LIPM - Laboratoire des intéractions plantes - microorganismes

Rapport Hcéres

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HCERES

High Council for the Evaluation of Research and Higher Education

Research units

HCERES report on research unit:

Laboratoire des Interactions Plantes-Microorganismes

LIPM

Under the supervision of the following institutions and research bodies:

Institut National de la Recherche Agronomique - INRA

Centre National de la Recherche Scientifique - CNRS

Evaluation Campaign 2014-2015 (Group A)

HCERES

High Council for the Evaluation of Research and Higher Education

Research units

In the name of HCERES,[1]

Didier HOUSSIN, president

In the name of the experts committee,[2]

Cyril ZIPFEL, chairman of the committee

Under the decree N°.2014-1365 dated 14 november 2014,

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

[2] The evaluation reports "are signed by the chairman of the expert committee". (Article 11, paragraph 2)

Evaluation report

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

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

Unit name:	Laboratoire des Interactions Plantes-Microorganismes
Unit acronym:	LIPM
Label requested:	Unité Mixte de Recherche
Present no.:	UMR 2594/441 CNRS/Inra
Name of Director (2014-2015):	Ms Dominique ROBY
Name of Project Leader (2016-2020):	Mr Claude BRUAND

Expert committee members

Chair:	Mr Cyril ZIPFEL, The Sainsbury Laboratory, United Kingdom
Experts:	Mr Emanuele BIONDI, CNRS Lille
	Mr Alain FILLOUX, Imperial College London, United Kingdom
	Mr Thierry HEULIN, CNRS Cadarache
	Mr Herman HOFTE, INRA Versailles
	Ms Franziska KRAJINSKI-BARTH, Max Planck Institute of Molecular Plant Physiology, Golm, Germany
	Mr Martin PARNISKE, University of Munich, Munich, Germany
	Mr Christophe ROBAGLIA, Université d'Aix Marseille (representative of the CoNRS)
	Ms Laura ROSE, Heinrich-Heine-Universität, Düsseldorf, Germany

Scientific delegate representing the HCERES:

Mr Steven BALL

Representatives of the unit's supervising institutions and bodies:

Ms Carole CARENTA, INRA, BAP

Mr Thierry GAUDE , CNRS, INSB

Mr Christian LANNOU, INRA, SPE

Mr Claude MARANGES (head of the SEVAB Doctoral School n°458)

1 • Introduction

History and geographical location of the unit

The Laboratoire des Interactions Plantes Micro-organismes (LIPM) was created in 1981 and is located on the INRA campus in Auzeville.

The LIPM is a joint research unit (UMR) between the CNRS [Institutes of Biological Sciences (INSB) and Ecology & Environment INEE)] and INRA [Divisions of Plant Health & Environment (SPE) and Plant Biology & Breeding (BAP)]. The LIPM is major actor within the local Research Federation (FR 3450 or FR AIB, Agrobiosciences, Interactions, Biodiversity; ex IFR 40) and within the LabEx TULIP, which bring together the main plant biology and ecology laboratories in the Toulouse area; the majority of them being located on the INRA campus in Auzeville.

The LIPM staff currently comprises 44 full-time researchers (chargés de recherche, directeurs de recherche and directeur de recherche émérite) (21 INRA, 18 CNRS and 5 professors/assistant professors), 50 full-time technical staff (32 INRA, 17 CNRS, 1 Agri-obtention), 15 PhD students, 10 postdocs and 22 long-term 'CDD' technical positions. Notably, although not all linked to the university, 5 staff members are from teaching institutions (Paul Sabatier University, INSA and INP-ENSAT). During the evaluated period, the permanent staff has increased by a total of 8 people, mainly due to the arrival of several additional INRA research staff.

The average annual budget of the LIPM is 3-3.5 million €.

Management team

Since 2011, the LIPM has been directed by Ms Dominique ROBY, assisted by Mr David BARKER and Mr Stéphane GENIN as Deputy Directors. The management team is assisted by the Laboratory Council, the Scientific Council, the Team Leader Council that meet regularly. A general assembly is also organized twice a year.

There are 9 research teams at the LIPM; all of which operate independently and are led by one or two group leader(s). The LIPM also hosts a platform of Informatics & Bioinformatics led by Mr Jérôme GOUZY.

From 2016, the proposed new management team will be composed of Mr Claude BRUAND as Director, and Ms Susana Rivas and Mr Stéphane GENIN as Deputy Directors.

HCERES nomenclature

Sous domaine: AEE

Sous domaine principal: SVE1-LS6

Sous domaine secondaire: SVE1-LS2; SVE2-LS8

Unit workforce

Unit workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions	5	4
N2: Permanent researchers from Institutions and similar positions	38	35
N3: Other permanent staff (without research duties)	50	49
N4: Other professors (Emeritus Professor, on-contract Professor, etc.)		
N5: Other researchers from Institutions (Emeritus Research Director, Postdoctoral students, visitors, etc.)	1	1
N6: Other contractual staff (without research duties)	32	26
TOTAL N1 to N6	**126**	**115**

Unit workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	14	
Theses defended	32+3 (E9)	
Postdoctoral students having spent at least 12 months in the unit	15	
Number of Research Supervisor Qualifications (HDR) taken	9	
Qualified research supervisors (with an HDR) or similar positions	33	

2 • Overall assessment of the unit

Global assessment of the unit

The LIPM is a research unit devoted to the study of the plant-microbes interactions, with a special emphasis on root endosymbiosis and the interaction between plants, their pathogens and their environment. The scientific production of the LIPM during the evaluation period is excellent and without doubt places the LIPM as one of the top French plant sciences institutes. A significant number of LIPM groups are also recognised world leaders in their field, which contributes to the excellent visibility of the unit internationally. The LIPM has an excellent interaction with the socio-economic world with a high number of contracts with industry. A significant number of patents have also been filed during the evaluated period. The management and organisation of the LIPM has been outstanding with a strong and visionary leadership, clear research themes, an active recruitment policy, and a good internal communication. Although not a joint-unit with any university, the LIPM hosts teaching staff from different teaching institutions and other staff members are also actively involved in post-graduate teaching. In addition, as expected from an active research institute, the LIPM is training a large number of Master and PhD students, as well as a significant number of postdocs. As such, their involvement in training through research is excellent.

Strengths and opportunities in relation to the context

The LIPM is a center of excellence perfectly located within the INRA campus of Auzeville. This offers a lot of unique potential collaborations that surely contribute to the competitiveness of the LIPM. For example, the LIPM is actively involved in the Research Federation (FR 3450 or FR AIB, Agrobiosciences, Interactions, Biodiversity; ex IFR 40), and the LIPM director, Ms Dominique ROBY, has been the co-initiator of the LabEx TULIP, and is now co-coordinating it. Building on a number of collaborations between LIPM teams, but also with groups from nearby institutes (such as the LRSV), the LIPM is very well positioned to attract significant public, as well as private funding. In addition, this local integration of different scientific units with distinct yet overlapping interests helps to increase the international visibility of the LIPM for recruitment. Also, while the LIPM can certainly rely on a long historical know-how in the study of the interaction (whether pathogenic or symbiotic) between plants and microbes, the LIPM has also successfully built on these partnerships to seize new opportunities that now see the LIPM further integrating evolutionary ecology approaches, developing quantitative and associative genetics, and studying the impact of an ever-changing environment on plant diseases and/or symbioses. These aspects are necessary to link biology with ecology; something that is required for a modern agriculture; and therefore will help the LIPM to continue achieving excellent fundamental research (which is core to its mission) while at the same time further interacting closely with the private sector.

Weaknesses and threats related to the context

The LIPM is publishing a large quantity of peer-reviewed articles, but only a small proportion is published in international generalist journals. This may be related to the reduction of the PhD period to 3 years with obligation to publish, which may cause premature publication of results at the detriment of articles with higher impact. Also, the number of students and postdocs is quite low (but in line with the French system), when compared to other research institutes in Europe or internationally. Therefore, the research capacity of some teams mostly composed of senior permanent staff members may not be optimal, which can cause a disadvantage; especially when working on competitive and fast-moving research topics. The LIPM is also seriously hampered by a significant lack of space for laboratories and offices. This last point is particular concerning as it affects the working conditions of current staff members, but also hinders the expansion of successful groups/teams when awarded large competitive grants, as well as the installation of potential new groups. A major current threat is also the lack of a team leader for the team “Genetics and genomics of abiotic and biotic stress responses of sunflower”, following the retirement of the previous one.

Recommendations

Because the unit has the human, financial and scientific capacity to be an outstanding international institute, the LIPM should further strive to increase the impact and visibility of the science in all the research teams by re-enforcing a culture of excellence. This could be done by persevering at going through high-impact journals.

The LIPM management should pro-actively encourage junior and senior scientists to apply for large and competitive funding (e.g. ERC, HSFP).

The LIPM management should pro-actively hunt for potential/new talents and attract them at LIPM. Linked to this recommendation, the LIPM should become more attractive to foreigners.

Given the permanent nature of the employment, staff scientists should dare more ambitious projects, and not necessarily projects that will only lead to incremental small increases in our knowledge.

While fundamental research must remain excellent to outstanding at LIPM, a pro-active strategy to work more on crops should be implemented. This is important to resolve crop-specific problems and to help securing funding, but also to provide better job opportunities for staff.

A logical extension of the crop portfolio investigated at the LIPM would be crop legumes of French and European relevance, such as pea. This would be the ideal translational extension of the strong programme on biological nitrogen fixation and would be in accordance with INRA’s mission towards a more sustainable agriculture, the goal that motivated the investment into biological nitrogen fixation in the first place.

As already done in some, but not all teams, the panel would recommend to rejuvenate the research teams from the bottom by promoting young team leaders.

The panel recommends that there is improved communication/collaboration between the teams within LIPM, but also with the groups working on root symbiosis at the nearby LRSV unit. This could be achieved via structural measures (e.g. joint lab meetings) and should be catalysed by new team leaders to avoid potential historical biases.

The LIPM management should improve mentoring of the students, and also increase the motivation of non-permanent staff.

A novel team leader with strong scientific and management leadership for the sunflower team should be recruited as soon as possible.

3 • Detailed assessments

Answer to the request from INRA of comments on developing ecology, evolution and population approaches at the LIPM:

Many independent teams within the LIPM have recently initiated projects that incorporate innovative, evolutionary approaches: e.g. i) comparative genomics of *Xanthomonas*, sunflower, etc. ii) experimental evolution of pathogens and symbionts on plants.

The bioinformatic platform has been instrumental in supporting the management of the genomic information and locating the novel mutations in the genomes of microbes. However, there are some aspects in these projects that cannot be addressed through collaborations with the bioinformatic platform alone. For example, prior to the design of the experimental evolution study on *Ralstonia*, the team contacted ecologists at the University of Toulouse for advice. The team acknowledged that the input from the ecologists helped them to design the best possible experiment. This is one indication that the LIPM could benefit from strategic hiring in the area of evolution and ecology.

The recent mobility of the leader of Team 9 and two PhD students, was reported by multiple scientists within the LIPM to be a positive development. However, one group alone cannot be expected to cover all the demands in this area. In the upcoming years, targeted recruitment of additional evolutionary geneticists would strengthen the LIPM. There are a number of top labs training such biologists worldwide. The scientist would ideally have expertise in population genetics, quantitative genetics, evolutionary genomics and have some experience working with crop species.

Answer to the engagement letter from the INSB (CNRS):

Translation of the relevant paragraph from the CNRS engagement letter:

"In the case of UMR 2594 and in addition to the general points summarized above, we would like that the HCERES review panel addresses the following specific issue. This laboratory is located a few yards away from the UMR 5546 (LRSV) headed by Mrs Elisabeth JAMET. Scientific collaborations and common equipment requirements exist between several teams within these two laboratories (for example culture space, greenhouses and greenhouse attendants). In addition to this a Research Federation (a higher order grouping of individual labs within a single geographical site) already exists within which both laboratories already quite actively interact. The INSB would like the panel to examine if a better and more common organization of technical, space and human resources could be implemented in the context of the 2016-2020 research project."

Two distinct HCERES evaluation committees have visited respectively the LRSV (UMR 2594; Nov 24-25) and the LIPM (UMR 5546; Nov 27-28) on the Castanet-Tolosan site. Two persons among the experts (Ms Franziska KRAJINSKI and Mr Herman Höfte) have attended both committees.

