LIPM - Laboratoire des intéractions plantes - microorganismes

Rapport Hcéres

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agence d'évaluation de la recherche
et de l'enseignement supérieur

Section des Unités de recherche

AERES report on the research unit

Laboratoire des Interactions Plantes Micro-organismes (LIPM)

From the

CNRS

INRA

Mai 2010

aeres

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Laboratoire des Interactions Plantes Micro-organismes (LIPM)

From the

CNRS

INRA

Le Président
de l'AERES

Jean-François Dhainaut

Section des unités
de recherche

Le Directeur

Pierre Glorieux

Mai 2010

Research Unit

Name of the research unit : LIPM (Laboratoire des Interactions Plantes Microorganismes)

Requested label : UMR INRA-CNRS

N° in the case of renewal : CNRS 2594 / INRA 441

Name of the director : M. Pascal GAMAS (future, Mrs Dominique ROBY)

Members of the review committee

Committee chairman

M. Marc Henri LEBRUN, UMR BIOGER, INRA/APT, Grignon, France

Other committee members

M. Pierre ABAD, UMR IBSV, INRA/CNRS, Sophia Antipolis, France

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M. Olivier LE GALL, INRA, chef de département SPE

Mrs Hélène LUCAS, INRA, chef de département GAP

Report

1 • Introduction

• Date and execution of the visit :

The committee has visited the LIPM in Toulouse from December 14th to 16th 2009. Presentations of the team's research projects happened in the Amphitheatre of the INRA centre from Toulouse (Castanet-Tolosan). The program of the visit was organized with the Délégué de l'AERES, Alain Pugin, the committee president, Marc-Henri Lebrun and the Director of LIPM, Pascal Gamas. The visit organisation was totally satisfactory. This holds for oral presentations from both directors and team leaders. Sufficient time was left for questions allowing a direct discussion between the committee and members of the LIPM. Additional meetings organized during these two days of visit allowed to increase the exchanges between the committee and the different categories of personnel from LIPM, and to discuss with the representatives from INRA, CNRS, and University of Toulouse (UPS).

• History and geographical localization of the research unit, and brief presentation of its field and scientific activities :

The LIPM was funded in 1981 as a joint CNRS - INRA unit devoted to the study of plant microbe interactions. It is located near Toulouse in the INRA centre of Castanet-Tolosan. The LIPM building gathers laboratories occupying 4176 m2. Recently, a new building was constructed close to the LIPM building to accommodate another unit (UMR SCSV) devoted to the study of plant physiology and plant microbe interactions, creating a recognized centre in plant sciences in Toulouse. These two units as well as others from ENSAT, INRA, UPS and Biogemma belong to the IFR40 on Agrobiosciences, Interactions and Biodiversity (Director Dominique ROBY, LIPM).

The LIPM scientific activities are focused on the study of plant microbe interactions from both the plant and microbe sides, creating a highly favorable multidisciplinary environment for deciphering molecular mechanisms involved in microbial symbiosis and pathogenicity on plants.

• Management team :

The actual director of LIPM is Pascal GAMAS (CNRS) and the adjunct director is David BARKER (INRA). The LIPM has nine teams and two platforms, each being leaded by one or two scientists. The LIPM management relies on meetings of the unit council (CDL, 15 members, 10 being elected) and of the scientific council of the unit (CS, 15 members, 7 being elected), as well as general meetings of the unit (3 times a year for CDL, and 7 times a year for CS). The new director of LIPM is proposed to be Dominique ROBY (CNRS) with adjunct directors Stéphane GENIN (CNRS) and David BARKER (INRA).

- **Staff members Past Future :**

	2006	2009
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	4	5
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	33	34
N3: Number of other researchers including postdoctoral fellows (Form 2.2 and 2.4 of the application file)	9	9
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	40	46
N5: Number of other engineers, technicians and administrative staff (Form 2.6 of the application file)	8	11
N6: Number of Ph.D. students (Form 2.7 of the application file)	16	15
N7: Number of staff members with a HDR or a similar grade		24

2 • Overall appreciation on the research unit

- **Summary :**

LIPM is developing fundamental research on the molecular mechanisms involved in plant-microbe interactions with a goal of improving agriculture for nutrient assimilation (symbiosis) and pathogen control. LIPM projects are focused on bacterial symbiosis and pathogenicity, from both microbial and plant sides, creating a favorable multidisciplinary environment for the study of these plant-bacteria interactions. From the microbe side, LIPM has developed first-rate research on symbiotic and pathogenic bacteria, as well as original comparisons between these different microbes. Projects on symbiotic fungi developed in collaboration with UMR SCSV allowed the discovery of the first fungal symbiotic signals. From the plant side, LIPM is developing excellent research projects on the perception of signals from either symbiotic bacteria and fungi or pathogenic bacteria. LIPM has also excellent projects on the pathways involved in early steps of nodule formation and plant defense induction. In 2006, a new INRA team joined LIPM. This new team’s research project is focused on the breeding of sunflower for resistance to abiotic/biotic stresses. It has now settled and is producing interesting results. LIPM has also a very efficient bioinformatics platform supporting its genomic projects that have also a recognized expertise at INRA and in France. The scientific production of LIPM is of very high quality with numerous breakthrough papers and a high overall international impact. LIPM is also well supported by competitive grants and PhD fellowships and has developed strong links with other units including UMR SCSV, through IFR40 and UPS doctoral school SEVAB. Overall, the LIPM has a strong, internationally recognized expertise in plant-microbe interactions, with very active and productive teams.

- **Strengths and opportunities :**

- High quality and competitive fundamental research on plant bacteria interactions.

- Integrated studies on symbiosis and pathogenicity from both plant and microbe point of views.

- Starting experimental evolution approaches to study the frontiers of symbiosis and pathogenicity, as well as new factors involved in pathogenicity and their durability.

- Access to genomics tools including databases and bioinformatics developed by LIPM.

- Positive ongoing organization evolution and shared resources/platforms.

- **Weaknesses and threats :**

- Some teams are too small. There is a need either for fusion or for additional support to these teams.

- For some research topics, the competition at the international level is strong. Therefore, there is a need for a focus on project(s) for which LIPM teams are the more competitive.

- Improving collaborations between LIPM teams and with teams from UMR SCSV and IFR40 will be a real added value to the existing links.

- Improvement of some experimental facilities is needed (increasing the number of greenhouses and controlled growth chambers). These investments could be planned in relation with other units of the campus.

- **Recommendations to the head of the research unit :**

- Stimulate collaborations between teams using different tools. The development of discussion groups on transversal topics leaded by scientists independently of team organization is a good start.

- Improve collaborations with nearby plant science UMR SCSV as exemplified by the existing collaboration on the identification of the Myc factor.

