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

Section des unités de recherche

AERES report on the unit:

Laboratoire Reproduction et Développement des
Plantes –UMR 5667

sous tutelle des
établissements et organismes :

CNRS

INRA

ENS

Université Claude Bernard Lyon 1

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Le Président
de l'AERES

Jean-François Dhainaut

Section des unités
de recherche

Le Directeur

Pierre Glorieux

Mai 2010



Unit

Name of the unit: Laboratoire Reproduction et Développement des Plantes (RDP) UMR5667 CNRS-INRA-ENS-UCBL

Requested label: CNRS-INRA-ENS-UCBL

No. in case of renewal: UMR5667

Unit director: M. Jan TRAAS

Members of the expert committee

Chairperson:

M. Vincent COLOT, Ecole Normale Supérieure, Paris, France

Reviewers:

M. Emmanuel FARGE, Institut Curie, Paris, France

Mrs Angela HAY, University of Oxford, Oxford, UK

M. Patrick LAUFS, INRA de Versailles, Versailles, France

M. Thomas LAUX, University of Freiburg, Freiburg, Germany

M. Jerzy PASZKOWSKI, University of Geneva, Geneva, Switzerland

Reviewer(s) nominated by the staff evaluation committees (CNU, CoNRS, CSS INSERM ...):

M. Michel LEBRUN (CoNRS)

M. Dominique ROLIN (CNU)



Representatives present during the visit

Scientific delegate representing AERES:

M. Alain PUGIN

University or School representatives:

M. Jacques SAMARUT (Président de l'ENS)

M. Germain GILLET (Vice-président du CS de l'Université Claude Bernard Lyon 1)

Research organisation representatives:

M. Loïc LEPINIEC (Chef de Département Biologie Végétale INRA)

M. André Le BIVIC (Directeur Adjoint Scientifique INSB CNRS)

Mrs Elisabeth RIVORY and M Sébastien BUTHION (Délégation régionale du CNRS)



Report

1 • Introduction

- **Date and conduct of the visit :**

The visit took place on January 27 and 28, 2010 at the RDP. The director presented the Unit, its organisation, resources, local scientific environment, as well as its main achievements and projects for the next four years. This was followed by a presentation by each team of their results and projects. We met the representatives from the Institutions (ENS, INRA, CNRS, UCB) and heard separately the three groups of Students and Post-docs, Technical staff and Permanent Scientists. The visit was concluded by a 4 hour closed-door meeting of the committee to prepare the present report.

- **History and geographical location of the unit and brief description of its field of study and activities :**

The laboratory was created by Prof. Christian Dumas in 1993. It is a joint research unit (UMR), funded by ENS-Lyon, CNRS, INRA and the UCBL1. It is located on the ENS campus at Gerland (Lyon), and occupies 1789 m², including a 250 m² greenhouse as well as 5 growth chambers. It is composed of 39 permanent staff (including 14 research scientists and 8 lecturers/professors) and ~20-25 temporary personnel. The laboratory is fully equipped for molecular and cell biology, biochemistry, imaging and modelling. It contributes directly to two platforms (protein chemistry, imaging) and has access to several other platforms, including one in genomics. RDP belongs to the IFR 128 Biosciences Gerland-Lyon Sud and is associated to the RTRA "Finovi". It is affiliated to the Ecole Doctorale "ED340-Biologie Moléculaire Intégrative et Cellulaire". Its annual budget is 2.7 M€, including salaries (of which ~700k€ comes from national or international grants). The main research focus of RDP is the study of plant reproduction and development, using molecular genetics, imaging and modelling approaches. Research is performed on several plant species, including *Arabidopsis* (capacity: 70000-90000 plants/year), maize, rose, petunia, *Cabomba* and *Amborella*.

- **Management Team :**

Prof. Christian Dumas was head of RDP from 1993 until 2006. Jan Traas took over the directorship in January 2007. The lab comprises 6 research groups, 3 of which have been substantially re-organized for the next contractual period. The direction team is composed of the director and the 6 group leaders : it meets at least once a month. The laboratory council meets 2-3 times per year, and a general assembly is convened once or twice a year.



