Evaluations and Comments

13th Meeting of the

RIKEN BioResource Center Resource Committee of Experimental Plants

(April 8, 2014)

1. Achievements

(1) Are there any activities or achievements worthy of special mention?

(a) Is the Division functioning adequately as an infrastructure for science? What are its plans and achievements? What of the quantity and quality of its users' output (number of papers)?

- The Experimental Plant Division has been accomplishing satisfactory results. Its enhancement of quality control and compliance are especially highly appreciated domestically and internationally.
- The Experimental Plant Division prepares plant resources, particularly those that have been originally developed in Japan, which are unique and important resources around the world.
- The Division has distributed its plant resources to 313 domestic institutes and 709 international institutes. These numbers are highly appreciated, because they suggest how necessary these plant resources are to researchers worldwide.
- The number of research papers that users wrote based on results obtained from these resources is high, which supports the fact that the scientific community trusts the Experimental Plant Division as a research foundation.
- The strategies of the Division are also reasonable and realistic, such as prioritizing its resources, including full-length sequencing of open reading frame (ORF) clones of transcriptional regulators.
- Single-cell analysis of the homogeneity and diversity of cultured cells will be important for basic science and stable applied research.
- The Experimental Plant Division is actively involved in agricultural research, and it is expected to develop cooperation with research institutes of Independent Administrative

Institutions under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries.

- The Experimental Plant Division should continue to strive to increase its value through such methods as translating public information, including technical data, into English and delivering e-mail news overseas.
- We recommend that the Experimental Plant Division perform surveys of domestic and international plant scientists for the purpose of better clarifying its activity results and collecting quantitative data.
- Investigation of differences in genetic background of wild plants will be required to understand the aspects of genetic and epigenetic mutations.
- Accurate systems are important for future industrial applications as well as for academia. The Experimental Plant Division should take a leadership role in discussions in Japan.
- To investigate adaptation and evolution using wild plants, they should be sampled as a group, and the variation of polymorphisms in the group should be analyzed.
- The Division mentioned that its research would be directed toward improving crops against abiotic and biotic stress, including drought. It should, however, establish more specific objectives.

(b) Is the Division functioning adequately as an infrastructure for society? What are its industry and international contributions? Is it returning the fruits of its achievements to the Japanese people, and has it stimulated people's imaginations?

- The Experimental Plant Division has been recognized as an international foundation for plant research and is making an international contribution to the research area.
- The Division has been expanding its research area into the environment, energy, and natural resource fields by providing information related to the usability of model plants and developing research on biomass plants.
- With respect to profit return and fulfilling the hopes of the public, the Division is actively making an effort to return its profits to society, for example, by holding public exhibitions at the BioResource Center and organizing observation events of *Arabidopsis thaliana* outside of the Center.
- The Experimental Plant Division is highly appreciated for maintaining a foundation of basic research rather than directly impacting industry. The Division is making good progress,

based on its plans, in respect to contributions to the development of advanced technology that will aid academic research on plants, and to developing an experimental plant for research on breeding grains.

- To advertise to the general public more efficiently and to enhance PR cost performance, we suggest that the Experimental Plant Division listen to the opinions of clients on the effects of the center in each small electoral district and that it perform PR activities mainly aimed at members of the Diet, which might be helpful in allowing the Division to become more familiar and widely recognized.
- The Division energetically performs PR activities at domestic and international scientific conferences. In high school biology textbooks, the genetic process of flower formation of *Arabidopsis thaliana* has been described. However, teachers seem to have trouble obtaining these materials. The Division might want to consider contributing to high school education.

(2) R&D, technology development, resource development, characterizations and quality control

- **Have these activities been effectively applied in advancing BRC's bioresource infrastructure program?**
- **Have advanced and innovative results been produced?**

- Development of the transformation technology of *Brachypodium distachyon* was a major breakthrough and it is appreciated as a significant result. The future plans for the development of genome editing technology are also reasonable.
- The Experimental Plant Division is making an effort to develop technologies for quality assurance and to prepare seed pools or sets of strains that represent genetic diversity.

(3) Other matters

- **Education and training**
- **Collaborations within BRC and within RIKEN**
- **Collaborations inside and outside Japan**
- **Public relations activities**

- With respect to human resource training, the Experimental Plant Division has been actively

organizing training activities and therefore contributing to the acquisition of handling skills of model plants and cells.

- The Experimental Plant Division liaises well with the RIKEN Center for Sustainable Resource Science in Yokohama.
- The Division has been proceeding with cooperation related to know-how of the resource project by liaising with the rice genome resource of the National Institute of Agrobiological Sciences and the NIAS Genebank for seed collection.
- The Division has been actively proceeding with liaisons with the Arabidopsis Biological Resource Center (ABRC) in the US and is contributing to international communities mainly by providing resources that originated in Japan.
- The PR activities related to *Brachypodium distachyon* were especially active, which resulted in an increase in the number of users.
- It is important for future development of technologies in Japan to provide opportunities for technical experts who are responsible for the resource project to improve their skills and careers. Because it is difficult to accomplish this change only within the RIKEN BioResource Center (BRC), it has to be considered from the view of the entire National BioResource Project (NBRP). In addition, it would be appropriate for the Division to cooperate with the system for University Research Administrators (URA), which was established by the Ministry of Education, Culture, Sports, Science and Technology last year.