LRSV is a 'Unité Mixte de Recherche (UMR)' CNRS - University Paul Sabatier and LIPM a UMR CNRS - INRA. The two laboratories are located together with a third laboratory 'Genomics and biotechnology of fruit (GBF)' in two interconnected buildings. A fourth laboratory, the French Plant Genomic Resource Center (CNRGV) is also present closeby on the Castanet-Tolosan site. All four laboratories are part of the FR3450. The latter two laboratories have not been evaluated by either of the two committees and will not be considered here.

***Some observations*:**

The following observations are based on the evaluation reports 2009-2014 for the LRSV and the LIPM and discussions with members of the two laboratories.

Scientific topics: there is considerable proximity/overlap between the two laboratories with respect to the research topics. Some examples:

- Endomycorrhizal symbiosis is studied by group 5 in LRSV and group 3 and 4 in LIPM.
- Group 4 in LRSV and group 3 in LIPM study Ca2+ signalling.
- Group 1 in LRSV studies cell wall proteins including those involved in plant microbe interactions in collaboration with group 6 in LIPM. Group 6 in LRSV studies plant immunity and effectors, like several groups in LIPM.
- Not surprisingly half of the ANR contracts of the LRSV are collaborative projects with LIPM. On the other hand, 20 % of the LIPM ANR contracts are collaborative projects with the LRSV and 8 % with EDB (a more recent member of the FR AIB). In addition, 24/171 (14 %) articles of LRSV have shared authorship with LIPM scientists

whereas 24/325 (7 %) of the LIPM articles have shared authorship with LRSV scientists. Thus, although a significant proportion of the interunit collaborations within the FR 3450 are between LIPM and LRSV, the relative importance of these varies somewhat for the two research laboratories.

Comments:

It occurred to the committees as odd to have on the same site, in two connected buildings, two independent laboratories that work to a large extent on related topics and which both are associated to the 'Institut de Sciences Biologiques (INSB)' of the CNRS. From an outside perspective, the creation of a strong plant center, could potentially boost the overal scientific impact, attractiveness and the local, national and international visibility of the Castanet-Tolosan campus. It also would allow administrative simplification, a better use of infrastructures, finances and human resources. Finally, synergy might also be expected by a better spreading of the EC over the two research units allowing a smoother integration of research and education and a better access to PhD students. The FR and the LABEX structures already fulfill part of these goals through the sharing of equipment and platforms, scientific programing, partnership with the private sector and outreach, but have the disadvantage of adding additional layers of administrative complexity.

In theory, many options exist to promote a better integration of plant research on the site. Possible solutions could range from maintaining the current configuration while trying to further promote scientific exchanges (this was a request from the PhD students and postdocs in one of the units); through the creation of different units with distinct identities (e.g. with a focus on academic excellence vs translational research); to the plain merger of 2 or more units. However, merging laboratories with a long history of cohabitation but with strikingly different cultures is a delicate process and would require the adhesion of a large majority of the members of the laboratories involved.

Assessment of scientific quality and outputs

Research at the LIPM is organised into two main axes: "Root endosymbioses" comprised of 4 groups, and "Plant-pathogen-environment interactions comprised of 5 groups. During the evaluated period, two groups (Mr David BARKER and P. Gamas) have merged into single group. Also, the group formerly co-led by Mr Stéphane GENIN and Mr Christian BOUCHER is now managed by Mr Stéphane GENIN alone following the retirement of Mr Christian BOUCHER. Notably, a new team ("Ecological genomics of adaptation in plant communities") led by Mr Fabrice ROUX (CNRS, previously at the University of Lille) has started at the LIPM in 2013 with a junior package from the LabEx TULIP.

The LIPM has historically focused its research on the models *Arabidopsis thaliana*, *Medicago truncatula* and tomato on the plant side, while focusing on the models *Ralstonia solanacearum*, *Sinorhizobium meliloti* and *Xanthomonas campestris* pv. *campestris* on the bacterial side. However, while maintaining these 'classical' models, several groups have now expanded their horizons by starting to work or expanding previous work on other relevant plant and pathogen models, such as sunflower, *Brachypodium distachyon*, cabbage, pea, soybean, wheat, *Plasmopara halstedii*, *Sclerotinia sclerotiorum*, *Cupriavidus taiwanensis*, for example. These investments will allow LIPM to tackle novel important biological questions, but also to apply for a wider range of funding, including with industry. In addition to diversifying models, the LIPM has seen a shift from 'classical' molecular studies to the integration of evolutionary ecology and quantitative genetics approaches, both of which have already been fruitful in term of publications, funding (e.g. ERC) and recruitment.

The LIPM during the evaluation period has produced a total of 325 publications with an average impact factor of 6.9, and with over 50 % of these publications in journals with an impact factor higher than 5. Importantly, some breakthrough papers were published in top journals (e.g. Nature, Science, PLoS Biology). Notably, a large number of patents (10) were also filed during the evaluation period. Despite an impressive number of publications, and as mentioned in the general recommendations, LIPM researchers should however try to run the 'extra mile' to push their publications to the very best journals more regularly and as corresponding authors, which is still not so often the case.

Short appreciation on this criterion

The scientific production of the LIPM during the evaluation period has been excellent. There was a clear increase in the number and impact of the publications, when compared to the previous evaluation period, and a few breakthrough papers were published. The unit has the potential to be outstanding though, and the LIPM management should do its best in the future to infuse a strict policy of excellence to staff.

Assessment of the unit's academic reputation and appeal

The LIPM is involved in a large number of contracts at the international, national and local level. Of particular note, LIPM researchers have been very successful at attracting ANR funding over the evaluated period (> 12 millions €), and have achieved a success rate of over 35 % for the period 2013-14 with the ANR, which is well above the national average. Importantly, a newly recruited permanent scientist in team E7 has been awarded a prestigious and competitive ERC Starting grant. A significant number of contracts also exist with industry. Importantly, two structuring 'Investissement d'Avenir projects' led by LIPM scientists were funded during the evaluation period: the LabEx project TULIP ("Toward an unified theory of biotic interactions: role of environmental perturbations"; 9 M€) and the project SUNRISE (7 M€).

A large number of published articles involved authors from at least two LIPM groups, and several publications were also obtained in collaboration with other laboratories based in Toulouse (56), nationally (86), or internationally (93).

LIPM scientists are regularly invited to national and international conferences. However, the number and frequency of the latter could be higher. There is also a large discrepancy between different groups in this respect.

Many LIPM scientists are involved in the decision-making and recruitment committees at the local and national level. Most senior LIPM scientists are actively engaged in reviewing manuscripts for specialised journals, but only a small number are members of editorial boards.

The LIPM only hosts a small number of foreign postdocs or PhD students. However, certain groups seem to have established successful collaboration with laboratories/universities abroad (e.g., China), which has helped increasing this number recently.

During the period evaluated, a total of 9 permanent scientists have been recruited, while 3 left. Also, the LIPM has attracted a new group leader financed by a junior package from the LabEx TULIP. This clearly represents a positive dynamics, which would hopefully continue. The LIPM management should however try to identify pro-actively international candidates to recruit them as group members or even group leaders.

Short appreciation on this criterion

The reputation and appeal of the LIPM are excellent, but its international visibility and attractivity should be improved. This could be for example achieved by engaging more pro-actively in participating to international conferences, and eventually in organizing a major international conference on a LIPM-related topic.

Assessment of the unit's interaction with the social, economic and cultural environment

Thanks to its strong scientific reputation and to the high relevance of the biological problems studies, the LIPM has been very successful at establishing contacts and securing contracts with industry (> 4 M€). In addition, 10 patents have been deposited during the period evaluated. Of particular note is the LIPM 'success story' on the use of LCOs produced by symbiotic micro-organisms to improve yield and stress tolerance in crops. In addition, the project SUNRISE brings together a number of industrial partners together with LIPM researchers working on sunflower. Many LIPM groups have listed partnership with the private sector and are now expanding their work from model organisms to relevant crops and/or pathogens.

A number of LIPM members frequently contribute to events aimed at communicating science to the general public, including to the yearly "Fête de la Science" and an open day that took place in 2013.

Short appreciation on this criterion

The interaction of the LIPM with the social, economic and cultural environment is excellent. It will be interesting in the future to assess how the large number of patent from LIPM will impact the private sector, and how more recent projects on crops and relevant pathogens will develop.

Assessment of the unit's organisation and life

The LIPM is currently composed of 9 research teams divided into the research axes: "Root endosymbioses" (4 teams), and "Plant-pathogen-environment interactions" (5 teams). This organization is coherent with the scientific mission and interests of the unit, and seems to work well thanks to clear transversal activities and regular internal

and external seminar series. A long-lasting philosophy of the LIPM is also to pool and share financial resources, which seems widely appreciated by all staff. A number of committees are also in place to take decision and to ensure open communication; this includes a Laboratory Council, A Scientific Council, a Team Leader Council, and a bi-annual General Assembly.

Short appreciation on this criterion

As with every research institutions, certain things can always be improved, but based on the feedback received by many staff member, it is fair to conclude that LIPM is oustandingly managed.

Assessment of the unit's involvement in training through research

All PhD students are affiliated to the SEVAB (ED458) doctoral school of the University of Toulouse. Lab members participate in the "Conseil de l'Ecole Doctorale". Several lab members also participate to Master 2 teaching in Toulouse (M2R BioSciences Végétales, M2R Microbiologie, M2P Diagnostic Microbiologique) and in other Universities. The lab appears regularly successful in the "concours de l'école doctorale". About 36 students (mostly from France) have completed their PhD at LIPM during the evaluation period. Twenty undergraduate students have also been trained. The follow up of the PhDs is done in partnership with the Doctoral School. The LIPM hosts one professor from the Toulouse University and 4 assistant professors, from the University and from engineer schools (INSA, ENSAT). Through the LabEx TULIP the LIPM is regularly organizing summer schools for international students.

Short appreciation on this criterion

Under this criterion the LIPM is excellent. The LIPM interaction with the doctoral school SEVAB is excellent and the unit is regularly attracting new PhD students from this doctoral school. However there is little initiative from the lab to attract foreign students to present them at the "external concours". Another point that can be improved is the training of PhD students through lab-specific initiatives such as the opportunity to meet with seed industry representatives who are already connected to the LIPM through various research projects.

Assessment of the strategy and the five-year plan

The proposed five-year plan is well in line with the current research of individual groups (see individual assessment of research teams). It reflects the recent human and financial investments in novel approaches (e.g. ecology, evolution, quantitative genetics) and novel models (including crops), which will enable further links with members of the LabEx TULIP, as well as with industry.

Most projects proposed for the teams composing the research axis "Root endosymbiosis" are somehow a logical continuity of previous successful projects. While many of them have the potential to be fruitful, others have the risk to only provide a small incremental increase in the current knowledge. Given the know-how, and reputation of these groups, and the job security offered by their employment, the panel would encourage more risk-taking from these groups to allow them to compete with the top international laboratories in this field and to more often come up with breakthroughs. Also, a better communication between the groups working on legumes within the LIPM and between the LIPM and the LRSV would be highly beneficial; this would allow capitalizing fully on the incredible scientific and human potential on this topic present on the Auzeville campus.

The teams composing the axis "Plant-Pathogen-Environment Interactions" seem more daring, at least in their organization. For example, the leadership of the team E6 ("Infection strategies of Xanthomonas") will change and the expertise of the new group leader is more on the plant side. Also, the current team E7 will generate two distinct groups, namely "Immunity networks and plant responses to the environment" and "Plant resistance pathway dynamics and adaptation to global warming". An interesting aspect proposed by both groups is the inclusion of quantitative genetics and evolutionary ecology approaches in their research programme.

Short appreciation on this criterion

The five-year plan is excellent, as it should ensure that LIPM stays at the same excellent scientific level. More daring projects addressing major biological and/or agricultural problems across the different research groups are encouraged to make the LIPM an outstanding unit.

4 • Team-by-team analysis

Team 1: E1 Symbiotic functions, genome and evolution of rhizobia

Name of team leader: Mr Jacques BATUT & Ms Catherine MASSON

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	4	4
N3: Other permanent staff (without research duties)	2	2
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	**6**	**6**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students		
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit	7	
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	3	

• Detailed assessments

Assessment of scientific quality and outputs

The team E1 is focusing on symbiotic rhizobial infection using two approaches: 1) the investigation of the evolution of the symbiotic interaction using Ralstonia evolved into a legume symbiont in Mimosa and 2) the role of adenylate cyclases during the infection process of Sinorhizobium meliloti in Medicago.