- Staff (according to the dossier submitted to AERES):

	In the report	In the project
N1: Number of professors (see Form 2.1 of the unit's dossier)	6	8
N2: Number of EPST, (Public scientific and technological institution) or EPIC, (Public industrial and commercial institution) researchers (see Form 2.3 of the unit's dossier)	13	14
N3: Number of other professors and researchers (see Form 2.2 and 2.4 of the unit's dossier)	2	
N4: Number of engineers, technicians and tenured administrative staff members (see Form 2.5 of the unit's dossier)	16,7	16,7
N5: Number of engineers, technicians and non-tenured administrative staff members (see Form 2.6 of the unit's dossier)	5	2
N6: Number of doctoral students (see Form 2.8 of the unit's report dossier and 2.7 of the unit's project dossier)	12	6
N7: Number of persons accredited to supervise research and similar	10	10

2 • Assessment of the unit

- Overall opinion:

The Unit occupies a unique position in France in the study of flower development and reproduction. It performs outstanding and pioneering research, which places it among the top laboratories in its field of expertise at the international level. In particular, researchers of the Unit are among the first to have combined 4D imaging, gene network reconstruction and computer modelling in an effort to explain how flowers and floral organs are initiated. The Unit has also made essential contributions in the study of cell signalling, notably in relation to intracellular trafficking, cell polarity, and organ initiation. More generally, the Unit uses a variety of plant species and approaches to conduct basic research on topics ranging from the evolution and mechanics of flower development, to the genetic basis of flower scent and seed development. The proposed organization for the next four years is aimed at reinforcing the evo-devo and modelling components of the Unit and indicates a clear commitment to maintaining excellence.

- Strengths and opportunities:

- Excellence and well-defined focus in a scientific field of fundamental and economical importance.
- Originality.
- Exceptional expertise in integrative biology, notably through modelling.
- High quality of scientific environment, with strong potential for interdisciplinary research (e.g. with the Institute of Complex Systems and the Joliot Curie Institute, located in the same and next buildings, respectively).
- Contribution or access to several platforms (imaging, protein chemistry, genomics...).
- A privileged access to first class students.



- Numerous collaborations in France and abroad with top rate labs.
- Successful in obtaining prestigious and highly competitive grants.
- Recent recruitment of very talented young scientists.
- Excellent cohesion within the unit.
- Implementation of quality assessment procedures to ensure good laboratory practice.

- **Weaknesses and threats:**

- Lab, office and greenhouse space is becoming critically limiting.
- Insufficient number of microscopes to perform live imaging of flower/organ emergence.
- No Next Generation Sequencing facility in the Lyon area.
- Large number of plant species studied.
- Too few PhD students and post-docs, especially from abroad.
- Insufficient integration of the 4 Biology Units of ENS.
- Insufficient links with UBCL for teaching and research.
- Controversial rotation scheme between teams for some of the technical staff.

- **Recommendations for the unit director:**

The lack of sufficient greenhouse space must be remedied urgently, as this will very soon impact the productivity of several groups within the Unit, including the newly hosted ATIP group. The imaging platform also needs to be expanded rapidly with the acquisition of at least one additional confocal microscope to enable live imaging over several days. The director should push for the recruitment of a high level research assistant (Ingénieur de Recherche) with specific expertise in modelling and computer visualization to fill an obvious and necessary need for the newly established Biophysics and Development group. More generally, the director is encouraged in his efforts to improve the general infrastructure of the Unit, with the addition of new lab and office space.



- **Data on work produced :**

A1: Number of <i>produisants</i> (professors and researchers whose names appear in a minimum number of "publications" over a 4-year period) listed in N1 and N2 in the project column	22
A2: Number of <i>produisants</i> among the other staff listed in N3, N4 and N5 in the project column	18
A3: Proportion of <i>produisants</i> in the unit [A1/(N1+N2)]	100%
Number of theses for accreditation to supervise research defended	0
Number of theses defended	12
Any other data relevant for the field (please specify)	

3 • Detailed assessments

The RDP Unit conducts basic research in the general field of plant developmental biology, with a particular focus on the reproductive stage, from flower formation to early seed development. The work is carried out using several model plant species (*Arabidopsis* and basal angiosperms), as well as two plant species of agronomic or horticultural interest (maize, rose). *Petunia* has recently been added, both as a model and a plant of economic interest. Over the last four years, the Unit has built on its strong thematic coherence to develop systems biology approaches aimed ultimately at producing an integrative view of plant reproduction. Thus, several teams have started to implement computational modelling and the first models of virtual organs and gene regulatory networks underlying flower initiation were produced. In parallel, the Unit has capitalized on its expertise in molecular genetics and cell biology to obtain highly significant results on the role of endocytosis and protein trafficking in the control of cell signalling and plant development. One can also note the development of the first robust transformation system for roses as well as the creation of an EST library for this species, which opens up the possibility for genome-assisted research on rose flower development and scent. However, as with any Research Unit of a relatively large size, not all teams perform at the same level of excellence, and this explains in part the proposed re-organization for the next four years (see project assessment below).

