Generation Challenge Programme

CULTIVATING PLANT DIVERSITY FOR THE RESOURCE POOR

2006 Annual Report and Year Four (2007) Workplan

Generation Challenge Programme

2006 Annual Report and
Year Four (2007) Workplan

Submitted by Jean-Marcel Ribaut, Director, and
Jennifer Nelson, Communications Manager

Generation Challenge Programme
c/o CIMMYT
Apdo. Postal 6-641
06600 Mexico, D.F., Mexico
+52 55 5804 2004

Correct citation: Generation Challenge Programme 2006 Annual Report and Year Four (2007) Workplan. Mexico, D.F., Mexico.

Table of Contents

Dear Friends and Colleagues of the Generation Challenge Programme,

It gives us great pleasure to present you with the Generation Challenge Programme 2006 Annual Report, which outlines our accomplishments over the past year. This year has been one of great success and change for the Generation Challenge Programme (GCP), and we are proud to inform you of these activities in the following report.

A major objective for the GCP is to help link 'basic' research with 'applied' science—to help make scientific innovations and new technologies relevant for resource-poor farmers, and to improve the access for scientists and researchers in the developing world to technologies that can make their work faster and more efficient. The GCP was intended to address the historical gap between bench scientists working on cutting-edge research in their high-tech labs and the plant breeders and resource-poor farmers that their research is supposed to help.

With this purpose in mind, quite a large and diverse set of products has been generated this year, including reference samples for most GCP mandated crops; characterised genes of high importance for plant performance under non-optimal conditions; analytical tools for evaluating data; molecular markers for genetic studies and breeding experiments; added value germplasm; and training materials for scientists. This list is obviously not exhaustive and major achievements for 2006 are presented in detail in this report. Generating quality products for use by partners along the delivery chain is of critical importance to the GCP, since the success of this programme will be judged by the quality of its science and the ability of its products to impact crop improvement.

This year also saw the second call for GCP competitive grants. For this call, the Management Team identified five thematic areas that the GCP prioritised for short-term development. Targeting the call to a specific set of themes allowed for more focused proposals. The Management Team is pleased with the output of this selection process and is confident that the six selected projects will consolidate and complement our current research agenda.

As anticipated from my message last year, and as already demonstrated through our thematic call for competitive proposals, the Management Team has been working on refining the objectives and better-defining the operational framework of the GCP. As an output of this effort, a Strategic Framework document has been produced and was approved by the PSC during its annual meeting in November. This Strategic Framework is a set of guiding principles for the GCP's strategic decisions and will be complemented by 'reference studies' that provide data about the GCP's impact targets. The GCP Strategic Framework and a first reference study—the Targeting Impacts paper developed by Glenn Hyman, et al.—is available on our website.

The GCP staff composition was also adjusted in 2006, resulting in the appointment of a Project Manager and the shift from half- to full-time positions for two Subprogramme Leaders. These changes represent a necessary step for a growing programme with a portfolio of about 70 projects that generate a massive amount of data and many products. These decisions also demonstrate that the GCP is serious about project implementation and product management and delivery. This being the first Annual Report since their coming on board with the GCP, I would like to welcome Adriana Santiago as our new Project Manager, Philippe Monneveux as SP3 Leader and Product Manager, and Carmen de Vicente as SP5 Leader and Product Delivery Manager. I would like to take this opportunity to express my gratitude to Communications Manager Jenny Nelson, who is leaving the GCP to pursue new challenges and continue her studies in the USA.

I would also like to thank the scientific community for their continued support. It was great to once again witness the enthusiasm and commitment of scientists working on GCP projects during the Annual Research Meeting in Brazil this year. The significant achievements of the Programme in 2006 were made possible thanks to the hard work and dedication of those scientists and the GCP staff, in addition to the strong support of our stakeholders and donors. A special thanks goes to the Swiss Agency for Development and Cooperation, who joined our donor group this year.

Looking back on our achievements over the last years and in 2006 in particular, I feel confident that we are on track to achieve our mission. We must strive to maintain our current momentum to develop tools and technologies that help plant breeders in the developing world produce better crop varieties for resource-poor farmers.

Jean-Marcel Ribaut
Director

Introduction and 2006 Programme Highlights

This year, the third in the Generation Challenge Programme's young life, was marked by impressive scientific progress, intensive research and strategic planning, and important administrative changes that reflect the new opportunities and challenges facing this programme. The first two years of the GCP were defined by the establishment and implementation of the GCP's operational structure and research portfolio, and Year Three presented the chance to identify what we are doing well and where we need more emphasis or improvement. The Management Team of the GCP strongly believes that the long-term success of this programme depends on our ability to learn from our experiences and adjust our strategies and structures as appropriate. We are also aware that the GCP is rapidly approaching its second phase (2009-2013), where this programme will be expected to show big scientific outputs and real impacts on plant breeding for the resource-poor.

Research activities in the GCP are generating intriguing outputs as well as interest from the scientific and development communities in our programme. The 17 competitive grants that began in January 2005 have now completed their second (of three) years, and, as evidenced by their presentations at the GCP Annual Research Meeting in September, are developing research and breeding products that will increase the efficiency, speed, and scope of plant breeding programmes in developing countries. Several new commissioned research projects were implemented this year as well, in addition to the group that started in 2005 and continued through 2006. A new call for competitive grants was issued in 2006. Six new two-year projects have been selected and, upon approval of the 2007 workplan by the PSC, should commence in 2007, along with a new set of commissioned projects. By early 2007, the GCP will have over 60 projects underway.

Of the new projects the GCP will initiate in 2007, one very notable addition is a project titled Improving Tropical Legume Productivity for Marginal Environments in Africa, funded by the Bill and Melinda Gates Foundation. This project represents a key new initiative in the GCP, as it promotes the application of modern breeding to improve the productivity of four legume crops (groundnuts, cowpea, bean, and chickpea) in sub-Saharan Africa.

Several important research groups, such as the Consortium for Spatial Information of the CGIAR and the French National Genotyping Centre, joined the GCP network of partners in 2006. The addition of new partners to the GCP network slowed significantly this year, partly because most of the new projects that started in 2006 built on existing work in the GCP and also because the GCP's universe of partners is already quite huge; if we want to foster healthy partnerships, it is important to cultivate the ones that we currently have. At the 2005 Programme Steering Committee meeting, provisional membership[1] was extended to four new organisations—INRA-Morocco, CINVESTAV-Mexico, BIOTEC-Thailand , and the Istituto Agronomico d'Oltremare (IAO) of Italy—whose full membership in the consortium is pending ongoing revisions to the GCP consortium agreement. The 2006 competitive grant proposal guidelines were modified to allow non-GCP consortium members to submit proposals and thus permit new partners to lead GCP research activities. Two of the six successful proposals to begin in 2007 are led by advanced research institute partners new to the GCP. Many of the new commissioned proposals to begin in 2007 also engage new collaborators, particularly NARS institutions, and a major goal of the GCP in 2007 will be to strengthen these and other partnerships.

Another important development in 2006 was the refinement of the GCP Strategic Framework. What started as a new strategy document for the GCP in late 2005 evolved over the course of 2006 into a Strategic Framework, which builds upon the existing strategy established by the founders of the GCP in 2003 and clarifies some fundamental issues in the GCP, such as how the programme articulates its research approach and how it will allocate resources. Part of this process involved the compilation of "reference studies" to identify the impact targets—farming systems, crops, and traits—of this programme. One such study that aimed to identify the farming systems with the highest incidence of poverty and the crops associated with those systems, Targeting Impacts in the Generation Challenge Programme, was presented at the PSC meeting in November.

[1] Provisional membership provides all benefits of full membership except for membership on the Programme Steering Committee, because the GCP Consortium Agreement is under review and there is currently no document for new members to sign. Once any changes to the Consortium Agreement are ratified, the provisional members will be offered full membership and will then be able to participate fully in GCP activities, including PSC membership.

Significant progress was also made in the implementation of the GCP Delivery Strategy. The Delivery Strategy, developed in 2005, defined the concepts of "product" and "user" in the GCP context and proposed that the GCP require "delivery plans" from all of its projects that clearly identify the products being produced and to whom they will be delivered. A group of experts in technology transfer, research management, impact assessment, and marketing convened in October 2006 to develop the GCP Delivery Plan Kit, which will assist investigators with the process of identifying their delivery pathways as well as provide a tool to GCP Management for monitoring project and delivery progress and impact.

As with previous years, the GCP Annual Research Meeting (ARM), held in São Paulo in September of 2006, was a major highlight. The Annual Research Meeting brings together all of the researchers leading GCP projects, a large group of dynamic individuals for whom the ARM is the one chance per year to hear about what their fellow GCP researchers are doing. The brainstorming sessions introduced at the 2005 ARM and repeated at the 2006 meeting proved particularly useful mechanisms for GCP Management to solicit ideas and opinions from the community about complex and contentious scientific issues. One discussion session focused on phenotyping protocols, and another focused on candidate genes.

Another crucial change this year happened in GCP staffing. To manage contracts and project reporting, a Project Officer, Adriana Santiago, was appointed in early 2006. Following Jonathan Crouch's departure as Subprogramme 3 Leader, the Programme Steering Committee approved the recruitment of a full-time Subprogramme 3 Leader and Product Manager, based on the recommendations of a PSC Task Force on GCP Management. That process was conducted during the second quarter of the year, and Philippe Monneveux was hired in May and joined the GCP at our Mexico headquarters in July. The Task Force on GCP Management also recommended that the Subprogramme 5 Leader position be adjusted to full time, since that position is expected to manage both capacity building and delivery issues. Carmen de Vicente was recommended for the job and will move to take up her new position with the GCP in early 2007.

The major highlights of 2006 are briefly described above, but in this report we are pleased to elaborate many more exciting new developments in this programme over the course of this year. The Generation Challenge Programme is gaining momentum, and while we face new challenges with each year, we also earn new opportunities to make a difference—in the scientific community, in the development community, and on the resource-poor—in innovative ways.

Administration and Governance

In addition to the staffing changes mentioned above, there were several other activities in GCP administration and governance conducted this year. At its 2005 meeting, the Programme Steering Committee assigned two Task Forces to develop recommendations on two issues of major importance to GCP administration and governance: Management Staffing and Governance Structure. The Task Force on Management Staffing was asked to review the management needs of the GCP and make specific recommendations about the SP3 and SP5 Leader positions. As mentioned above, they recommended both positions be adjusted to full time, and they participated in the development of the Terms of Reference for both positions. The Subprogramme 3 Leader position now also includes the responsibilities of GCP Product Management, a new area of emphasis in the programme and one which requires significant discussion within the Management Team to define "product management" in the context of this programme. The Subprogramme 5 Leader position includes both management of capacity building efforts and delivery issues, as well as intellectual property, policy, and impact assessment research.

The Task Force on Governance Structure interacted extensively via email and met in Italy in June to develop a set of options and recommendations for reforming GCP governance.

The Programme Steering Committee also agreed at its last meeting that the GCP was to submit to an internal audit by the Internal Audit Unit of the CGIAR. The audit was conducted in October of 2006 and involved an extensive review of internal project and financial management procedures as well as an assessment of the host relationship between CIMMYT and the GCP. One of the recommendations of the Internal Audit was the urgent need for a host agent agreement between CIMMYT and the GCP. This recommendation was responded to immediately, and a draft agreement was jointly developed. The GCP is fully committed to implementing the approved version of the Host Agent Agreement as well as the other recommendations made by the Internal Audit.

Another activity under GCP administration and governance was the development of the GCP Manual, a document that describes the history, purpose, structure, policies, and procedures of the Generation Challenge Programme. The GCP Manual is accompanied by every official document produced by the GCP since its inception. Originally conceived to help orientate new staff to the beast that is the GCP, we quickly realised that it is an indispensable and transparent resource for

GCP staff and partners as well as donors and stakeholders. The first version was developed in 2005 and an updated version was produced in 2006 and is available to the public on the GCP website (http://www.generationcp.org/brochure.php). It will be updated once yearly with new policies and other relevant information.

A number of activities were dedicated to improving project management in the GCP this year as well. A database for managing project budgets, disbursements, and reports was developed in early 2006, and with the recruitment of Adriana Santiago, Project Officer, significant strides have been made in integrating that database with CIMMYT's financial management system. To streamline product and project management in the GCP, a new project proposal template was developed that helps investigators begin planning their projects with concrete outputs along a concrete timeline, which will in turn help the GCP Management Team review their progress. A new technical report template was also developed, both to complement the new proposal format and also to help ingrain a "product orientation" into all the GCP's processes. To further standardise the reporting process, the GCP plans to introduce web-based reporting in early 2007.

Research Management

Research management in the GCP involves a number of levels: first, the overall research strategy and resource allocation for the programme must be determined; second, the calls for proposals or concept notes for both competitive and commissioned research must be developed and rigorous, transparent guidelines for evaluation of proposals must be employed; and third, the selected projects must be monitored to ensure the production of timely and useful outputs as well as their delivery to users. In 2006, its third year of operation, the GCP dealt with all of these levels.

