

**Response to Recommendations from the Committee of Visitors  
for the  
Division of Biological Infrastructure  
Plant Genome Research Program  
June 6-8, 2007**

**Introduction**

The Directorate for Biological Sciences (BIO) would like to thank the Committee of Visitors (COV) for their thoughtful analysis and the time members dedicated to evaluating the management and outcomes of the Plant Genome Research Program (PGRP) at NSF. BIO knows that serving on this committee requires effort above normal duties and that the time spent on COV activities is in addition to other review activities the members provide to NSF. The thought and care that went into the preparation of their report is appreciated by BIO, DBI and PGRP.

In particular, BIO acknowledges the thoughtful responses to the questions in Part C of the report. The COV stated that the PGRP should place more emphasis on comparative genomics to increase understanding of plant biodiversity and its impact on global biodiversity, particularly the diversity of plant-pest, plant-pathogen, plant-beneficial microbe and plant-pollinator interactions and that it should encourage research proposals that involve systems approaches to integrating genetics, genomics and bioinformatics to unravel the biology of plants. By encouraging the concept of “systems genomics” the PGRP will be contributing to conceptual advances in all life forms.

Responses to questions in Part D were also very thoughtful and will provide the basis for discussions about the future of the program and its role within the biological sciences. Comments such as “In order to address basic questions of plant biology, as well as the practical application of genomic research to global issues of food security, human health and energy sustainability, a greater diversity of plant genomes will still be required. The COV believes that plant genomics holds a keystone position in biology” will provide the starting point for fruitful discussion.

**Recommendations and Responses**

***Recommendation:*** *The inclusion in its future planning, plant genome research that takes into account the effects of global climate change (e.g., temperature effects, altered quality of light due to changes in ozone layer, water and salinity problems). Examining those adaptive mechanisms from a whole genome basis could play an important role in ensuring global food security, energy sufficiency and a sustainable world. The National Genome Research Initiative has identified these issues as being of national importance.*

**Response:** BIO agrees and notes that past PGRP solicitations have always encouraged proposals that addressed plant responses to environmental factors (light, drought, stress, salinity). Future solicitations will also highlight the need for a systems approach to understanding plant environmental responses.

**Recommendation:** *Historically, the PGRP has focused on plant systems of economic importance to the US. The COV believes that the PGRP should expand its focus to plants important to human health and crop plants important to developing countries.*

**Response:** As congressionally mandated, the mission of the PGRP is to focus on economically important crops and plant processes of economic value. Focusing on crops of economic importance to the US allowed NSF to capitalize on the expertise of the US research enterprise to develop foundational tools for reference species and the linking resources to enable leveraging to developing country issues. Other public (US AID) and private (Gates Foundation) institutions can now use these resources to focus their resources on specific developing nation issues. The PGRP will continue to encourage Plant Genome researchers to collaborate with researchers from developing nations on crops of importance to those nations through supplements as mentioned in the PGRP program announcements.

**Recommendation:** *More emphasis should be placed on supporting comparative genomics to increase understanding of plant biodiversity and its impact on global biodiversity, particularly the diversity of plant-pest, plant-pathogen, plant-beneficial microbe and plant-pollinator interactions.*

**Response:** BIO agrees and will ensure that the program incorporates this suggestion into future solicitations. These issues will also be discussed at the next awardee meeting.

**Recommendation:** *The PGRP should encourage research proposals that involve systems approaches to integrating genetics, genomics and bioinformatics to unravel the biology of plants. By encouraging the concept of “systems genomics” the PGRP will be contributing to the development of unifying theory for all life forms. The analysis of diverse plant genomes supports this goal.*

**Response :** The PGRP will continue its evolution in this direction which began in 2007. In addition the Program will organize a session at the next awardees meeting to obtain community input on the topic. BIO notes that one of the goals of the planned Plant Science Cyberinfrastructure Collaboratory is the integration of different data types into a plant science knowledge system.