- **Production results :**

A1: Number of permanent researchers with or without teaching duties (recorded in N1 and N2) who are active in research	27
A2: Number of other researchers (recorded in N3, N4 and N5) who are active in research	
A3: Ratio of members who are active in research among permanent researchers [(A1)/(N1 + N2)]	70%
A4: Number of HDR granted during the past 4 years	5
A5: Number of PhD granted during the past 4 years	18

3 • Specific comments on the research unit

- **Appreciation on the results :**

  – Relevance and originality of the research, quality and impact of the results :

LIPM has developed a large array of research projects in the field of plant microbe interactions that are original, relevant and competitive at the international level. The results obtained by the different teams are of high quality and have led to regular breakthroughs in the corresponding fields. Although these projects may seem quite diverse, they are frequently complementary, as the identification of both microbial signals (Nod and Myc factors, Avr gene products from bacteria) and their plant receptors (Nod factor receptors, R gene product), have allowed teams to follow up these interactions at the molecular level. Additionally, the deciphering of these recognition events was strategic for the study of pathways triggered by these signals, a theme now largely developed at LIPM both for symbiosis and pathogenicity. A significant number of projects have used complementary approaches (molecular genetics, biochemistry and functional genomics) on the same plant model (Medicago, Arabidopsis), allowing the development of shared resources and collaborative integrated projects on symbiosis (recognition, nodule formation) and pathogenicity (resistance, susceptibility). Such wise strategy has increased the competitiveness of teams and opened new research areas.

Breakthrough were obtained in different fields of research at LIPM:

- identification of novel Nod Factor signaling pathway components,
- demonstration of the involvement of microRNAs in symbiosis,
- identification of novel cellular modifications induced by fungal symbiosis in roots,
- bacterial and plant comparative genomics,
- identification of novel bacterial effectors and their plant targets,
- deciphering the mechanisms involved in recognition of avr proteins by resistance plant proteins,
- identification of novel regulatory components of plant defense pathways,
- identification of novel plant susceptibility factors.

A major breakthrough is also expected as a result of the recent characterization of the Myc factor, the first fungal symbiotic signal identified (publication ongoing).

— Number and quality of the publications, scientific communications, thesis and other outputs :

LIPM has a high number of high quality publications (133 publications, among which 106 are in the first rank of their discipline). Major publications have been obtained in the period, including 2 Science, 1 Nature Biotechnology, 2 Genes and Development, 1 Genome Research, 1 Genome Biology, 12 Plant Cell, 8 PNAS. LIPM has also produced databases linked to genomic projects and software made available to the community in bioinformatics that have a large impact.

LIPM has a strong input in the training of young scientists, with 21 PhD being submitted during the period. A large majority of these PhDs have published their results in high ranking journals, and are now performing post-doctoral training in international laboratories.

LIPM has a significant level of collaborations with privates companies, including plant breeding companies that have led to significant patents (2).

— Quality and stability of partnerships (optional) :

LIPM teams have developed strong partnerships with private companies either in the symbiotic field (Agricultural use of Nod factors with US based biotech company, Myc factors with different partners), or in the pathogenicity field (Biogemma and breeding companies, mainly through Genoplante projects). These partnerships have supported some fundamental research projects at LIPM, and have allowed the development of field applications with some success (Nod factor).

• Appreciation on the impact, the attractiveness of the research unit and of the quality of its links with international, national and local partners:

— Number and reputation of the awards obtained by staff members, including invitations to international conferences and symposia :

Some LIPM members have received important awards, including membership to the French National academy of science (1). LIMP members are also frequently invited to international conferences indicating the high level of scientific recognition of the research performed by the different teams at the international level.

— Ability to recruit high levels scientists, post-docs and students, and more particularly from abroad:

LIPM has a very good ability to recruit high quality young researchers (post-docs, young permanent researchers), including a large number od scientists from European and other countries. LIPM has also some success in CNRS competitive hiring (1 CR2) and a strong support from INRA (1 CR2, 2 CR1, 1 DR2).

— Ability to raise funds, to successfully apply for competitive funding, and to participate to scientific and industrial clusters :

All the teams from LIPM have been successful in raising funds through competitive grants (28 ANR, 3 EU, 6 International), and a large number of these collaborative projects are coordinated by LIPM.

— Participation to international or national scientific networks, existence of stable collaborations with foreign partners :

LIPM has a very strong level of scientific collaboration at national, European and international level). This is well exemplified by the high number of competitive grant coordinated by LIPM members, and the number of scientific networks leaded by LIPM members.

• Appreciation on the strategy, management and life of the research unit:

— Relevance of the research unit organization, quality of the management and of the communication policy :

LIPM is well organized and its management is efficient both at organizational and communication levels. Collective discussions are organized through two councils (management and scientific) that meet regularly on ongoing projects/problems. These councils take collective decisions that are fully supported by members of the unit. LIPM has a specific funding strategy relying on sharing resources that is fully supported by members of the unit. This strategy allows teams accessing to experimental support independently of their intrinsic funding. All teams have been successful in getting competitive grants, increasing the level of LIPM shared resources. This favorable situation allowed the development of a significant number of experimental platforms that are accessible to all members of the unit.

— Relevance of the initiatives aiming at the scientific animation and at the emergence of cutting edge projects :

LIPM is supporting different level of scientific animation. Classical seminar series allows team's members to present original results. Cycles of invited speaker seminar series are organized with IFR40.

— Contribution of the research unit staff members to teaching and to the structuration of the research at the local level :

Although there is only a limited number of LIPM members that have a teaching position, a large number of scientists are teaching, mostly for Master's lectures. LIPM members are also very actively participating to the organization of the PhD school SEVAB and to the training of PhD students. The impact of LIPM on the organization of research at the local level is high, since LIPM members were essential for the construction of IFR40 (D. ROBY from LIPM is the head of IFR40), and the PhD school SEVAB. The moving of UMR SCSV and ENSAT teams to the INRA campus close to LIPM has also been a great success, since it allowed setting up a visible and unique plant science centre in Toulouse.

- **Appreciation on the project :**

— Existence, relevance and feasibility of a long term (4 years) scientific project :

The overall scientific project of LIPM is focused on the deciphering of molecular mechanisms involved in plant bacteria interactions. It is build up on the more interesting or more promising ongoing projects from each team. LIPM teams are following up a strategy that is feasible, since they all have strong expertise in the biology and genetics of the plant microbe interactions studied, as well as in molecular/genomics tools for both plants and microbes (bioinformatics, cellular biology, transcriptomics, proteomics, metabolomics). These tools are available either at LIPM or in nearby units. Internal transversal projects are planned on both symbiosis and pathogenicity topics, through for example shared transcriptomic analyses or mutant collections and their in depth screening. The projects developed from the bacterial side of symbiosis involve deciphering novel regulatory networks during infection and a transcriptomic spatial analysis during different stages of nodule formation. On the plant side, LIPM teams are wisely focusing on the study of the novel Myc factor they identified. Indeed, they will use this new molecule(s) to identify its receptors and specific signaling pathways (mutants screening in Medicago, transcriptomics, reverse genetics using LysM-RLKs) and their relation to the Nod pathway. On the microbial side of pathogenicity, the projects are focusing on bacterial comparative genomics and on pursuing the functional studies of bacterial effectors and their targets using refined screens. A novel field is emerging on the grounds of successful pilot experiments. It uses experimental evolution to identify novel factors involved in bacterial symbiosis or pathogenicity. On the plant side, the discovery of novel plant defense pathways, allows their in depth study and the identification of the different components involved. Pursuing the study of the interaction between resistance gene RRS1 and avirulence gene pop2 is also a good strategy, since significant advances were obtained by LIPM in this field which it is becoming of a wide interest, as it is involved in different plant microbe interactions. Finally, the novel team devoted to sunflower plant breeding, has now reach a significant step in its development that should lead to interesting results in the genetics of sunflower, in particular in the genetics of plant microbe interactions as it can take advantage of the expertise of the LIPM in this field.