The GCP's overall research strategy and resource allocation was an issue that occupied quite a bit of the Management Team's time in 2006. As mentioned in the Introduction, the GCP Strategic Framework document evolved over the course of the year to its current form and inspired several related activities that produced important information to supplement the Strategic Framework. The Framework is a set of principles regarding how the GCP organises its research and the criteria we use to allocate resources. Because the question of resource allocation with a programme as wide-ranging as the GCP is such a complex one, the GCP undertook several studies to explore how it might prioritise its targets. One study aimed to identify the farming systems where poverty is most severe and the crops associated with those systems. Not a simple or straightforward exercise, the results of this study are nevertheless very compelling and were presented at the PSC meeting in November by its main author, Glenn Hyman. Because of the content of the GCP, two other critical pieces of information are needed to inform our resource allocation decisions: 1) the genetic and genomic resources available in our mandate crops, which are the raw materials for all GCP work, and 2) the plant phenotyping and breeding capacity of the national programmes and other research institutions working in or for our target farming systems. Surveys to gather this information were distributed and compiled by the GCP in 2006. This information is also complex and difficult to gather in an objective way, but the output of the 2006 surveys is an important first step towards identifying resources and gaps. In summary, the GCP Strategic Framework, developed in 2006 and approved by the PSC, provides a clear guide to the GCP's research philosophy and resource allocations, and the reference studies described above provide the critical information for implementing that framework. The Management Team views the reference studies as a set of "living" documents that will be constantly updated and augmented with additional information about other aspects of the GCP's targets to help them continue to make educated decisions and execute the GCP's strategy.

The second research management issue is the development of the calls for proposals or concept notes for the GCP competitive grants and commissioned projects. The overall research strategy of the GCP provides general guidelines on how the GCP approaches its dual mandates of both generating useful knowledge and developing practical tools for the breeding community, but the criteria for pursuing certain crops, scientific areas, or approaches must be tailored for each call for proposals by the Management Team to ensure that the proposals received match the GCP's long-term research strategy and ensure continuity of the strongest elements of the research portfolio. The second call for competitive grant proposals was announced by 15 February 2006 and was targeted to five "thematic areas":

A. Methodological research for improving efficiency at various steps of the GCP product development process, including (1) association studies to validate candidate polymorphisms/genes, (2) refinement of drought tolerance through the documentation of new traits, and (3) development and application of gene-based markers for abiotic stress;

B. Generation and advancement of breeding populations with a view to elaborating and applying novel practices which integrate knowledge generation and breeding progress, including (1) the introgression of new alleles in breeding material, and (2) the use of marker-assisted selection to breed for abiotic stress.

Targeting the call for proposals to a specific set of thematic areas also serves to limit the number of proposals the GCP receives, as the Management Team strongly believes that the GCP's reputation as a high-quality scientific programme rests on a reasonable rate of success for proposals. To further limit the number of proposals, the GCP also put in place a 4-proposal limit for every organisation on which they may participate as a partner (they were limited to 2 proposals as Principal Investigator). Given that every proposal must have a GCP consortium member as a partner, and the consortium members can only participate in a total of 4 proposals, the maximum number of pre-proposals that could be submitted was 88 (4 proposals x 22 consortium members). Forty five pre-proposals were received, and 20 were selected to submit a full proposal (there was a 44% chance of being selected to submit a full proposal). Of the 20 full proposals, 6 were selected in the top tier (33% chance of success). Like the first round of competitive grants, an independent review panel composed of well-recognised experts in the fields of molecular genetics, genomics, plant breeding, and delivery was selected by the GCP Director and were provided with thorough transparent guidelines for proposal evaluation. Wayne Powell, as chair of the Programme Advisory Committee, was involved in the selection process. The 6 selected proposals have been approved by the PSC.

The Management Team also develops the ideas for commissioned research projects. Commissioned research in the GCP is intended to link the competitive grants into a coherent platform, to ensure continuity of research, and also to spearhead important research areas that might not make it into a competitive grant process. Having learned from the previous two years that strong commissioned research proposals need sufficient time for development, the MT began the development of commissioned research ideas early in 2006. The budget allocated to commissioned research in 2007 is reduced, as 2007 is a transition year supporting two waves of competitive grants. But the new projects capture important, exciting new work in the fields of genomics and gene discovery that can further enhance the GCP's overall mission. Notably, several projects will be initiated to promote the use of molecular markers in national programmes (vertical projects in SP3) in developing countries, namely Morocco, Thailand, and China. This new emphasis on strengthening the use of molecular technologies at NARS will increase in the future.

The third level of research management in the GCP is the monitoring and evaluation of the research projects. In addition to hiring a Project Officer, who organises all of the contracts, proposals, and reports at GCP Headquarters, the GCP has put in place several project management policies to help streamline the process, such as a new report format and a Project Management Policies webpage (http://www.generationcp.org/gen.php?da=0642324) with detailed explanations of the GCP's policies and procedures as well as all relevant documents and templates. The GCP Manual, described above and available on the GCP website as well, is also a useful project management resource, particularly for contract and financial officers at our partner institutions. The Management Team plans to further streamline project reporting procedures in 2007 by implementing a web-based application for technical reporting. Along with the project proposals, which are already posted on the GCP website, the reports would also be publicly available, which we hope is further incentive to produce high quality scientific outputs on time. Assuring quality in the research projects is critical to the success of the GCP overall, and in 2007 the Management Team is putting in place several measures to help assure quality: a Genotyping Data Quality project in SP1 and a Project Progress Monitoring initiative in SP5, which provides funds for the Subprogramme Leaders to bring in outside experts to evaluate progress and quality. Subprogramme 4 is also sponsoring a help desk for data analysis, which will help flag and resolve problem areas. The project report template was also modified this year, as well as the research contract, to require researchers to be specific about where and when they will post their data. They will be expected to post it to a public database (including GCP databases) within 6 months after the project ends (with some exceptions made in cases where scientists are waiting to publish, etc.).

Another important research management mechanism is the Review and Advisory Panel (RAP), which is a group of five experts selected by the respective Subprogramme Leaders to serve as external reviewers of the projects under their tutelage. They provide an objective perspective on GCP activities, and they are able to focus on the major issues they believe each Subprogramme Leader must deal with, both skills which are highly appreciated by the Management Team. The RAP participates in the Annual Research Meeting each year, provides extensive feedback to the MT on the research conducted within each Subprogramme, and reviews the commissioned research proposals. In addition, the RAP may accompany their respective MT member to on-site visits to GCP partner institutions. It is the MT's goal for each MT member to conduct two site visits per year to review GCP products and get feedback from our partner institutions about how to strengthen our collaborations.

The Annual Research Meeting (ARM) is another important opportunity to evaluate GCP projects. All principal investigators are required to participate in the ARM, give a presentation on their project, and present a poster. At this intense five-day meeting (increased from three days last year), the Subprogramme Leaders are able to interact with the researchers in their Subprogrammes and see the progress they've made. In addition to the research management aspect of the event, the ARM is crucial in helping create a sense of community among the research groups scattered all over the globe who are working on GCP projects.

Progress and outputs of the individual research projects are described in detail in the Subprogramme Reports of this document.

Research management in the GCP also entails the cultivation of funding opportunities for the GCP from donors, particularly non-traditional ones. In 2006, the Management Team was very busy with the development of a proposal requested by the Bill and Melinda Gates Foundation, titled "Improving Tropical Legume Productivity in Marginal Environments for Sub-Saharan Africa." This project proposes to develop key genomic resources that are currently lacking in legumes (including cross-legume molecular markers for comparative genomics), identify molecular markers for traits of importance to resource-poor farmers (biotic stresses and drought tolerance), and implement breeding capacities in sub-Saharan Africa. The project involves partners at US universities, CGIAR centres, and NARS institutions in Sub-Saharan Africa.

Product Management and Delivery

The Generation Challenge Programme believes that it must deliver useful products to plant breeders to ensure that it will make impacts on resource-poor farmers. The GCP's ability to deliver quality products is closely linked to the research management issues elaborated above, but the GCP is currently in the process of defining what, exactly, are "products" in the GCP and how they should be managed. The new Subprogramme 3 Leader position includes the responsibility of Product Management in the GCP, but this is a new concept in the public sector and it is important that the GCP take the time to explore the various ways in which product management could be implemented in our programme. Product management is also, obviously, closely linked to delivery, which is the purview of Subprogramme 5, so the scope of each of these areas—research, products, and delivery—must be clearly defined for maximum efficiency and minimum burden on the researchers.

Even so, significant progress was made in 2006 in both the product management and delivery areas in the GCP. A new project proposal template was developed to solicit critical information from researchers in the project planning stage about their quantifiable outputs and their anticipated products. A Delivery Plan Kit (DPKit) to gather information from projects about their products, partners, capacity building needs, intellectual property constraints, and other issues pertinent to successful delivery was prototyped with several external experts in agri-marketing, impact assessment, and technology transfer, in addition to two GCP project leaders. The DPKit shows much promise for organising product and delivery information for use by the Management Team. Following further refinement, the DPKit will be implemented in the new batch of competitive grants at a kick-off meeting for each project.

Partnerships

This year has been fruitful in identifying new research opportunities and collaborators. However, interactions with the private sector are still quite limited. We aim to improve this during 2007.

Our collaboration with the Global Crop Diversity Trust was formalised through a Memorandum of Understanding developed this year and signed during the 2006 CGIAR Annual General Meeting that took place in Washington, DC. The MOU establishes that the Trust and the Generation Challenge Programme will collaborate in carrying out activities of mutual interest, particularly concerning the conservation, research, and development of plant genetic resources for food and agriculture.

How to develop a more concrete collaboration with Genoplante has also been explored this year. Several active players in Genoplante participated in the 2006 Annual Research Meeting. A first step towards collaborative activities was the agreement to routinely communicate on our respective activities and share and/or link our respective databases and genomic resources.

Because GCP research is mostly "upstream," it is important to align with organisations that are involved in large-scale plant breeding, seed multiplication, and distribution. In recent years, the role of The Rockefeller Foundation in those downstream activities has been increasing though the encouragement of Joe DeVries; this effort has been boosted recently with the joint founding by the Gates Foundation and The Rockefeller Foundation of the Program for African Seed Systems (PASS). The Rockefeller Foundation sees the

GCP as a good way to develop and bring new molecular markers for plant breeding to Africa, and the GCP sees PASS as an efficient way for GCP products to be used by breeders and have impact in farmers' fields. As a concrete action, the GCP has already agreed to support some training activities at the African Centre for Crop Improvement at the KwaZulu-Natal University in South Africa, a centre supported by The Rockefeller Foundation. Doing so allows the GCP to be involved in the training of African breeders, involve some of them in GCP research activities, gain a better understanding of what is going on in African breeding programmes, and identify potential new partners for the GCP.

Discussions with the Syngenta Foundation are also currently underway to explore the idea of demonstrating how the technology developed by the private sector can impact plant breeding in the South. The GCP is also exploring with the Syngenta Foundation the possibility of developing a project development and management tool, taking into account what has been developed in the private sector. Sharing experience in research planning (how to ensure that your research has a high rate of success and high potential impact) represents another major potential contribution from the private to the public sectors.

A new collaboration with the Kirkhouse Trust was also explored this year. The GCP Director met with Ed Southern and colleagues from the Kirkhouse Trust on a trip to the UK. It was agreed that routine communication should be established, in particular on research activities conducted to improve tropical legumes, as the Kirkhouse Trust is supporting the development of genomic resources for cowpea in Africa. Over the last years, they have also invested in building laboratory capacity for the use of molecular markers in Africa.

NARS participation in the GCP is integral to achieving our goals, and in 2006, several important collaborations with new NARS partners began. Though many of the projects will begin in 2007, the discussions to build the partnerships started early in 2006. BIOTEC-Thailand, INRA-Morocco, and IAR-Mali will be involved in new commissioned projects under SP3. Many new NARS were also engaged through the capacity building activities of Subprogramme 5 (see the SP5 section for details). With the new commissioned and competitive projects starting in 2007 and the new "capacity building a la carte" programme, we expect to strengthen these partnerships and start new ones.

Policy and Legal Matters

Several key achievements in legal, policy, and intellectual property issues have been made in 2006. As mentioned in the Administration and Governance section above, a major milestone this year was the development of a hosting agreement between CIMMYT and the GCP, the features of which the legal report explains in detail. The legal report also explains the importance of contracting between lead institutions on GCP projects and non-consortium member participants as well as the basic intellectual property rights (IPR) provisions of the Consortium Agreement.

Compliance by GCP consortium members with their obligation to file annual IPR management reports has been light so far. The report further explains the reasons for the IPR management reporting requirement, gives instructions on compliance, and highlights the importance of monitoring subcontractors' IPR obligations by lead GCP institutions.

