Report on the Workshop on Establishing a US Rice Resource Center

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Background and Rationale of Workshop

On September 25, 2002, a group of researchers and agency representatives met at the National Science Foundation in Arlington VA to discuss the need to establish a rice resource center in the U. S. and the planning of a workshop to discuss such an endeavor. Present at this initial planning meeting were Cal Qualset (University of California, Davis CA), Neil Rutger (USDA-ARS, Stuttgart, AR), Sarah Hake (USDA-ARS, PGEC, Albany CA), Robin Buell (The Institute for Genomic Research, Rockville, MD), Ralph Dean (North Carolina State University, Raleigh NC), Venkatesan Sundaresan (University of California, Davis CA), as well as representatives from the federal agencies including the National Science Foundation (NSF), USDA Agricultural Research Service (USDA-ARS), and the USDA Cooperative States Research, Education and Extension Service (USDA-CSREES). The participants discussed some of the major issues with rice resources (molecular and seed) and access to these resources by US scientists. It was determined that to best assess the needs and the guiding principles for a US Rice Resource Center, a workshop should be held to discuss these issues and encapsulate them into a document. Robin Buell and Venkatesan Sundaresan volunteered to write a proposal for NSF to fund a workshop on establishing a US rice resource center. The NSF funded this proposal (DBI-0309050) and a workshop was held on January 10, 2003 at the Town and Country Hotel and Convention Center in San Diego, CA prior to the start of the annual Plant and Animal Genome Conference. As maximal interaction was desired from the workshop, a total of 27 participants attended who represented rice breeding, rice biology, rice genomics, rice genetics, cereal genomics/genetics, and Arabidopsis research. Representatives from three major stock centers (Arabidopsis, maize, and Drosophila) were present. Agency participants included representatives from the NSF, USDA-ARS, and USDA-CSREES. A complete list of participants can be found in Appendix 1.

Community Need for a Rice Resource Center

The participants clearly stated that there was a need for a dedicated rice stock center that would enable access to rice DNA stocks and seed stocks. A listing of the resources that could be deposited in such a stock center is listed in Appendix 2. Interest in rice stocks (seeds and molecular reagents) was demonstrated by rice biologists, rice breeders, rice genomicists, cereal geneticists, and Arabidopsis researchers. It was clear from the discussions that the need for a rice resource center went far beyond that of rice most especially due to the release and availability of the rice genome sequence. For maize geneticists, the more advanced status of rice genomics and the ease of transformation in rice could be very advantageous in furthering their own research in maize if there was easy access to rice resources. In addition, it was highly anticipated that there will be (is) a convergence of Arabidopsis researchers interested in testing hypotheses in crop species with rice the first choice for this research. Evidence of the surge in rice research is through the increased number of publications focused on rice in the last few years (See Appendix 3).

In order to enable plant research utilizing rice, researchers need to know that there is a long-term center where stocks can be deposited, archived, and retrieved. For current rice researchers, the establishment of a rice resource center would alleviate them of the burden (fiscal and time) of being *de facto* stock centers. Experience with Arabidopsis research has clearly demonstrated that access to resources through a resource center has enabled research that previously was inconceivable. Thus, the time and effort saved by housing/centralizing/cataloguing resources for a community cannot be understated.

Some of the special issues with rice stock distribution were discussed as to date these have limited free exchange of currently available rice resources. First, a number of these resources are large collection sets of tagged or mutant lines or sequenced clone sets and thus it is inconceivable to expect the generator of these stocks to distribute them to all researchers. Thus, a centralized distributor with a sole mission of service would facilitate dispersion of these large collections from donor scientists to a broad range and a large number of downstream scientists. Second, a stock center would streamline the importation, sanitation, and amplification of seed stocks as rice is under USDA Animal Plant Health Inspection Service (APHIS) restrictions that require processing (hot water treatment) of seed, and a grow-out generation under quarantine conditions before the seed is further distributed. Thus, the volume of seeds available to researchers from donors is limited and a stock center could serve as an amplification point for these seed stocks. Third, a rice resource center would establish the minimum standards and quality control needed for the distributed stocks thereby unifying the quality of material within the research community.