— Existence and relevance of a policy for the allocation of resources :

LIPM has an original policy for allocating resources, since all competitive grants are pooled and redistributed to the teams. This strategy permits the allocation of important resources to dedicated platforms and significant investments in novel technologies. This is a good strategy giving access to a large set of diverse and efficient experimental facilities

— Originality and existence of cutting edge projects :

LIPM is proposing cutting edge projects on both symbiosis and pathogenicity, as well as in genomics

- genomic tools for symbiosis (bioinformatics, cellular biology, transcriptomics).

- Myc factor receptors and specific signaling pathways and their relation to the Nod pathway.

- experimental evolution to identify novel factors involved in bacterial symbiosis or pathogenicity.

4 • Appreciation team by team

Team : "Symbiotic functions, Genome and Evolution of Rhizobia"

Team leaders: Jacques BATUT and Catherine MASSON-BOIVIN

Staff members:	In the report	In the project
N1: Number of professors (see Form 2.1 of the unit's dossier)	0	0
N2: Number of EPST, *Établissement public à caractère scientifique et technologique* (Public scientific and technological institution) or EPIC, *Établissement public à caractère industriel et commercial* (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	4	4
N3: Number of other professors and researchers	1	2
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	2	2
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)		
N6: Number of doctoral students	1	1
N7: Number of persons accredited to supervise research and similar	2	2

• Assessment of work produced and scientific quality:

This team is relatively small with four researchers, two technicians, one PhD student (left at end of 2009) and one post-doc. The team has developed microbiological research projects focused on the infection process of legumes by Rhizobia. There are two ongoing projects with different strategies and Rhizobium-legume models. The first project is focused on cAMP signalling pathways in Sinorhizobium meliloti interacting with Medicago species. The project came from the observation that the genome of S. meliloti contains an unusually high number of genes encoding adenylate cyclases. A signalling pathway involving 3 related receptor-like adenylate cyclases and a downstream transcription factor were identified and showed to play a role in the control of the infection process. A first publication describing these results is in preparation. The second project is looking for a gain-of-function approach using experimental evolution experiments and exploiting the close phylogenetic relationship between the β-Rhizobium Cupriavidus and the root-pathogen Ralstonia. The objective is to identify variants with an improved infection and nitrogen-fixing nodule formation. This novel project has already yielded positive and interesting results that will be published shortly in a high impact journal. These two research topics (cAMP, experimental evolution) are original and really interesting. The members of the team are experts in this field, which guarantees the successful outcome of the projects. The results already obtained are excellent and highly appreciated by the international "plant microbe-interaction" community.

The team has produced nine publications (i.e. more than two per year) in good impact journals of the field, including two papers in general and high impact journals as well as numerous communications at international conferences.

• Assessment of the influence, appeal and integration of the team or the project in its environment:

Three PhD theses were defended. Five post-doctoral fellows, including foreigners, were welcomed. Fifteen invited presentations at international conferences are testifying of the high visibility of the group. The experimental evolution project is well funded by several grants and benefits from a well established network of collaborations. The cAMP project will be the subject of a forthcoming ANR proposal.

- ### Project assessment:

The three proposed research topics address highly relevant questions and rely on feasible approaches in expert hands. The cAMP projects aims at identifying putative plant signals modulating cAMP levels in the bacterium and cAMP pathway downstream target genes. The Ralstonia experimental evolution strategy has a strong potential to select new symbiotic bacterial strains or improve existing ones with possible agronomic impact. The team is active and successful in fund raising. The projects are highly original and timely.

- ### Conclusions:

This team has a good scientific production and has a recognized experience in the field of plant symbiotic bacteria interactions. Their projects are exploring new research fields (role of cAMP in bacterial symbiosis, experimental evolution) and are based on strong results recently obtained by the team with promising outputs. More interactions with teams from the Institute will be welcome.

— Strengths and opportunities:

An excellent research team with a good output and long term experience in the field. Their projects rely on novel approaches and are exploring novel niches with promising novel outputs and insights.

— Weaknesses and threats:

The team is small and needs more collaborations within the institute.

— Recommendations:

More lateral interactions with the other teams developing evolutionary approaches at LIPM should be encouraged as well as collaborations with other LIPM bacterial molecular microbiology groups.

Team : "Responses to Stress and Environmental Signals in Rhizobia"

Team leader: Claude BRUAND

Staff members:	In the report	In the project
N1: Number of professors (see Form 2.1 of the unit's dossier)	0.8	0.8
N2: Number of EPST, *Établissement public à caractère scientifique et technologique* (Public scientific and technological institution) or EPIC, *Établissement public à caractère industriel et commercial* (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	2	2
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit's dossier)		
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	1	1
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	0.5	
N6: Number of doctoral students (see Form 2.8 of the report unit's dossier and 2.7 of the project unit's dossier)	1	2
N7: Number of persons accredited to supervise research and similar	2	2

Assessment of work produced and scientific quality:

This is a small team with two researchers, one assistant professor at 80%, a technician and a PhD student. The group was created in 2005 and has experienced a change in leadership, and the recent arrivals of an assistant professor (2007) and a PhD student (2008). This team has two research projects related to the regulation of bacterial stress response in the symbiont Sinorhizobium meliloti. A transcriptomic approach allowed the team to discover a novel major regulatory pathway of the general stress response in S. meliloti. The second topic of the team focuses on a specific stress induced by nitric oxide produced in nodules. The approach combines transcriptomic and molecular analysis of candidate genes. The research is original and relevant and the team has made an original finding that is of broad significance for proteobacteria. However, the competition in this field is very high involving strong international groups. Indeed, other teams have discovered the same regulatory pathway in other alpha-proteobacteria and have obtained interesting results that have reduced the impact of the team discovery.

Based on journals in which team's results were published which are good to very good, the impact of the team has been well recognized. In the last 4 year period, three papers in international journals were published and one PhD thesis has been started. There is a good level of scientific communications and poster presentations at national and international scientific meetings.

Assessment of the influence, appeal and integration of the team or the project in its environment:

In light of its recent establishment in 2005, the international visibility of the team is not yet sufficiently established. The ability to recruit new researchers has been limited. The group welcomed an assistant professor in the past period which will increase the visibility of the group towards potential students. The group has been successful in obtaining three research contracts with co-operations within and outside the LIPM. The group has good national collaborations but currently no international ones related to the projects.

Project assessment:

The overall team project is subdivided into 3 projects. Two projects are a continuation of previous researches. The third concerns a transversal project within the LIPM on laser micro-dissection of different type of nodules to spatially analyze bacterial gene expression and its regulation in nodules. The first two projects are well supported by local technological collaborations and know-how (e.g the tap-tag technology) and by national networks on NO signaling and stress responses. The laser micro-dissection and transcriptome analysis offers new opportunities and will strengthen collaboration with other teams of the LIPM. The two main projects are based on the previous original findings and the new transversal project can be considered as cutting-edge and will be under the responsibility of collaborating groups within the institute.

Conclusion:

This team has a good production even though it started in its actual form within the past 4 year period. It has produced significant information on the Rhizobium life-style with sufficient potential for relevant new findings in the coming years.

— Strengths and opportunities:

The study of the functions of Rhizobia within the nodule is of real importance to better understand the opportunities and limitations of rhizobial nitrogen fixation under natural and field conditions. The team has a growing expertise in the Rhizobium field as well as very good and proven expertise in transcriptome analysis that will be useful for the proposed projects.