Another achievement in 2006 was the establishment of an IP Helpdesk on the GCP website (http://www.generationcp.org/iphelpdesk.php?da=0629604) to assist GCP researchers with IPR questions. Both IPR matters and legal issues relating to obtaining access to genetic resources must be taken seriously in all GCP research projects; for this reason the GCP supports the development of such resources as the IP Helpdesk.

The GCP Management Team has also developed a new draft of its Statement on Transgenics, per the request of the Programme Steering Committee. This document is a position statement specific to the GCP on the issue of using transgenics for research purposes versus the development of varieties. This statement is available on the GCP website.

Communications

Communications in the GCP aims to facilitate information flow within the GCP as well as establish and maintain a positive public image of the programme. A major effort towards accomplishing both of these objectives is the GCP website, which has grown tremendously since its launch in 2003. As a rule, the GCP makes all of its documents available on the website, so that people can come to one place to find anything related to the history, structure, composition, policies, and procedures of the GCP consortium. In addition, the website publicises news items of interest to the plant molecular genetics and breeding communities.

Another effort to establish the GCP as an important player and partner-of-choice in the research community is the sponsorship of key symposia and workshops around the world. The GCP session at the Plant and Animal Genome (PAG) Conference each year draws upwards of 200 people. The GCP Director and Subprogramme Leaders also participate in various international and national conferences, in addition to PAG, as GCP ambassadors.

The communications unit coordinates the development of all GCP publications and reports, which in 2006 included:

- ♦ 2005 Annual Report and Year 3 Workplan
- ♦ 2005 GCP Research Highlights
- ♦ 2007-2009 Medium Term Plan
- ♦ 2005 Annual Report to the Executive Council of the CGIAR
- ♦ 2006 Mid-Year Project Reports (proceedings of the Annual Research Meeting)
- ♦ GCP posters and brochures
- ♦ Donor reports (European Commission, Sweden International Development Agency, etc.)

In 2006, some joint communications activities were undertaken or initiated to add value to complimentary efforts. For instance, the GCP coordinated the development of a joint brochure featuring all four Challenge Programmes.

The GCP's flagship public awareness publication—the Research Highlights—was a big hit in 2006, and to follow up, the communications unit is now producing another Highlights, this time to feature partners and products of the GCP. The idea is to alternate each year: one year Research Highlights, the next the Partner and Product Highlights.

In addition, in 2006 the communications unit continued its core activities of:

Management and improvement of information flow within and outside the GCP:

- ♦ E-newsletter: a periodic compilation of announcements of interest, GCP events, training opportunities, etc., was distributed to all GCP member scientists, partners, and many stakeholders (distribution list contains over 1,500 contacts)
- ♦ Latest News on the GCP website: Latest News includes GCP news as well as items of interest to the plant molecular genetic and breeding community. Over 100 people, mostly from NARS, have signed up to receive the Latest News Alerts, which are generally sent out bi-weekly.

Coordination of public awareness efforts for target audiences:

- ♦ GCP Website: the communications unit is responsible for the development and maintenance of the Generation website (www.generationcp.org), which serves as the virtual library for GCP official documents and is the public face of the GCP. The site receives over 3,000 hits per month. The unit also develops content for the site, such as features for the Capacity Building Corner and Latest News items.
- ♦ GCP public awareness materials and outreach to media: the communications unit develops GCP public awareness materials and pitches stories to national and international media. GCP reports, brochures, posters, and other items were sent to thousands of people in 2006.
- ♦ Targeted public awareness materials for international conferences, specific campaigns, etc.: the communications unit provides the service of developing materials about GCP themes or activities for outside events.

Packaging and communication of GCP outputs:

- ♦ GCP products: the communications unit constructs web pages and publications to distribute and publicise GCP products such as informatics tools, training materials, protocols, and other useful information.

The communications manager was also closely involved in the development of the Strategic Framework document in 2006. Because product management and delivery issues also have a strong communications component, the communications unit has also been engaged with the Subprogramme 3 and Subprogramme 5 Leaders in the discussions and workshops about these important issues.

Jenny Nelson, communications manager of the GCP since it began in 2003, announced her departure from the programme at the end of 2006.

Subprogramme Updates

Subprogramme 1: Genetic Diversity of Global Genetic Resources

Rationale

Providing access to sources of genetic diversity that may supply genes and alleles involved in key agricultural traits, especially stress tolerance, is the foundation of the GCP. Through our network of consortium members and partners, vast germplasm collections are accessible, but in order to unlock the genetic diversity present in those collections, their structure must be understood through coordinated surveys of molecular and phenotypic variation. A large effort was therefore launched at the start of the GCP with the molecular markers then available. With hundreds of thousands of accessions across over 20 crops in gene banks around the world, high-throughput molecular screening techniques must be applied to genotype suitable representatives of the collections. Efforts must be focused on gaining efficiency in a collective platform using fast-evolving techniques. Appropriate methods to characterise germplasm subsamples for traits such as drought tolerance also need to be developed and applied in order to obtain reliable and analysable phenotype descriptions accompanied by relevant descriptions of the environment and weather conditions. Methodological and organisational requirements are being addressed. Once the genotypes and phenotypes have been established, sound association studies must be conducted to understand their interactions. Current approaches can be applied directly and sometimes must be adapted to best serve the diversity of the GCP crops.

Major Achievements

The analysis of germplasm structure has progressed markedly for most of the 21 GCP crops. New representative samples were finalised for six crops and new SSR markers were identified for ten crops for use in large-scale genotyping. The SSR genotyping effort per se has been completed for several crops, providing the definite basis for identification of reference samples. Massive data have been deposited in the GCP repository for maize, wheat, chickpea, potato, and coconut. New genotyping methods were found remarkable for their throughput (DArT for whole-genome profiling) and their cost efficiency (EcoTILLing for targeted gene diversity). Experience has progressed in the use of high-throughput SNP genotyping and in the revelation of non coding SNPs that may cause allelic imbalance. A drought phenotyping network was strengthened by integrating modelling approaches with Embrapa in a multidisciplinary effort. A more general inventory of capacities has begun. The understanding of linkage disequilibrium has progressed for rice and sorghum. A community of practice has emerged for less advanced and slow-to-breed crops such as potato, cassava, Musa, and coconut. A pilot project on rice refined interspecific introgression population panels between Asian and African cultivated rice and further developed interspecific backcrosses with various wild species. Altogether this should facilitate association studies in various types of populations.

Activity Report

1.1 Creation of an improved understanding of the structure of the diversity for the major world food crops

SP1 has undertaken systematic work on crops for which the CGIAR has active breeding programmes. This work started in 2004 for eleven crops, was extended in 2005 for another seven, and again in 2006 for another three. Initially, the main undertaking in SP1 has been the genotyping of representative germplasm samples with SSR markers.

The characterisation of composite sets with molecular markers is almost complete for rice, maize, wheat, sorghum, chickpea, potato, groundnut, and coconut, with final range of data coverage from 70 to over 100 percent. The advancement is summarised in the chart on the following page.

Given the multiplicity of steps in the task, the heterogeneity of progress between crops, the involvement of diverse partners, and the particular importance of data quality, reporting of these activities will not converge in a significant manner until final validated data sets are deposited in the GCP repository and structure analysis is published. Plans for a collective publication are progressing in order to complete this extensive genotyping exercise with an important landmark and asset.

Molecular characterisation of composite sets in GCP crops

Crop	Lead institution and partners	Year start – end*	Composite sample genotyping target N acc. x N loci	Genotyping % Oct-2006
Rice	IRRI-CAAS-CIAT-WARDA-Agropolis	2004-2007	3000 x 50	92
Maize	CIMMYT-CAAS-IITA-Agropolis	2004-2006	1775 x 50	70
Wheat	CIMMYT-CAAS-ICARDA-Agropolis	2004-2006	3000 x 50	73
Sorghum	ICRISAT-Agropolis-CAAS	2004-2006	3000 x 50	97
Barley	ICARDA-CAAS	2004-2006	3000 x 50	50
Common bean	CIAT-EMBRAPA	2004-2006	3000 x 50	60
Cowpea	IITA	2004-2006	2000 x 50	30
Chickpea	ICRISAT-ICARDA	2004-2006	3000 x 50	97
Cassava	CIAT-EMBRAPA-IITA	2004-2006	3000 x 36	60
Potato	CIP	2004-2006	1000 x 50	80
Musa	IPGRI-IITA-Agropolis	2004-2006	200 x 50	66
Finger millet	ICRISAT	2005-2007	1000 x 20	20
Groundnut	ICRISAT-EMBRAPA	2005-2006	1000 x 20	>100
Pigeon pea	ICRISAT	2005-2006	1000 x 20	85
Lentil	ICARDA	2005-2006	1000 x 30	68
Yam	IITA	2005-2006	350 x 20	20
Coconut	Agropolis	2005-2006	1000 x 22	>100
Sweet potato	CIP	2005-2006	500 x 50	60
Faba bean	ICARDA	2006-2007	1000 x 20	20
Foxtail millet	ICRISAT	2006-2007	500 x 20	20
Pearl millet	ICRISAT	2006-2007	1000 x 20	20

* including no-cost extensions

1.2 Development of a range of flexible HTP (high-throughput) genotyping techniques accessible in reference laboratories

As complements to standard molecular characterisation for elucidating germplasm structure, such as SSRs, other technologies will be very useful if proven efficient. IRRI and Agropolis are collaborating with CNG to develop a set of 1536 SNPs to be used in an Illumina platform. Re-analysis of updated rice sequences resulted in the consolidation of over 2.6 million indica/japonica SNPs from previous studies. Four sets of SNPs having Illumina scores > 0.9 were chosen for whole-genome assays with 1 SNP/80 kb in each set, and two sets of SNPs for each of twenty specific regions (covering a total of 25 Mb) were chosen with 1 SNP/25 kb window and one set retaining a window of 50 kb. The final set of 1536 SNPs will be determined with Illumina by the end of 2006 and used in early 2007. Several competitive projects include work on SNP discovery and detection in rice, maize, and barley.

Along another line, work is ongoing in barley to develop allele mining based on non-coding regulatory SNPs. Primers are being designed and tested for the imbalance assay in reciprocal hybrids. The experimental protocol for allelic imbalance is now available at Udine, NIAB, and ICARDA.

EcoTILLing data have been generated for rice among over 330 accessions on 10 genes. Unfortunately the efficiency of the rice primers for amplification on sorghum (despite favourable homology) and Musa (no homology information) is poor. The successful revelation of EcoTILLing markers using agarose gels has been published and makes this technique very attractive.

DArT represents a potential platform for whole genome profiling in orphan crops. During this year, DArT technology has been proven to enable a remarkable throughput. Using existing commercially available services, a total of 276 sorghum, rice, and wheat lines were typed within a week by the genotyping service at DArT P/L, which generated over 150,000 data points. The global diversity pictures obtained with DArT are very comparable with results obtained with isozymes, RFLP, and SSR.

For cassava, coconut, and Musa, the GCP had specific resources developed with DArT P/L. New polymorphic markers were developed, bringing the numbers to over 800 in cassava, 350 in coconut, and 1,000 in Musa.

1.3 Establishment and implementation of a scientific and organisational framework to describe tolerance to drought

The groups involved in a Drought Phenotyping Network at Embrapa and in Whole Plant Modelling have set up a global coordination.

The definition of target populations of environments is nearly completed for Brazil using the SARRAH crop model for maize and rice. The sorghum case should be completed in the next six months after extension to another case study in West Africa also including photoperiod.

The evaluation of model-assisted phenotyping compared to directly measured growth traits requires more experimental effort and better coordination. It is so far based on morphogenetic traits for maize, rice, and sorghum using four to five genotypes per species and relies on three seasons of experiments in up to six Embrapa stations. The second season is still underway at some sites. A first appraisal of first season experiments revealed that, despite considerable work, more systematic and thorough protocols are required, and thus more frequent communication and exchange among actors must be organised. Two workshops held in September allowed for the rectifying of some second season experimental designs. The specific agro-climatic conditions must also be diversified, because no significant stress occurred during rice culture before flowering in either season.

In order to improve crop models, QTLs for leaf expansion rate and ASI (Anthesis-Silking Interval) are being integrated in the APSIM platform. The whole-plant growth model ECOMERISTEM was adapted and tested in June-July with the rice response to water stress during the pre-flowering phase. Its capacity to assist high-throughput phenotyping is being tested on a rice mapping population focusing on rice morphogenetic response to Phosphorus deficiency and on a 200 rice representative sample for a model-assisted analysis of morphogenetic trait genetic diversity. Data analysis is proceeding.

At the whole GCP level, the importance of high quality phenotyping for drought tolerance was fully recognised and was the subject of a large training workshop in Montpellier.

Meanwhile, a global inventory of the phenotyping capacities accessible to the GCP worldwide has begun, including the collation of drought phenotyping protocols for GCP crops and overlaying resources required for precise measurement, and a survey of the availability of resources and facilities required for appropriate phenotyping.