In the past four years, the Unit has produced 66 publications (3.6 per permanent scientist) in peer-review journals, including 13 primary reports in *Nature*, *Cell*, *Science*, *PLoS Biology*, *PNAS* (5), *Plant Cell* (3) and *EMBO J*. These numbers reflect a clear commitment to publishing in high impact journals. In addition, a total of 12 theses were defended.

Many of the group leaders are regularly invited at international meetings, and the Unit was the main organizer of the XVth FESPB congress, which took place in Lyon in 2006 and gathered over 800 participants.

One of the group leaders was elected to the EMBO in 2008, and several prizes were awarded to an exceptionally talented PhD student in 2007 and 2008. The director received in 2008 the Jaffe medal of the French Academy of Sciences for his contribution to Integrative Biology.

The Unit has hosted two visiting professors : J. Chory, Salk Institute, USA (one month 2006) and M. Fröhlich, Botanic Gardens, London, UK (almost all of 2009).



The Unit has been successful in recruiting over the last four years three new group leaders (including the new Director and one PI from abroad), as well as five junior scientists and six Research Assistants. This more than compensated for the departure of five scientists or research assistants during the same period, which further illustrates the dynamism and continuous ambition of the Unit. However, the Unit clearly suffers from not having enough post-docs and PhD students (5 and 12, respectively, for a total of 19 permanent scientists in 2009).

Approximately 25% of the total budget (including salaries) comes from grants (ANR, UE, HFSP...). This indicates a high rate of success in obtaining essential complementary resources through competitive calls.

With the exception of the contentious issue of rotating technical staff, the organization of the Unit appears excellent in every respect. Notably, thanks to the high degree of transparency in the decisions taken by the Director, and frequent consulting of the different organizational committees set up to assist the Director, conflicts seem very limited. Indeed, one is impressed by the strong scientific and administrative cohesion of the Unit.

The Unit has made considerable efforts over the past four years in establishing itself as a prominent centre for systems biology and modelling, and should be commended for this success. This has already had a major impact on the organization of research in the region, notably in formalizing strong links with the Institute of Complex Systems and the Institute Joliot Curie in Lyon, as well as with the Plant Research Unit located in Grenoble in the framework of the "Cluster 9 Région Rhône Alpes".

The Unit hosts eight Professors and Lecturers (5 ENS, 3 UCBL), of whom most are actively engaged in both teaching and research activities. Many of the CNRS and INRA research scientists also contribute to teaching to varying extents. Moreover, one of the senior CNRS research scientists is the current director of the Ecole Doctorale "ED340-Biologie Moléculaire Intégrative et Cellulaire", which further illustrates the strong commitment of the Unit to teaching. However, it should be mentioned that for historical reasons, there is little coordination between ENS and UCBL in designing/organizing courses in the field of plant sciences, and teaching at UCBL by members of the Unit remains complicated.

The projects presented by the Unit are globally sound, with appropriate level of risk-taking in the domains of cell biology, molecular genetics, evo-devo, systems biology and modelling (a detailed evaluation of projects can be found in the team by team analysis which follows). Multi-disciplinary, multi-level approaches are further strengthened by the reorganization of three of the six previous teams. The new organization should greatly contribute to maintaining the high level of excellence and expertise of the Unit in the field of plant reproductive development.



4 • Team-by-team and/or project-by-project analysis

Name of the team : Floral meristem initiation and function

Name of team leader: Jan Traas

- Team staff or staff allocated to the project (according to the dossier submitted to AERES):

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

- Assessment of work produced and scientific quality:

This team uses mathematical modelling to address fundamental questions related to patterning and morphogenesis. The group has pioneered this approach and its principal investigator is recognized as a leader in the field. Publications are outstanding, both with regard to the impact factor of the journals (Science, PNAS, Plant Cell) in which they have appeared and with regard to their influence. It is worth mentioning that in a seminal paper (Hamant et al., 2008, Science) the group has provided a conceptual framework for understanding how mechanical forces can influence microtubule orientation, and then the next steps of biomechanical morphogenesis, which is a major milestone.

