the experts committees and signed by their chairman." (Article 8, paragraph 5)

<sup>2</sup> The evaluation reports "are signed by the chairman of the expert committee". (Article 11, paragraph 2)

## Evaluation report

This report is the sole result of evaluation by the expert committee, the composition of which is specified below.

The assessments contained herein are the expression of an independent and collegial reviewing by the committee.

**Unit name:** Récepteurs et Canaux Ioniques Membranaires

**Unit acronym:** RCIM

**Label requested:** UPRES EA and USC Inra

**Current number:** UPRES EA 2647 USC Inra 1330

**Name of Director (2015-2016):** Ms Valérie RAYMOND

**Name of Project Leader (2017-2021):** Ms Valérie RAYMOND

## Expert committee members

**Chair:** Mr Luc BELZUNCES, Inra (representative of Inra CSS)

**Experts:** Ms Nadine FRESQUET, Université François Rabelais, Tours (representative of CNU)

Mr David B SATELLE, University College London, UK

**Scientific delegate representing the HCERES:**

Mr Jean-François HOCQUETTE

**Representatives of supervising institutions and bodies:**

Mr Christian LANNOU, Inra, SPE

Mr Christophe PIHET, University of Angers

**Head of Doctoral School:**

Mr Philippe DELAVault, University of Angers, Doctoral School n° 495 VENAM  
"Végétal, Environnement, Nutrition, Agroalimentaire, Mer"

## 1 • Introduction

### History and geographical location of the unit

The laboratory of Neurophysiology has been created in 1971 at the University of Angers. Since 2002, this laboratory is named "Receptors and Membrane Ion Channels" (RCIM), and is located at the Faculty of Sciences (Belle Beille Campus).

The RCIM laboratory is recognized as UPRES EA and, in 2002 obtained the label USC ("Unité Sous Contrat") Inra within the department "Plant Health and Environment" (SPE) managed by Mr Christian LANNOU. This laboratory is a partner of the French competitive cluster Végépolys. It has also been involved in the creation of the SFR 4207 QUASAV ("Qualité et Santé du Végétal", Head P. SIMONEAU) founded in 2008. In the current contract, the laboratory is part of the PRES LUNAM ("Pôle de recherche et d'enseignement supérieur", l'Université Nantes Angers Le Mans).

For the next contract, the RCIM laboratory will become the SiFCIR laboratory (Laboratory for "Functional Signalling of Ion Channels and Receptors").

Located on the scientific campus of the University of Angers since 1971, the RCIM "Récepteurs et Canaux Ioniques Membranaires" laboratory historically focuses its scientific activity on the mode of action of insecticides and/or repellent molecules on the insect central nervous system.

### Management team

The laboratory has been managed by Prof B. LAPIED from 2001 to 2013. Since 2013, Ms Valérie RAYMOND is the head of the unit.

### HCERES nomenclature

Principal: SVE1\_LS5 Neurobiologie

Secondary: SVE1\_LS6 Immunologie, microbiologie, virologie, parasitologie  
SVE1\_LS1 Biologie moléculaire et structurale, biochimie

### Scientific domains

The scientific domain is "Agronomical and Ecological Sciences".

The RCIM laboratory contributes to the development of innovative strategies to control insect pests and more recently insect vector-borne diseases. The research developed in this laboratory aims to optimize the efficacy of insecticides and repellents while reducing the doses used in treatments.

## Unit workforce

Unit workforce [FTE (Full-time equivalent) between brackets]	Number on 30/06/2015	Number on 01/01/2017
N1: Permanent professors and similar positions	4	5 [5 FTE]
N2: Permanent researchers from Institutions and similar positions	2	
N3: Other permanent staff (technicians and administrative personnel)	4	5 [4.5 FTE]
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)	4	
N5: Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (technicians and administrative personnel)	3	
N7: PhD students	4	
TOTAL N1 to N7	20	
Qualified research supervisors (HDR) or similar positions	6	

Unit record	From 01/01/2010 to 30/06/2015
PhD theses defended	6
Postdoctoral scientists having spent at least 12 months in the unit	5
Number of Research Supervisor Qualifications (HDR) obtained during the period	1

## 2 • Overall assessment of the unit

## Introduction

The primary objective of the research unit has been to understand receptors and channels and their interactions with insecticides for which they are major targets. These membrane molecules are important biological nano-switches normally activated by endogenous chemicals such as neurotransmitters and neuromodulators resulting in rapid and transient transmembrane currents. They mediate signalling in the nervous system at neuromuscular junctions and elsewhere. Importantly, they are also targets for many drugs used for human and animal health applications and for many chemicals used to control agricultural pests and human disease vectors. Developing chemicals specifically targeting invertebrate pests without actions on beneficial invertebrate species, humans or mammals has proved an extremely difficult challenge, and for a safer and more sustainable future for agriculture and for the control of neglected tropical diseases, the basic and applied work of the kind undertaken by RCIM is essential. Since 2011, the unit has pursued and made progress on research themes according to its goals and introduced a new co-director Ms Valérie RAYMOND who will become the new future overall director of the group.

The scientific strategy mainly focuses on the development of innovative methods in the fight against pests to propose alternative methods that optimize a more selective use of pesticides, while reducing the doses. Studies are more focused on the cellular and intra-cellular mechanisms involved in the modulation of the sensitivity of insecticide targets.