**Recommendation:** *The PGRP should establish a process to ensure that it stays current on emergent technologies needed for the rapid and efficient analysis of plant genomes. This process may include establishing industrial liaisons in the*

*area of genomic technology. For instance, NIH supports three cooperative centers for sequencing and they use an outside advisory group to provide advice to the staff regarding sequencing center operations and productivity. The PGRP should require its grantees to use the most cost effective technologies when appropriate. For example, since sequencing costs per base will decrease as new and more efficient technologies come online, the PGRP should require PIs to transition from older to newer technologies when possible.*

**Response :** BIO agrees with need for PGRP researchers to use the latest technologies. BIO will encourage the program to continue to meet with counterparts at NIH and tap the expertise of review panels to remain knowledgeable about the latest sequencing tools. The Program will help insure that PIs are aware of the latest technological developments by continuing to organize technology sessions at annual grantees meetings. Currently, the PGRP encourages and permits transitions from old to new methods in existing awards. In addition, PGRP will continue to support the development of tools to integrate new sequencing approaches into plant projects. Finally, the merit review process will continue to be a strong impetus for PIs to adopt the latest proven technologies.

**Recommendation:** *The COV believes it is critical for the PGRP to disseminate the fruits of plant genome research in forms that are interactive, easy to understand and easy to use by the scientific community and the public. The COV recommends that PGRP explore collaborations with NSF-sponsored visualization centers to develop high-dimensional visualization and graphics tools for genomic data.*

**Response:** BIO agrees and will ensure that the PGRP includes this type of activity in the next program solicitation. In addition, the proposed Plant Science Cyberinfrastructure Collaborative will play a major role in promoting the kind of activities and collaboration needed to develop high dimensional visualization and graphics tools for genomic data.

**Recommendation:** *FastLane and eJackets are important new improvements in how the NSF and PGRP manage the application, review and award process. Of course, like any newly developed software there will be bugs that can only be identified when users test it. NSF should pilot new software more fully before implementing it through all its programs.*

**Response:** BIO agrees and will pass along this suggestion to the NSF e-systems developers. In addition, PGRP, DBI and BIO Program Officers have and will continue to volunteer as beta testers for new electronic improvements. In this way, PGRP helps insure that the e-systems that are developed meet the needs of the PGRP community.

**Recommendation:** *Rotators and new employees have a steep learning curve and must pick up all the knowledge to do the job as a program staffer on-the job. The COV recommends that NSF be systematic in assigning rotators and new employees to mentors and that perhaps their workload for the first round be such that it more effectively facilitates acquisition of the necessary skills for the tasks at hand.*

**Response:** BIO will insure that all new PGRP, indeed all new BIO, staff members are assigned mentors. PGRP will continue to provide regular, hands-on training as well as update the on-line how-to primers for new employees. PGRP will also continue to balance workload so that a new PO can focus on learning and mastering one or a group of skills at a time. The Program will enroll new rotators in Program Officer Seminars as quickly as possible after they arrive at NSF

**Recommendation:** *The PGRP should encourage greater industry-academic interactions. Industry often has strategies and technologies that could be beneficial to the academic plant genome researcher. PGRP should explore the potential for closer industry collaboration and the leveraging of industry funds for mutually beneficial projects.*

**Response:** BIO agrees with this suggestion and will encourage the PGRP to explore the feasibility of enhanced industry-academic collaboration at professional meetings and will encourage the PGRP PIs to do likewise. Currently, there are a number of successful collaborations, including; Monsanto and Syngenta sharing their rice genome sequence data with the public efforts and Monsanto releasing wheat EST's into the public sector. Intellectual property issues complicate but should not prevent academic and industrial researchers from collaborating. However, the PGRP will continue to insist that PGRP PIs openly share their data and information with the public including the industrial sectors as well as the international community.

**Recommendation:** *We are anticipating an explosion of data in metagenomics and this information must be rapidly disseminated to the scientific community in a useful/usable format. The PGRP should consider innovative ways of disseminating this information.*

**Response:** BIO agrees that metagenomics will impinge on the PGRP community, perhaps through plant-microbial interactions. The Program will keep abreast of developments in this area and work with the community to build into the Plant Cyberinfrastructure Collaborative the flexibility and capacity to accommodate metagenomics data relevant to PGRP projects.

**Recommendation:** *The PGRP is encouraged to expand funding opportunities to small colleges and universities, particularly those institutions with a track record for education outreach and training.*

**Response:** BIO strongly agrees and will monitor the progress that the PGRP makes in this area. To date the Program has been promoting the ROA (Research Opportunity Award) and other opportunities for researchers at smaller colleges to participate in the PGRP through its solicitations, outreach visits, websites and e-notices to the universities. The PGRP will make a special effort to contact and encourage postdocs trained under earlier PGRP grants and now working at small colleges to participate in PGRP projects with their students.