— Weaknesses and threats:

A major weakness of the team is its small size and the lack of sufficient national and international visibility, which makes the group less competitive. International competition is high in this field and attraction of the necessary PhD students and post docs to support team's projects is essential.

— Recommendations:

The team and the direction of the institute should consider the possibilities to merge the team with another team or to enlarge the team to make it internationally competitive. In the present situation, the team should be very careful in the number of projects followed up and avoid increasing its research scope by novel topics such as sncRNAs, which is again a highly competitive domain, including S. meliloti.

Team : "Cellular dynamics and regulation of symbiotic infection and nodule development"

Team leaders: Pascal GAMAS and David BARKER

	Past	Future
N1: number of researchers with teaching duties (Form 2.1 of the application file)	0	1
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	7	6
N3: Number of other researchers including postdoctoral fellows (Form 2.2 and 2.4 of the application file)	3	2
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	5	5
N5: Number of other engineers, technicians and administrative staff (Form 2.6 of the application file)	2	1
N6: Number of Ph.D. Students (Form 2.7 of the application file)	3	2
N7: Number of staff members with a HDR or similar grade	5	5

• Appreciation of the results:

The team has performed highly relevant research in a very competitive field and obtained important new results on key questions on cell and molecular biology of root symbioses in the last four years. They have identified interesting transcriptional regulators acting either downstream of Nod factors recognition or during nodule development. They have been essential to the development of high-throughput transcriptomic approaches for studying Medicago truncatula symbiosis, as well as reverse genetics tools to study candidates genes picked up according to their expression patterns. Additionally, they have been involved in the discovery of important transcription factors (TF) and the regulation of one of these TF by a microRNA. This has prompted the team to start a successful collaborative work on miRNA acting during symbiosis in Medicago truncatula. In the field of cell biology of root symbioses, they have a leading position, and have obtained excellent results on fungal symbiosis induced cellular re-organization of plant root cells. Their participation to the annotation of Medicago truncatula was also very significant.

The publication output of the team is impressive. In the last four years, the team had 15 original high-impact publications (four in Plant Cell, two in Genes and Development, four in Plant Physiology, four in Molecular Plant-Microbe Interactions, one in Journal of Experimental Botany) and 13 collaborative publications (four of them in Plant Journal). Three PhD. theses were submitted in the last four years. The only weakness is that a team of such quality is may be its too small size for the projects planned.

• Appreciation of the impact, the attractiveness of the team and the quality of its links with international, national and local partners:

In the last four years, team members have received 10 invitations to international congresses and 14 invitations to seminars (no awards). The three PhD students that finished in the reporting period have obtained each one a publication with a first authorship. Two of these first authorships corresponded to Plant Cell papers. The team recruited two international (German and Austrian) post-docs, one of which meanwhile left for a group leader position in Germany. They have welcomed a MC and technicians from other groups and hired an engineer on an ANR grant.

The team was very successful in raising money (12 national and four international grants). They participated to two Marie Curie Research Training Networks and one EU FP6 project. Altogether, outside the LIPM, they have nine national and nine international collaborations. These collaborations are strategic and well designed to limit the danger of wasting resources by competion, and to compensate for the lack of plant growth space (Medicago truncatula mutant screens are performed in collaboration in Madison, WI, USA).

• Appreciation of the project :

The research proposed for the next four-year period is the logical continuation of previous high impact research. So far, the research is well funded and the institute has a policy on sharing resources. The limitation of plant growth space which limits research options is compensated by collaborations. In the proposed lines of research, the imaging platform and the bioinformatics platform represent important assets. The fusion of the two previously independent teams will integrate cell biology and transcriptomics/molecular biological approaches in research projects on microsymbiont factor signal transduction, and the responses elicited in the plant by such factors.

• Conclusion:

This is a very well positioned team that approaches the response of legumes to microbial signal factors from different, now integrated angles (cell biology, molecular biology of signal transduction pathways and transcriptional regulation). The team has obtained very interesting results on transcription factors involved in Nod factor signaling and nodule formation and their complex regulation (miRNA, microORF), and has developed excellent transcriptomic and cellular biology resources on symbiosis.

— Strengths and opportunities:

Thanks to the good financial situation and access to state-of-the-art technical equipment, the planned research is highly feasible. The problem of the institute – limitation of plant growth - is compensated by well-placed collaborations within the Medicago truncatula field.

— Weaknesses and threats:

The only factor that could limit the impact of the research results is the competition of Lotus japonicus research field (with regard to nodule microRNAs), but the team has already one paper published on this subject, while the L. japonicus field is lagging behind (Nod factor signal transduction, nodule-specific transcription factors, cell biology).

— Recommendation:

The integrated research projects of the team resulting from the fusion of two existing teams are of great interest. There is a need to recruit more PhD students and post-docs and to integrate the response of the plant to Myc factors (from Team 4) in the forthcoming research plans.

Team : "Symbiotic signals and their perception/transduction"

Team Leaders : Clare GOUGH and Julie CULLIMORE

Staff members:	In the report	In the project
N1: Number of professors (see Form 2.1 of the unit's dossier)	0	0
N2: Number of EPST, *Établissement public à caractère scientifique et technologique* (Public scientific and technological institution) or EPIC, *Établissement public à caractère industriel et commercial* (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	8	8
N3: Number of other professors and researchers including post-doctoral fellows	4	2
N4: Number of engineers, technicians and tenured administrative staff members	4	4
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	3	1
N6: Number of doctoral students (see Form 2.8 of the report unit's dossier and 2.7 of the project unit's dossier)	5	1
N7: Number of persons accredited to supervise research and similar	5	5

- **Assessment of work produced and scientific quality:**

This team has conducted highly relevant research in a very competitive field. Important new results were obtained with regards to the perception of Nod and Myc factors, as well in the signaling pathways involved in the transduction of these microbial signals. The research program of this team is divided into several projects for which important findings were obtained in the evaluated period. One breakthrough is the identification of a novel symbiotic signal, the Myc factor produced by the symbiotic fungus Glomus (structure not disclosed due to patent filing). The team has also obtain key results on the perception of Nod factors, through the molecular characterization of the NFP/Lyk3 LysM receptor-like kinases using structure activity relationships and domain swapping. The team has also started identifying the possible interactors of NFP/LYK3/DMI2 to pave the way to DMI2. A new regulator of the Nod factor pathway, RPG, has also been identified. Finally the team has played an important role in the sequencing of the Medicago truncatula genome through fine-mapping and coordination of sequencing of chromosome V.

This team has published relevant, original, and high impact papers. 8 papers are primary publications of the team (1 Plant Journal, 3 Plant Physiology, 1 PNAS, 2 MPMI, 1 Glycobiology), while 8 are collaborative publications (1 Science, 1 PNAS). The team has an good output in young researchers training (3 PhD thesis finished, 2 in progress). The team has also filed one patent for the structure of the Myc factor. All students who completed their PhDs have at least one first author publication and all of them are doing post doctoral training. The team has also been extremely successful in raising money (8 international grants, 9 national grants, 3 company grants).