1.4 Identification of favourable genetic factors, i.e. potential genes (or genome segments), and superior alleles (or haplotypes) through association studies

Association studies, which relate genes (or chromosome segments) to desirable phenotypic features, and which identify alleles (or haplotypes) that are most favourable, require comparison of molecular and phenotypic data. Such comparisons are going to be generalised in the coming years. They are formally planned in various projects on maize, rice, and barley. Under the coordination of CIMMYT, CIAT, and ICARDA, respectively, the groups have generated valuable data; final synthesis will be undertaken next year.

Taking only the example of maize, genotypes have been assigned into different precocity groups of 110, 170, and 120 accessions. These groups were planted in Mexico in 2005 and leaf samples, silks, and ear tips were harvested for metabolite analysis. This is the second year of field evaluation and analysis of tissue metabolites on this material. These have already been harvested and sent from two trials (well watered and stress) with three replicates. Hybrid seeds of the inbreds crossed to CML312 (n = 43) were sent to all collaborators for field analyses. These have now been planted in sites in Mexico (June, well watered), Kenya (June, well watered and stressed), Zimbabwe (July, well watered and stressed), and Southern China (September, well watered and stressed), and will be planted in Thailand (November, well watered and stressed) and Mexico (November, water stressed).

Phenotyping will include a dozen traits in all sites. In addition, the chlorophyll content at the beginning and the end of the stress and root conductance will be measured in Mexico and Thailand (in the drought cycle only). Samples of leaves, silk, and ear tip from lines under both well watered and severe stressed conditions were collected at flowering and sent to Cornell in June. Metabolite analysis was done for sucrose and glucose, and measurements of ABA, ABA glucose ester (ABA-GE) are underway.

The same materials are being used to determine population structure using SSR markers. They are also being investigated for a total of 112 candidate genes which possibly affect the performance of maize plants under drought conditions.

1.5 Development of novel population approaches for relating genotypes to phenotypes

Relating genotype to phenotype for important traits can rest on direct functional involvement of molecular variation in the trait or on indirect association through linkage disequilibrium (LD) between the markers and the causal functional polymorphism. The extent of LD in a crop is essential information. It has been monitored in annual autogamous sorghum and rice, and perennial allogamous coconut. In sorghum, LD was found to span 2 to 3 cM in a telomeric region. A whole-genome survey is being attempted with the development of a dense coverage with DArT markers. In rice, the study focuses on three regions bearing disease resistance genes (Xa7, xa13, Xa4/Xa22/Xa26) and spanning about 5 Mb covered by a hundred SNPs. LD most commonly spanned about 5-800 kb, with some variation between loci and between subspecies. In coconut, LD was strong between two tightly linked SSR markers but was lower or absent when genetic distance was above one centiMorgan.

Simultaneously, similar exercises are ongoing on materials derived from breeding programmes on cassava, potato, triploid banana, and coconut as well as from a yam germplasm evaluation programme. SSR loci separated by small genetic distances as well as large numbers of anonymous AFLP or DArT markers are being surveyed in order to calibrate LD in the materials. Data analysis benefits from the methodological support of WUR. These surveys represent examples of feasibility studies which can be supported by the forthcoming GCP 'genotyping support service' project launched by SP5.

Populations obtained from widening the current germplasm base can also serve both breeding and analytical purposes. The base is being widened in rice by the production of novel materials through systematic introgression of chromosome segments from related species into cultivated rice, namely Oryza glaberrima (already in advanced generations), O. rufipogon, O. meridionalis, O. barthi, and O. glumaepatula. Four new BC1F1 progenies have been produced and advanced to BC2F1 prior to selection on the basis of multiplexed SSRs that ensure comprehensive genome coverage.

Lessons Learned and Conclusions

The undertaking of massive genotyping has challenged the internal organisation of most laboratories. Uneven efficiencies have been observed. The network basis within an international effort, with its difficulties and advantages, requires comparative data quality assessment before final delivery as a public good. The round of SSR genotyping must be concluded by a collective report showing the use of similar analytical methods on this remarkable range of diverse crops.

The extraction and distribution of reference samples for further characterisation is a priority. Such samples should have a flexible definition in order to be adapted to diverse experimental constraints. They should also be enriched in a sustainable process.

SNPs in candidate genes benefit from increased technical efficiency, but cross-species comparisons suffer from the complexity of determining orthology relationships, due to the more and more clearly documented reality of ancient polyploidy.

Phenotyping for drought tolerance remains a major challenge. Facility upgrading and multidisciplinary approaches must be encouraged and well-managed in order to reconcile disciplinary views and produce novel knowledge.

LD depends on the species biology but also on the germplasm compartment under consideration. Be it due to admixture, recent bottleneck, or other reasons, LD will affect differently the strategies to best conduct association analyses. Easy and efficient genotyping is essential for drawing the best information of phenotypic information that can be gathered or produced.

Perspectives on 2007

The SSR genotyping work completion is a priority. Data production is now routine in most laboratories. A data quality validation exercise across laboratories must be conducted to ascertain quality. Then dynamic reference samples can be proposed to the scientific community.

Complementary genotyping can rest on efficient laboratories, practical marker kits, and alternatives to SSRs, altogether assembled in a genotyping support service. Further efforts in phenotyping methodology refinement, capacity inventory, and building in conjunction with the availability of reference materials will boost the production of phenotypic data.

Advanced understanding of population structure, together with the development of new populations with high genetic information retrieval potential, will ensure delivery of association studies and will enable tagging of favourable genes and alleles to enrich breeding programmes.

Subprogramme 2: Comparative Genomics for Gene Discovery

Rationale

Plant traits for adaptation to environmental stresses are often controlled by complex genetic systems subject to influence by genotype x environment interactions. To effectively combine the right complements of genes and alleles in a breeding programme, we need to have an adequate understanding of the genetic mechanisms underlying the adaptive processes. Such an understanding is particularly important in cases such as drought tolerance, where the genetic effects are often small and the phenotypes are difficult to measure. Advances in genomic tools and knowledge from model organisms provide exciting opportunities to dissect the genetic control of complex traits and identify potentially useful genes. Yet, practical applications of the new tools for agronomic improvement require a level of integration that is often difficult to implement by individual disciplines alone.

To achieve an understanding of the genetic mechanisms underlying the adaptive processes, a scientific and collaborative environment to enable gene discovery as well as applications is needed. A cross-cutting research platform for efficient applications of genomic tools and knowledge to decipher genetic control of complex traits must be established to identify genes and traits to alleviate target problems. To realise the potential of these approaches, however, capacity to apply new tools must be enhanced and a pipeline to move results into practice must be developed. Demonstrating success of these approaches in a few targeted cases in the short- to medium-term is important to help lay the road map for broad applications of these new areas of science.

Subprogramme 2 is designed to maximise the use of genomic and genetic resources available in the research community. We support the production of specialised stocks that will elevate the level of genetic research in different crops. We apply comparative approaches to leverage genetic knowledge from multiple plant species to investigate and validate gene functions important to stress tolerance. Multi-disciplinary teams are formed to apply the validated genes in breeding programmes. The overall research portfolio focuses on drought-tolerance traits as well as genes and agronomic characters that improve crop resilience in difficult environments. We expect the results and materials generated to be used by researchers and breeders within the GCP as well as by the global research community interested in applying genomics to agricultural improvement.

Major Achievements

The key resources and tools produced by Subprogramme 2 are: specialised genetic stocks, data of gene expression assays, cloned genes for specific trait improvement (tolerance to diseases, water stress conditions, and soil problems), and desirable gene combinations in elite genetic backgrounds (pre-breeding materials). Steady progress has been made in each of these categories. For the first time, mutant populations (thought still in early generations) of bean and potato mutant stocks have been produced, representing unique genetic resources resulting from GCP investment. The genomic resource base of Musa has been expanded, a step leading to the generation of a Musa-rice syntenic map.

Results from several experiments on transcriptome analysis of stress (disease and drought) response have provided a genome-wide view of genetic regulation of stress tolerance. A bioinformatics pipeline and computing infrastructure provided by SP4 has enabled the identification of gene sets that are relevant to realistic physiological and phenotypic responses. By aligning differentially expressed genes and regions of correlated gene expression with QTL maps, a relatively small set of genes are identified, providing a short cut for finding genes responsible for stress tolerance phenotypes. A cadre of students and postdoctorals has been trained in microarray data analysis and integration of mapping data. They are the key “agents” in linking and deriving synergy between projects.

A collection of genetic materials—NILs with characterised disease QTL, NILs carrying Al toxicity tolerance, salt and P-deficiency tolerance—has been produced, paving the way for molecular cloning. Candidate genes and tightly-linked markers are now available for use in selection. The candidate genes for Al toxicity tolerance, salt, and P-deficiency tolerance represent promising near-term products for NARES.

Activity Report

2.1. Assembly of genomics and germplasm resources through consolidating and developing specialised genetic stocks and framework genetic markers

This project focuses on adding value to existing genetic and genomic resources and creating new ones where such investment would open new approaches and leverage collaboration. One activity concerns the utilisation of existing wheat genetic stocks. So far, approximately 600 wheat genetic stocks were assembled at CIMMYT from different institutions. These include alien chromosomal substitution lines. The seeds are being multiplied for systematic phenotyping and distributed upon request.

A rice mutant phenotyping network has identified mutant lines with insertions in stress-associated genes (SAG). From the available international mutant collections, mutants were identified for SAG using the OryGenes DB (http://orygenesdb.cirad.fr) with about 140,000 insertion sequences tagged. Currently, the available insertion mutants give a 50% success rate of finding a tagged mutation. Reverse genetic screens of 694 SAG T-DNA tagged lines for drought sensitivity identify 18 mutant families, out of which 4 mutants show co-segregation of inserts and phenotypes. Gain-of-function over-expression lines for AP2/ERF transcription factor genes revealed improved drought resistance and water use efficiency at the vegetative stage.

Progress is being made in the generation of mutants in bean and true-seed potato. The CIP team has produced a first generation of EMS-derived mutants of Solanum verrucosum (2n = 24), one of the very few self-compatible and highly fertile tuber-bearing wild species. At CIAT, the group has produced M2 progeny of bean (about 3000) and is in the process of advancing them to M3 generation. The investment in bean and true-seed potato is expected to stimulate the use of mutational analysis of target traits.

In terms of genomic resources, the production of drought-response EST libraries for cowpea and pearl millet was completed and EST data were deposited into the public EST database. For the SNP analysis of 20 diverse rice varieties, long-range PCR amplicons for 130 Mb were designed by Perlegen Sciences to cover 100 Mb of the rice genome for hybridisation analysis. A pilot experiment was completed by interrogating a region of 379 kb on chromosome 3. An average frequency of 1 SNP/ 200 bp was observed among the 20 varieties.

The creation and enhancement of specialised genetic and genomic resources is expected to open new research opportunities. This project leverages the wealth of resources produced by different institutions and countries and at the same time strengthens linkages among these institutions.

2.2. Development of comparative maps within and across species and framework genetic markers for target crops
Generation of common markers and consensus maps across species aims at providing a framework to leverage information across different crop species—some with more advanced molecular information and others with valuable phenotypes. This project aims at identifying markers that may be functionally conserved across species. The investigation of orthologous markers has set the stage for more systematic study of genes in comparisons between rice, Musa, and other model species. The Musa-rice comparative project has identified 192 Musa cDNAs on the rice genome, representing an important step towards developing a Musa-rice syntenic map. We have planned more focused activities through a new set of projects on allelic diversity of orthologous candidate genes and cross-species marker development in legumes.

Drought-related traits (root morphology and development) in rice have been mapped using both recombinant inbred populations and advanced backcross lines. In addition, in silico mapping has proved fruitful in sorghum and rice. An integrative map is available at http://rice-brcdb.cines.fr. The effect of QTL on deep root development was confirmed in advanced backcross lines. In bean, phenotyping protocol for drought response in the field has been developed, and a large collection of EST has been made. The EST resource is expected to be valuable for mapping within bean and across legumes.

2.3. Assignment of genes and pathways to phenotypes through the convergence evidence of genome variation, expression patterns, and phenotypic data

This project emphasises comparative analysis to understand the common mechanisms for stress response across species and to identify candidate genes conditioning stress-tolerance traits. A strategy adopted by these studies is the use of convergent evidence from four main experimental domains: bioinformatics/gene function inference, positional (QTL), expression polymorphism, and response to selection (either natural or artificial). Integration of these data is expected to reveal the causal relationship between genetic/genomic variation and phenotypes.

Through comprehensive phenotyping and field testing, QTL conferring broad spectrum disease resistance was found in maize and in rice. QTL for multiple diseases were found correlated in maize. Quantitative resistance to southern leaf blight has been mapped, providing a useful reference for comparative analysis. In rice, 35 gain- and loss-of-resistance mutants were identified as a means to discover genes responsible for multiple disease resistance. The genetic architecture of disease resistance in maize and rice has been summarised, providing a framework for aligning differentially expressed genes across rice and maize.