**Recommendation:** *The NSF should develop programs to educate universities to the value of collaborative research (i.e., tenure committees give preference to individual grants) and facilitate the transition of established scientists from other disciplines into the plant sciences. Junior faculty should be encouraged to engage in multidiscipline research as an example of showing creative contribution in large projects.*

**Response:** NSF promotes multidisciplinary projects through all its solicitations and policy statements. In addition, the PGRP will consider reinstating the Young Investigator Award opportunity which specifically called for multidisciplinary proposals. Through its outreach activities, PGRP will also continue to encourage plant genome researchers to participate in the Integrative Graduate Education and Research Traineeships (IGERT) program to promote interdisciplinary training of the next generation of scientists.

**Recommendation:** *The COV believes that the current process creates an excessive workload on PGRP staff and we believe that new ways of engaging reviewers should be considered. For example, instead of increasing the number of solicitations to obtain the needed number of reviews based on a 25% to 30% success rate, the PGRP should explore ways of increasing positive responses for the solicitations. Are there financial or non-financial incentives that could be used to increase the recruitment rate of ad hoc reviewers?*

*Regarding reducing staff workload and increasing the efficiency of the grant review process, the COV wonders if the PGRP could impose a limit on the number of resubmissions on a given topic. The COV believes that three submissions may be a reasonable limit because the research topic and attendant technologies are likely to have changed significantly over a three to four year period. Can the PGRP program officers use a triage process to eliminate unfundable proposals before ad hoc reviews are solicited? While these suggestions may not be strictly in the tradition of NSF grant review process, we suggest that the PGRP be used as a pilot program for new reviewer solicitation methods and a process to reduce the number of less meritorious applications that are submitted to panelists and ad hoc reviewers for evaluation.*

**Response:** BIO appreciates the COV's concern for the merit review process and workload issues. Neither issue is unique to PGRP or even BIO.

The issue of low return rate for reviews is an NSF- wide problem. A recently completed NSF study called the Implications of Processes for Award and Merit review Management (IPAMM) concluded that stresses in the entire research enterprise are impacting the quality of merit review. NSF is now considering the report's recommendations which will undoubtedly be implemented NSF wide.

BIO is considering various options for managing workload including wider use of preproposals, reviewed letters of intent, and triage mechanisms. While triage would reduce some work, without a full review PIs, especially junior PIs, might not get sufficient feedback to develop a competitive proposal. Success rates of resubmissions are slightly higher than for first time submissions, indicating that reviewer comments are generally helpful to the PIs. BIO's and PGRP's goal is to increase the number of quality proposals and at the same time lessen the burden on the review community.

***Recommendation:*** *The COV is concerned about the consequences of terminating large, multi-investigator, multiyear grants projects. Although termination of projects, regardless of project size, is a necessary component of any competitive grant program, the COV believes that after making substantial investments in such projects, an orderly phase-out mechanism should be available for large projects. This would help ensure the orderly transfer and archiving of information and biological materials as well as ensure that project personnel are out-placed into appropriate positions. PIs should be required to include reasonable phase-out procedures in their proposals. In this way, the PGRP will have some additional protection in its investment in research and training of a highly skilled workforce. Perhaps this concern could be addressed with more frequent site visit reviews of large multiyear awards so that PIs can be apprised early of concerns about progress and how that may affect any potential project renewals? Could the PGRP use one-year extensions to assist PIs with the orderly phase-out process? The COV believes that this is an issue of program sustainability and that a new agency-wide policy may be required to address this concern.*

**Response:** BIO agrees that PIs should include a discussion in their proposals of how a project will be sustained, if the PI feels that the project will not be completed within the time requested for funding. However, phase-out needs to be, and is, carried out on a case-by-case basis. Sometimes, supplemental funds are provided if a phase-down is required. In other cases, the work is completed by the end of the project, the goals accomplished and the physical resources and data house in depositories or public databases. Program directors review annual reports and conduct site visits for all projects funded through cooperative agreements or when signs warrant such an activity. NSF is currently studying the impact of ending large grants or large grants programs on the long-term health of the scientific enterprise.

**Recommendation:** *The COV had some suggestions on how to streamline the COV review process. These suggestions are as follows:*

- *breaking the COV committee into smaller groups to meet with different groups of program directors/officers*
- *continue to update and streamline the COV review template to reduce redundancies and ambiguities in the questions and terms*
- *provide a block at the beginning of the template for an Executive Summary*
- *provide more clarification in the READ ME document of what is expected of COV members at the meeting*
- *schedule the meeting with the Assistant Director earlier in the review process*

**Response:** BIO appreciates these suggestions and implemented some of them during the DBI COV that was held a couple of weeks after the PGRP COV. In addition, we will forward these suggestions to the NSF wide working group responsible for oversight of the COV process.