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

Members of the group have been regularly invited to international conferences (13 invitations). The group leader has received the Jaffe Medal of the French Academy of Sciences for integrative biology in 2008. Importantly, the group leader has not only built an internationally recognized team but has also ignited the establishment of computational biology at RDP. Furthermore, the team displays a productive flat hierarchy with researchers being given a considerable amount of scientific freedom and responsibility. The team has an excellent funding record over the past 4 years. Numerous collaborations have resulted in publications with other first ranking groups.



- **Project assessment:**

The research project aims to unravel the signalling network that controls meristem formation, using genetical, morphological, and computational approaches. Establishment of the genetic network in auxin and cytokinin patterning and function, and resolution of such network in 4D by combining genetic tools and advanced imaging are the foci of this research program. As one milestone, the group is developing an integrated view of the shoot apical meristem in the form of a dynamic 3D model. This model will have the form of a 'programmable' tissue, where every cell will have a virtual molecular regulatory network and the capacity to communicate with its neighbours.

- **Conclusion:**

- **Opinion:**

This is a world leading group in plant science, merging modelling, imaging and network analysis in plant development. The team has used international collaborations to expand their expertise allowing for a multidisciplinary approach to studying pattern formation. The flat hierarchy in the team provides a stimulating and productive atmosphere for young scientists. The proposal focuses on biological questions of central importance to understanding the principles of plant development and the implementation of modern approaches will make accessible long sought for answers to classical problems in plant development.

- **Strengths and opportunities:**

The proposed project should further push the boundaries in imaging as well as modelling, and should provide important conceptual insight into mechanisms of pattern formation.

- **Weaknesses and threats:**

There are no obvious weaknesses. The group is aware that a multipronged strategy has to be implemented to validate network models with regard to biological relevance and regulatory robustness and that the required functional validation of models is time consuming and thus deserves special attention.

- **Recommendations:**

The strengths of the group should be further developed. Concerning network analysis, tools need to be developed to define a focus of interest if, for example, regulatory nodes are not obvious. Attention should be paid to the questions of robustness of theoretical genetic networks emerging from simulations and of mechanisms ensuring buffering to fluctuations that could be independent from the structure of the network itself (robust cell statistical collective effects, for instance). To develop a dynamic, spatialised model of the shoot meristem the group depends entirely on external collaborations at the present time, which could potentially harm their position if collaborators decide to shift their interest. Therefore the recruitment of a senior research assistant (Ingénieur de Recherche) in the field of informatics is strongly recommended for this team to secure its leading position.



Name of the team : Flower Morphogenesis

Name of team leader: Mohamed Bendahmane

- Team staff or staff allocated to the project (according to the dossier submitted to AERES):

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

- Assessment of work produced and scientific quality:

This group is producing high quality basic science, addressing important questions in plant developmental biology using both Arabidopsis and a less conventional model, rose. The group has developed original research aimed at elucidating the interplay between a petal-specific transcription factor BPEp and jasmonate and auxin signalling in the control of petal size in Arabidopsis. A new axis of research has been recently started that investigates the role of the Arabidopsis TCTP protein during development. In parallel to this work in Arabidopsis, the group has established rose as a new model to investigate flower architecture and scent. Several functional genomics tools (ESTs, microarrays, transformation protocol) have been developed to this end. The group has identified the key genes responsible for the production of the phenolic scent molecule present in wild-type Chinese roses. They have also identified a major role for C-function genes in the control of rose petal number. The quality of the basic science work is recognized by publications of high international standards (PNAS, EMBO J, Plant J, Plant Phys), while the rose transformation protocol was recently made available to the rose community via a PCTOC publication.

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

The group received several grants (ANR, region) and attracted 14 masters and 2 PhD students over the past 4 years. They also developed numerous collaborations with other French groups. The group plays an outstanding role in promoting rose as a model and contributed alone or via the coordination of larger national and international projects to the production of several generic molecular tools or protocols. This puts the group clearly in a leading international position for rose genomics. In addition, one group member belongs to the "ornamental horticulture" group at DS INRA, thus ensuring potential links with more applied research.