The choice of the topics appears strategic in the context of the competition in the field allowing this group to maintain a unique and strong position in the community in France and worldwide. Results obtained opened new theories about evolution of complex traits (such as nodulation) and also identifying possible methods to apply the natural nitrogen fixation to non-legumes. At the same time the team has elucidated the role of bacterial cAMP in the

signaling between rhizobia and plants. The team E1 has also participated to the project SYMbiMICS in collaboration with other teams of LIPM re-annotating the S. meliloti genome and identifying genes which are differentially regulated in nodules.

In particular the team has been progressing on both topics both numerically and qualitatively (15 total peer-review articles). Several excellent achievements have been published in top-level journals (PNAS, PLoS Biology, ISME J., MPMI). These articles place this team in a promising position for the next future as clearly addressed by the team in the future perspective section.

Short appreciation on this criterion

The team E1 proved in the evaluation period a constant and excellent level publication quality with novel and very promising research lines.

Assessment of the team's academic reputation and appeal

The team leaders have a strong national and international reputation. The team E1 has been financed by several national projects (ANR, LabEx and INRA). No European or international agencies have directly awarded grants to this team.

Several team members have been involved in seminars and organization of conferences. Members of the team presented data at 31 scientific meetings. This intense participation in scientific divulgation activity clearly demonstrates the international visibility and quality of the group. In particular the team leaders have been involved in the organization of national and international events.

The team has also an exchange of PhD students from China paid by the Chinese government council and two foreign postdocs (USA, Argentina).

Short appreciation on this criterion

The ranking in this criterion is excellent. The team is actively recruiting PhD students and postdocs from different countries and team members are frequently invited to seminars and international conferences.

Assessment of the team's interaction with the social, economic and cultural environment

The team leaders have been involved in round-table discussions and events specifically set up to favor the meeting between academic and private partners. Thanks to the ANR Rhizocamp the lab has been labeled by the “Pôle de compétitivité AGRI-SO Innovation”. Junior members of the team have been involved in professional orientation for students, such as “Fête de la Science” or “Nuit des chercheurs”.

One of the team leaders also is the president of the important initiative, named “Fédération de Recherche Agrobiosciences, Interactions et Biodiversité” (FR AIB ou FR3450).

Short appreciation on this criterion

The ranking in this criterion is very good. Members of the team are involved in several public initiatives. There is no contract or agreement with private companies.

Assessment of the team's involvement in training through research

Many people of the team (both permanent and temporary) are well involved in training and teaching activities. Moreover the team has supervised training periods for 4 PhD and several M2R, M1 and BTS students. Worth noticing also is the activity in classes at the M2 level and in summer schools.

Short appreciation on this criterion

The ranking in this criterion is very good. Although members are involved in training and teaching activity no professor or lecturer belong to this unit. The number of PhD students potentially will improve thanks to the recent acquisition of the HDR by one of the team members.

Assessment of the strategy and the five-year plan

The team will investigate two research lines: 1) Evolution and design of N_2-fixing symbionts; 2) cAMP signalling and the control of infection. The two research lines clearly depart from the previous activity well developed by the in the last years at LIPM.

The "Evolution and design of N_2-fixing symbionts" research project will be supported by the recently awarded ANR named Shape and the INRA-SPE 2014-2016. In this context the team will focus on the evolution of improved nitrogen-fixing clones also by collaborating with the imaging platform of FR AIB. A mix of genomics and plant experiment are envisioned for the functional and agronomic characterization of lab-evolved strains. Collateral to this fundamental biology approach, the team will aim to select for N2-fixing symbionts able to interact with non-legume hosts such as cereals. This latter part will allow the team to expand their research to applied studies possibly reinforcing the partnership with private entities.

The research line "cAMP signaling and the control of infection" currently has no active grant. The scientific goals, in continuity with previous research, will pursue exploring the functionality of the bacterial adenylate cyclases by identifying the plant signals that induce the cascades and defining the effects of the cAMP signalling pathway during the infection process. Several collaborations are envisioned with other teams of the research unit and in France and Belgium.

The previous scientific production and the expertise of the team E1 represent a strong indication that the team will continue producing excellent science and research. However as nitrogen fixation is has a strong potential for applied science, a strong recommendation is required in order to reinforce the collaboration with private companies and entities that could apply the knowledge accumulated over the years by the team. Moreover the experimental strategy for evolution of symbiotic properties could be applied to other models, such as *Sinorhizobium-Medicago*.

Short appreciation on this criterion

The ranking in this criterion is excellent. Due to the importance of the recent discoveries by the team members the ranking could be outstanding if more models in the evolution experiments were introduced, especially in the context of the Sinorhizobium/Medicago system.

Conclusion

- Strengths and opportunities:

The team leaders have a strong national and international reputation. The choice of the topic appears strategic in the context of the competition in the field allowing this group to maintain a unique and strong position in the community in France and worldwide. Their scientific production is excellent.

- Weaknesses and threats:

The PhD and postdoc recruitment at the international level is not very prominent. As the research project on the adenylate cyclases is not funded at the moment, the team should reinforce grant-wise this scientific direction possibly finding applied research lines that are in the context of cAMP.

- Recommendations:

The team should improve the connections with private companies and the ability to recruit PhD students. Also a general tendency to homogenize the model systems should be attempted. Finally the research lines, especially on cAMP, should be reinforced by more people involved and more grants.

Team 2: E2 Responses to stress and environmental signals in rhizobia

Name of team leader: Mr Claude BRUAND

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions	1	1
N2: Permanent EPST or EPIC researchers and similar positions	3	3
N3: Other permanent staff (without research duties)	1	2
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	**5**	**6**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	2	
Theses defended	2	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	2	
Qualified research supervisors (with an HDR) or similar positions	4	

- Detailed assessments

Assessment of scientific quality and outputs

Sinorhizobium meliloti is a very well studied microorganism in many laboratories across the world. The team found its niche and expertise in studying more specifically the general stress and nitric oxide (NO) responses in *S. meliloti*, how does the bacterium cope with and respond to such stress. The team also aims at understanding how does NO benefit/challenge the symbiotic interaction between *S. meliloti* and the model plant *Medicago truncatula*.

The team has made interesting advances in this field by identifying RpoE2 as an extracellular sigma factor (ECF) associated with the general stress response and has defined the RpoE2 regulon. The team has also determined the main regulators associated with the NO response, i.e. FixLJ and NnrR.

The team collected a large amount of transcriptomics data that could be used in further studies, and also plan to use metabolomics to understand the role of unknown target genes from the stress regulon. This is certainly a comprehensive approach and methodological breakthroughs could be highlighted more clearly.

Over the evaluated period they produced 8 'team' publications in very good bacteriology and plant journals (J Bacteriol (x 2), MPMI, Plant Sci (rev), PLoS One, New Phytol, Plant Signal Behav, Plant J) and 4 'inter-team' publications (Plant Physiol, New Phytol, Front Plant Sci (rev), DNA Res). They edited three books and three book chapters. Six papers (2009-14) are cited more than 5 times/yr. They were invited two times to international conferences. One senior scientist is mostly active in writing and editing books.

Short appreciation on this criterion

The scientific production of the team is very good in medium impact papers but lacking the originality which could lead to publishing in higher impact factor journals.

Assessment of the team's academic reputation and appeal

One can identify international collaborations with teams in Portugal and in Japan. Yet the international visibility could be improved.

The team made some contributions in organizing national conferences. The team is partner in but does not coordinate ANR projects/consortia. They are instead coordinators of several specific INRA projects.

One team member edited three books in molecular microbiology and several book chapters. Other team members delivered several seminars in France, mostly by the PI, and have only few invitations at international conferences.

Short appreciation on this criterion

The assessment of the academic reputation and attractiveness of the team is very good at the national level with a deficit of visibility at the international level.

Assessment of the team's interaction with the social, economic and cultural environment

The team members have reasonable amount of public engagements like open day and school visits.

The team patented in 2010 a method for increasing legume productivity by cultivating a plant with an associated *Rhizobium* overexpressing a flavohemoglobin protein. This type of improved *Rhizobium* strain for the NO response is certainly a new tool for agriculture.

Short appreciation on this criterion

As attested by their patent on a method to increase legume productivity, their potential interaction with the economic environment is evaluated as very good to excellent considering the possibility to get the patent licensed.

Assessment of the team's involvement in training through research

The PhD students are well supervised and trained as validated by the authorship on very good publications for the two students who defended their thesis in 2011 and 2012

The MCU contributes to the teaching associated with the team while another member contributes book edition and book chapters.

Short appreciation on this criterion

In this respect the team was evaluated as excellent because of the impact of the books edited on student education.

Assessment of the strategy and the five-year plan

Some aspects of the project are original and the whole is well structured. The team uses standard approaches in this field of research. A challenging part can be the study on post-translational modifications and the impact of NO on the up and down of symbiosis. The study and exploration of the role and function of proteins and small RNAs of unknown function might lead to new scientific knowledge and breakthrough.

The use of improved Rhizobium strains (cf. patent) is clearly a translational aspect of the project.

Short appreciation on this criterion

Overall the feasibility of the research plan is very good.

Conclusion

- Strengths and opportunities:

The research project is well structured and designed with strong feasibility. There is a clear potential translational impact for agriculture. The PhD training is excellent with very good track record of published work.

- Weaknesses and threats:

The international visibility is limited and competition might be increased. The team has to be more attractive for post-doctoral positions.

- Recommendations:

The team must highlight further the originality of the work within the context of international competition, and has to be proactive in attending international conferences and disseminating findings. One can strengthen the goup by recruiting high profile post-docs (via ANR grant for example or EMBO and Marie Curie fellowships).

Team E3: Cellular dynamics and regulation of symbiotic infection and nodule development

Name of team leader: Mr David BARKER & Mr Pascal GAMAS

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions	1	1
N2: Permanent EPST or EPIC researchers and similar positions	5	5
N3: Other permanent staff (without research duties)	3.5	3.5
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	**9.5**	**9.5**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	2	
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	4	

- ## Detailed assessments

Assessment of scientific quality and outputs

The team E3 is working on symbiotic plant-microbe interactions and mainly focusing on the arbuscular mycorrhizal (AM) symbiosis and the root nodule symbiosis (RNS). Using the legume *Medicago truncatula* as model plant, the team investigates three different aspects of these root endosymbiosis: (I) the cellular infection and the cellular reprogramming during infection, (II) the in-depth analysis of the root nodule development and (III) potential analogies of signalling mechanisms involved in root endosymbiosis development to signalling events in parasitic associations or during root development.

One important finding of the group was the identification and functional characterization of transcription factor (TF) networks involved in plant-microbe signalling. The application of novel *in vivo* imaging techniques led to the identification of relationships between host-microbe communication, TF gene expression and the cellular

remodelling of the host cell. The identification of short-chain chitin oligomers as novel symbiotic signals can be regarded as one key finding related to symbiotic signalling in the reporting period.

In collaboration with several LIPM platforms and other LIPM teams, the team leads a project aiming at a comprehensive analysis of host and symbiont gene expression during nodule development and functioning. For this purpose, laser capture microdissection is coupled to RNA sequencing to investigate gene expression at a cell and tissue-specific level. This dataset has provided a highly valuable resource to identify novel regulator genes of nodule development.

Analogies between symbiotic signalling and pathogenic root-microbe interactions are currently analysed in collaborations with LRSV groups and other LIPM teams. Several symbiosis-associated TFs were shown to be involved also in plant pathogen interactions and it is assumed that certain TFs may possess essential functions during both types of interaction.

The team has developed tools for studying root symbiosis at tissue or cellular level *in vivo* and the group is highly recognized for this contribution to the research field.

During the reporting period the team published and contributed to 37 articles in high to very high-ranking journals and has contributed novel findings to this research field. The team published 13 papers and 22 in collaborations demonstrate a good collaboration network. Several papers attracted recommendation (F1000).

Short appreciation on this criterion

The team is highly recognized due to its outstanding work related to the analysis of mycorrhizal infection processes at cellular resolution. However, some results had the potential of being published in top-ranking journals instead of very good journals. Therefore, the scientific production is considered excellent to outstanding.

Assessment of the team's academic reputation and appeal

Members of the team have coordinated seven projects during the reporting period. In addition, the team has a high number of collaborations with international and French research groups. Scientists of the team are regular reviewers for several very good- to high-ranking journals (for example: Plant Cell, Plant Journal, Plant Physiology) and for international research councils. Four members of the team have were co-organizing scientific meetings. Also, team members have been recruited very often to give invited talks at other institutes. Altogether this shows that the team has a high international visibility and is recognized as one of the leading teams in its field. It is attracting some young scientist through competitive funding (ANR).