(4) Response to items pointed out previously

- We appreciate that the Division has initiated an effort to develop novel resources related to the production of food, biomass, and useful materials, in addition to research on basic physiological functions, growth, and differentiation of plants using model plants.
- The Division has been proceeding with resource infrastructure and public relations by liaising with the RIKEN Center for Sustainable Resource Science and the Biomass Engineering Program. Analysis of phenotypes will be an important issue in the future. It is important to investigate analytical systems by focusing on wider phenotypes, including metabolites.
- Because the research institutes of the Ministry of Agriculture, Forestry and Fisheries, Tsukuba University, and the Experimental Plant Division are located in Tsukuba City, it

may be useful for broadening the resources for the Division to expand liaison with these institutes.

2. Plans as RIKEN's proposed change of status to a new system for Independent Administrative Institutions

(1) Are plans of the Division appropriate to the proposed change in RIKEN's status? Please evaluate and give us advice and suggestions from the following view point:

(a) Can dramatic advances be expected from their strategies and plans for the next 5 to 7 years?

- **Will they be able to function as an essential infrastructure for science, innovation, and society?**
- **Are there any new resources that they should place priority on collection?**
- **What kinds of results and effects can be expected?**

・ Because a bold shift of the central activity of the Experimental Plant Division is required from "strengthening functions of *Arabidopsis thaliana* as a standard resource" to "creating a novel plant model and standardizing it internationally," we agree with its plan to develop *Brachypodium distachyon* as a novel model plant of Poaceae. To establish this plant as a standard model of Poaceae worldwide, the Division needs apply its efforts in different areas, such as collecting all sorts of wild strains, selecting and growing multiple standard strains based on comparison among wild strains, and analyzing the genomes of these standard strains. It is impossible for the Division to accomplish everything by itself, and therefore collaborations with other domestic and international researchers will be necessary to set up collaborative projects with BRC's budget. If data obtained from these projects are open to the public and an allocation system is established, the RIKEN BRC will be more strongly recognized as the international center of experimental plants.

・ We anticipate that *Brachypodium distachyon* will be a useful model plant that will become a link between experimental plants and crops. The Division has been preparing for some of the required processes, such as establishment of the transformation and mapping of cDNA using this plant. Further establishment of research procedures and public relations will make this plant a model that leads world plant research. In addition, the RIKEN BRC will likely become a center of this research.

- The most important thing is to maintain the quality of the research that leads the resource project of plant science. Development of the research using *Arabidopsis thaliana* proved that a novel plant resource is a driving force for research. The Division needs to investigate resources that may lead to various research projects in the future, and other matters including methodology for the analysis of these resources. It is important to liaise with researchers in the field of plant science and biomass in the RIKEN Center for Sustainable Resource Science in the future.
- There is the possibility of an increase in the number of users of RIKEN-originated resources, such as cassava (*Manihot esculenta Crantz*) and poplar (*Populus nigra*).
- As the first step toward becoming the center of plant research globally, we anticipate the Division becoming the center of plant research in Asia.
- The Division should consider informatics resources and the development of new technologies for analysis of big data.

(b) Can dramatic advances be expected from their research and technology development plans for the next 5 to 7 years?

- **Are these plans effective and essential to promoting BRC's resource infrastructure?**
- **Can advanced and innovative results be expected?**

- Activities focused on *Brachypodium distachyon*, a model plant of Poaceae, are useful and essential as an international resource infrastructure project in the future. Sufficient advanced and innovative results are expected. On the other hand, we do not think that another objective, presented as "Plans after FY2014" (entitled "Issues to which *Brachypodium distachyon* contributes: 1. Turning wasteland green; 2. From resource-dependent agriculture to resource-saving agricultural methods"), is achievable with *Brachypodium distachyon* alone, although it is so impressive that we would like to support it. The Division must provide a detailed explanation about the possibilities and limits of "model plants" and show a road map for this objective.
- In addition to collecting, storing, and providing resources, more development of the project is anticipated if technologies to analyze mutants are provided, e.g. analysis of metabolites and some hormones. Additional information about mutants will be available if the Division

embarks on phenome analysis.

- Reliability of resources and accuracy of additional information are the results of the accumulation of steady effort, and this continuous progress is a leap forward. As presented in the plans of research development and technology development, developing and providing the resources and the kits that researchers require, for both *Arabidopsis* and *Brachypodium*, will result in leading expansion of the research.

(2) Are suggestions made previously reflected in their current plans and strategies? Have they endeavored to re-inspect their activities to date and made appropriate decision about what should be continued or discontinued?

- The previous review is appropriately reflected in the new plan. Previous experiences and knowledge are used in the plan and the details of embarking upon new resources are also logically described.
- The Experimental Plant Division has been making satisfactory progress, including the development of *Brachypodium distachyon*, by responding accurately to the previous review. It may be a good idea to consider sharing resources worldwide (not commercially, but in cooperation with other countries).
- It is important to narrow down matters to be prioritized by reviewing previous and current resources and categorizing them as either central resources to be developed in the future or resources for conservation.