- **Project assessment:**

The research project on Arabidopsis follows two well-defined paths that are elaborations of previous work and that are supported by a critical mass of researchers including 2 PhD students and 2 Post-Docs. One path concerns the control of petal growth by BPEp and is already quite advanced. A second path concerns the role of TCTP in regulating cell proliferation and appears only distantly related to the main focus of the group. The rose project aims at further improving and using the functional genomics toolkit, including transcriptomic analysis of flower architecture and scent, functional analysis of selected genes, next generation sequencing of a comprehensive EST collection, and improvement of the transformation protocol. Investigating the molecular basis of variation in C gene activity and their effect on rose flower architecture is also proposed.

- **Conclusion:**

- **Opinion:**

This is a successful team that has both produced original results in Arabidopsis and developed important tools for functional studies in rose. The group however appears to operate as two distinct entities, with few connections between the Arabidopsis and rose research projects.

- **Strengths and opportunities:**

The group occupies a unique niche in the exploration of growth control in Arabidopsis petals. The group also developed a local collaboration within ENS to place their research in Arabidopsis in a comparative framework with *Drosophila*. This solid network of complementary collaborations provides opportunities for success in a competitive field. There are also strong opportunities both within the team and more broadly within the lab to place the rose work more firmly in both a developmental framework and an evo-devo context. Their emphasis on tool development in rose has allowed the unique opportunity to do basic research on a plant species of commercial interest.

- **Weaknesses and threats:**

There is strong international competition in the field of Arabidopsis organ growth control. Currently the group does not capitalize on its unique findings in Arabidopsis to inform its research agenda in rose and there is no clear strategy to work closely with other teams to facilitate knowledge transfer from models to crop. International efforts are likely to be launched to sequence the rose genome in the near future and the group needs to make sure it is well positioned to maximise return on their investment in developing tools for rose functional genomics. A strategy is required to maintain their position at the forefront of rose research.

- **Recommendations:**

The group is producing excellent research on Arabidopsis but should rethink its strategy to increase its focus and to enhance the benefits resulting from work on both Arabidopsis and rose. It is recommended that the team refocuses its attention on petal development to enhance coordination between both projects. In order for the rose project to be competitive, the group should get involved in international genome sequencing projects and the development of genomic resources. This effort will benefit from refocusing within the group but will also require strong support from external sources that can provide complementary skills.



Name of the team : Evolution and Development of the Carpel

Name of team leader: Michiel Vandenbussche

- Team staff or staff allocated to the project (according to the dossier submitted to AERES):

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

- Assessment of work produced and scientific quality:

This new team results from the reorganization and fusion of two previous teams working on the development and evolution of carpels on the one hand, and floral meristem determination on the other hand, and from the merger of these two teams with a newly appointed CNRS ATIP-AVENIR team working on the comparative analysis of placenta formation in two contrasting species, Arabidopsis and Petunia. The past production of members present during the last four years is honourable, with some publications in high impact journals (PloS Biology, Plant Cell, PNAS), but still limited considering the number of permanent scientists involved (5).

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

The recruitment of a new research scientist from The Netherlands to lead this re-structured team brings top-level international expertise and additional ATIP-AVENIR funding to augment the national funding already in place. This newly formed team will ensure its position at the forefront of Petunia genetics through continued links with the Gerats lab while establishing itself at Lyon.

- Project assessment:

This comparative development project to understand placenta formation is both innovative and internationally competitive; based on solid expertise of the new team leader. The genetic resources available in both petunia and Arabidopsis allow a unique depth of comparative analysis at the molecular genetic level. Innovative solutions are also proposed to work with genetically intractable species to address the evolutionary origin of the carpel. For example, SELEX and Surface Plasmon Resonance will be utilised as in vitro methods to study transcription factor function in



basal lineages. However, genome sequence information and transformation techniques for basal angiosperms and gymnosperms are essential in order to make substantial international impact with this project.

- **Conclusion:**

It is impressive that this new team has already identified a common question with significant evo-devo interest that should provide scientific synergies amongst its members. This is a large but heterogeneous team of five permanent scientists with strengths in developmental genetics and non-model systems. This project provides the opportunity to focus their efforts on a central theme and take advantage of a niche in petunia genetics. Future success will rely on cohesion of the team structure to transmit expertise and creative synergies throughout the group. It is imperative to avoid the organisational threat posed by the continuation as three sub-teams, which each lack critical mass to achieve at a top level.