Short appreciation on this criterion

The team’s academic reputation and appeal is considered excellent to outstanding, due to its international visibility and continuous funding.

Assessment of the team's interaction with the social, economic and cultural environment

The team shows an active interaction with different social media and the local community and members actively contributed to different cultural and social events. Several presentations and events have been organized for the public and for school pupils. The group has a long list of academic contracts of different team members with collaborative projects.

Short appreciation on this criterion

The team made significant contributions to the local environment; however there seems to be no significant collaboration with the private sector. Therefore, the team's interaction with the social, economic and cultural environment is considered very good.

Assessment of the team's involvement in training through research

During the reporting period, 5 doctoral students, 2 postdocs and 16 undergraduate students have been trained by the research team. In addition, the team members contribute a significant amount of teaching to different

institutions at the M1 and M2 levels. Also, some members of the team are participating at university recruitment panels and "concours de l'Ecole Doctorale". In addition, the quality of PhD and master thesis of the team points to very good student guidance.

Short appreciation on this criterion

The team contributes to teaching, however the number of doctoral and postdoc students in the group can still be increased. Therefore the team's involvement in training through research is considered very good.

Assessment of the strategy and the five-year plan

The presented main perspective and future directions of the team mainly represent a continuation of the successful work of the last years. Ca^{2+}-signaling and the cellular re-modelling will also be analysed during actinorhizal association to explore intracellular infection mechanisms in different plant microbe associations.

The identified ERN-TFs will be in detail characterized to investigate their role in AM symbiosis as well as to identify ERN-regulated genes and targets. Also the precise role for the identified NF-Y TFs will be investigated further with regard to target gene identification and interacting proteins.

The large-scale RNA sequencing data of the SYMbiMICS project will be further exploited and TFs and other genes chosen from this dataset will be analysed concerning their role in nodule meristem development. For this project, *Pisum* sativum will be included in order to work on a crop plant and moreover in order to take advantage of its diversity.

The presented future plans are all based on currently successful projects, therefore, it might be anticipated that they will significantly contribute to novel, ground-breaking knowledge in the next few years.

Short appreciation on this criterion

The team proposes mainly a continuation of its successful projects and some novel work including aspects on actinorhizal symbiosis, which has the potential for novel scientific breakthroughs. Therefore the team's strategy and the five-year plan are considered excellent.

Conclusion

- Strengths and opportunities:

The team is amongst the world leading teams in the field of root symbioses with an excellent publication record and international reputation. The team has significantly contributed to the research field in the reporting period by the identification of novel key regulators, novel signaling mechanisms and by the development of novel imaging tools leading to novel insights in microbe-host communication.

- Weaknesses and threats:

Currently the team has only 2 PhD students, which seems to be a rather small number related to the permanent scientific staff of the group. Some recent articles of the team had the clear potential of being published in top journals.

- Recommendations:

The team has an excellent international visibility. Therefore, it should try to attract more international PhD students or postdoctoral fellows via international training programs. From the scientific point of view, the projects of the future plan are very promising and will certainly lead to novel ground-breaking findings in root endosymbiosis research and highly assessed publications.

Team 4: E4 Symbiotic signals and their perception/transduction

Name of team leader: Ms Clare GOUGH & Ms Julie CULLIMORE

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	8	8
N3: Other permanent staff (without research duties)	5	5
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)	1	1
N6: Other contractual staff (without research duties)	5	6
TOTAL N1 to N6	**19**	**20**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	1	
Theses defended	4	
Postdoctoral students having spent at least 12 months in the unit	2	
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	7	

• Detailed assessments

Assessment of scientific quality and outputs

The team has made groundbreaking and outstanding contributions to the field of arbuscular mycorrhiza (AM) research by identification of lipochitooligosaccharides from an AM fungus. This constituted a paradigm shift in our understanding of this symbiotic interaction and the steps involved in the evolution of root symbiosis. The complementary receptor on the plant side has been elusive, and accumulating evidence indicates that the LysM receptors that are likely involved in their perception form complex and – at least in *Medicago*- partially redundant interactions, making their analysis tedious. However, the team has now made progress in the chase for the long sought-after 'Myc-factor receptor', by pinpointing a LysM receptor candidate from tomato via RNAi based approaches. Furthermore, the team has identified a high affinity LCO binding protein, MtLYR3 from *Medicago*, mutation of the corresponding gene does not show a symbiotic phenotype. Genetic analysis has identified loci involved in LCO structural recognition that do not appear to encode LysM proteins. This finding bears the potential of identifing a novel class of LCO-binding proteins. The scientific output of the team, as a whole, is remarkable with 17 publications

driven by team members (1 Nature (not a genome paper), 1 Nature genome description where the team played a pivotal role, 1 Development, 1 Plant Cell, 1 PNAS, 2 JBCs as major outputs) and 17 high profile collaborative papers involving mainly other teams of the LIPM. The team has also supplied contributions to 6 scientific books.

Short appreciation on this criterion

The rating of this criterion is outstanding.

Assessment of the team's academic reputation and appeal

Members of the team have been very successful in attracting and coordinating grants at the international level, such as an EU wide research training network 'NodPerception' ending 2010 and an collaborative grant between researchers in St Petersburg and INRA Toulouse (INRA-Russie). There are a number of funded national ANR grants in the portfolio. Overall the team demonstrated a very good performance in the acquisition of competitive grants. The senior team members are internationally recognised experts in their field and regularly invited as speakers to relevant international meetings.

Short appreciation on this criterion

The rating of this criterion is excellent to outstanding.

Assessment of the team's interaction with the social, economic and cultural environment

The collaboration between the team and the company Novozyme is very fruitful and of great agricultural potential. Patents and large scale field applications resulted from this collaboration and the LCO discovery, respectively. LCO technology is, also in an international comparison, the single most important showcase for the translational value of research into biological nitrogen fixation.

Short appreciation on this criterion

The rating of this criterion is outstanding.

Assessment of the team's involvement in training through research

The team has or is currently training four PhD students. This appears a small number for an academic lab of similar size. There is a larger number of master students trained in the team. The large number of permanent researchers represents potential for the training of additional PhD students.

Short appreciation on this criterion

The rating of this criterion is very good to excellent.

Assessment of the strategy and the five-year plan

Overall the five years plan shows a coherent and clear focus on the microbial origin of LCOs and related signals, their perception by plants and the downstream responses elicited. There is a well established working relationship established with the company Novozymes that represents an excellent exploitation pipeline. In detail, the five year plan lists the following aspects:

Symbiotic and related signals

The team wants to explore the structural diversity of LCOs and their biosynthetic pathways in plant associated microbes 'in a wide range of symbiotic and pathogenic fungi'. It appears mandatory for the team to follow up on their discovery of LCOs from AM fungal hyphae and the investigation of their biochemical origin in the absence of classical nod genes from the glomeromycotean genome will be an outstanding contribution. The team also proposes the very good plan to unravel the discriminating features in LCO structure for the nodulation of pea and Medicago. The relevance of nod factor decorations for determining host-rhizobia specificity has been a in the center of interest in the 1990s. The rationale for following this aspect is not apparent. In general, the team is exceptionally well

positioned to do this type of research due to well established expertise in the lab and collaborations including the LCO synthesis expertise in Grenoble.

LCO and related signal perception in plants; Mechanisms of symbiotic signal discrimination

This is a very competitive field and the team is advised to carefully identify areas in which they can bring a competitive advantage to bear. Although some of the proposed aspects, like the structural elucidation of the LCO-LYSM ligand receptor pair are a logical and stringent continuation of the ongoing research in the team, the impact will be limited, since it seems to be already at least partially preempted through the crystal structure of the chitin receptor and its ligand. However, the immanent identification of the Myc-factor receptor through complementary approaches promises high impact publications and will be an outstanding contribution.

Elicitation of downstream symbiotic and developmental responses

Again this is an interesting and highly competitive field also covered by other teams within the LIPM. In order to strengthen the competitive position of the team and to sharpen the focus, it appears mandatory to achieve maximal interteam synergies at the LIPM and avoid parallel investigations. It appears that the transcriptional downstream responses are competently covered by other teams at the LIPM.

Research and development towards a more sustainable agriculture; Improvement of crop growth by the use of LCO and related signals.

This is an outstanding and very mature aspect and the translation of LCO technology into the field has already been achieved. It is hoped that this can be continued and the technology further refined and improved.

Transfer of the rhizobia symbiosis to cereals

The biotechnological transfer of the root nodule symbiosis to cereals is a very high risk project. The team has to critically evaluate whether these avenues fall into the area of their core competencies. The second proposed strategy to explore biodiversity of wheat for interactions with associative nitrogen-fixing bacteria is excellent to outstanding and more directly applicable.

Short appreciation on this criterion

The rating of this criterion is excellent to outstanding.

Conclusion

- Strengths and opportunities:

The team has an outstanding track record in the identification of lipochitooligosaccharides (LCO) and has critically contributed to the development of LCO applications in the field now widely used in agricultural systems to improve yields. LCO technologies are one of the if not the most important biotechnological applications resulting from molecular legume-rhizobium research apart from rhizobium inoculants themselves. The interaction with Novozymes as exploitation alliance is fruitful and commendable. A key breakthrough of the reviewing period was the discovery of Myc-LCOs as published in Nature. The team also boasts strong expertise in the biochemical analysis of receptor-kinases, and (L)CO-binding proteins. The team proposes an excellent to outstanding research plan for the next five years.

- Weaknesses and threats:

The work on LysM receptors and LysM proteins is a major focus of the team, but the overal impact of the contribution at an international comparison lags behind that of the leading labs in the field. This may be because the projects chosen are designed to yield incremental gains of knowledge rather than breakthroughs. The involvement in technologically and scientifically disparate projects like receptor-kinase biochemistry and genome sequencing appears to be a dilution of efforts. The BMGF funding may be distracting resources from the main thrust of the team.

- Recommendations:

With a strong number of permanent staff without teaching obligations, the team is better positioned than others to take on 'high risk, high gain' projects in the field of receptor kinase biology. The team must identify highly rewarding projects in order to further increase its impact. With some of the key mechanisms in receptor activation and ligand binding solved at the structural levels by other labs, it may be wise to adjust priorities in the main research direction of the team to avoid the production of confirmatory data. BMGF funds to engineer cereals to form root nodules are economically tempting. However, the consequences for the research focus of the laboratory as a whole should carefully be monitored.

Team 5: E5 Ralstonia pathogenicity determinants and their plant targets

Name of team leader: Mr Stéphane GENIN

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions	1	1
N2: Permanent EPST or EPIC researchers and similar positions	3	3
N3: Other permanent staff (without research duties)	2	2
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)	2	1
TOTAL N1 to N6	**8**	**7**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	2	
Theses defended	5	
Postdoctoral students having spent at least 12 months in the unit	1	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	2	

• Detailed assessments

Assessment of scientific quality and outputs

The team has historical expertise on using *Ralstonia solanaceraum* as model organism and was likely among the first to develop a systematic analysis of T3SS effectors using a genomic approach.

In the recent years the team has developed approaches and methodologies to dissect and categorize the large number of T3SS effectors identified. This has led to constitute effector classes and therefore give opportunities to study the function of each class by avoiding redundancy issues.

Another elegant and innovative approach to study *R. solanacearum* pathogenesis is to understand specifity towards different plant species. The team used an innovative method by passaging strains on the same host for many generations and perform genomic analysis to characterize adapted variants. Gain of fitness on one particular host could lead to loss of fitness onto another species. Study of adaptation mechanisms will be supported by a

comprehensive understanding of *R. solanacearum* metabolic pathways which have been reconstructed by the team using mathematical modeling and systems biology approaches.

The production of the team over the evaluated period is of high quality with 20 papers (including 2 reviews) in both specialized journal or with higher impact factor (e.g. Curr Opin Microbiol, Molecular Biology and Evolution).

International visibility is reasonable with lectures at international conferences by the PI, e.g. the FEMS congress in 2009 or an ibero-americano meeting in Barcelona on *Ralstonia* in 2011, other members ot the team presented in Japan and China. The PI has also been senior editor for 'MPMI' (2009-2010).

Short appreciation on this criterion

The team is excellent, dynamic and develops original and interdisciplinary projects. The output of 20 publications over the last four years is excellent but the team should aim at publishing in even higher impact factor journal to reach the outstanding level.