Successes and Challenges as Reported by the Arabidopsis, Drosophila, and Maize Stock Centers

Presentations were made by representatives from three major stock centers in the US: Randy Scholl (Arabidopsis Biological Resource Center at Ohio State(ABRC-OSU)), Marty Sachs (Maize Genetics Cooperation - Stock Center) and Kathy Matthews (Drosophila Stock Center). All three centers distribute living stocks (seeds or flies) while only the ABRC-OSU distributes molecular resources. The representatives had prepared written responses to a questionnaire to provide the participants with an overview of their collections, distribution load, user base, and other issues. This allowed the presentations

to be focused on providing information on the successes and challenges with managing stock centers.

At the ABRC-OSU, the issues that affect the success of the center include fluctuating staffing needs, space requirements (and limitations), fluctuating demand for stocks, quality control issues, lack of feedback with respect to problematic or erroneous donations, and anticipating the donation of new stocks. Other issues that arose in the history of the ABRC-OSU were the institution of user fees which allows cost recovery but resulted in a temporary drop in requests and in the use of a Material Transfer Agreement (MTA) with some stocks. Another feature of the ABRC-OSU that was controversial is the "User History" which is a compilation of all the scientists that have requested a stock, thereby alerting new users that someone else is already working on that stock.

The USDA-ARS Maize Genetics Cooperation Stock Center (Urbana, Illinois) has evolved from a small center that began nearly 80 years ago to successfully establish itself as the main resource center for maize genetic stocks world-wide. Some issues that this center has identified as problematic have included the requirement by some donors that a MTA or Intellectual Property (IP) be associated with the seed, the inability of the donor to donate a large seed set (thus requiring grow out), and regulations regarding the shipments of transgenic materials.

At the Drosophilia Stock Center (Bloomington, Indiana), the successes include a large active community of researchers that support the center, a strong tradition of sharing materials among Drosophila researchers, service as the only goal of the center, a close association with FlyBase (Drosophila annotation and resource database), the centralization and expansion of the collection, and an emphasis on accessible

information associated with the stocks. Similar to the ABRC-OSU, although the existing facilities were adequate there were imperfections. Similar to the Maize Genetics Cooperation Stock Center, the Drosophila Stock Center does not accept materials with MTAs.

For all three centers, the location at a university was seen as important as it provided interaction and feedback for the center staff. For the ABRC-OSU and the Drosophila Stock Centers, there is continual pressure to take on additional stocks which taxes the staff and available resources. Both the ABRC-OSU and the Drosophila Stock Center have Advisory Committees that they utilize extensively, especially in decisions to accept stocks that may impose a large burden on the facilities.

Access to Rice Seed Stocks in the US

U.S. rice seed (germplasm) accessions are maintained by the USDA-ARS National Plant Germplasm System. Seeds of rice and other small grains (wheat, barley, oat, rye and triticale) are stored and distributed by the National Small Grains Repository (Aberdeen, Idaho). The collection is also kept in long-term storage at the USDA National Center for Genetic Resources Preservation, Ft. Collins, CO. A complete listing of U.S. plant germplasm accessions including the *Oryza* collection is at: www.ars-grin.gov/npgs.

The Genetic Stocks-*Oryza* (GSOR) collection will be established this year at the Dale Bumpers National Rice Research Center (DB-NRRC) to complement the USDA-ARS National Plant Germplasm *Oryza* collection. The GSOR will conserve and distribute rice stocks which require specialized maintenance techniques that are not available at the NSGC site, such as propagation of low seed set lines and/or bagging of panicles to prevent outcrossing. The collection will include dominant and recessive male steriles,

recombinant inbred lines (RILs), tetraploids, cytogenetic stocks such as primary trisomics and telotrisomics, and numerous morphological and physiological mutants.

Priorities for a US Rice Resource Center

There was discussion on what types of resources would be most useful for distribution through a resource center. At least initially, resources with high priority for distribution would include characterized mutants, collections of insertion lines, and recombinant inbred lines. Because of the growing interest in the plant community in using rice as a model, some basic tools such as the widely used cultivars and transformation vectors could also be usefully distributed through a center. For the operation of the resource center, there should be a complete focus on service. Therefore, it needs to be run by scientists dedicated to community service. Close association with a university or research institute was desirable, in that it enables the resource center to remain in touch with advances in research, and anticipate future needs of the research community.