- **Recommendations:**

The RDP provides a stimulating environment for this group to establish its new identity. We recommend that petunia is supported here as a new genetic system by the provision of sufficient high-quality plant growth resources.

Name of the team : Maize kernel development

Name of team leader: Peter Rogowsky

- **Team staff or staff allocated to the project (according to the dossier submitted to AERES):**

	In the report	In the project
N1: Number of researchers with teaching duties (Form 2.1 of the application file)	1	1
N2: Number of full time researchers from research organizations (Form 2.3 of the application file)	2	2
N3: Number of other researchers including postdoctoral fellows (Form 2.2 and 2.4 of the application file)	1	0
N4: Number of engineers, technicians and administrative staff with a tenured position (Form 2.5 of the application file)	1	1
N5: Number of other engineers, technicians and administrative staff (Form 2.6 of the application file)	1	1
N6: Number of Ph.D. students (Form 2.8 of the application file)	3	3
N7: Number of staff members with a HDR or a similar grade	1	1

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

The team is interested in isolating and studying genes that govern the development of the maize kernel, using both forward and reverse genetics approaches. The first approach proved extremely difficult, and only three genes were identified in this way from a collection of over 150 kernel deficient mutants. Thus, the group successfully cloned a novel allele of Brittle 2 coding for a subunit of AGPase, a key enzyme in starch synthesis. Combining transcriptome and metabolome approaches, they demonstrated that the lack of Bt2 dramatically alters carbon flow. The second main contribution concerned the characterization of two members of the HD-ZIP IV family of transcription factors, OCL1 and OCL4, and the demonstration of their role in a multiplicity of processes throughout maize development. In parallel, the team has contributed to set up a maize transformation platform. The work is of good quality overall, as



judged by several publications in relatively high impact journals (Plant J, Plant Physiol, Plant Mol Biol), but there is some concern about the team diversifying too much.

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

The team has few interactions with other groups of the unit but has built some strong collaborations in France and abroad, as reflected by the fact that all 11 publications produced by team include external collaborators. The group was able to attract a good number of PhD students (6), several temporary research assistants but only one post-doc. The group was successful in competing for grants (4 ANR grants) and was involved in the Maize Genetics Conference Steering Committee from 2007 to 2009. The group leader mentions no invitation to international conferences, and participates minimally to teaching.

- **Appreciation of the project:**

The objective of the team is to focus now on "the regulation of the switch from early development to grain filling". The study of maize orthologs of genes regulating this switch in Arabidopsis is still an open area of research, which is particularly interesting given that the structure of the maize kernel is strikingly different from that of Arabidopsis seeds. The further characterization of Wri1 and NAC10 action would also fit in the new project. The team plans in addition to identify additional regulatory genes using deep sequencing of RNAs extracted from a dozen functionally defined tissues or cell groups. On top of this heavy program, the team proposes to conduct positional cloning of the *gim* (*gynogenesis in maize*) locus in maize through a densification of markers, and the isolation of additional recombinants. The identification of the gynogenesis gene is certainly of great interest, but appears unrealistic given the current size of the team. Similarly, it is not evident whether continuing the characterization of the OCL gene family, through extensive phylogenetic and expression studies of the entire gene family, phenotypic analysis of double mutants, etc. is reasonable.

- **Conclusion:**

French teams working on maize are few and should continue to be supported, given the economic importance of this crop species as well as its unsurpassed genetics. This is especially true now that its genome has been sequenced, which will open tremendous scientific and economic opportunities for the future. The team is however strongly encouraged to set itself priorities between the different projects that it proposes.

- **Recommendations:**

The team has set up original technical and conceptual approaches to study maize kernel development. It is well connected to other teams working on maize in France and abroad, and should continue to nurture these collaborations. The team is in a good position to take full advantage of the recently published maize genome sequence, and should make the most of its expertise in maize transgenesis. However, given the constraints inherent to working with maize and the small size of the team, projects need to be reassessed and more limited in scope.