Assessment of the team's academic reputation and appeal

The team seems to have a tight connection with China and several postdocs or PhD students, as well as visitors, are from foreign countries.

At the national level the team has been involved in the organisation of conferences. The team coordinates several ANR projects and is also part of an European consortium. The team has been particularly successful in securing ANR 'Jeune chercheurs' grants.

There has been a wide range of visiting scientist from China, India, New-Zealand, Canada, Germany, Spain or Argentina who visited the lab revealing a very good international visibility of the team. Postdocs are most exclusively from China highlighting a long term collaboration.

Invitation at International conferences is very good but could be improved. Yet invitation to give seminars are quite abundant and this for nearly all team members.

Short appreciation on this criterion

The team has an excellent international visibiliy and has historical contribution in the field of *R. solanacearum* pathogenesis. This visibility is clearly demonstrated by an excellent track record for funding and by attracting foreign students and visitors.

Assessment of the team's interaction with the social, economic and cultural environment

The orginality of the methods developed by the team is very interesting and the implementation of new tools quite abundant. This could go back to the first website/database reporting the T3SS repertoire, a collection of strains mutated in individual T3SS effector, or a yeast-two-hybrid cDNA library from pathogen-induced or naïve tomato roots.

There are obvious connections with private companies including Hybrigenics and Syngenta and one patent for methods on *Ralstonia* detection (2010).

The team is also engaging with the public through school visits or contributions to the 'Fête de la Science' days.

The team has produced a good number of tools and resources, which will be available to the scientific community.

These studies have obvious agricultural impact knowing that *Ralstonia* is a devastating plant pathogen and the approaches led by the team aiming at understanding Ralstonia specifity for various plants could be very valuable in this context.

Short appreciation on this criterion

The team research has an excellent agricultural impact considering the importance of *R. solancearum* as a plant pathogen. Connection with companies is there, as well as one patent. The translational pipeline should be pushed further to reach the outstanding level.

Assessment of the team's involvement in training through research

All four PhD students who recently graduated have 1st author publications and the one lecturer of the team is significantly involved in teaching.

Short appreciation on this criterion

The students supervision is excellent. The ranking for this criterion is excellent.

Assessment of the strategy and the five-year plan

The project is original and ambitious. It will fill gaps in current knowledge in the field of bacterial pathogenesis and bacteria/host interaction with clear impact on agriculture. The team size, expertise and current supporting data largely guarantee project feasibility. The team has generated a significant number of tools that will be useful for the scientific community. The project is interdisciplinary using standard molecular microbiology and biochemistry, bacteria-plant interaction, genomics and bioinformatic, mathematical modelling, sytems biology.

Short appreciation on this criterion

The project is excellent and the PI has a clear vision. Research approaches are original and cutting edge, in particular the element of experimental evolution combined with metabolic profiling.

Conclusion

- Strengths and opportunities:

Excellent track record in the field both for publication and funding.

Originality, innovative/ambitious approaches.

Project is nicely defined and well structured

Project is largely interdisciplinary

Agricultural impact and good connection with industrial network.

Team is attractive with many scientifc visitors from international horizons.

- Weaknesses and threats:

The T3SS field is highly competitive.

- Recommendations:

Further contribution to international conference to match the standard of the team.

Make sure to recruit a new wave of PhD students.

Team 6: E6 Infectious strategies of Xanthomonas

Name of team leader: Mr Matthieu ARLAT & Ms Emmanuelle LAUBER

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions	2	1
N2: Permanent EPST or EPIC researchers and similar positions	2	2
N3: Other permanent staff (without research duties)	1	1
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)	1	1
TOTAL N1 to N6	**6**	**5**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	1	
Theses defended	4	
Postdoctoral students having spent at least 12 months in the unit	1	
Number of Research Supervisor Qualifications (HDR) taken		
Qualified research supervisors (with an HDR) or similar positions	3	

- Detailed assessments

Assessment of scientific quality and outputs

The team studies bacterial infectious strategies in *Xanthomonas* with a focus on exploitation of plant resources, recognition/transduction of plant signals and the nature and modulation of plant resistance and susceptibility.

The team has been strongly involved in *Xanthomonas* genomics (part of an INRA network on Xanthomonads) with the support of the LIPM bioinformatics platform (e.g. 6 communications in 'genome announcements' in 2013). This encompasses the sequencing & annotation of 40 genomes, RNAseq on 5 strains expressing or not the Hrp type III secretion regulon.

The team focuses on the TonB-dependent family (TBDT) of transporters and the characterization of TBDT-containing carbohydrate utilization (CUT) systems. In this context they identified a GlcNAc CUT system which might

have a role in chito-oligosaccharide or N-linked glycan metabolism in xylem sap. This provides an interesting link between metabolic and pathogenic adaptation.

The team also studies Xc effectors identified by genome sequencing, in particular TAL effectors and identification of TAL targets in *Brassica rapa* promoters.

Finally, the team identified the first two resistance genes against Xcc in Arabidopsis, which encode RLCKs (receptor-like cytoplasmic kinases). Later the team isolated two more *R* genes, which encode a RLCK and a CC-NB-LRR (coiled-coil nucleotide binding domain (NB) and leucine rich repeat domain containing) R (resistance) protein.

The team has produced in total 33 articles, with a leading role in 15 of those. More highly cited are a paper in BMC genomics (2009) on the genome sequence of *Xanthomonas albilineans* (50 citations), a paper in J. Bacteriology (2009) on the identification of the GlcNAc CUT in Xcc (18 cit) and a paper in Proteomics (2011) on the analysis of secreted proteins in xylem sap (24 cit). In addition, the team has one important paper on the identification of the first R-genes for Xcc in *Arabidopsis* in PLoS One (2013) and an interesting paper also in mBio on the identification of the GlcNAc CUT system, in which the authors propose the exciting hypothesis that this CUT system plays a role in inactivating GlcNAc-containing PAMPs. In a similar vein the paper in New Phytologist (2013), on the role of the xylan CUT also may have a significant scientific impact. Finally 6 of the team's publications are on the genome sequence of various isolates in 'genome announcements'. The latter publications certainly contribute to an extremely valuable resource for datamining, but it is unlikely that they will be cited very much as such.

Short appreciation on this criterion

Scientific quality is very good: the team is leader in *Xanthomonas* genomics. They also have cloned four Xcc resistance genes.

The work on the characterization of TBDT and CUT systems, is not particularly innovating as such since such systems are already extensively studied in gut microbes. However, the demonstration of a potential link of CUT systems to pathogenesis, for instance through the scavenging or modification of signaling molecules, is to our knowledge a completely novel idea.

The work on the TAL effectors is more of a continuation of the groundbreaking work of a German group. However, this avenue has the potential to lead to interesting applications as witnessed by the industrial contract.

The publication record of the team was very good but certainly is on an extremely positive trajectory since 2013.

Assessment of the team's academic reputation and appeal

Some of the team's publications are reasonably well cited. However, some of the more recent papers in particular on the CUT systems and the cloning of the resistance genes are expected to have a higher scientific impact in the future.

The team is very active in the animation of a French INRA network on *Xanthomonas*.

Team leaders were invited few times as speaker at international conferences and the new team leader has been frequently invited for seminars (8 times),

Team members participate in reviewing articles, some for high impact journals (Plant Cell, Nature Rev Microbiol), and grant applications (7: ANR, DFG, PEERS), but have no editorial activities

The team has secured 3 ANR grants.

The team has trained 3 PhD students and has attracted 4 engineers (IR or IE) on ANR contracts.

Short appreciation on this criterion

The team is very well recognized in the French microbiology community. However, there is room for improvement of its international visibility. The recent boost in the activity of the team should certainly contribute to such an improvement. This criterion can be judged as very good.

Assessment of the team's interaction with the social, economic and cultural environment

The team has secured 4 ANR grants (acronyms TBDTomic, Xanthomix, Xopaque, CROpTAL). Three of these are coordinated by the team which also coordinates an industrially-funded grant on TALE effector targets. The team has one patent application filed and participated in some outreach activities (Festival des savoirs partagés, Toulouse; Muséum d'histoire naturelle, Toulouse and 'La science en fête').

Short appreciation on this criterion

Given their industrially-funded grant and their patent application, the contribution of the team can be considered as very good to excellent.

Assessment of the team's involvement in training through research

The team has one Professor and one Assistant-professor who are actively involved in teaching. The professor is extremely well committed to the organisation of student education and recognized for this since he recently has been promoted 'Vice-président délégué' of the University (in charge of the 'Numérique'). They also trained 5 PhD students.

Short appreciation on this criterion

Given the strong commitment to student education of the team leader, the team training through research can be considered outstanding.

Assessment of the strategy and the five-year plan

A new team leader will be appointed. The team will continue to use comparative genomics to study TBDT and T3E and continue the identification of other resistance genes.

They also plan to study early stages of hydathode infection, determine sites and timing of pathogenicity determinants, using transcriptome studies at different locations of the leaf. This work has been recently submitted to the ANR.

The team will investigate the role of GlcNac and pectin CUT systems in the scavenging of PAMPs or the inactivation of PAMP receptors. They will also study TALE effector targets in B. oleracea and B. rapa, which may lead to the selection of loss of susceptibility alleles and their use in Brassica breeding programs.

Short appreciation on this criterion

With the recent advances and the arrival of the new CR, the team has significantly improved its potential, and many scientific opportunities are emerging, in particular in the study of the CUT systems in the context of plant-pathogen interaction, the study of effector functions and the developmental study of the Xcc infection process via hydathodes. Also the use of TALE effectors may lead to interesting applications.

However, given the small size of the team and the competitiveness of several of the topics, it will be important to focus only on some key topics. The work on the hydathode infection is particularly innovating in this respect. This strategy of the team can be considered as very good.

Conclusion

- Strengths and opportunities:

Strong know-how on genomics/bioinformatics of Xanthomonas-Plant interactions, good combination of the study of pathogen and plant signaling.

The identification of CUT systems with a potential role in pathogens is very original.

The arrival of the new CR in the team has significantly boosted its productivity and has created ample opportunities for collaboration within the unit.

- Weaknesses and threats:

The team may have a subcritical size, in particular given the teaching duties of the current group leaders. This may have changed since the arrival of the new leader, provided that sufficient funding and PhD students can be found.

There is strong competition from other groups working on CUT systems in particular in human guts, and on TALEN effectors.

- Recommendations:

The team may have to focus more on a few topics to remain competitive given its relatively small size.

It will be important to collaborate more at the level of the unit to build ambitious projects with a high visibility in the academic and private sector to create more momentum for securing funding and attracting students and postdocs in the future.

Team 7: E7 Resistance, susceptibility and cell death in *Arabidopsis thaliana* in response to bacterial pathogens

Name of team leader: Mr Yves MARCO & Ms Dominique ROBY

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	8	6
N3: Other permanent staff (without research duties)	4	3
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)	6	5
TOTAL N1 to N6	**18**	**14**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	3	
Theses defended	7	
Postdoctoral students having spent at least 12 months in the unit	3	
Number of Research Supervisor Qualifications (HDR) taken	3	
Qualified research supervisors (with an HDR) or similar positions	7	

• Detailed assessments

Assessment of scientific quality and outputs

This group has been historically studying the molecular mechanisms underlying the interaction between the plant model Arabidopsis *thaliana* and bacterial pathogens, with a particular focus on *Xanthomonas campestris* pv. *campestris* and *Ralstonia solanacearum*. In addition, a significant line of research concerned the regulation of plant cell death. In recent years, the group has expanded these lines of research by starting to work on the natural variation in the quantitative resistance of *Arabidopsis thaliana* to *Xanthomonas campestris pv. campestris*, but also to the fungus *Sclerotinia sclerotorium*, both of them being important pathogens of crop plants.

This large and dynamic group has made significant contributions in all these subjects, which led to the publications of a large number of peer-reviewed papers (n=56) with several of them published in top-tier journals (e.g. Plant Cell, PNAS, PLoS Genetics, PLoS Pathogens, Developmental Cell, Nature Communications, Science).

Highlights from the last 5 years include (but are not limited to):

- An understanding on how the Ralstonia effector PopP2 activates RRS1-R mediated immunity, which provides a step-change in our understanding on how plant intracellular immune receptors work (under revision for publication in Cell).

- The identification of novel regulators of plant cell death through a combination of diverse innovative approaches. These discoveries expand our understanding on the complex regulation of this key process regulating diverse processes ranging from immunity to development.