**Recommendation:** *In advance of an increased federal emphasis on both climate change and bioenergy research, the COV recommends that the NSF make early seed investments in the PGRP so that it can more quickly respond to research initiatives and proposals that bridge existing PGRP research and resources with these areas. Furthermore, over time and with careful consideration and input from the research communities, a plan should be developed to evolve and position this program to contribute to these (and perhaps other) national missions yet to emerge consistent with NSF's overall research and education missions in basic research.*

**Response:** BIO believes that PGRP funded projects have already contributed foundational knowledge in plant biology that has enabled some of the current expansion in biofuels research and development. Similarly, research on the genomic basis of carbon sequestration and on plant responses to environmental signals will contribute science-based knowledge to inform issues such as climate change. Clearly, NSF's and the PGRP's contribution to national needs will continue to be discoveries and new knowledge generated through world-class plant biology research and educational activities.

**Recommendation:** *As has been recognized elsewhere in the report (see Section B3), there has been a considerable degree of planning and input gathering from the bioinformatics, genomics, and plant science communities. Much of this input and the resulting recommendations are now reflected in the recently announced PSCIC. Once the PSCIC is funded the opportunity exists to pull together a detailed business management plan for all PGRP (and perhaps even the NPGI) activities that integrates the various components together, centered on the*

*PSCIC initiative. We recommend that the PGRP take the lead for the NPGI in drafting a program-wide business plan for the management of in silico resources.*

**Response:** The PGRP appreciates the COV's recognition of our role in establishing the PSCIC program. PGRP staff has been and will continue to be involved with the Plant Science Cyberinfrastructure Collaborative. Once the PSCIC awardee is selected, PGRP will work with the PI to ensure that all PGRP PIs take full advantage of PSCIC. In terms of a program-wide business plan for in silico resource management, the program will convey to the Office of Cyberinfrastructure at NSF the COV's assessment of the merit of such plans.

**Recommendation:** *The COV concluded that the PGRP is working hard to include scientists at all levels into funded projects and to equip them with appropriate skills. However, more effort should be made to ensure interoperability between projects and to disseminate genomic information that is user-friendly. Examine the long-term career paths of postdoctoral and research professors to understand their integration and roles in the field. The PGRP should be aware of the challenges related to young genome researchers in securing tenure when they have been part of a large plant genome project. The project PIs should be encouraged to develop effective mentoring programs to aid in the career development of their staff.*

**Response:** BIO, the PGRP and NSF are very aware of the challenges that young investigators who have worked on multi-PI projects face in getting tenure. PGRP program directors have had numerous discussions with Deans and Department Chairs. The young investigators are invited to a mentoring lunch at the awardee meeting every year. Since tenure is a university decision, while NSF can encourage change, change can only occur with support from within the University system. This is happening at some but not many institutions.

**Recommendation:** *After reviewing the evidence of the program's success, and realizing its potential to continue to inform core areas of biological inquiry in the future, the COV recommends continued funding for the PGRP for the foreseeable future.*

*The COV recommends continued funding for the PGRP until such time that the quality and creativity of proposals to the PGRP are seen to become derivative or redundant in their goals or show limited scope and prospects for new discoveries. Other reasons for reconsidering funding could include reduced quality and impact of publications. The COV does not expect this situation to occur anytime, soon, however. Indeed, the COV anticipates the need for PGRP funding to increase for the foreseeable future.*

**Response:** BIO agrees that "plant genomics holds a keystone position in biology" and plans to continue the PGRP. BIO also appreciates the COV's willingness to suggest metrics that might be used to determine when the PGRP



or indeed any program should end. BIO feels that the PGRP has been and should continue to be dynamic and responsive to the needs of the community while supporting research, education and resource development at the frontier of plant biology.

**Recommendation:** *The COV feels that hard data to document the impact of the PGRP is available and urges the PGRP to establish mechanisms to enhance the return of such information from their awardees. COV discussed possible indicators such as:*

*Quality and number of applicants for tenure track positions in the plant field*

*Numbers of students applying for graduate training and the numbers graduating*

*Laboratory space devoted to plant research in research universities and institutes*

*Transition of established scientists from another area into plant sciences*

**Response:** BIO agrees that this information would be extremely useful and the PGRP will convey the COV's suggestions to the NSF-wide working group that is redesigning the NSF annual and final report templates.