Another activity in disease resistance focuses on the unique phenomenon of a lack of rust diseases in rice and explores the use of non-host disease resistance in wheat. Transcriptome analysis of non-host interaction in rice and wheat showed that non-host and host resistance share many components. From the 811 differentially expressed genes identified, 387 were found specific to non-host resistance. The genes differentially expressed in blast-inoculated rice are globally similar (signal transduction genes, resistance genes, defense genes). In contrast, the genes found in rust-inoculated rice (non-host) are involved in transcription, oxidative stress, and secondary metabolism.

To identify common mechanisms and candidate genes controlling the maintenance of tissue growth in cereals under water stress, the Agropolis-led team has established the means for detailed phenotyping of tissue growth of maize, rice, and wheat in response to drought. Once the inheritance and genetic parameters are determined, gene expression profiling will be conducted for the target tissues in different crops.

Results from a comparative analysis of gene expression between a drought-sensitive (IR64) and tolerant variety (Apo) have revealed new insights in drought tolerance. First, differential expression genes identified in the two genotypes support the observed physiological response expressed by the plants. Second, from scanning the expression patterns across the rice genome, 14 regions (each with about 20 genes) showed patterns of correlated expression. Some of these regions co-localised with reported QTL for drought tolerance. The study demonstrates the potential of transcriptome analysis to reveal a new pool of candidate genes or chromosomal regions worthy of functional validation.

2.4. Validation of genes and pathways through evaluation of under or over-expression constructs or variants (induced or natural) of the target genes

This project comprises studies that have potential to apply genes and gene combinations for the development of advanced elite lines for on-farm evaluation. The first activity aims at identifying genes important for tolerance during water stress at reproductive stages through comparative analysis of wheat and rice. Physiological and gene expression analysis of peduncle suggests that impact of drought stress on peduncle elongation in rice may be mediated by down regulation of cell wall invertase genes, reducing the supply of carbon from sucrose in phloem. On the other hand, fructan accumulation in wheat peduncle may provide an alternative carbon source, which may account for the lower sensitivity of peduncle elongation in wheat than in rice. Identification of the genes controlling these processes may provide an entry point for intervention.

In the second activity, the objective is to identify genes that can enhance tolerance to phosphorus-deficiency and salinity in problem soils in Asia. Progress has been made in fine mapping the Pup1 gene (phosphorus up-take) within a 300 kb region that contains 22 candidate genes. Phenotyping capacity has been established by a NARES partner in Indonesia that will enable good evaluation of breeding materials. For salinity tolerance, the group has concentrated on the Saltol1 region on rice chromosome 1 derived from a salinity tolerant variety Pokkali. Constructs of additional candidate genes have been made and are now available for functional tests either by over-expression or gene silencing. Through collaboration with national breeding programmes, popular varieties as recipients for Saltol and Pup1 have been identified and are being improved using marker-aided backcross selection.

The third activity aims at identifying genes to alleviate aluminium toxicity in sorghum and maize in Africa and Latin America. The team has identified a strong candidate gene called AltSB that confers Al tolerance in sorghum. The spatial expression (at root tip) and inducible nature of the gene are consistent with the hypothesis that AltSB is responsible for the tolerant phenotype. Elite Al-tolerant sorghum hybrids have been developed in breeding programmes. Through comparative genomic analysis, preliminary candidate genes for maize Al tolerance have also been identified.

A main outcome from these studies is an improved understanding of the interrelatedness among tolerance mechanisms against different stresses, and that such knowledge can be channelled to breeding programmes. These activities build upon the progress made in previous work by different laboratories and institutions around the world. Thus, this project provides examples of how the GCP has created a venue for international collaboration to address practical problems.

Lessons Learned and Conclusions

A significant improvement in 2006 has been the better integration of competitive and commissioned projects. Recommendations from an external review committee and experts have helped realign some activities to achieve synergy. This approach must continue in 2007 and beyond.

The GCP recognises the importance of well-designed genetic stocks for gene identification. The production of these materials is often more time-intensive than originally anticipated. For GCP investment to be effective, it is important to have institutional commitment for stock development, maintenance, and distribution. To realise the benefits of such genetic stocks, a plan must be in place to promote usage of the stocks. This may involve the formulation of networks or linkage with existing research consortia.

While not all the SP2 studies are directly addressing drought tolerance, the phenotypic consequences of enhancing crop resilience (to problem soils and biotic stresses) in drought-prone environments are equally important in achieving GCP objectives. For example, better resistance to diseases is a prerequisite for productivity in these environments. Improving P-uptake and aluminium toxicity tolerance in crops leads to better root health to cope with water stress. Indeed, it is possible that some of the root enhancing traits manifest themselves as drought tolerant QTL.

Recognising the multiple constraints in different environments, the concept of "trait packages" for drought-prone environments is necessary to ensure that research results are incorporated into germplasm with an appropriate combination of traits. Several research projects supported by the GCP are in a good position to create such "trait packages." Such synergy should be promoted by proactively linking activities between projects and across subprogrammes.

For the first time, we obtained concrete results from transcriptome analysis to gain new insights on gene regulation in stress responses. This approach has proved promising in bridging the gap between genotype and phenotype at stages that are agronomically relevant. Although such analysis is thus far limited to model species with adequate genomic resources, we should actively exploit the information to benefit other crops. Equally, genetic resources and genomic tool kits are needed for individual species in order to capitalise on such knowledge. It is important to take stock of what is available to the community and what the GCP has contributed to produce, and how the extra investment of the GCP can nurture the research platform for the long term.

Perspectives on 2007

Results from several projects have demonstrated the use of convergent approaches to narrow the list of worthy candidate genes. We anticipate this approach to be particularly relevant for determining the genes underlying complex traits. Given the increased robustness of transcriptome analysis, along with declining cost in conducting such experiments, it is expected that genome-wide analysis will be widely used in the coming years. Thus, breakthroughs from the whole-genome expression analysis can be expected. We will need to continue to strengthen the integrated analysis of mapping and expression data. It is hoped that the increased emphasis in data analysis in SP4 can create more opportunities for comparative biology as a means for gene function discovery. Finally, several SP2 projects are close to delivering promising practical products, including advanced germplasm and cloned genes (hence perfect markers). Focused investment to build capacity in NARES to use these products is needed to ensure uptake. This can be effectively achieved by enhancing the function of existing research and breeding networks.

Subprogramme 3: Trait Capture for Crop Improvement

Rationale

The general objective of Subprogramme 3 ('Project 3' in the MTP) is to assure a widespread impact of new genes and traits and selection of appropriate background genotypes for molecular breeding programmes. For this purpose, this subprogramme aims to create appropriate technologies for application of marker-assisted selection in national breeding programmes and to provide technical assistance to facilitate rapid and effective uptake of molecular breeding in tropical staple crops. Subprogramme 3 also aims to link upstream research outputs with practical product development. The weakness of these linkages in the public sector constitutes a major obstacle to the uptake of research results and the impact of investments in applied research. Subprogramme 3 plays a vital role in creating community linkages with plant breeding programme end-users who are also heavily involved in the evaluation, validation, and refinement of molecular breeding technologies generated by the GCP.

The development of effective systems for breeding complex traits such as drought tolerance has eluded most breeders in the last decades. The recent developments in genomics, computation systems, and biometrics offer a real opportunity for simultaneously manipulating the component traits of drought tolerance. However, the resources currently available to the GCP are insufficient to support a comprehensive programme in all crops. In the case of major cereal crops (rice, maize, sorghum, wheat), global research progress already allows the development and application of gene-based marker systems for components of tolerance to drought, and emphasis in the GCP on these crops is more on the translation and/or application of pre-existing research outputs. In other, more neglected crop groups, careful prioritisation will be applied to ensure rapid and compelling proof-of-concept in some key representatives (e.g., cowpea in legumes, cassava in clonal crops). Phenotyping has been recognised as an essential component of drought research and the definition of accurate protocols as a condition of success. The reinforcement of phenotyping capacities within the GCP is consequently considered a major priority. To achieve this, training and capacity building activities are developed in collaboration with Subprogramme 5. Documents on phenotyping protocols will also be elaborated and diffused.

Many activities in Subprogramme 3 can show efficiency in time, cost, and effectiveness by following a community-based approach, which can facilitate centralised validation and refinement of new technologies for routine application in NARS, development of low cost high-throughput genotyping services based on technologies beyond the reach of most national breeding programmes, and capture of interdisciplinary synergies and end-user feedback on priorities and outputs. Product management implementation conducted by SP3 may play an essential role in the flow, validation, and diffusion of products and their further delivery to breeders in NARS.

Major Achievements

- **Holistic teams established for the development of molecular breeding systems.** Subprogramme 3 projects have been successful in establishing strong collaborations across disciplines, crops, and institutions. Most projects involve NARS, ARIs, and a CGIAR centre, and are based on strong associations between genomics, genetics, physiology, and biometrics.
- **Phenotyping approaches refined. Phenotyping is actually recognised as a bottleneck in many genomic studies.** Efforts have been made to reinforce phenotyping capacities within the GCP by developing information on methods allowing a better definition of the testing environment and a more accurate choice and measurement of phenotyping traits.
- **New paradigms in plant breeding fostered. New and innovative approaches have been developed to increase the genetic diversity or enhance potential genetic gains.** For example, combining wide crosses and recent genetic and molecular techniques has permitted the development of new synthetics in groundnut, thus increasing the available genetic diversity and opening access to new sources of disease resistance and drought tolerance. In rice, many interesting traits can be introgressed into Asian rice (Oryza sativa L.) from African rice (O. glaberrima Steud.). The combination of accurate crossing schemes with the use of the latest genetic marker technologies and gene discovery techniques may allow a full and quick access to a new allelic diversity. The transfer of these experiences to other crops will be stimulated and favoured.

- ♦ **Molecular breeding systems for simply inherited traits pilot-tested.** SP3 focuses on high-impact, simply inherited traits, pending the availability or resources for drought tolerance. For example, some markers have been developed and validated for resistance to leaf diseases in wheat and maize and for resistance to Striga in cowpea.
- ♦ **Low-cost assay and high throughput technologies developed.** Significant progress has been made in the development of low-cost assay technologies for gene-based assisted selection for grain quality in maize, and pest and disease resistance in rice and cassava. Low technology methods such as dot-blot assay and micro-plate based (MPB) assay, and high throughput techniques for hub laboratories such as micro-assay based genotyping (MBG) and fluorescence resonance energy transfer (FRET) assay, have been refined, tested, and are ready to be disseminated in breeding programmes.

Activity Report

1.1 Characterisation of segregating populations, identification and/or validation of molecular markers for target traits to increase plant breeding efficiency

Physiological traits have been identified and described that make cassava one of the most drought-tolerant crops. This led to a better understanding of the biological basis of drought tolerance in this species that would considerably increase further plant breeding efficiency. A combined utilisation of genetic and genomic tools has permitted us to unlock genetic diversity of peanut's wild relatives (Embrapa), allowing access to a substantial range of new sources of disease resistance and drought tolerance that can now be used in breeding programmes. SCAR markers have been developed for Striga genetic diversity analysis and resistance in cowpea by IITA, in collaboration with several West African NARS. The expected impact is a better source of germplasm for African cowpea farmers.

1.2 Development and evaluation of novel breeding or molecular technologies to better serve modern breeding

Low-cost assay and high throughput technologies have been developed through a wide collaboration between IRRI, CIMMYT, and Asian NARS that will allow quicker, cheaper, and larger-scale screening for important agronomic traits including bacterial blight resistance in rice, grain quality in maize, and pest and disease resistance in cassava. CIAT, in collaboration with Embrapa and national programmes in Africa, is leading a project on marker assisted back-cross aiming the introgression of useful genes from wild relatives into cassava. Transgenic products (rice, wheat, potato, groundnut) with putative drought tolerance, developed by JIRCAS, have been evaluated under controlled water-stress conditions by IRRI, CIAT, CIMMYT, ICRISAT, and CIP to evaluate the impact of DREB1A constructs on tolerance to different durations, intensities, and timings of drought stress, allowing the detection of significant but variable effects of DREB1 transgenic events RD2 and RD11 on some drought tolerance related traits (transpiration efficiency, delayed dehydration) and showed that impact of grain yield remains limited. New molecular breeding systems, simulation models, and decision support tools have been developed. They will permit access to a substantial range of new sources of disease resistance and drought tolerance in groundnut or cassava (Embrapa) and help to better capture the value of molecular screening data in cereals (CSIRO).

1.3 Application of molecular markers in breeding programmes

Significant progress has been noted in the application of molecular markers in breeding. Drought tolerant rice cultivars have been developed for North China and South/South-East Asia by pyramiding QTLs from diverse origins (CAAS). Plans have been developed for effective product development, delivery, and use. An improvement of rice yield in drought affected regions is expected. Markers of salinity and low phosphorus tolerance have been developed in rice (IRRI). A major sorghum Al tolerance gene (AltSB, which functions as a root citrate efflux transporter in the root tip) has been identified through a collaboration between Cornell University (USA) and Embrapa (Brazil). These markers will be validated soon, and will be further disseminated in NARS breeding programmes.