- The establishment of the Sclerotinia sclerotorium/Arabidopsis thaliana pathosystem to study quantitative disease resistance. This initial investment has nicely paid off with the outstanding acquisition of the highly competitive ERC Starting grant to a newly recruited scientist in the team, which will enable this project to flourish.

- The identification of the the pseudokinase RKS1 has a major contributor of broad-spectrum quantitative disease resistance to Xanthomonas campestris and other Xanthomonas species. Again, this major discovery was enabled by a long-lasting investment of the team in this pathosystem and the recent move to ecological evolutionary approaches to identify novel important and ecologically-relevant components of the plant immune system.

Short appreciation on this criterion

The team had an outstanding productivity in the evaluated period and published in top specialised and generalist journals.

Assessment of the team's academic reputation and appeal

Despite working in a very competitive field of research, this team has a great momentum and an excellent reputation.

Members of the team are very successful in attracting and coordinating both national and international grants. They are also involved in the organisation of scientific meetings.

Permanent members of the team are regularly invited to present their research at the national and European level. However, given the size of the team and their publication output, one could maybe expect better representation at the international level.

Thanks to their ability to raise significant funding and to their reputation, the team has successfully recruited 3 permanent researchers, including one who secured a very competitive and prestigious ERC Starting Grant. One of these permanent members has however left the team after 2 years.

Most senior team members assume editorial duties in specialised journals and are actively involved in peer-reviewing for both specialised and generalist journals.

Short appreciation on this criterion

The team has an excellent local and national reputation and appeal, but could maybe work on improving their international visibility. This could be achieved by presenting more at big international conferences and continue publishing in the very top journals.

Assessment of the team's interaction with the social, economic and cultural environment

Despite working on a model plant, the team has managed to establish a number of links with major companies leading to actual funding, and has filed 3 patents since 2009. Part of this was enabled by the long-lasting work on important pathogens of crop plants, and the recent inclusion in their research of crop plants themselves (e.g. *Brassica*, tomato).

Short appreciation on this criterion

The team has excellent interactions with the social, economic and cultural environment, as it has a number of contracts with industry and has filed 3 patents.

Assessment of the team's involvement in training through research

Despite the fact that no team member is a formal teaching staff, several team members are regularly involved in teaching activities for Master and PhD students, as well as with high school students. They are also actively involved in the summer undergraduate school of the LabEx TULIP. In addition, as expected for an active and successful research group, they are regularly and successfully supervising PhD and Master students.

Short appreciation on this criterion

The team is excellent at training through research as reflected by their active involvement in post-graduate training and the success of their Master and PhD students.

Assessment of the strategy and the five-year plan

The retirement of one of the team leaders and the developments of new research lines has led to a proposed split of the team and a reorganization of the remaining original team. One team will now be called 'Immunity networks and plant responses to the environment', while the other will be called 'Plant resistance pathway dynamics and adaptation to global warming'. The reading of the specific objectives seems to justify a separation, but the exact names of these now independent teams are somehow confusing and the proposed split is not necessarily scientifically justified. Indeed, the two newly proposed teams appear as having overlapping objectives (for example, the study of the role of the environment on resistance). One other possibility (which is more scientifically sound) could be to have one team working on effector-triggered immunity and cell death control, while the other would work on quantitative disease resistance.

In both teams, the specific projects seem otherwise well-defined and will employ multi-disciplinary approaches, bridging the molecular level to the organismal, environmental and evolutionary levels. The proposed projects will capitalize on their most successful recent projects and on newly developed collaborations. They will address important biological questions, which in addition to providing fundamental insights into plant immunity, have also the potential to deliver translational solutions to disease resistance in crops. The proposed projects are ambitious, but given the quality of the team and of their collaborators, no major difficulty is foreseen. The only potential danger, which the team is well aware of, is represented by the strong scientific competition in this field.

Short appreciation on this criterion

The proposed project is excellent, as it capitalizes on the most exciting research that emerged from the team in the past years, and will enable further links between mechanistic studies and ecological/environmental aspects of plant immunity.

Conclusion

- Strengths and opportunities:

The original team will now split into two independent teams. This represents an opportunity to re-focus some of the research, but also to expand novel research lines. Independently of the team considered, all permanent members have an excellent track-record, and no technical difficulty is expected.

The team 'Immunity networks and plant responses to the environment' will focus on RKS1, quantitative disease resistance to *Sclerotinia sclerotorium*, and on cell death control mediated by MYB30. All these projects are directly built on recent successful developments are well funded, are adequately staffed, and the proposed leader for each project/team is very well chosen. The evolutionary and potential translational aspects of the projects on RKS1 and quantitative disease resistance to S. *sclerotorium* are particularly interesting.

The team 'Plant resistance pathway dynamics and adaptation to global warming' will mostly focus on the study of effector Pop2 and of the RRS1-R/RPS4 immune receptor complex. This new team will capitalise on recent ground breaking work on this subject, and will further expand on chromatin biology.

- Weaknesses and threats:

Threats

The major threats for both teams will be competition.

Weaknesses

- Team 'Immunity networks and plant responses to the environment': it is unclear why the mathematical and statistical modelling proposed within the MYB30 project is required at this stage, and which kind of significant discoveries are expected from this.

- Team 'Plant resistance pathway dynamics and adaptation to global warming': the team leader of this novel team does not have much international visibility, as reflected by the low number of invitation to present the research on the subjects covered. No major funding seems active beyond 2014. The project on the effect of temperature increases on RRS1-R-mediated resistance does not seem well defined, and may be a distraction.

- The proposed split of projects bears potential for refocusing of the resulting teams, but the work areas could be defined more distinctly.

- Recommendations:

- Team 'Plant resistance pathway dynamics and adaptation to global warming': secure funding as soon as possible. Also, the team leader must rapidly increase the national and international visibility of the team at the scientific.

- Reconsider the scientific orientations of the two new teams resulting from the split of the presently very large team. One team could be working on effector-triggered immunity and cell death control, while the other could work on quantitative disease resistance.

- All senior team leaders should aim to obtain ERC funding.

Team 8: E8 Genetics and genomics of abiotic and biotic stress responses

Name of team leader: To be determined

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	3	3
N3: Other permanent staff (without research duties)	5	4
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)	1	
N6: Other contractual staff (without research duties)	7	6
TOTAL N1 to N6	**16**	**13**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	1	
Theses defended	4	
Postdoctoral students having spent at least 12 months in the unit	1	
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	2	

• Detailed assessments

Assessment of scientific quality and outputs

The team studies the resistance of sunflower to drought stress and pathogens (primarily downy mildew) using genetic methods. The team has developed biomarkers (3 genes) for the water stress status that work independently of genotype. The team has identified QTL for flowering time, and identified and mapped QTL for downy mildew and phoma resistance. The team is responsible for building and organizing many genetic resources. They published 16 papers since 2009. High IF papers were in collaboration (Plant Cell 2011), while most publications are in specialized journals (TAG, Plant Cell Environment), but also in interdisciplinary journals (BMC Genomics).

Short appreciation on this criterion

The team has a good activity given that they work with a crop plant where functional genetics is yet not feasible. A question is whether it is sustainable to work simultaneaously on biotic and abiotic stresses, given the

scientific environment of LIPM. The molecular identification of (any) sunflower QTL would be a key element of visibility and efforts may be oriented towards this goal. On this criterion, the group is evaluated as very good.

Assessment of the team's academic reputation and appeal

The team is involved in the international sunflower sequencing project. Several national projects are coordinated by the team. The previous team leader was president of the CTPS committee for registration of sunflower and soybean varieties. One team member is part of executive committee of a COST European project. The team members attend international meetings on sunflower genetics. Team members are not involved in many editorial activities.

Short appreciation on this criterion

At the national level the team has secured an impressive amount of funding from both the ANR and in partnership with breeding companies. The team has a very good visibility in the sunflower community and it is involved in the sequencing consortium (although its real activity is not clear from the report).

Assessment of the team's interaction with the social, economic and cultural environment

- Methods are those of quantitative genetics and products are knowledge (genes, markers) that can be used in sunflower breeding (disease and stress resistance).
- Characterization of fungal effectors through transient expression is mainstream in plant pathology. Methods for gene/QTL characterization seem to be in frame with the most recent knowledge (next generation sequencing, bioinformatics) and will be improved by the joining of an expert statistician geneticist.
- One patent was filed on bioinformatics and genome assembly methodology.
- The team has a durable partnership with breeding companies.
- The scientific knowledge generated by the team may improve the economic position of private partners.
- The partnership with private breeding companies help to define the specific research objectives and may give opportunities to access genotypes of particular interests.

Short appreciation on this criterion

The methods are producing original knowledge concerning markers and genes for sunflower breeding. The team has a strong link with professionials (funded grants), ‘grey’ publications are linked to this activity toward breeders. The team leader is member of a panel in ANSES regulatory agency. The team is involved in the sunflower sequencing consortium. On this criterion, the team is evaluated outstanding.

Assessment of the team's involvement in training through research

Five PhD theses were completed. Several students at different levels were trained. Several students found employment in private companies. However apart from 12h teaching at the master level the team’s involvment in teaching is modest.

Short appreciation on this criterion

Based on these considerations, the team is evaluated on this criterion as very good.

Assessment of the strategy and the five-year plan

The absence of a team leader makes it difficult to evaluate the strategy. The identification of a group leader is therefore mandatory to define a research focus for the team. The project as it is presented appears to lack focus. In the context of LIPM, the expert committee suggests to concentrate on downy mildew resistance and to orient the abiotic stress project towards the interaction with beneficial microbes sustaining growth. The team is very visible in sunflower genomics but its lack of focus prevents it from reaching excellence. Molecular characterization of a QTL for

resistance to downy mildew would be a major achievement. The arrival of a statistical geneticist should improve the team efficiency in genomics

Short appreciation on this criterion

Based on these considerations, the team is evaluated on this criterion as very good.

Conclusion

- Strengths and opportunities:

Good national and international visibility. The competition is limited in the field. Recent recruitment of new staff with excellent expertise in statistical genetics. Good interaction with private companies and access to germplasm. Steering of a sunflower genomics platform.

- Weaknesses and threats:

Lack of leadership. The project is lacking of focus considering the team forces. The team needs to improve its integration within LIPM.

- Recommendations:

A leadership in the group must be identified. The strategy can then be defined to take advantage of the implantation within LIPM.

Team 9: E9 Ecological genomics of adaptation in plant communities

Name of team leader: Mr Fabrice ROUX

Workforce

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
N1: Permanent professors and similar positions		
N2: Permanent EPST or EPIC researchers and similar positions	1	1
N3: Other permanent staff (without research duties)		
N4: Other professors (PREM, ECC, etc.)		
N5: Other researchers (DREM, Postdoctoral students, visitors, etc.)		
N6: Other contractual staff (without research duties)		
TOTAL N1 to N6	**1**	**1**

Team workforce	Number as at 30/06/2014	Number as at 01/01/2016
Doctoral students	2	
Theses defended	3	
Postdoctoral students having spent at least 12 months in the unit		
Number of Research Supervisor Qualifications (HDR) taken	1	
Qualified research supervisors (with an HDR) or similar positions	1	

• Detailed assessments

Assessment of scientific quality and outputs

The team of 'Ecological genomics of adaptation in plant communities' has been newly founded in September of 2013. In the report, the team leader has described on his work between 2009 up to present and briefly outlined the questions he will address in the years to come. The team leader has strength in quantitative genetics and evolutionary ecology. His work broadly addresses the process of adaptation in natural populations. The team leader is well integrated both within and outside of France and has an excellent publication record.

The main areas of activity in the group are as follows:

1. Adaptation of life history traits to climatic factors, such clinal variation in flowering time.

2. Adaptation to bacterial pathogens.

3. Adaptation to interspecific competition.

Short appreciation on this criterion

This group was recently (Sept. 2013) founded and therefore no score is given during this evaluation.

Assessment of the team's academic reputation and appeal

Due in part to the strong publication output of this group, this young team is already well-known at the national and international level. The team leader has served on steering committees and on scientific advisory boards within France. Also the team leader has been successful in securing 3rd party funds within the French scientific funding community (e.g. ANR and INRA). The team leader increases the visibility of the group by consistently attending national and international conferences. Since 2009, the team leader has given over 13 invited seminars, many outside of France. The team leader also reviews grants for multiple European agencies and is an associate editor for Plant Biology.

Short appreciation on this criterion

This group was recently (Sept. 2013) founded and therefore no score is given during this evaluation.