Accessibility and quality control of the stocks were identified as priorities. For users to rely on the resource center for materials, it should preferably monitor and verify where possible, the accuracy of submitted stocks. However, the responsibility for verification must ultimately rest with the end-user. It was agreed that it would be important for the resource center to have an Advisory Committee from the research community for consultation and advice on these and other operational matters.

Do the Stocks Have to be Housed at a Single Site?

The discussion of whether a single site was required for the stock center was discussed. The clear consensus was that expertise and location were central to the seed stock center while the molecular resources were rather generic and did not require personnel

with expertise in rice. The only complication seen to a separation of the molecular and seed stocks was the possibility that DNA would be isolated from certain seed stocks and this uncoupling may lead to difficulties. Aside from this potential complication, it would be essential that the informatics would have to be coordinated if the molecular and seed stocks were housed separately. Specifically, a single web site would have to be utilized if the seed and molecular resources where housed and distributed from multiple sites.

Informatics Requirements for the Center

The resource center should have a strong informatics component to serve the users. Navigation of the website for the center should facilitate viewing details of the materials deposited. Examples would be a single access point to link BACs and ESTs, linking ordering of RI lines with associated data, etc. A standard format for mutant descriptions is important. In addition, with the increasing number of researchers who are beginning to work with rice for the first time, it would be very desirable to provide access to protocols from different labs for growing rice, transformation etc. through links on the website. Other links would be to international centers (e.g. as in Japan) as well as to private companies that are willing to share their resources.

Incorporation of International Resources

As much of the current research on rice is being conducted outside the United States, it would be important to make the internationally generated resources easily available to US researchers through a US resource center where possible. There were some international resources identified as being available immediately, such as the collection of mutants at IRRI. It was also likely that in the absence of a European rice stock center, materials being generated in Europe would be deposited in the US center. Materials

from Japan will be available through a center there, although this does not preclude their deposition in a US center at a later time through negotiated exchanges.

Sources of Funding

It was recommended that funding be obtained that provided long-term stability to the resource center. These sources included the federal agencies, endowments, and user fees although it may be advantageous to not implement user fees until the center was well established among the community. Corporate support for the center could be in the form of funding an endowment that would provide a source of long term funding.

Intellectual Property Issues

An important issue in any system for distribution of biological materials is the question of intellectual property restrictions. There was a very strong consensus that a resource center should distribute materials without MTAs associated with them. However, some valuable international resources such as the mutant collections at IRRI may not be available without MTAs limiting institutional liability. Therefore, under special circumstances to be decided by an Advisory Committee, some materials with associated MTAs might be considered, at least in the initial period of establishment of the center. It was felt that even in such special cases, only a minimal MTA (similar to the “NIH MTA”) was likely to be acceptable.

Community Support for the Resource Center

In order for the resource center to be successful in the long term, there needs to be community support through donation of stocks. This could be accomplished through publicizing the resource center to the community, emphasizing the convenience of transferring the burden of distribution to a committed center. In addition, strong

incentives to deposit stocks could be provided by requirements by the funding agencies and journals for wide and unrestricted distribution of research materials for publicly funded research and published research, respectively. The existence of the stock center would be an important adjunct to such requirements for laboratories that lack the manpower and resources to distribute published materials themselves. In the future, large-scale proposals seeking public funding could be encouraged to include the cost of deposition and maintenance in the stock center as part of the budget. These large projects would also be encouraged to donate their materials during the course of their projects rather than waiting till the end of the project.

Monitoring the Needs of the User Group

The user group was defined well by the participants while discussing the community need for a US rice resource center. It was felt that the Advisory Committee would well represent the needs of the user group. It was also felt that there was a responsibility on the users themselves to state their needs/requests. There would be a mechanism for the center to receive feedback in the form of ad hoc inquiries and that the presence of the stock personnel at appropriate meetings would allow for contact with the user group.

Dissemination of the Results from the Workshop

This report from will serve as the primary mechanism for dissemination of the results of the workshop and will be posted on relevant websites such as Gramene, TAIR, and GRIN for community comments on the proposed rice resource center. Comments regarding this report should be directed to C. Robin Buell (rbuell@tigr.org) and Venkatesan Sundaresan (sundar@ucdavis.edu). In addition, the co-organizers will submit this report to Plant Physiology for publication.