1.4. Product management implementation

Several tools have been implemented to improve product management such as new templates that facilitate the identification and further management of outputs and products. On-site visits have been realised, allowing a better knowledge of the capacities of the different projects to generate, use, and disseminate products. The communication with PIs of the different projects has intensified and improved. As a consequence, the flow of information and products (e.g., new protocols and technical tools, markers, germplasm, etc.) among the different GCP projects has been significantly enhanced.

Lessons Learned and Conclusions

The initiation of many Subprogramme 3 projects suffered delays due to problems experienced by consortium members' negotiating sub-contractor arrangements and transferring funds, or by partners shipping germplasm or recruiting project-dedicated staff. Nevertheless, exciting progress has been made in many areas fundamental to the GCP's product development pathway, in actual application of marker-assisted selection for a variety of traits, including drought tolerance. The application in SP3 of technology outputs from SP1 and SP2 toward SP3 has been initiated and may intensify in the near future. More generally, the development of collaborations and exchanges between GCP projects, and the resulting synergies that will emerge, are expected to generate substantial progress both at the upstream and downstream levels. Greater emphasis will be given to validate and refine molecular breeding technologies in a range of national breeding programmes. "Molecular Breeding Communities of Practice" are expected to amply serve this purpose.

Perspectives on 2007

Further projects and activities aim to serve as the implementing mechanism for the GCP's forthcoming strategy and research priorities. For the coming year, SP3 has identified projects that will be developed and will serve as flagships for this strategy. A first project aims to develop the use of Oryza glaberrima to improve disease resistance and drought tolerance in rice. A second project will develop sweet potato germplasm with enhanced resistance to viruses, which is the main factor limiting the yield of this food crop in Africa. New progress is also expected from collaborations developed between cassava scientists. The other projects that focus on wheat in China and North Africa and maize and rice in Southeast Asia may ensure the dissemination and scaling up of GCP products through Communities of Practice. Next year will also be dedicated to the development of new collaborative projects with International Agencies (FAO-IAEA) and the private sector (Syngenta Foundation) that would further increase the impact of GCP products.

Implementation of Product Management in the GCP

Our major objective in 2007 will be to implement a product management process ensuring an optimal flow of upstream research outputs to more applied research within the GCP. Product management has already started off with a few "pilot" product management exercises. For example, we are getting the SSR microsat kits and reference collections of wheat and rice developed by SP1 and SP5 to some NARS involved in new commissioned projects. We are also establishing connections between projects allowing a commissioned project conducted in collaboration with NARS in Africa to evaluate and use the pre-breeding rice germplasm that the GCP will develop through upstream (competitive) research projects. We are learning a lot from these first study cases, for example, "Where does research management (i.e., the role of the SPLs) end and product management begin?" This experience, together with other actions allowing a better definition of needs or opportunities (e.g., implementation of templates for product identification and on-site visits, as described above) may considerably help us soon build a dynamic product management, with our final aim being the delivering of more efficient approaches and technologies (e.g., validated markers) to breeders and enhanced germplasm to farmers.

Subprogramme 4: Information Systems and Bioinformatics

Rationale

The value of the data generated in the GCP will largely depend on the way they are stored, managed, made accessible, and analysed. The value of the analysis will, in turn, depend on the availability of analysis tools and other information sources. Subprogramme 4 addresses the challenge of linking and integrating these information components and analysis tools into a coherent information gateway. A bioinformatics, biometric, and advanced data management system is being designed to support an integrated genetic resources, genomics, and crop improvement information network. This platform will give access to the data generated in the GCP, and will provide tools to analyse these data. Furthermore, it will link GCP data and tools to the global biodiversity and bioinformatics networks.

Such a platform could not be developed from scratch. First of all, there were numerous local systems in place from the beginning; these are being integrated into one system without dictating architecture and/or organisation. Secondly, the elements that are integrated need to be of sufficient quality. Data management can best be completed as close as possible to the place where the data are generated, allowing proper curation and avoiding problems of ownership. This requires the development of local skills and facilities. Finally, the other subprogrammes need support in the selection, use, and sometimes creation of tools and data sources.

Major Achievements

The major achievement of SP4 so far is the community it has built from an extremely diverse set of actors, each with their own institutional culture, approaches, and solutions. There is now a functioning group of software developers, bioinformaticians, and biometricians creating products on the basis of common standards and methodologies. The selection and introduction of these standards and methodologies, supported by the implementation of collaborative development environments such as the GCP Wiki and CropForge, can also be considered major achievements.

SP4 has had considerable impact on bioinformatics capacity in the GCP consortium. The investments of SP4 created a momentum that resulted in the establishment and/or strengthening of bioinformatics programmes in several partner institutions.

On a more technical level, SP4 has created a solid basis for the development of the bioinformatics platform: domain models and data formats have been developed, the technology for web-services has been made 'GCP-ready' and has been rolled out over the consortium by training and simple initial installations. The platform as such has also been created, and beta-versions are now being tested, both as local client plug-ins and as web based applications. Finally, some major tools supporting the other SPs have been developed and presented.

Activity Report

4.1 Establishment of the GCP Information Platform

The first project in SP4 addressed the question "How can the information flow between researchers in the GCP be organised in such a way that local curation of the data and tools can be maintained?"

Activities have focused on a number of elements. First of all, standards were created for data storage and exchange. This involved a number of experts in the specific fields (such as "passport," "evaluation and characterisation," "functional genomics") and adopted existing standards as much as possible for our purpose. This resulted in the publication of a number of domain models that are being used within SP4, such as in the development of the Data Templates and the GCP Information Platform (both described later).

Secondly, SP4 collaborated in the development of Bio-MOBY, as a standard for the bioinformatics web services and/or by creating and releasing the MOBY Services Support (MOSES) and an associated MOBY Dashboard tool supporting web services provider specification, implementation, and testing of web services.

A third activity installed relatively simple web services (based on BioCase protocols) with a number of GCP partners, and staff was trained accordingly. This was done to make the GCP actors familiar with the web services technology, anticipating a much more complete adoptionin the years to come.

To support joint (open source) software development, the environments CropForge and a GCP Wiki were created for use by GCP scientists, and their use was promoted and supported. CropForge is an environment for open source software development, similar to SourceForge. The GCP Wiki is a Wiki environment used for joint development of concepts, specifications, etc.

The final two activities in the first project aimed at creating better access to the data created within the GCP. To allow a standard representation of data and the associated meta-information, data templates for passport and molecular marker data were developed on the basis of the domain models and made available to the GCP scientists, who also gave active support in using them.

Finally, a Central Repository was created, where data sets, preferably in the above-mentioned templates, can be uploaded by GCP scientists. This repository can be searched by anyone using a targeted search facility, and the data can be downloaded and analysed locally.

4.2. Improvement of the GCP Information Platform Components

This project focused on creating the platform and assuring sufficient quality of its elements and capacity in its nodes.

First of all, the actual platform was created. Based on the three layer architecture for the GCP workbench that was agreed upon before, middleware was developed that allows the plugging in of both data sources, analysis tools and web services (as consumer) on one side and user interfaces and web services (as provider) on the other. A client will have to be installed locally to allow optimal functionality. It will also allow web based analysis, but this will have strongly reduced capabilities. A range of applications and potential plug-ins were developed. Also the compatibility with other platforms, such as GDPC, was assured.

One of the tools in the GCP Information Platform is the High Performance Computing facility installed at three GCP partner sites. This facility has been maintained and additional software packages (including Structure and GeneMatcher2) were installed and made available via web-interfaces. Some "power users" were identified whose use cases were fully developed.

Another line of activities aimed at assuring the quality of the data in the system. This proved a difficult task, and activities have been limited to developing and publishing methods for handling data at the source: bar coding methods such as LIMS protocols, methods for using PDAs in data collecting, and phenotyping protocols. Good experiences in the consortium were documented and shared with colleagues using the GCP Wiki and other means.

An ad-hoc activity supported the installation of the ICRISAT LIMS at BecA in Nairobi. In this context the LIMS was ported in an open source environment (using PostgreSQL), and the documentation was improved, allowing wider distributionin the GCP.

Finally, the last phase of financial support for bioinformatics capacity building was completed. As in previous years, this resulted in a wide range of activities (largely at the discretion of the institutions involved): from purchasing books and software via organising workshops or participation in courses to hiring additional staff. This activity, which has now ended after three years, has had a major impact on the bioinformatics capacity in some of the GCP partner institutions.

4.3. Creation of software in support of GCP activities

Based on feedback from the leaders of the other SPs, a package of activities has been performed aimed at directly supporting GCP scientists. In 2006 these included five activities.

First, in support of SP3 and SP5, a software package that supports MAS/MAB was developed based on existing software; potential software elements were screened on their quality and functionality, the necessary licenses were obtained, a platform for integrating the software components was created, and the software was incorporated in the platform. The product that combines all the best of the available free software in this area is called iMAS. It was documented, has been tested with a number of test users, and is now ready for use by NARS and others.

Secondly, in support of SP1, algorithms for the selection of germplasm for association analysis based on SSR fingerprints were developed and implemented in appropriate software. These algorithms allow SP1 scientists to select material from their collections, avoiding population structure that disrupts LD mapping. The algorithms have been temporarily implemented in a statistical package called DarWin, but will be made available as a web service in the future.

The third activity, in support of SP2, aimed at developing a tool to discover, document, and explore gene orthologs and their relationships across species (and paralogs across gene families). This product is now available to the research community.

The fourth activity, also in support of SP2, established a generic database for storing expression data on crop plants based on a similar existing Japanese system for rice. The tools to mine the data were also created. This product is also ready and available.

The fifth and final activity is an ongoing activity in support of SP3 to create an eco-physiological framework for the analysis of GxE and QTLxE data generated in abiotic stress trials. This framework will allow the design and analysis of trials, and also the re-analysis of existing data sets using additional environmental (weather and soil) data. It is planned to be finalised at the end of 2008.

Lessons Learned and Conclusions

SP4 has been successful in creating the community it needed to develop its products. As a result, most work can be done within the GCP consortium. The obvious positive aspects are the capacity and community building elements, but on the other hand there is the threat of the dependency on a relatively small group of people and the difficulty of objective quality assessment.

SP4 has created a solid basis for product development; it has designed the software architecture, developed the domain models, selected the technologies, and created development environments. This basis allows for the development of sophisticated user software. The first of these products for the users are starting to appear, but this is going slower than anticipated. As a result, the potential users are getting impatient, and, more importantly, the possibility to involve the user in the development of the software is hindered. This was observed in 2005 and dedicated efforts were made to improve this situation in 2006. However, the platform development activities in particular required middleware and models that have only become available in 2006. Some other activities, however, were able to become more user-oriented and create outputs that were visible and useful to the users. Examples are the Data Template and Central Registry activities, the HPC activities, and all activities in the third project (4.3. Creation of software in support of GCP activities).

The bottom line is: SP4 is on track and at full speed. However, we need to become more user-oriented, promoting and supporting the use of our products and using feedback from the users to improve the software.

Perspectives on 2007

Activities in 2007 will be the logical extension of those in 2006. We will continue to develop the platform, the GCP workbench will be introduced and promoted, new plug-ins will be developed, more data will be made accessible, analysis tools will be developed, etc.

The SP4 mantra for 2007 is “Make Happy Users.” This implies that users will actively participate in all projects were this can be somehow relevant. For example, no additional software will be installed on the HPC without named users working with it. Furthermore, helpdesks for pro-active user support will be set up.

The foundation is ready; the user will decide what SP4 should build on it.

Subprogramme 5: Capacity Building and Enabling Delivery

Rationale

The technological divide between developed and developing countries in contemporary cutting edge knowledge is a distressing reality. In the context of the GCP, major knowledge gaps exist in the effective use of genetic resources, awareness of developments in genomics, access to the tools and funds needed for genetic and genomics studies, and the prospects of merging new knowledge with traditional crop improvement practices. Access to the wealth of research information available in the developed world is also a major constraint for developing countries. In addition, institutional and national policies on intellectual property and access and benefit sharing implied in the framework of the GCP are also woefully lacking, both in the developing and developed world.

The GCP needs mechanisms to build capacity in NARS to enable collaboration with partners in the developing world, ensuring long-term sustainability of the research platform and toolbox of the GCP itself. The GCP's ability to impact farmers' fields is directly associated with the ability of NARS to use its technical outputs in their breeding programmes, addressing the needs of the farmers and consumers for whom they work. Then, linking with NARS is also essential for an effective delivery plan for GCP products. Subprogramme 5 is a cross-cutting theme, meaning that it is mandated to build capacity in and deliver the products of all four technical Subprogrammes (Subprogrammes 1-4).