Name of the team : Cell signaling and endocytosis

Name of team leader: Thierry Gaude

- Team staff or staff allocated to the project (according to the dossier submitted to AERES):

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

- Assessment of work produced and scientific quality:

The team studies the role of endocytosis and protein trafficking in the control of cell signaling and plant development. Two complementary lines of research are pursued. One concerns molecular signaling of self-incompatibility, and the other the plant retromer complex. The team has recently developed a transgenic system of self-incompatibility in *Arabidopsis thaliana*, which opens up the possibility to use forward and reverse genetic approaches to analyze further the role of endocytosis in this process. In the retromer field, the team has made two major discoveries. The first is that *Arabidopsis thaliana* SORTING NEXIN 1 (AtSNX1) is involved in the auxin pathway, and that PIN2, but not PIN1 or AUX1, is transported through AtSNX1-containing endosomes. The second is that VPS29, a member of the retromer complex, mediates the formation of new axes of development. Furthermore, the team has shown that VPS29 is required for endosome homeostasis, PIN protein cycling, and dynamic PIN1 repolarization during development. The publication record of this team is excellent, with notably two primary reports in *Nature* and *Cell*, both signed by an exceptionally talented PhD student as first author.

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

The team leader has been regularly invited to speak at prestigious international conferences. One PhD student received several awards for his outstanding work on retromers, and in 2008 the team leader was elected an EMBO member. The team has several collaborations supported by competitive grants with other groups in France and abroad. It often plays a coordinating role, which further underlines its leading position in the field.



- **Project assessment:**

The projects are focused, well planned and clearly presented. They are the logical extension of the ongoing studies of self incompatibility, endocytosis and cellular trafficking. The team plans to decipher trafficking mechanisms involved in self incompatibility, hormonal signaling, seed biology and various additional aspects of plant development. To this end, a broad range of complementary approaches will be used, from cytology, cell biology, molecular biology, biochemistry to genetics. These combined approaches are likely to uncover common principles linking endocytosis to various plant regulatory mechanisms. Although quite ambitious in places, the proposed projects are certainly feasible considering the very high competence of the team. Overall, the proposed research is cutting edge, and the team is very well positioned to carry on being successful in this highly competitive field.

- **Conclusion:**

- **Opinion:**

This is an excellent team, which performs research at the highest possible level. The proposed projects are likely to provide new important insights into the basic molecular mechanisms associated with intracellular trafficking and their involvement in various aspects of plant development and cellular signaling.

- **Strengths and opportunities:**

The team has made significant discoveries and is recognised worldwide. The team performs cutting edge research, and the proposed projects are a logical extension of their previous investigations. The team coordinates several collaborative efforts.

- **Weaknesses and threats:**

The small size of the group, which operates in a very competitive field.

- **Recommendations:**

To sustain its leading position the team needs to get increased financial support and to be able to recruit more post-docs and PhD students.



Name of the team : Biophysics of Development

Name of team leader: Areski Boudaoud

- Team staff or staff allocated to the project (according to the dossier submitted to AERES):

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

- Assessment of work produced and scientific quality:

This is a new team, lead by a newly appointed Professor and staffed by people previously involved in modelling the control of cell fate during organ initiation in the Arabidopsis shoot apical meristem. Past work included the production of an original model of meristem morphogenesis based on interplay between growth patterns and microtubule orientations along mechanical stress field leading to growth anisotropy. This work is of very high quality, as indicated by two publications in Science and PNAS. Biophysical methodologies were developed that account for specificities of plant development, for instance the existence of strong mechanical constraints. Although the use of a complex system model introducing the single cell level would not appear necessary at first (a continuous medium description may have been sufficient to address the question of the orientation of small size microtubules network into the stress fields), this is likely important for future research in which cell-cell interactions are taken into account.

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

The team has stable collaborations with Montpellier Inria for modelling and Paris ENS Physics labs for biophysics, as well as with several teams abroad. Several members of the team have been awarded prizes (Prix La Recherche) and are regularly invited to international conferences. The creation of this team offers a rare opportunity to develop world-class molecular to multi-cellular integrative research in the field of plant development.



- **Project assessment:**

The team proposes an ambitious and original project based on solid previous internal expertises, and a large and diverse network of collaborations (ENS-Paris, Montpellier, INRA Versailles...). One of the challenges will be to combine multiple scientific expertises, with high relevance in each discipline (common vocabulary often describes different concepts between different disciplines, possibly introducing ambiguities in the scientific conclusions from the data emerging from researches at the interface between disciplines), to achieve a common interdisciplinary goal. An important aspect of the project is to introduce simpler models (2D, or uni-cellular) to address more basic questions. Here, the risk is one of over-simplification, as well as one of multiplication of biological models. Clearly, the team misses a high level research assistant (Ingénieur de Recherche) with specific expertise in modelling and computer visualization.