Establishment of a Working Group

While the meeting was productive in that it identified the guiding principles of a proposed US Rice Resource Center, additional discussion and development of the logistics required for such a center were seen as essential prior to the submission of proposals for a resource center. Thus, it was agreed that a working group be formed to further expand on the requirements of a US rice resource center. For example, the Working Group will explore the feasibility of phasing in a stock center versus waiting until there is full funding. Volunteers for the Working Group include Pam Ronald, Neil Rutger, Cal Qualset, Jan Leach, Susan McCouch, Robin Buell, and Venkatesan Sundaresan. The Working Group will self-organize and following further definition of the requirements/logistics of the US rice resource center, report out on continued progress in planning a US rice resource center at future meetings.

What's Next

Following the activities of the Working Group, it is envisioned that individuals or groups of individuals would submit proposals to relevant funding programs such as the NSF Living Stock Collections and the Plant Genome Research Program.

Appendix 1: Participants at NSF-funded workshop on Establishing a Rice Resource Center in the US; January 10, 2003; San Diego CA

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Appendix 2. List of rice stocks of interest for a US rice resource center

List of Potential Accessions for the Proposed US Rice Resources Stock Center

Description	Number	Source
Rice EST collection	> 80,000	Japanese Rice Genome Program
Rice EST collection		Hans Bohnert
Rice EST collection	~35,000	Ralph Dean NSF rice blast project
Rice cDNA libraries (from specific genotypes or tissues)		Pam Ronald, Guoliang Wang, Yinong Yang, Jan Leach
Rice genomic libraries (from specific genotypes or tissues)		Susan McCouch, Tom Tai
Rice Full length cDNA collection	~28,000	NIAS, Japan
Rice kinase baits for Y2H	250	UCD-Ronald/UF-Song
Rice cDNA librairies in Y2H	3 libraries	UCD-Ronald
Rice BAC libraries	>25 libraries (including the wild Oryza libraries)	Japanese Rice Genome Program; Clemson University
Filters for Rice BAC libraries	> 5 sets	Center generated?
Genetic marker collection	~1000	Cornell University, Susan McCouch
RFLP marker collection	~2,000	Japanese Rice Genome Program
YAC-anchored EST markers	~6,500	Japanese Rice Genome Program
Rice Unigene set used in Microarrays		Various microarray projects
Vectors commonly used in rice transformation	Cambia, TAP tagged and ubi constructs	Various independent researchers-UCD/UN; Cambia
Rice characterized mutants	500-1,000	Philippines (IRRI), Japan, USA, Korea
Rice insertion lines T-DNA	~150,000	Korea (Postech), France (Genoplante)
Rice insertion lines Tos17	~50,000	Japan (NIAS)
Rice insertion lines Ac-Ds	~40,000	Korea, Japan, Netherlands, Singapore
Mapping populations (e.g. RI lines)		several countries
Deletion populations	~15,000	Philippines (IRRI)
Rice activation tagged starter lines	400	UCD-Ronald/OSU-Wang
M202 Deletion mutants and DNA pools	30,000	Maxygen/KSU
Moroberekan, C039 deletion mutants	40,000 M2	UCD-Ronald
RIL260 (Pi5) deletion mutants	20,000 M2	Kyung Hee University-Jeon

Kitaake, Nipponbare, Liao Geng stocks	for transformation etc	UCD Ronald and others
Kitaake transgenics expressing TAP tagged kinases	275	UCD-Ronald and UF-Song
Kinase knockout mutants (T-DNA, RNAi)	200	UCD-Ronald and UF-Song

Appendix 3. Publications involving rice as assessed through PubMed.

Year	“Rice/Oryza” in Title	“Rice/Oryza” in Abstract
1998	211	452
1999	231	562
2000	381	765
2001	404	843
2002	444	868

The total number of publications in PubMed were determined for each year. The requirements were that rice or *Oryza* was present in either the title or the abstract of the deposited papers. Note that these numbers only represent the journals which are tracked through the PubMed system and therefore are a partial representation of the total publications on rice on a worldwide basis.