Major Achievements

SP5 major achievements can be summarised as follows: 1) The strengthening of the Fellowship and Travel Grant Programme, which has so far awarded 16 fellowships and 47 travel grants. The Programme is now well-established and has witnessed a considerable increase in the number of applications. Its focus ensures that gains have an impact in ongoing GCP research and research in progress at NARS institutions. 2) The launching of the Genotyping Support Service, which is meant to facilitate the access to genotyping technologies and promote the use of genotypic data in NARS breeding programmes, bridging the gap between science in the laboratories and that conducted in the field. With this service, the GCP wants to encourage the use of the most cost-efficient services for genotyping worldwide, while providing access to data and assisting with its interpretation to those that can make the best use of it. 3) The development of the concept of Capacity Building à la Carte that seeks to provide tailored capacity building to a select group of research teams at developing country NARS who will benefit significantly from long-term, personalised training and research support. These teams may hopefully grow to be GCP champions in the regions, and as such turn into the best possible hubs for GCP product delivery. 4) The first articulation of the Delivery Strategy through the second call for competitive proposals and the development of the Delivery Plan Kit, which is now ready for implementation in the newly-awarded projects. 5) The beginning of a series of projects for impact targeting and the ex-ante impact analysis of ongoing GCP research, as a means to help focus research and assist decision-making on resource allocation.

Activity Report

5.1. Increase in NARS scientists' capacity to participate in the GCP – GCP Fellowship and Travel Grant Programmes, Training Materials, Courses, and Contributions to Special Conferences

Thirty-eight applications for GCP fellowships were received and seven candidates won awards: 1) Supat Thonjuea, Thailand, "RiceGeneThresher: Expert System for identifying candidate genes in the oryza genome"; 2) Maxwell Assante, Ghana, "Quality rices for West Africa: Mapping of aroma gene in nerica rice"; 3) Suhaila Rahman, Bangladesh, "Cloning of 50-100 kb DNA from Pokkali linked to salinity tolerance traits in Binary BAC vectors and transformation of rice"; 4) Trushar Shah, Kenya, "Development of an informatics tool for analysis of stress response-enriched ESTs and comparative genomics"; 5) Amrou Abdelkhalek, Egypt, "Assessment of fine scale local linkage disequilibrium and haplotype structure related to the indica and japonica differentiation as revealed by SNP markers in rice"; 6) Kurniawan Rudi Trijatmiko, Indonesia, "Targeted Discovery of Superior Disease QTL Alleles in the Maize and Rice Genomes"; 8) Nimai P. Mandal, India, "Marker-aided improvement of the drought tolerance of the eastern Indian upland rice variety Vandana."

One hundred and one applications were received for the Travel Grants Programme. Nineteen scientists received funds to travel to international conferences (5th International Rice Genetics Symposium), training courses (ICIS, May 8-12; WUEMED, June 5-10) and advanced research centres for hands-on training (CIRAD, University of California, University of Pretoria, ICRISAT, CIMMYT).

The first learning module entitled "Dynamics of diversity in cultivated plants" has been finished and the module on genomics and comparative genomics was revised and changes are being implemented. A course outline for materials in bioinformatics was agreed upon.

A course was conducted on "Phenotyping and Water Deficit" (Montpellier, France, July 3-12). The main topics covered were: stress characterisation, choosing and measuring the appropriate phenotypic traits, and data analysis and modelling. Twenty-three candidates attended from Italy, France, Germany, Brazil, Peru, China, Thailand, India, Kenya, South Africa, Uganda, Vietnam, Nigeria, Indonesia, and Switzerland. Participants from developed countries attended with their own funds.

A course titled "Databases, Internet resources and Bioinformatics Workshop" was organised by the University of Pretoria in collaboration with Wageningen University and held in Pretoria (4-7 September) with the participation of 16 Sub-Saharan African NARS scientists—crop breeders and molecular biologists/biotechnologists from Sudan, Kenya, Ghana, South Africa, Zimbabwe, Ivory Coast, Angola, Nigeria, Uganda, and Ethiopia. Participants were introduced to bioinformatics resources and taught how to integrate them into their own research.

SP5 contributed to the International Plant Breeding Symposium, held in Mexico (20-25 August). The Symposium brought together scientists from the public and private sectors, developing and developed countries, students and professors, to share knowledge and technology to advance science and understanding on current, field-based breeding topics covering the major crops and world regions. Seven GCP-sponsored participants represented Uganda, Honduras, Bangladesh, Indonesia, Ethiopia, Burundi, and Iran.

SP5 partly funded the International Workshop on Genomics-Enabled Improvement of Legumes, held August 29-September 1, in Asilomar, Pacific Grove, California, USA. The meeting gathered legume biologists and biotechnologists to enhance synergies within and across species and to identify priorities in legume genomics, emphasising the applications of genomics to breeding. Species of particular focus included chickpea, cowpea, common bean, and peanut.

Continuous updating of the Interactive Resource Centre and Helpdesk has taken place. Postings addressed requests for information on suppliers: links to vendors, descriptions of products (e.g. laboratory equipment, reagents, primers, kits, etc.), and how to find regional representatives. A new section was added for Sorghum and Millet Resources. Publications freely available without a subscription are downloadable, others are linked to an abstract or pay per view opportunity.

5.2. Establishment of broad regional mechanisms for sustainable capacity to participate in the GCP

SP5 has considered several avenues for the identification and selection of partners as direct beneficiaries, as well as for the definition of their roles in collaboration. Importance is given to feedback received during the first NARS meeting in 2004, needs assessments surveys circulated at workshops, and comments gathered from impact updates sent from collaborators. With this, SP5 devised a new capacity building concept (Capacity Building à la Carte) seeking to provide tailored capacity building to a select group of applied researchers at developing country NARS who will benefit significantly from long-term training and research support. A refinement of the selection process is underway.

SP5 launched the Genotyping Support Service (GSS). The GSS is a genotyping service to help assess the potential of breeding materials, with appropriate phenotypic data, to identify good markers for relevant agronomic traits. The goal is to provide capacity to NARS scientists to understand and use the genotypic data in their own breeding work, while the genotyping is conducted by the most cost-efficient laboratory elsewhere. Applications from NARS were received and reviewed, and the participants were selected. Current participants include:
1) Cassava: NRCRI—Nigeria, MARI—Tanzania, and NAARI—Uganda; 2) Potato: INIA—Chile and Proinpa—Bolivia; 3) Groundnut: BAU—Bangladesh and Proinpa—Bolivia; 4) Musa: Embrapa—Brazil and University of Southern Mindanao—Philippines; 5) Coconut: VARTC—Vanuatu and ICOPRI—Indonesia.

SP5 has also engaged with the African Centre for Crop Improvement at the University of Kwazulu-Natal at its Pietermaritzburg campus on a project for capacity building and research activities in sub-Saharan Africa in plant breeding and molecular genetics. One of the objectives is aimed at producing highly-trained SSA PhDs through the recruitment of a full-time professor of molecular breeding to teach and mentor students in plant breeding and conduct research on GCP crops.

5.3. Development and adoption of policies and protocols to allow proper access and benefit sharing from the derivatives of the programme

The models of the distance-learning course focusing on (inter)national and institutional policies were finalised as planned and fitted into the educational background. The different technical support components (small movies, assignments, discussion "barometers") were included by the network university, and the content was checked by a legal specialist before the module was offered for a test-run before the GCP Annual Research Meeting. The distance-learning course is available now at http://www.netuni.nl/courses (with password), and different options are being considered for its implementation among GCP scientists.

The IP help desk web site (http://www.generationcp.org/iphelpdesk.php) has been populated with information useful to GCP members, partners, and stakeholders; much of this is original material written expressly for the GCP IP help desk. The interim web address for the site was sent to members of an expert panel and revisions were made to the site based on feedback from this group. The help desk web site has been made available to GCP scientists and the wider scientific community. It contains a wealth of current information on IP matters.

5.4. Articulation and implementation of the GCP product delivery strategy

Relevant to the implementation of the Delivery Strategy in the GCP was the inclusion of the requirement of a basic Delivery Plan in all project proposals submitted to the GCP's second call for competitive funding. Principal investigators were informed that the GCP would, after approval, provide funds for a preliminary meeting to fully develop delivery plans. A tool in the form of a series of spreadsheets was developed: the Delivery Plan Kit (DPKit). A draft was presented during the Annual Research Meeting and a meeting with experts followed to improve the DPKit. This tool will serve as the basis of the preliminary meetings of the new batch of competitive projects as soon as they can start.

A practical online service was developed in the project "Reporting for Product Distribution: An asset inventory system for the GCP." It aims to facilitate a dynamic inventory of third party materials used by GCP scientists as well as products produced by GCP research to maximise product development and delivery to end-users. A series of internet-ready forms and a database are completed. Technical manuals are in place and the structure of the database is designed to accept future revisions.

SP5 commissioned an impact targeting study to assist the GCP decision-making process and resource allocation across scientific areas and crops. The study should also help prioritise geographic targets for delivery. It used global crop, climate, and poverty data to identify agricultural regions of high priority for genetic and genomic resources research and development in marginal areas with poor populations. This study will continue through another round of commissioned research. A companion exercise identified the relative importance of traits for selected crops (given that drought is such an elusive trait, what are other traits which could help overcome drought if they were solved?). Another project was commissioned to do ex-ante impact analysis of MAS technologies supported by the GCP.

Lessons Learned and Conclusions

In the GCP we believe that is not numbers that matter but the quality of the work we do to ensure some type of impact during the course and at the end of the programme. In consequence, one of the lessons learned in the implementation of SP5 is that activities need to be tailored to the real needs of our customers, and that they require the simultaneous commitment of the national programmes where the scientist collaborators conduct their work. This translates to the necessity to set up collaborations with the institutions themselves rather than only with the individuals. At the same time, this forces SP5 to be more restricted and forget pleasing a wider clientele that might not produce the expected impact in a reasonable time.

Also in relation to impact, the GCP exercise to target impact—geographical areas, crops, and traits—has shown the difficulties of such an endeavour. The GCP should invest where its efforts are needed most and where it has the highest chance for success. However, the GCP is an upstream scientific programme with the unique character of enabling the assimilation of emerging opportunities. The impact targeting study evidenced the agricultural challenges that the GCP faces and also taught the GCP that there is no perfect answer to warrant its success. In all, the study showed that it is essential to base decisions on data as objectively as possible, but that diverse viewpoints need to be taken into consideration to ensure that the GCP achieves its goals as expected.

Perspectives on 2007

A number of SP5 activities will continue as already implemented. These include the Fellowship Programme, the Travel Grant Programme, translation of training and reference materials in the interest of reaching out as far as possible, contribution to relevant conferences, the operation of the IP helpdesk, the expansion of the Genotyping Support Service, and the support of competitive projects in development of delivery plans, their implementation through the identification of expected products, and corresponding users and their capacity needs.

SP5 will devote new attention to the implementation of the Capacity Building à la Carte Programme, which will incorporate some research funds, specialised training opportunities, hands-on research visits, mini-grants for small equipment or consumables, and the option of technical backstopping missions by expert researchers to provide on-site support. In addition, a strategy for product marketing will be needed as a complement to the delivery strategy as a step further to guarantee that the GCP reaches its users.

Year 4 (2007) Summary Workplan and Budget

2007 Summary Competitive and Commissioned Research

Institution Type	Competitive (three-year average)	Commissioned Projects	TOTAL
CGIAR	1,740,091[1]	1,334,709	3,074,801
GCP ARIs	906,574	643,820	1,550,394
GCP NARS	650,815	422,855	1,073,670
non-GCP ARIs	844,726	194,840	1,039,566
non-GCP NARS	539,572	504,354	1,043,926
Partners to be identified	-	1,207,702	1,207,702
Estimate total [2]	4,681,777	4,308,280	8,990,057
Real 2007			
TOTAL [3]	**4,393,832**	**4,308,280**	**8,702,112**

Competitive 3-Year Total

Institution Type	Competitive Grants (total over 3 years)
CGIAR	5,220,272
GCP ARIs	2,719,721
GCP NARS	1,952,444
non-GCP ARIs	2,534,177
non-GCP NARS	1,618,716
TOTAL	**14,045,330**

[1] Per year average of projects, for comparative purposes
[2] Estimate 2007 total is sum of yearly average
[3] Actual total amounts distributed in 2007. Differs from the estimate due to larger first year budgets in some projects
(Difference between real and estimate reflects uncommitted research funds to be allocated in 2007)

2007 Commissioned Research - GCP Consortium Members

(See Appendix C for full project details)