- **Assessment of the influence, appeal and integration of the team or the project in its environment:**

Researchers from the team were invited to 11 international congresses, and have obtained three awards including a nomination to the French Academy of Sciences. The team is attractive since they were able to recruit four excellent postdoctoral scientists, to obtain competitive CR2 positions and to attract one excellent CR1. The team has been active in establishing a large number of scientific collaborations at national, international and EU level as well as industrial collaborations to exploit the agricultural use of Nod and Myc factors as exemplified by the increasing use of Nod factors in agriculture in North and South America.

- **Project assessment :**

The project is in the logical continuation of previous high impact research. The team will develop an array of projects using the Myc factor that they have recently identified. This strategy will give them a tremendous advantage and will be really helpful in deciphering the commonalities and differences between Myc and Nod factors perception/signaling. Such a topic is original and competitive. To be efficient, the team has reoriented significant internal resource to support this project. In addition, the arrival of a specialist of Nod factor perception will strengthen the research projects on the perception of this signal. The team is well funded and the institute has a policy on sharing resources, so their projects will be sufficiently supported. However, LIPM has a clear limitation of plant growth space, limiting the screening of mutants. Such genetic screens will therefore rely on external collaborations that seem to be already well in place.

• Conclusion:

Team 4 has an excellent scientific record and is very well positioned for delivering major breakthroughs in the coming years. Projects related to perception and signal transduction of the Nod factor should be carefully selected given the high level of competition in the field.

— Strengths and opportunities:

Thanks to their key role on the identification of the Myc factor, the team will have a leading role on the study of the novel Myc factor. Additionally, the subsequent projects on the perception of the Myc factor and its signal transduction will also nicely complement the projects of the team on Nod factor signaling.

— Weaknesses:

Research on Nod factor signal transduction is a highly competitive field, and strategic decisions should be made by the team to stay competitive. Loss of focus or delays in team objectives can allow other groups to take the lead (e.g., Nod factor receptor domain swapping was first published by the Aarhus group). Given the size of the group (19 members), more publications could have been expected, but we assume that the ongoing preparation of Myc factor papers had the priority (which is a sound strategy).

— Recommendations:

The team should carefully focus their research on the Nod factor signal transduction pathway to stay competitive at the international level. The study of the Myc factor will likely lead to breakthrough research in this field and certainly help research projects on the Nod factor perception and signaling.

Team : “Ralstonia pathogenicity determinants and their plant targets”

Team leaders: Stéphane GENIN and Christian BOUCHER

Staff members:	In the report	In the project
N1: Number of professors (see Form 2.1 of the unit's dossier)	0	1
N2: Number of EPST, *Établissement public à caractère scientifique et technologique* (Public scientific and technological institution) or EPIC, *Établissement public à caractère industriel et commercial* (Public industrial and commercial institution) researchers (see Form 2.3 of the unit’s dossier)	4	3
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit’s dossier)	2	2
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit’s dossier)	2	2
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit’s dossier)	0	0
N6: Number of doctoral students (see Form 2.8 of the report unit’s dossier and 2.7 of the project unit’s dossier)	4	4
N7: Number of persons accredited to supervise research and similar	4	3

- ## Assessment of work produced and scientific quality:

The research projects of this team were focused for many years on studying the pathogenicity of the bacterium Ralstonia solanacearum on tomato. The team has developed a well focused, original and rigorous research program to explore the role of type III secretion and the coordinated regulation of the virulence genes expression. Over the past four years, this team has made a strong and time-costly investment in developing and exploiting novel genomic and experimental resources. The team has developed two main research strategies. The first one is focused on the functional analysis of type III effectors, the other on developing bacterial experimental evolution on host range and pathogenicity. The functional approach is based on general and systematic studies of type III effectors. For this purpose, they have generated all required tools (effectors delivery systems, systematic expression in plants, simple and multiple deletions mutants). In addition they have used multiple host plant testing and competition assays that are original and proved successful (novel Avr on Medicago, novel Avr on Tobacco, PopP2 fitness effect). These results and resources have a high potential for deciphering the role of effectors in plant microbe interactions, as well as identifying the regulatory network controlling effector delivery and expression. Successful identification of effectors with original function has been done by the group but difficulties have appeared to identify their targets in plant due to redundancy and complexity of the system. The study of the impact of GALA effectors on plant cell is challenging but interesting. The group should focus strategy on a simplified biological situation to unlock the system. (i.e: role as such Avr in Medicago). The evolutionary studies are original and strategic for the group. The distribution of the Type III effectors among isolates/species is relevant both for identifying host specificity and the core effector set and minimal effector content. The experimental evolution is very interesting and of general relevance in the field. The identification of genes required for adaptation to new host or cultivars represent an ambitious project that has already proved feasible with promising results. This approach could answer important questions in relation to the prediction of durability of resistance/host range switches. In that respect an increase sharing of the evolutionary analyses with team 1 is recommended.

The team has been very productive (12 primary and 3 collaborative publications), with regular publications in high quality journals (2 PNAS, 1 PLoS One, 2 PLoS Pathogens). The outlook is excellent with one patent pending on diagnostic.

- ## Assessment of the influence, appeal and integration of the team or the project in its environment:

Five PhD students and 7 post-doc were/are present over the past four years showing the attractiveness of the group. The ability to raise funds and to successfully apply for competitive funding is excellent with 4 ANR grants, one CNRS-Maladies infectieuses projects. In addition this group has a good collaborative international network on Ralstonia and leads a national network on microbial/bioaggressor effectors.

- ## Project assessment :

The project for the four coming year is ambitious and original with both functional and evolutionary approaches that should deliver an interesting view on the role of effectors in bacterial pathogenesis. Based on the resources already developed they can expect the best output from their biological model. The team should increase its collaborations on the experimental evolution in bacteria within LIPM and with other labs, while continuing its well established collaborations with the LIPM team working on the plant side of the interaction.

- ## Conclusion:

This team has excellent research projects, is well funded and very productive, with an excellent record of publications and of PhD students tutoring. They have developed original and efficient combination of functional and evolutionary approaches to decipher the role of bacterial effectors in plant bacterial interactions.

— Strengths and opportunities :

The team has a good and original position in a competitive field and is on the leading edge of that field.

— Weaknesses and threats :

In regard to the small size of the team and to its ambitious project, there may be a need to define priorities. However this aspect has been until now properly managed since the group was highly productive during these past 4 years.

— Recommendations:

The committe recommends pursuing the dual strategies on functional and evolutionary approaches since they will bring an original and integrated point of view on bacterial effectors. The group needs to keep a good balance on both projects and try to develop its experimental evolution projects.

Team : "Adaptation and pathogenicity of Xanthomonas"

Team leader : Mathieu ARLAT

Staff members:	In the report	In the project
N1: Number of professors (see Form 2.1 of the unit's dossier)	2	2
N2: Number of EPST, *Établissement public à caractère scientifique et technologique* (Public scientific and technological institution) or EPIC, *Établissement public à caractère industriel et commercial* (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	4	2
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit's dossier)	2	1
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	2	1
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	0	0
N6: Number of doctoral students (see Form 2.8 of the report unit's dossier and 2.7 of the project unit's dossier)	3	2
N7: Number of persons accredited to supervise research and similar	4	3

• Assessment of work produced and scientific quality:

The team is composed of one professor and one assistant professor from the University Paul Sabatier, two scientists from CNRS and one engineer from INRA. The research of this team focused on the adaptation and the pathogenicity of the plant pathogen bacterium Xanthomonas. The team has two main research programs, one focused on the characterization of an avirulence gene specifically expressed in vascular tissues, the other on the identification of TonB- dependent transporters (TBDTs) involved in specific regulatory systems named CUT which is used for nutrient uptake by bacteria during infection. The first project based on functional analysis of an avr gene is not very original per se but the localization and the putative function of the protein is promising for the emergence of novels concepts in term of vascular immunity and protein post-translational modifications of plant proteins by avirulence proteins. The work on TBDTs/ CUT systems is promising and many exciting ideas are developed by the team. The results obtained over the past four years in comparative genomics opens routes for the functional analyses of novel functions and will deliver an interesting contribution of the mechanisms of bacterial adaptation to their environment.