Assessment of the team's interaction with the social, economic and cultural environment

The team leader won a Fulbright fellowship in 2012 for a seven-month stay at the University of Chicago in the group of Joy Bergelson. This academic contact set the foundation for many fruitful projects and high profile publications. Within France, the team leader is integrated at the national, regional and local scale. His largest grant is the LabEx TULIP grant which runs through 2018. Most of the focus of the lab will be guided and addressed within this context. In 2012, the group leader was a co-inventor on a patent for resistance to black rot.

Short appreciation on this criterion

This group was recently (Sept. 2013) founded and therefore no score is given during this evaluation.

Assessment of the team's involvement in training through research

The team leader does not appear to be integrated in teaching at the bachelor's or master's level. This may reflect the short time that the group has been in Toulouse. The team leader currently oversees two PhD students in Toulouse. Training through research appears to be a point that can be strengthened in the coming years.

Short appreciation on this criterion

This group was recently (Sept. 2013) founded and therefore no score is given during this evaluation.

Assessment of the strategy and the five-year plan

The strategy for the next five-year focuses on evolution of genes affecting disease resistance and interspecific competition. Additionally the team leader would like to break into the emerging field of plant-microbiota community interactions. The team leader has established a strong record in evolutionary/ecological genetics, QTL mapping and biodiversity, so there is no reason to doubt that these are not realistic goals. Also, the active acquisition of 3rd party funding shows that not only does the team leader want to address these questions, but has the financial means to do so. His strong national and international collaborative network means that he can also move forward on many fronts simultaneously, without being stretched too thin. This ensures that these ambitious goals will be achieved in a thorough and thoughtful way and not simply proposed and addressed superficially.

Conclusion

- Strengths and opportunities:

This team will flourish in the upcoming years. The track-record of the team leader is impressive and the ideas are straightforward. The team leader is already well and rapidly integrated within the LIPM and is a positive force. The other scientists in the unit are also very enthusiastic about the potential for collaborative projects with him. The team is in an optimal position to build integrative projects for mutual benefit of many labs at the LIPM.

- Weaknesses and threats:

The microbiome project appears not to be well formulated. Since this is a central project in the Tulip initiative, it is essential that the scope of this project is better defined. In the scientific presentation, the team reports that 212 natural populations of *A. thaliana* have been located in Southern France. It is possible that the team intends to survey all locations for microclimate, soil characters, microbiota diversity, interspecific competition and genetic variation. Not enough details were given to determine if this project is at all feasible for such a small group.

- Recommendations:

The five-year plan is ambitious, but the team leader has shown the ability to be flexible and work on many different topics in parallel. However, there is a risk in working on too many topics at once. At this point, a more focused approach may be beneficial and some consolidation in the research lines (for example two major parallel projects, rather than three) may be more sustainable and rewarding.

5 • Conduct of the visit

Visit dates

Start: Thursday, 27th of November, 2014, at 8:15 am

End: Friday, 28th of November, 2014, at 7:00 pm

Visit site:

Institution: Centre Inra Midi-Pyrénées – site d'Auzeville Tolosane

Address: FR AIB seminar room – Pôle de Biotechnologie Végétale – Auzeville

Conduct or programme of the visit:

Day1

08h15-08h30	Welcome of expert committee members and presentation of evaluation procedures by HCERES delegate
08h30-10h15	Presentation of LIPM and scientific achievements (2009-2014) by former director and by the LIPM project (2015-2020) director

Scientific Presentations

10h30h-11h00	E1 Symbiotic functions, genome and evolution of Rhizobia Fonctions symbiotiques, génome et évolution des rhizobia
11h00-11h30	E2 Responses to stress and environmental signals in rhizobia
11h30-12h15	E3 Endosymbiotic infection and nodule development
13h00-14h00	Closed meeting of the experts committee

Scientific Presentations

14h00-14h45	E4 Symbiotic signaling
14h45-15h15	E5 *Ralstonia solanacearum* pathogenesis and adaptation to the plant environment
15h15-15h45	E6 Infectious strategies of Xanthomonas
15h45-16h45	Closed meeting of the experts committee

Scientific Presentations

17h00-17h45	E7 Resistance, susceptibility and cell death in *Arabidopsis thaliana* in response to bacterial pathogens
17h45-18h15	E8 Genetics and genomics of abiotic and biotic stress responses in sunflower
18h15-18h45	E9 Ecological genomics of adaptation in plant communities
18h45-20h00	Closed meeting of the experts committee

Day 2

08h30-08h50	Presentation of PF1. Informatics and Bioinformatics Plateform
08h50 -09h20	Meeting with LIPM researchers
09h20-09h50	Meeting with LIPM 'Ingénieurs, Techniciens & Administratifs'
09h50-10h20	Meeting with LIPM non-permanent staff (PhD students, post-doctoral fellows, CDD)
10h45-11h15	Meeting with the head of the SEVAB Doctoral school (ED 458)
11h15-11h45	Meeting with CNRS and INRA delegates
11h45-12h30	Meeting with the LIPM Direction teams (present and future)
13h30-18h30	Final closed meeting of the expert committee

6 • Supervising bodies' general comments

LABORATOIRE INTERACTIONS PLANTES MICRO-ORGANISMES
LIPM - UMR 2594/441

Objet : Pré-rapport HCERES
S2PUR160009991 - Laboratoire des Interactions Plantes - Microorganismes - 0755361V

INRA-Délégation à l'Evaluation
147 rue de l'Université
75338 Paris cedex 07

OBSERVATIONS DE PORTEE GENERALE SUR LE RAPPORT D'EVALUATION HCERES

I. General comments concerning the HCERES report

1 - The LIPM **appreciates** that the committee has underlined the following points:

- *"the LIPM has also successfully built on these partnerships to seize new opportunities that now see the LIPM further integrating evolutionary ecology approaches, developing quantitative and associative genetics, and studying the impact of an ever-changing environment on plant diseases and/or symbioses. These aspects are necessary to link* ***biology with ecology****; something that is required for a modern agriculture; and therefore will help the LIPM to continue achieving excellent fundamental research (which is core to its mission) while at the same time further interacting closely with the private sector."*

  These new research orientations at the interface between biology and ecology are essential not only for the LIPM, but also as a strong structuring element of the scientific policy in the local context (see further below).

- *"Although not a joint-unit with any university, the LIPM host teaching staff from different teaching institutions and other staff members are also actively involved in post-graduate teaching"*

  This may be one of the reasons why the LIPM is very attractive to students.

- *"The LIPM is also seriously hampered by a significant lack of space for laboratories and offices. This last point is particular concerning as it affects the working conditions of current staff members, but also hinders the expansion of successful groups/teams when awarded large competitive grants, as well as the installation of potential new groups."*

  The infrastructure issue is a major concern for the LIPM. We are currently examining opportunities to occupy additional labs and offices in a nearby building, which should therefore rapidly solve part of the space problems. Looking further ahead, new infrastructures (part of the "Plan Campus" operation) will be available in 2018 on the INRA Auzeville campus. These new facilities will be occupied mainly by staff from the LIPM (about 70%) and EDB (about 30%) laboratories, thus

providing additional lab and office space for existing teams and allowing the installation of new teams. This organization will also reinforce the human/scientific links between the LIPM and EDB.

2 – In addition, the LIPM wishes to comment on the following points:

- "*the number of **students and postdocs** is quite low (but in line with the French system), when compared to other research institutes in Europe or internationally. Therefore, the research capacity of some teams mostly composed of senior permanent staff members may not be optimal, which can cause a disadvantage; especially when working on competitive and fast-moving research topics*."

  Indeed, the number of PhD students supervised at the LIPM is completely in line with the French system, and will be difficult to improve for the following reasons: i) the LIPM is already very attractive for undergraduate and master students at the local and national level, in spite of the relatively low number of teaching staff, ii) the number of scientists able to supervise students (HDRs) is already very high and iii) the LIPM is already very successful at obtaining doctoral contracts from the government through the annual doctoral school competition, and at the moment very few additional possibilities to finance PhD students are available.

- Concerning the recommendation "*A **novel team leader** with strong scientific and management leadership for the **sunflower** team should be recruited as soon as possible*.", the head of the INRA BAP division is actively searching for a new leader for this team, in line with the strategy adopted after discussions between the Direction of the LIPM, the head of the BAP division and the permanent personnel of the team.

- Several conclusions have been drawn by the HCERES committee from the **table (page 10)** of the report. This table suffers from several drawbacks:
  (i) Some numbers are inaccurate (for example 24 technical staff in the 1st column become 20.4 in the 2nd; 32 scientists in the first column but 33 announced in the text; how are the 20 FTE scientists calculated in column 2?)
  (ii) Some numbers correspond to rough estimates (for example the technical staff's salaries)
  (iii) This analysis only applies to 2013, and not for the 5 year mandate
  (iv) It does not include scientific production (publications, patents, etc…)
  (v) Some calculations could not be verified by our administrative staff

In conclusion, we request the removal of this table, (as well as the text based on it: i.e. p9: "Some numbers") from the final, publicly available, report.

To our knowledge, such a comparison of two research units in the context of a HCERES evaluation is highly unusual and thus questionable. The inaccuracy of the table is a serious problem, as is the asymmetrical comparison below.

- We were very surprised to find the following sentence in the committee report:
- *"Not surprisingly half of the ANR contracts of the LRSV are collaborative projects with LIPM. In addition 24/171 articles of LRSV have shared authorship with LIPM scientists. A large proportion of the inter-unit collaborations within the FR 3450 are between LIPM and LRSV."*

This asymmetrical comparison introduces a strong bias in the description of the local situation.. A symmetrical and unambiguous formulation would be:

…..half of the ANR contracts of the LRSV are collaborative projects with LIPM. On the other hand, **20% of the LIPM ANR contracts are collaborative projects with the LRSV and 8% with EDB** (a more recent member of the FR AIB). In addition 24/171 (14%) articles of the LRSV have shared authorship with LIPM scientists, whereas **24/325 (7%) of the LIPM articles have shared authorship with LRSV scientists**.

Finally, concerning the LIPM publications, we would like to underline that the total number of **LIPM publications is in fact 325** (annex A), and not 232.

3- Regarding the ***answer of the committee to the engagement letter from the INSB (CNRS):***

(a). Firstly, we would like to underline the fact that the LIPM has many **collaborations with different research laboratories** and not only with the LRSV, as mentioned page 6, and more importantly page 7. In this context, we appreciated the fact that the committee mentioned **certain** of the other laboratories belonging to our FR:

"*LRSV is a 'Unité Mixte de Recherche (UMR)' CNRS - University Paul Sabatier and LIPM a UMR CNRS - INRA. The two laboratories are located together with a third laboratory 'Genomics and biotechnology of fruit (GBF)' in two interconnected buildings. A fourth laboratory, the French Plant Genomic Resource Center (CNRGV) is also present closeby on the Castanet-Tolosan site. All four laboratories are part of the FR3450*."

However we would like to underline the fact that two other laboratories also belong to the FR: SEEM (Station d'Ecologie Experimentale de Moulis, CNRS) and EDB (Evolution & Diversité Biologique, CNRS-UPS-ENFA), both of which are of primary importance for the LIPM, the FR AIB and the project TULIP, since they develop **evolutionary ecology projects in line with new scientific orientations of the LIPM**, and which has been identified by the committee as "*helping the LIPM to continue achieving excellent fundamental research"*. These labs, and particularly EDB, collaborate increasingly with the LIPM, generating several contracts and publications (e.g. 3 ANR contracts between EDB and LIPM). Beyond SEEM & EDB, the LIPM also fruitfully interacts with many other labs in Toulouse, France and worldwide (approx. 30% of the LIPM publications are co-authored by international researchers). Thus, LRSV constitutes only one of the numerous collaborators of the LIPM.

(b). For many years the LIPM has favored (and continues to favor) the Federative Institute (FR AIB, ex-IFR40; https://www.fraib.fr/) as a vehicle for optimizing our scientific and technical exchanges with the other local research units. The FR AIB brings together the main Toulouse research teams in the fields of plant biology and microbiology, molecular and experimental ecology and the analysis of biodiversity. This scientific strategy corresponds to the current movement towards restructuring research at the interface of « green biology » and ecology in Toulouse. The LIPM continues to make a major contribution to FR activities (e.g. current Director: Jacques Batut), based on the principle that our federative institute is the best catalyst for scientific exchange and developing synergies between neighboring research laboratories, as well as providing a strong regional pole in agrobiosciences and ecology.