In the forthcoming years, the scientific interests will be restricted to the cellular mechanisms involved in the modulation of the sensitivity of insecticide targets. The diversity of insect models will also be reduced to three: the cockroach *P. americana*, the pea aphid *A. pisum* and the mosquito *An gambiae*. New experimental methods will be introduced such as molecular and behavioural studies in collaboration with MIVEGEC laboratory (Montpellier).

The scientific activity is organized according to three main research themes: (i) the study of cellular and molecular factors involved in the efficacy of insecticides; (ii) the study of cellular and molecular impacts of resistance mechanisms on the susceptibility of targets for insecticides; and (iii) the use of microorganisms and chemical substances as synergistic agents for optimizing insecticide effects.

### Global assessment of the unit

RCIM/SiFCIR has built on a long and distinguished history of insect neurophysiology at the international level, and is leader in the development of new strategies to optimize the efficacy of insecticides in order to reduce the doses used, to increase health safety and to better control plant pests and insects involved in vector-borne diseases. The research activity is not only academic but also applied, as reflected by the collaborations with industrial partners, which has recently led to 4 patents. The publications are of high level and have contributed to substantial knowledge in the pesticide modes of action.

RCIM/SiFCIR is highly recognized at the regional, national and international levels, as reflected by the involvement in 5 scientific journals in which members are editor or members of the editorial board. It is highly embedded in the social and economic environment via its industrial partnership, the diffusion of research towards the society, and via its expertise activity in instances involved health safety and in the assessment of research. In addition, its recent links with Inra, SFR 4207 QUASAV and Vegepolys have strengthened its impact and broadened its reach. As consequences, RCIM/SiFCIR developed an outstanding activity of training through research.

The unit is reorganized in a new democratic structure including 1 team centered around an ambitious research project with 3 themes focused on the knowledge of the insecticide modes of action, and new strategies to optimize the efficacy of pesticides and to circumvent the resistance of insects to insecticides.

### Strengths and opportunities in the context

With a talented director, a clear target of innovative strategies to increase insecticide efficacy and safety, a clear leadership identified for the 3 main research themes, which together drive the central goal, the prospects of success are high. Leads for the 3 themes are established with an identified professor heading each research theme.

The unit has been very productive in 2010-2016 and, importantly, some new mechanistic discoveries have paved the way for the upcoming program, which is highly focused and with an excellent chance of success. The unit has been very innovative with the development of new strategies in the control of insect pests and insects involved in vector-borne diseases. RCIM/SiFCIR carry out a large number of approaches, methodologies and techniques for investigating insects ranging from the single gene to the integrated behaviour.

RCIM/SiFCIR draws on a wide network of collaborations spread from the local to the international level. It is noteworthy that the collaborations are developed not only with academic research structures, but also with technical and industrial partners. Angers is a go-to place nationally for advice on Insecticide actions and targets for Government agencies and Industry. Securing external grants and attracting good students and new faculty provide ample evidences of their reputation.

RCIM/SiFCIR is pro-active in linking with schools and the public at large. Its advice and consultation is sought by Industry and it is also pro-active in establishing links with the media. RCIM/SiFCIR members are also very involved in expertise and consulting for health safety Agencies and in research evaluation.

The unit has set up different procedures for a better and more democratic management of the unit: research positions, materials and technologies, health and safety, and development of new research programs and scientific collaborations.

All faculty members and researchers contribute to the substantial teaching efforts of the group. The research unit is very involved in the functioning of the Doctoral School (DS): Creation and Direction of DS by one unit member, participation to DS Council, and involvement in the trainings of DS. The number of PhD supervisions is very satisfying.

The strategies and the research perspectives for the next contract appear very exciting. The new forward program is innovative, builds on the unit recent discoveries.

### Weaknesses and threats in the context

Some weak points have been identified by the expert committee:

- reduced staff and especially the number of full-time researchers. The impact of this reduction will likely be minimized by the high research activity of the members and the quality of the research performed;
- in the research project of the unit, very few details were provided on the methodology expected to be used to perform the behavioural studies on the effects of synergistic associations in insects;
- in theme 2, the strategies intended to circumvent the resistance of insects to insecticides appear innovative. They are based on the knowledge of insecticide modes of actions. However, the final objective of the studies on metabolism, especially on cytochrome P-450, is not clearly defined.

### Recommendations

It will be important that the new director has full support of all faculty and researchers.

It will be important to continue targeting high profile journals wherever possible. This task gets harder each year but increasing research focus and expanding international links will assist in achieving this.

The expert committee encourages continuing the group expertise for regulatory and health agencies.

In terms of organisation, it is vital that the group maintains a strong team ethic. To achieve this, maybe co-opting one or more international members on to the board, to help review annual progress towards goals, would be helpful.

Considering the reduced staff, attention must be drawn on the risk of training PhD students beyond the supervision capacity of the research unit.

The expert committee also encourages the SiFCIR to continue developing research programs at the international level in response to calls for proposals. Taking into account the high level and the innovative aspects of the research conducted, the possibility of being involved in a future European program or human frontier program, for example, should be considered.

Considering the reduced staff, and especially the number of full-time researchers, attention must be drawn on the risk of developing too many research programs beyond the supervision capacity of the research unit, especially since the capacity of doctoral supervision is not high.

In the development of the theme 3, the attention has to be focused on the development of stable collaborations to carry out field studies abroad (Asia and Africa) on the impact of synergistic combinations on mosquito behaviour.