The quantitative productivity of the team should be considered firstly by its size, which is relatively small, secondly in the light of the recent scientific switch of the team leader to this field (2003) and finally by the fact that the team leader is professor and play an important role in teaching. He is head of the Microbiology/Agroscience department at the present time. Therefore, the quality and number of publications are good with 4 primary and 1 collaborative publications, including 1 PLoS One article. During this period the team supervised the work of 3 PhD students and 2 post-docs.

Assessment of the influence, appeal and integration of the team or the project in its environment:

The impact of the team is good but could be improved. The team has developed a few but strong collaborations with national and international groups (in particular one good publication with a Chinese group). In the last four years, team members received 5 invitations to international congresses and 5 invitations to seminars. The team has welcomed one CR1 and recruited two post-docs and was successful in raising money (4 national grants). The fact that one young researcher will take the co-direction of the team will optimize efforts to exploit the scientific potential of the team. The team is well integrated in the LIPM through durable collaborations in genomics, bioinformatics, and molecular microbiology.

Project assessment :

The project is original and is appealingly linking metabolic pathways to the adaptation of pathogenic bacteria. However, the attractiveness and international profile of the team is currently not optimal and the primary aim should be to increase the scientific potential of this team based of the coming retirement of the assistant professor. Combining this recruitment with the recent arrival of a CR1 CNRS and the ongoing collaborations at the international and national levels with teams working on biochemical and structural biology would guarantee success. In addition a good coordination with the team “Resistance, susceptibility and cell death in Arabidopsis thaliana in response to bacterial pathogens” to achieve concerted approaches will gain more and more interest to this bacterial system in the coming years.

Conclusion:

In spite of the small size of the team, the two themes on functional analysis of an AVR gene and on TBDTs/ CUT systems produced important and original data which are promising for the project proposed by the team.

Strengths and opportunities :

The originality of the project, the ongoing collaborations at international and national levels combined with interactions with other LIPM teams is reinforcing the competitiveness of the team in this research field.

Weaknesses and threats :

The main weakness is that the team has not yet a critical mass to deal efficiently with all the raised research questions.

Recommendations :

Because of its small size, the team will have to structure ,well and to make priorities among its research questions raised for the two themes and to reinforce its collaborations in particular at the LIPM level to increase its publication level and its attractiveness.

Team : "Resistance, susceptibility and cell death in Arabidopsis thaliana in response to bacterial pathogens"

Team leaders: Dominique ROBY and Yves MARCO

Staff members:	Dans le bilan	Dans le projet
N1 : Nombre d'enseignants-chercheurs (cf. Formulaire 2.1 du dossier de l'unité)	0.5	0
N2 : Nombre de chercheurs des EPST	6	7
N3 : Nombre d'autres enseignants-chercheurs et chercheurs	0	0
N4 : Nombre d'ingénieurs, techniciens et de personnels administratifs titulaires	4	4
N5 : Nombre d'ingénieurs, techniciens et de personnels administratifs non titulaires (cf. Formulaire 2.6 du dossier de l'unité)	0	0
N6 : Nombre de doctorants (cf. Formulaire 2.7 du dossier de l'unité)	5	3
N7 : Nombre de personnes habilitées à diriger des recherches ou assimilées	4	4

- **Appreciation on the results :**

The research of the team is highly relevant and original. Researchers make use of unique pathosystems (Arabidopsis thaliana in combination with the bacterial pathogens Ralstonia solanacearum and Xanthomonas campestris pv. campestris) allowing them to find a niche in a very competitive field of research. The four themes of team's research are (i) pathogen perception using the PopP2/RRS1-R system; (ii) cell death (HR) control; (iii) quantitative resistance to Xanthomonas campestris pv. campestris; and (iv) plant susceptibility factors.

A combination of modern imaging techniques and interaction studies allowed nice progresses on the study of the PopP2 recognition complex. On the other hand, molecular genetics and transcriptomic studies combined with key collaborations on lipid signaling enabled deciphering the roles of lipids in AtMYB30-controlled cell death. The fine regulation of AtMYB30 through post-translational modifications was also successfully investigated. The recent development of natural variation studies to identify components underlying quantitative resistance to Xanthomonas campestris pv. campestris led to the identification of a new kinase, whose study should prove very interesting in the future. The role of cell wall integrity, as well as known regulators of meristem development, in susceptibility to Ralstonia solanacearum was revealed by a combination of forward- and reverse-genetic.

The team has an impressive scientific production over the last 4 years, with 11 primary publications including 1 FEBS Letters, 4 Plant Cell, 2 PlosONE, 1 Genes and Development, 1 Plant Physiology, and 2 Mol. Plant Pathology. This was complemented by 10 collaborative publications (including 3 Plant Journal and 1 PloS Pathogens).

- **Appreciation of the impact, attractiveness and the quality of its links with international, national and local partners:**

In the same period, 9 PhD theses were prepared, including 6 already completed. Most of the students who completed their PhD published a first-author paper in excellent journals, such as Plant Cell. Researchers of the team were invited to 12 international conferences and received 13 invitations to give a seminar, highlighting its international acknowledgement. The team is highly active and has recruited/welcomed: - 1 CR1 CNRS, 1 CR2 INRA, 1 MCU, but lost in the same time 1 CR1 INRA and 1 MCU. 5 post-docs were hired during the period, with only 2 currently remaining, but 2 new ones are expected in the next 2 coming years. The majority of the post-docs are foreigners.

The team has been extremely successful in obtaining competitive funding; especially national (9 ANR grants were obtained). A link with an industrial partner on the study of cell death control existed for 3 years, but concrete outputs of this collaboration are difficult to judge based on the information given in the report. No patent has been deposited by the team. Researchers from the team are members of several national and international consortia.

- **Appreciation of the project :**

The project will be based on the four research axes currently being pursued in the laboratory. Most of the projects are in continuity with previous and successful projects, and have adequate personal and financial support. They are also timely and relevant to the scientific community. The project on the functional analysis of the components of quantitative resistance is of great interest both at the fundamental and applied levels. The recent recruitment of a new permanent researcher for this project should foster this project. The involvement of RRS1 in resistance to multiple pathogens should also provide new research avenues. The project related to genes involved in both development and susceptibility appears to be of lower priority.

- **Conclusion :**

The study of resistance, susceptibility and cell death in response to pathogens is a highly competitive field of research. The team has demonstrated its expertise in this field and is extremely well positioned to develop the scientific projects proposed for the next period.

— Strengths :

The team is highly competitive in term of publications, attractiveness and in obtaining funding. It participates to a very efficient scientific cluster and develops a partnership with a private company.

— Weaknesses :

Out of the 5 post-docs, only 2 published a first-author publication, and most of them moved to another post-doc, while 1 became technician and one is unemployed. The quality of the recruited post-doctoral researchers or the feasibility of the corresponding projects should be improved.