Through the FR, we share common seminars and forums, technological platforms and equipment, increasing numbers of bi-lateral contracts and also personnel (**currently 2.5 LIPM personnel (ingenieurs) work on these platforms and in 2015 they will be joined by an additional member of our laboratory**). This organization allows exchange and sharing in many domains, while at the same time maintaining individual research units at what **we consider manageable dimensions**. This choice has been rewarded in numerous ways during the 10 last years:

- A **multiplicity of contracts for LIPM teams** in collaboration with different teams from the LRSV, EDB etc…
- **Numerous contracts for our technological platforms**, and in particular the FR AIB imagery platform
- **The decision to construct a major new facility** (**Operation Plan Campus**, 2010, 11 M€, approx. 3000 m^2; planned construction date: 2015-2017) for the extension of our various research units

(certain, such as the LIPM and EDB are seriously overcrowded; see comment above), for housing the entire Imagery platform and providing adequate facilities to welcome new teams.

- **The financing of the LabEx TULIP project**, selected after the first round of Investissement d'Avenir in 2011 (9 M€) and coordinated by Dominique Roby (DR CNRS, LIPM) and Etienne Danchin (DR CNRS, EDB), involving approximately the same laboratories as the FR AIB (https://www.labex-tulip.fr/labex-tulip_eng/The-TULIP-LabEx). The main objectives of TULIP are to provide funding for a number of "core projects" based on the current strengths of the five partner laboratories, in addition to funding "New Frontiers" projects aimed at exploring new concepts, technologies or synergies. The LIPM has received support for several projects funded by TULIP and contributes significantly to the different activities of TULIP, including both the pedagogical and economic development features of the TULIP project.

- **The financing of a FEDER – Région Midi Pyrénées Project for a Phenotyping Platform** (Coordinators : J. Batut & D. Roby), and we have recently been informed that we have also obtained financial support for the **second phase** of this project (phenotyping in different environmental conditions, Contrat Plan-Etat Région).

In conclusion, our opinion is that an effective research federation (FR AIB) acting locally, in association with the dynamics provided by the TULIP LabEx, is the best way to maximize the benefits of existing and future interactions between our unit and the LRSV. Furthermore, it is worth underlining the existence of **(i)** successful long-term collaborations with certain LRSV teams (on-going ANR projects, projects financed by the FR AIB etc), **(ii)** cost-sharing when necessary in order to save unnecessary expenditure on common equipment, technical platforms, etc, **(iii)** excellent visibility for the LIPM, the FR AIB and the Labex at the local and national levels (indeed we are not at all convinced that a fusion would increase this visibility).
Finally, it should be noted that the FR AIB (in association with the Labex TULIP) has been recognized by the HCERES evaluation committee as having a key role in structuring agrobioscience/evolutionary ecology research at Toulouse as underlined in the comments of the committee below:

« *rôle structurant dans le domaine de l'agrobiosciences et de l'écologie évolutive sur le site Toulousain, comme le témoignent notamment la réussite du projet de LABEX TULIP et de celui de construction d'un bâtiment "FR" dans le cadre du Plan Campus* »

« *La FR AIB regroupe une association de compétences originale dans le paysage national, et à ce titre constitue un fort potentiel pour développer des approches intégratives pour la gestion durable de la biodiversité et des agroécosystèmes. La mise en place de plateformes technologiques performantes, le soutien de projets de recherche aux interfaces entre unités et l'investissement dans des activités d'animation scientifique ont constitué des outils clés permettant de créer un environnement scientifique de grande qualité pour les membres de la FR AIB. Cet investissement a porté ses fruits au travers d'un bilan remarquable de production scientifique, tant en qualité qu'en quantité, de valorisation en termes d'obtention de brevets et de contrats industriels, de recrutement de chercheurs de grande renommée internationale, et de montage de projets ambitieux tels que le LABEX TULIP et la participation au Plan Campus. Globalement, le bilan de l'activité scientifique de la FR AIB est de niveau exceptionnel.* »

So what is the best structuration?

In response to the comments made by the evaluation committee page 9 including three different possibilities, our opinion is the following:

(i) The first possible scenario relies on the creation of a 'strong plant center' based on the fusing of the LIPM and LRSV units as evoked in the first paragraph of the Committee's report:

"*From an outside perspective, the creation of a strong plant center could potentially boost the overall scientific impact, attractiveness and the local, national and international visibility of the Castanet-*

Tolosan campus. It also would allow administrative simplification, a better use of infrastructures, finances and human resources."

Beyond the primary interest of creating a big plant center (and we consider that the attractiveness of an institute does not only depend on its size but rather on its scientific renown), we would also like to underline the following important points:

- The current evolution of research themes at the LRSV are only very partially overlapping with those of the LIPM, particularly with the major development of projects at the LIPM oriented towards ecology-evolution, which in the long term could rather encourage a closer association between the LIPM and other partners such as the EDB. **No research project currently exists to justify the LIPM/LRSV fusion**, and in our opinion this would be difficult to construct taking into account the future divergence of research themes in the two research units.
- Instead of an 'administrative simplification' such a fusion would rather lead to **increased administrative and organizational complexity** with an increase from **150 to 240 personnel**, associated with very different modes of internal functioning, and adding a third research body (INRA, CNRS & University Paul Sabatier) each with their specific financial resource management tools
- There are major differences between the two research units in terms of resources (financial, human and infrastructure), **which could lead to a negative impact on the current dynamics of the LIPM** for which certain of these resources are already limiting (e.g. plant growth facilities)
- **The high human cost generally associated with this type of fusion** leading to the creation of a very large institute, as has been reported for a number of similar operations in recent years in France (occasionally even with counter-productive results)
- Finally, as indicated above, **the FR 3450 is already a scientifically rich structure which favors multiple interactions within our local scientific community**. Of course, additional infrastructure/personnel sharing is always possible, and our community has been (and will continue to be) active in this domain.

For all these reasons, **we do not consider that the fusing of the LIPM and LRSV laboratories would be beneficial for the LIPM** in the present circumstances and does not represent a desirable option in the immediate future. It is important for us to underline these various points, since, rather surprisingly, the fusing of our two laboratories has been presented in the HCERES evaluation report essentially from the point of view of the LRSV.

(ii) An additional possibility mentioned in the HCERES report is "*maintaining the current configuration while trying to further promote scientific exchange*". **Over the last decade, the LIPM has been a central actor in a significant number of mutualisation actions** including active participation in the direction of the IFR40/FR3450, supporting different technical plateforms and scientific exchange onsite, coordination of the LabEx TULIP, the mutualisation of personnel in the newly created Phenotyping Plateform, to cite only a few.

As stated by the future Direction Team in their project for the next mandate, ***"our laboratory will continue to support this organization in the future as it provides an essential structuring for local research on plant biology, biology of plant-microbe interactions and environmental sciences".*** In our view, this mutualisation should be developed in concert with all members of the FR3540 and the LabEx TULIP. This approach has already proved successful in developing a new scientific dynamic on site, exemplified by financial support to fund new research orientations, including the arrival of Fabrice Roux's team at the LIPM or the future creation of the "Plan Campus" that will host different teams of the FR and the LabEx TULIP, thereby setting the stage for further scientific interactions and mutualisation actions in the future.

(iii) Finally, the last option mentioned in the HCERES report involving **the creation of different research units with distinct identities**, is a possibility worth considering in the future. However, the

proposed focus “academic excellence vs translational research” is not appropriate, since the LIPM already develops both of these aspects, in line with our INRA missions. Consequently, we do not consider at present the possibility of a reorganization based on this criterion.

3 Reply to appreciation team by team

Team 2 “Responses to stress and environmental signals in rhizobia”
Team leader: Claude BRUAND

Assessment of scientific quality and output:
Although we generally agree with the evaluation, we regret that it does not take into account the progress in scientific production, both qualitative and quantitative, made since the last evaluation. Also, we regret that it does not consider the small number of permanent staffs involved in research during the evaluated period (1 Scientist -the PI-, 1 Assistant professor -part time- and 1 Technical staff), which makes the number of publications per permanent staff particularly high, especially if the Assistant professor is counted as 0.5 full time equivalent.
Regarding the scientific quality and originality, we would like to emphasize the pioneering role of the team in i) characterizing the general stress response in Alphaproteobacteria, and ii) identifying NO as an important symbiotic signal. Although these two fields are now becoming strongly competitive, the team members published 4 papers in 3 ‘plant’ journals of high impact (>6).

- Assessment of the team’s involvement in training through research:
Although this criterion was judged as excellent, we regret that the heavy teaching workload (1 Assistant Professor) and the high ratio of supervised PhD students per permanent staff are poorly valorized in the short appreciation of the criterion.

Team 4 “Symbiotic signals and their perception/transduction”
Team leaders: Clare Gough & Julie Cullimore

The team 4 would like to change the text of the section "Assessment of scientific quality and ouputs" to replace "The scientific output of the team, as a whole, is remarkable with 16 publications driven by team members (1 Nature (not a genome paper),....." by "The scientific output of the team, as a whole, is remarkable with 17 publications driven by team members (2 Natures, ..."
To explain this change, the group would like to point out that they have made a major contribution to the international effort to sequence the *Medicago truncatula* genome, as shown by F. Debellé being co-first author together with the corresponding author (N. Young) on the resulting Nature paper (Young, Debellé, Oldroyd, et al 2011). This driving role of the group in this area has considerably enhanced the International reputation of the group and the LIPM in the *M. truncatula* field.
(also listed in the “Erreurs factuelles” file)

Team 6 “Infectious Strategies of *Xanthomonas*”
Team leader: Laurent NOEL

page 34: The team has played a pioneer role in the identification of CUT systems (Blanvillain et al. 2007). We agree that the characterization of TBDT and CUT systems in gut symbionts is very advanced but this work is not informative as whether these gene sets (more than 70 TBDTs in *Xcc*) are relevant for *Xcc* biotrophic/necrotrophic life and pathogenicity on plants.

Team 6 subcritical size: A lecturer position is opened in the group after Martine Lautier's retirement. We are also actively applying to ANR calls and supervising Master and PhD students to increase our critical size. Though highly competitive, we'll also contact younger researchers to apply at CNRS permanent positions to strengthen the group and ensure its development.

Collaborations within the LIPM: We are surprised with the final recommendation "collaborate more within the unit". Indeed, we have numerous past and ongoing collaborations with Team 7 and Team 9, which are supported by 3 recent co-publications. As another illustration, a PhD started in 2014 is co-supervised by Team 6 and Team 7 members.

Focus: As described in the report, the Team 6 will engage in two major research axes in the five years to come:

- Hydathode's immunity and transcriptomics
- PTI suppression by TBDTs/CUT systems

In parallel, we'll valorize some of the Team's existing results/ressources (comparative genomics and transcriptomics of *Xcc*) and pursue the more applied project CROpTAL which has just been selected and funded by the ANR.

Team 8 "Genetics and genomics of abiotic and biotic stress responses"

The Sunflower Genetics and Genomics team was created to develop the knowledge on sunflower in association with socio-economic partners and help the development of a greener agriculture. It was based in the LIPM because of its strong expertise in biology, genetics and genomics. This was confirmed again by the INRA BAP department, as well as the positioning of our team on a tripod genetics and genomics / abiotic stress / biotic stress.
Following this recommendation and accordingly to the socio-economic partner's interests, we develop and coordinate strong research projects on drought tolerance: Sunyfuel (2008-2011, 1.2M€), Oleosol (2009-2013, 3.6M€) and Sunrise (2012-2019, 7M€). The inter-disciplinary approach that we develop with agronomists and ecophysiologists requires long-term investments and will start to bring fruits in the very close future. In addition, our systems biology approach to study drought stress is adequately positioned in the TULIP community and addresses the problematic issue of complex trade-offs between physiological functions in order to understand adaptation to environmental constraints. This approach will certainly be of interest to the entire LIPM as it should be advantageously transfered to any environmental interaction.
To date, the sunflower community does not identify the interaction between abiotic stress and microorganism as a realistic way to improve sunflower crop competitiveness, and more knowledge on mycorrhizae x drought stress interaction is required to reorient our research efforts in this direction.

Taking into consideration all these different aspects, we will keep following the research developments on the beneficial impact of microorganisms on abiotic stress tolerance and their possible implications for sunflower.

Concerning the biotic stress, we agree on continuing the downy mildew project towards the finding of more sustainable resistances : cloning of the resistance QTL QRM1 and identification of broad-host range sunflower resistance loci through *Plasmopara halstedii* effector study (ANR Effectoores 2014-2017, 0.5M€). These approaches are strongly linked to LIPM other themes.

Dominique ROBY
Directrice du LIPM