- **Conclusion:**

- **Opinion:**

This is a new team, with tremendous potential to develop molecular to multi-cellular integrative approaches. The proposed project is fundamentally sound.

- **Strengths and opportunities:**

The team brings together highly qualified scientists, who have a proven track record in the field of biophysics and modelling of plant development. There are strong interactions with other groups in the Unit, as well as with external collaborators.

- **Weaknesses and threats:**

The small size of the group, the lack of high level research assistant for modelling and computer visualization.

- **Recommendations:**

The team needs to hire rapidly a high level research assistant (Ingénieur de Recherche) with specific expertise in modelling and computer visualization. The team should pay attention to the issue of not isolating scientists involved in the physical and numerical aspects of the work, from those more directly involved with development itself. Progressing in the study of the mechanical-biochemical interplay, the team should at a given stage define whether the underlying mechanism of the interplay is passive or active, and in the latter case think about strategies to study the components involved.



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

Nom de l'équipe : *FLORAL MERISTEM INITIATION AND FUNCTION*

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

Nom de l'équipe : *FLOWER MORPHOGENESIS*

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

Nom de l'équipe : *EVOLUTION AND DEVELOPMENT OF THE CARPEL*

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



Nom de l'équipe : *MAIZE KERNEL DEVELOPMENT*

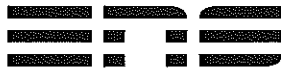
Note de l'équipe	Qualité scientifique et production	Rayonnement et attractivité, intégration dans l'environnement	Stratégie, gouvernance et vie du laboratoire	Appréciation du projet
<i>A</i>	<i>A</i>	<i>A</i>	<i>non noté</i>	<i>B</i>

Nom de l'équipe : *CELL SIGNALING AND ENDOCYTOSIS*

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

Nom de l'équipe : *BIOPHYSICS OF DEVELOPMENT*

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



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Le Directeur général de l'ENS de Lyon

à

Monsieur Pierre Glorieux
Directeur de la section
des Unités de recherche
AERES
20, rue de Vivienne
75002 – PARIS

Lyon, le 22 mars 2010

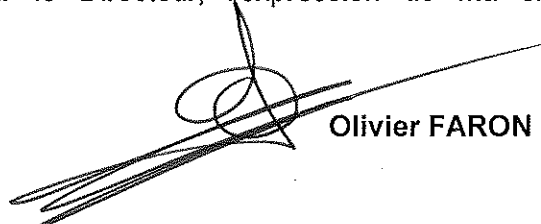
Monsieur le Directeur,

Je vous remercie de m'avoir transmis le rapport d'évaluation du Laboratoire de Reproduction et Développement des Plantes UMR 5667.

L'ENS de Lyon rend hommage au travail d'analyse du Comité. Elle se félicite de l'évaluation très positive de cette unité mixte de recherche qui contribue fortement à la politique d'excellence de notre établissement et des autres tutelles. Nous réaffirmons notre soutien à l'unité pour maintenir la qualité de la recherche qui y est menée.

Je vous invite à trouver, ci-jointe, la réponse du Directeur de l'unité.

Je vous remercie ainsi que les évaluateurs pour la qualité de leurs travaux et vous prie d'agréer, Monsieur le Directeur, l'expression de ma sincère considération.



Olivier FARON



Reproduction et Développement des Plantes
UMR 5667 CNRS/INRA/ENSL/UCBL

Lyon, March 29, 2010

To whom it may concern,

The laboratory would like to thank the reviewing committee for their very positive and constructive remarks. We appreciate the pertinent recommendations made to the direction team and individual groups, which will provide a useful basis for the further elaboration of our projects. The strong advice regarding the extension of lab space and green house facilities will be extremely helpful in our ongoing and future discussions with our funding institutions (cf accompanying letter of the director of the ENS). Likewise, we hope that the recommendations concerning our lack of expertise in computer science will help us to obtain either permanent or non-permanent positions in this field.

Sincerely,

Jan Traas
Director