— Recommendations :

The committee suggests to put a stronger emphasis on the quantitative resistance project, in particular in the functional analysis of the identified components, since there is an increasing interest for such topic and its possible application in agro-biotechnology. The study of RRS1 and its pathway is also a very interesting project, but the team needs to take in consideration the increasing competition in this field.

Team : “Genetics and genomics of abiotic and biotic stress responses of sunflower”

Project leader: Patrick VINCOURT

Staff members	Past	Future
N1: number of researchers with teaching duties	0	0
N2: Number of full time researchers from research organizations	3	3
N3: Number of other researchers including postdoctoral fellows	1	1
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	4	4 + 2.5*
N5: Number of other engineers, technicians and administrative staff		
N6: Number of Ph.D. Students (Form 2.7 of the application file)	1	1
N7: Number of staff members with a HDR or similar grade	1	1

* Anticipated development

- **Appreciation of the results:**

At the request of INRA, this group was created in 2006 to develop genomic and genetic studies on sunflower in relation to biotic and abiotic stresses, with the aim to apply the results in an agro-economic context. Since its creation the group has been expanded by the recruitment of several staff members with very good-excellent track records, providing a scientific environment of high potential. In collaboration with teams within and outside the LIPM, the group has developed several tools (collections and databases) that are essential prerequisites for studying sunflower genetic, genomic and transcriptomic.

In collaboration, the group leader has published a first paper on genetic resistance of sunflower to downy mildew, testifying the emerging position of the group in this field.

• Appreciation of the impact, the attractiveness of the team and the quality of its links with international, national and local partners:

The group has quickly reached a sufficient size, has obtained four research contracts, and is actively collaborating both nationally and internationally.

• Appreciation on the strategy, management and life of the team:

The group leader has a strong track record in R&D management in the seed industry. He has proved to be able to create a strong group with efficient collaborations, which holds much promise for the future.

• Appreciation of the project:

The group is highly ambitious in aiming to proceed over a broad front: studying both the substantial genetic variation in sunflower for tolerance to drought, and the characterization of mainly quantitative resistance to the downy mildew oomycete Plasmopara halstedii, as well as genes involved in resistance to the Phoma macdonaldii. To this end, the group is collaborating effectively with the LIPM Informatics & Bioinformatics Platform (development of the HELIAGENE portal), largely supported by outside funding and notably from industry. Private companies are involved in most aspects of the project. The organization and management of the various lines of research appears well conceived and guarantees a good chance of success.

• Conclusion:

The group has made a good start but has still to prove itself within the environment of the LIPM. The project is broad but well conceived, while being heavily dependent on various types of collaboration.

— Strengths and opportunities:

This is a group with high-potential scientists and technicians. New recruitments are foreseen in the next four years to ensure efficient progress. Bioinformatics facilities are available within the LIPM. The group leader is able to develop an extensive research program with collaborators at the national and the international level and strong support from private companies. The group should take full advantage of the facilities and expertise within the LIPM.

— Weaknesses and threats:

The individual lines of research are quite diverse and could easily diverge into different directions if not well managed. So far, the connections with other groups within the LIPM are limited. For their experiments, the researchers are currently entirely dependent on facilities of collaborators elsewhere. It is of utmost importance that facilities necessary to carry out research at the LIPM will not be delayed.

— Recommendations:

For the moment the group should concentrate on the further development of genetic tools in order to efficiently conduct the genetic characterization of a limited number of biological traits (drought tolerance and resistance to downy mildew), and also on the phenotyping processes, notably bioassays to quantify levels of disease. In addition, the group should promote its own visibility within the LIPM by cooperating with other teams, and outside by “advertising” their unique position as a unit devoted entirely to sunflower genetics.

Note de l’unité	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l’environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	**A+**	**A+**	**A**	**A+**

Nom de l’équipe : *SYMBIOTIC FUNCTIONS, GENOME AND EVOLUTION OF RHIZOBIA*

Note de l’équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l’environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	*A*	*A+*	*non noté*	*A+*

Nom de l’équipe : *RESPONSES TO STRESS AND ENVIRONNEMENTAL SIGNALS IN RHIZOBIA*

Note de l’équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l’environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A	*A*	*B*	*non noté*	*A*

Nom de l’équipe : *CELLULAR DYNAMICS AND REGULATION OF SYMBIOTIC INFECTION AND OF NODULE DEVELOPMENT*

Note de l’équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l’environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	*A+*	*A+*	*non noté*	*A+*

Nom de l'équipe : *SYMBIOTIC SIGNALS AND THEIR PERCEPTION/TRANSDUCTION*

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	*A*	*A+*	*non noté*	*A+*

Nom de l'équipe : *RALSTONIA PATHOGENICITY DETERMINANTS AND THEIR PLANT TARGETS*

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	*A+*	*A+*	*non noté*	*A+*

Nom de l'équipe : *ADAPTATION AND PATHOGENICITY OF XANTHOMONAS*

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
B	*B*	*B*	*non noté*	*A+*

Nom de l'équipe : *RESISTANCE, SUSCEPTIBILITY AND CELL DEATH IN ARABIDOPSIS IN RESPONSE TO BACTERIAL PATHOGENS*

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
A+	*A+*	*A+*	*non noté*	*A+*

Nom de l'équipe : *GENETICS AND GENOMICS OF ABIOTIC AND BIOTIC STRESS RESPONSES OF SUNFLOWER*

Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
non noté	*non noté*	*non noté*	*non noté*	*A*

LABORATOIRE DES INTERACTIONS
PLANTES MICRO-ORGANISMES

LIPM - UMR INRA / CNRS
441 / 2594

OBSERVATIONS DE PORTEE GENERALE SUR LE RAPPORT D'EVALUATION DE L'AERES

1. General comments concerning the AERES report.

The LIPM appreciates that the committee has underlined the following points:

- "*The high number of high quality publications*" and the "*scientific breakthroughs*" achieved by the laboratory during the past 4 year period, as well as the good quality of collaborations and private partnerships.
- The investment of the LIPM in teaching, reflected by the number of PhD students (21), the significant contribution of the teaching staff (although few), and the very active role of LIPM members in the Doctoral school SEVAB.
- The importance of "*the shared resources/platforms*" in the successful functioning of the LIPM, which will be maintained and improved during the future 4 year period. Indeed the LIPM wishes to emphasize (i) the critical role played by the two LIPM platforms, respectively dedicated to microscopy/imaging/cell biology and informatics/bioinformatics; (ii) the major investment of several LIPM groups in the development of genomic or genetic resources for *Medicago*, sunflower, *Ralstonia* and *Xanthomonas* species, over and above the major experimental results obtained.
- The severe limitation in the development of the LIPM resulting from the shortage of laboratory space and key facilities (e.g. plant growth chambers). The future Direction intends to make requests to the funding organisations in order to resolve these limitations. The current and the future Direction also totally agree with the fact that it is of utmost importance that the planned facilities to welcome Patrick Vincourt's team will not be further delayed.

Regarding the description of the LIPM scientific activity, the words "bacteria" and "bacterial" (eg. *bacterial symbiosis and pathogenicity* and *plant-bacteria interactions*) are often used. In fact the term "microbe" would be more appropriate since the LIPM is also actively working on AM symbiotic fungi and on interactions with pathogenic oomycetes or fungi. Replies to some comments specifically related to individual teams can be found in the section 3.

Finally the LIPM notes two points that are missing in the evaluation report:

- the conclusions drawn from the various meetings organised between the AERES committee and the different categories of LIPM personnel: technical staff, permanent and non-permanent research staff.

- the outcome of the meeting of the committee with the representatives of both INRA and the CNRS.

2. Reply to the recommendations to the head of the research unit (page 5)

I. "Stimulate collaborations between teams using different tools. The development of discussion groups on transversal topics leaded by scientists independently of team organization is a good start"

With reference to point 1 of the 2011-14 scientific project:

In addition to developing regular exchanges between scientists working on different research topics *via* a number of shared (transversal) scientific and technical themes, it should be underlined that the principal proposal is to structure the entire laboratory (4 groups each) around the two main research topics of the LIPM "Plant-Pathogen-Environment Interactions" and "Root Endosymbioses". Scientific discussions will be organised by elected "animateurs" from each of the topics. This new organisation, referred to in the section "Strengths and Opportunities" as "positive ongoing organisation evolution", aims to reinforce the overall scientific communication between the LIPM research groups, an objective of particular importance for the new Direction team.

II. " Improve collaborations with nearby plant science UMR SCSV as exemplified by the existing collaboration on the identification of the Myc factors "

There are indeed a number of excellent collaborations between groups from the LIPM and SCSV, and these will of course be encouraged in the future. Having said this, the LIPM has also developed collaborations with all the IFR40 units, as well as other research groups in Toulouse. In particular, fruitful interactions with the EDB, based on novel ecological and evolutionary approaches for the LIPM, will be strongly encouraged during the next 4 years. In this context, we would like to draw attention to the major role played by the IFR40 in promoting inter-unit collaborations, as well as the contribution of the LIPM to the IFR Direction and its current evolution.

Concerning the question of the possible association between the LIPM and SCSV, a subject of regular and lengthy discussion within both units, we would like to make the following comments:

- These two research laboratories were co-founders of the IFR40 in 1996 and are neighbours on the INRA campus since 1999 (and not recently as suggested on page 3 of the AERES report).
- As a result, the two units already share the facilities of the IFR technical platforms and other common equipment.
- Furthermore, their visibility is already excellent at the local, national and international levels both individually and through the IFR.

As a result, we do not consider that there is any obvious advantage in re-structuring the two units as a TGU, which in addition would lead to a major imbalance between the current IFR40 members.

3. Reply to appreciation team by team

Team "Symbiotic functions, Genome and Evolution of Rhizobia"
Team leaders: Jacques BATUT and Catherine MASSON-BOIVIN

1. "Experimental evolution of a plant pathogen into a legume symbiont" should have been considered as one of the breakthroughs of LIPM. This work has indeed been published in PLoS Biology (2010, doi:10.1371/journal.pbio.1000280) as mentioned during the committee visit and highlighted since then in PLoS Biology (2010, doi:10.1371/journal.pbio.1000279), Nature Microbiology Reviews (2010 8(3): 157), Nature Genetics (2010 42(3): 195), Today's Science (February 2010) and Genome Biology (to appear). Hence this project that was started in the group more than four years ago has already been recognized as one of the highlights in the field by the international community.

2. Weaknesses and Recommendations(p10)
The group would like to emphasize that it already has established strong interactions with other bacterial and plant groups at LIPM, including:
- the GENIN-BOUCHER team (ACI Microbiologie 2003-2006. Ralstonia as a model to investigate common genetic functions required for pathogenesis and symbiosis. Coordinator C. Masson-Boivin, 60 k€). We apologize this contract had indeed been omitted in our report.
- the BRUAND and GAMAS teams, via the transversal SYMbiMICS ANR project (2009-2011) to which we contribute very actively
- more recently the CULLIMORE-GOUGH team. A joint ANR application around the cAMP project has been deposited in January 2010.

These two last collaborations were explicitly mentioned during our evaluation talk.

Team : « Symbiotic signals and their perception/transduction »
Team Leaders: Clare GOUGH and Julie CULLIMORE

Quality and stability of partnerships (p6)
It could be concluded from the evaluation report that the identification and analysis of Myc factors has been carried out with more than one private company. This is not the case.

Assessment of the influence, appeal and integration of the team or the project in its environment
"*The team has been active in establishing a large number of scientific collaborations……. as well as industrial collaborations to exploit the agricultural use of Nod and Myc factors as exemplified by the increasing use of Nod factors in agriculture in North and South America*"
We wish to point out that Myc factors have not yet been exploited in agriculture and underline that the identification of the structure of Myc factors has involved an industrial collaboration.

Project assessment
"*Such genetic screens will therefore rely on external collaborations that seem to be already in place*"

We wish to point out that genetic screens are also being performed directly by the team.

Team “Resistance, susceptibility and cell death in *Arabidopsis thaliana* in response to bacterial pathogens”

Team leaders: Dominique ROBY and Yves MARCO

We are very thankful to the committee members for their positive and useful comments about our research activities. We would like however to comment some specific points:

"The team is highly active and has recruited/welcomed: - 1 CR1 CNRS, 1 CR2 INRA, 1 MCU, but lost in the same time 1 CR1 INRA and 1 MCU."

Concerning the MCU, Catherine Riou was "delegated" by the University of Limoges for a period of 2 years. More generally, we would like to emphasize that personnel mobility is a positive factor (even in France) for the life and project advances of research groups.

"A link with an industrial partner on the study of cell death control existed for 3 years, but concrete outputs of this collaboration are difficult to judge based on the information given in the report."
Two collaborative projects with industrial partners are being pursued, and for both of them, there will probably be fruitful outputs in the next future. Concerning the AtMYB30 project in collaboration with Clause, Villemorin and Biogemma, transgenic plants of agronomical interest have been generated and are under analysis. For the Sclerotinia project in collaboration with Biogemma, a paper is now in press (Perchepied, Balagué et al., MPMI in press) and the collaboration is still active.

"Out of the 5 post-docs, only 2 published a first-author publication, and most of them moved to another post-doc, while 1 became technician and one is unemployed. The quality of the recruited post-doctoral researchers or the feasibility of the corresponding projects should be improved."
One should consider that a two year period for post-doc is often insufficient to produce high level papers and their project is generally pursued by other team members, which explains the delay between their departure and publication of their work. Concretely, concerning the 5 mentioned post-docs, all have papers either published, submitted, or in preparation.

"The committee suggests to put a stronger emphasis on the quantitative resistance project, in particular in the functional analysis of the identified components, since there is an increasing interest for such topic and its possible application in agro-biotechnology. The study of RRS1 and its pathway is also a very interesting project, but the team needs to take in consideration the increasing competition in this field."

We are fully aware of the increasing international competition on projects of high/general interest such as quantitative resistance, cell death regulation, pathogen perception or susceptibility factors.

In the coming years, we will adjust our human potential according to the evolution of these different projects. Research is indeed a dynamic process!

Team “Genetics and genomics of abiotic and biotic stress responses of sunflower”
Project leader: Patrick VINCOURT

The "sunflower" group is twice described (p4 and p8) as dedicated to plant breeding, whereas in fact this team aims to generate both fundamental knowledge and tools, including the identification of genetic resources of interest, with the purpose of the genetic improvement of sunflower.

Pascal Gamas, Directeur du LIPM

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