Project Code	2007 total	Agropolis	BIOTEC	Bioversity	Embrapa	CAAS	Cornell	CIAT	CIMMYT	CIP	ICARDA	ICRISAT	IITA	INRA-M	IRRI	JIC	NIAS	WUR	WARDA	Others
SP1 Commissioned																				
2005-06	148,430				148,430															
2006-01	90,614				12,256			12,020			6,010	18,030			42,298					
2006-02	287,000	184,800						2,400		72,000	2,400	25,400			x					
2006-04	49,000			49,000																
G4007.01	50,000	50,000																		
SP1 total	**625,044**																			
SP2 Commissioned																				
G4007.02	100,272														33,012					67,260
SP2 Total	**100,272**																			
SP3 Commissioned																				
G4007.03	65,000		44,000																	21,000
G4007.04	34,775		25,689																	9,086
G4007.05	100,000																			
G4007.06	74,600					57,000														17,600
G4007.07	114,000									114,000										
G4007.08	126,909																		66,729	60,180
SP3 Total	**515,284**																			
SP4 Commissioned																				
2005-22	150,000	14,750		14,750				14,750	14,750						61,500		14,750			14,750
2005-23	120,000			120,000																
2005-24	80,000	10,380		61,360											8,260					
2005-25	80,000			11,180					40,000						28,820					
2005-26	85,550			73,750					11,800											
2005-27	73,750									44,250		14,750			14,750					
2005-34	38,940														38,940					
2006-08	62,500								21,220						19,760	10,900	10,620			
2006-16	150,000	50,000													50,000		50,000			
2006-17	147,500			29,500								39,530			15,930			53,100		9,440
2006-35	75,000																	75,000		
G4007.09	100,000																	100,000		
G4007.10	56,640																	56,640		
G4007.11	80,000								80,000			65,250			8,850					
G4007.12	100,000																			

Project Code	2007 total	Agropolis	BIOTEC	Bioversity	Embrapa	CAAS	Cornell	CIAT	CIMMYT	CIP	ICARDA	ICRISAT	IITA	INRA-M	IRRI	JIC	NIAS	WUR	WARDA	Others
SP5 Commissioned																				
2005-CB16	30,000			30,000																
2005-CB23	300,000																			
2006-12	160,000																			
2006-14	50,000																			
2006-15	280,000																			
2006-27	30,000																			
2006-36	100,098																			100,098
G4007.13	600,000																			
G4007.15	50,000																			
G4007.16	50,000																			
	17,702																			
SP5 Total	**1,667,800**																			
	4,308,280	**309,930**	**69,689**	**389,540**	**160,686**	**57,000**		**29,170**	**167,770**	**230,250**	**8,410**	**162,960**			**322,120**	**10,900**	**75,370**	**284,740**	**66,729**	**299,414**

Competitive Grants (3 year projects) – GCP Consortium Members

#	CIMMYT	CIP	IRRI	CIAT	IITA	IPGRI/ INIBAP	WARDA	ICRISAT	ICARDA	CAAS	EMBRAPA	Cornell	JIC	NIAS	WUR	Agropolis (CIRAD. INRA, IRD)	Others	TOTAL
1			489,360											106,200			304,440	
2			468,120														431,880	
3				226,949	100,207						272,379	172,138					95,472	
4	60,300														222,500		224,350	
5								276,120			238,695					59,400	324,020	
6					296,143												603,857	
7												64,900					35,100	
8			145,317									347,731					406,563	
9				409,342							140,066						345,498	
10				459,300			89,700				87,300	353,600					85,000	
11	105,000										150,000		185,000	85,000		235,000	140,000	
12			316,800							572,700							0	
13	473,180											155,760				42,480	227,632	
14	436,010				26,845					17,405						129,210	107,675	
15	289,100		160,480													194,700	254,406	
16											473,898	366,102					60,000	
17									392,000								507,000	
TOTAL	**1,363,590**		**1,580,077**	**1,095,591**	**423,195**		**89,700**	**276,120**	**392,000**	**590,105**	**1,362,338**	**1,460,231**	**185,000**	**191,200**	**222,500**	**660,790**	**4,152,893**	**14,045,330**

First Round of Competitive Grants
Budget per Year

#	Project Title	Yr1 2005	Yr2 2006	Yr3 2007	Yr4 2008	Total
1	Identifying Genes Responsible for Failure of Grain Formation in Rice and Wheat under Drought	305,836	295,768	298,396		900,000
2	Revitalising Marginal Lands: Discovery of Genes for Tolerance of Saline and Phosphorus Deficient Soils to Enhance and Sustain Productivity	312,300	342,244	245,456		900,000
3	Identifying the physiological and genetic traits that make cassava one of the most drought tolerant crops	298,540	294,883	273,722		867,145
4	An eco-physiological - statistical framework for the analysis of GxE and QTLxE as occurring in abiotic stress trials, with applications to the CIMMYT drought stress programmes in tropical maize and bread wheat	169,550	175,050	162,550		507,150
5	Unlocking the genetic diversity in peanut's wild relatives with genomic and genetic tools	390,311	277,589	230,335		898,235
6	Marker Development and Marker-Assisted Selection for Striga Resistance in Cowpea	300,000	300,000	300,000		900,000
7	Measuring linkage disequilibrium across three genomic regions in rice	100,000				100,000
8	Targeted discovery of superior disease QTL, alleles in the maize and rice genomes	294,297	291,386	313,928		899,611
9	Development of Low-Cost Technologies for Pyramiding Useful Genes From Wild Relatives of Cassava into Elite Progenitors	298,194	298,164	298,548		894,906
10	Exploring Natural Genetic Variation: Developing Genomic Resources and Introgression Lines for Four AA Genome Rice Relatives	331,700	337,800	325,200	80,200	1,074,900
11	Functional genomics of cross-species resistance to fungal diseases in rice and wheat (CEREALIMMUNITY)	387,000	327,000	186,000		900,000
12	Drought Tolerant Rice Cultivars for North China and South/Southeast Asia by Highly Efficient Pyramiding of QTL's fro Diverse Origins	296,500	296,500	296,500		889,500
13	Development of informative DNA markers through association mapping in maize to improve drought tolerance in cereals	268,080	293,420	337,552		899,052
14	Characterisation of genetic diversity of maize populations: Documenting global maize migration fro the centre of origin	305,620	183,490	228,035		717,145
15	Determination of a common genetic basis for tissue growth rate under water-limited conditions across plant organs and genomes	297,678	302,398	298,610		898,686
16	Isolation and Characterisation of Aluminium Tolerance Genes in the Cereals: An Integrated Functional Genomic, Molecular Genetic and Physiological Analysis	300,000	300,000	300,000		900,000
17	Allele Mining Based on Non-Coding Regulatory SNPs in barley germplasm	300,000	300,000	299,000		899,000
	TOTAL	**4,955,606**	**4,615,692**	**4,393,832**	**80,200**	**14,045,330**

Table.1 In-Kind Contributions in 2005-2007 GCP Competitive Grants Awards.

Institution	N	3yr Budget	In-Kind	%
CGIAR	7	5,225,805	2,222,220	42.52%
Non-CG GCP	7	4,566,845	3,018,100	66.09%
Non-GCP	35	4,054,981	3,062,540	75.53%
Total	**49**	**13,847,631**	**8,302,860**	`
Non-CGIAR Institutions	42	8,621,826	6,080,640	70.53%

Financials

The summary financial reports (statement of income and expenses plus statement of changes in net assets) for 2006 and 2007 are shown in Tables 2 and 3. Detailed expenditures for 2006 and 2007 are shown in Appendices D and E. Financial information presented for 2006 is based on actual year-end financial reports while 2007 is a projection based on anticipated income and expenditure. It is clear that the largest portion of our 2006 funds (approximately 85%) went directly to supporting the research and capacity building efforts of the GCP and its partners.

2006

The GCP has maintained a healthy financial position, thanks in large part to the donor community that generously supports it. Our major donors are the European Commission (EC), the UK Department for International Development (DFID), and the World Bank (WB), who contribute about 90% of our total income. We are also particularly thankful to the Swiss Agency for Development and Cooperation, who agreed to support the Programme starting in 2006.

The income for 2006 (US$ 15.5 M) is higher than 2005 (US$ 14.2 M), mainly due to the following:

- A special contribution from the World Bank of US$1.25M, which is expected to be received in early 2007. Note that the original World Bank support was reduced by US$ 500K (US$ 2.5 M in 2005 versus 2.0 M in 2006);
- New funding from Switzerland amounting to US$ 370,000; and
- An increase in the EC contribution of 100,000 Euros (2005 contribution received in February 2006).

After deducting the GCP contingency reserve of US$ 1 M and the special contribution for the World Bank that was outstanding at the end of the year, net assets at the end of the 2006 financial year represented approximately US$ 6 M. This amount was higher than originally budgeted, reflecting the delay in dispersing some funds linked to the operational practices of the GCP and the delayed receipt of some donor contributions, as we received about US$ 3 M of 2006 funds in December 2006. From this US$ 6 M, about US$ 2.8 M has already been committed to activities to be conducted in 2007 and to pay the remaining 20% of some activities conducted in 2006. The uncommitted carryover for 2007 therefore amounts to US$ 3.3 M. Because of our reduced contingency reserve compared to that of a CG centre, we must keep a significant amount of uncommitted carryover every year to face unexpected changes in our funding situation.

2007

An accurate prediction of the financial situation for 2007 is challenging mainly due to some uncertainty related to the amount of the 2007 EC contribution.

The EC contribution to the Generation Challenge Programme represents roughly 40% of our annual budget. Because the GCP usually receives the EC contribution in January of the following year, the 2006 EC contribution had been factored into the GCP 2007 proposed workplan and budget. Because the EC did not find an arrangement with the World Bank to disburse the 2006 EC contribution, this contribution was formally cancelled in November 2006. This non payment means that, for the time being, a significant portion of the GCP 2007 budget is now uncertain.

It is important to underline that the Directorate of the EC has reaffirmed its commitment to the CGIAR and assured the community that they are working intensively to remedy the present situation. The EC's support of the GCP is, therefore, unwavering.

Despite this temporary setback, funding prospects for the GCP are positive for 2007. Although funds are not secured yet, we received indications that DFID will maintain their contribution to the programme at the same level as previous years. We have also been informed that because of the problem that occurred in 2006, the 2007 contribution from the EC may include a (partial) compensation of the 2006 non-funding. To be very conservative, we have projected the 2007 EC contribution to be the same amount as the 2006 proposed allocation, which will cover research activities in 2007 and early 2008. This contribution should be received before the end of 2007 and therefore will be accounted as 2007 income. Those numbers are used to support our projected financial table for 2007.

Because of our current uncertain financial situation, some new activities for 2007 have been put on hold, but as soon as financial support is assured, the GCP will adjust its research portfolio to what was originally planned for 2007.

The GCP Management Team remains confident about the financial health of the programme, as we continue to have the support of our current donor community, as well as bright prospects to attract new sources of funding in 2007. The GCP Management Team, and the Director in particular, will dedicate special efforts in 2007 to diversifying the GCP's funding base to bring in additional funds for the purpose of further consolidating the research agenda and implementing GCP product delivery.

Table 2. Summary Financial Report

USD

2006 Income Vs Expenditures

			Actual
Income			
DFID [1/]			4,730,626
EC [2/]			5,673,840
Pioneer			20,000
RF			1,044,147
Sweden [3/]			97,552
Switzerland [4/]			369,505
World Bank [5/]			2,000,000
World Bank [6/]			1,256,000
Sub-Total			**15,191,669**
Interest			327,106
Total Income			**15,518,775**
Expenditure			
Salaries & Benefits			323,737
Salaries & Benefits (Subprogram Leaders 1,2,4,5)			284,134
Operational Travel (GCP Management)			54,754
Conferences & PSC expenses			659,109
Office Supplies & Services			73,884
Printing & Design			49,450
Vehicle Expenses			12,755
Consulting			165,541
Research			10,900,742
Commissioned Research WorkPlan Yr2 (2005 - 20%)		619,039	
Commissioned Research Yr3 (2006 - 80/100%)		4,498,274	
Competitive Grants Yr2 (2006 - Round 1)		4,360,029	
SP1	2,575,380		
SP2	2,623,324		
SP3	1,460,601		
SP4	1,701,811		
SP5	1,116,226		
Operational Support SPLs		400,000	
RF Grants Yr2 (2006)		1,023,400	
Sub-total			**12,524,106**
Capital			19,862
Sub-Total			12,543,968
Indirect Costs 4%			487,207
Total Expenditure			**13,031,175**
Surplus for year [7/]			**2,487,600**

[1/] Equivalent to GBP 2.5m
[2/] Equivalent Eur 4.7m
[3/] Equivalent SEK 0.700m
[4/] Equivalent CHF 0.450m
[5/] Annual Contribution
[6/] Special 2006 contribution from WB expected to be received in early 2007
[7/] See Statement of Changes in Net Assets - below

Statement of Changes in Net Assets

	2005	2006
Designated		
Opening balance	6,219,945	4,853,435
Net Surplus/(Deficit) for year	(1,366,510)	2,487,600
Closing Balance - Net Assets	**4,853,435**	**7,341,035**
Undesignated		
Contingency Reserve	**1,000,000**	**1,000,000**
Total Net Assets	**5,853,435**	**8,341,035**
Represented by:		
Accounts Receivable	-	1,256,000
Cash held at Cimmyt	5,853,435	7,085,035
Total Net Assets	**5,853,435**	**8,341,035**

[a/] Carry-Forward breakdown:

67,107	2004 Commissioned Research commitment
730,821	2005 Commissioned Research remaining 20%
694,216	2006 Commissioned Research commitments
170,670	2006 Competitive Projects commitments
1,662,815	
1,114,466	2006 Commissioned Research remaining 20%
4,563,754	2007 budget - carryover
7,341,035	Total

Table 3. Summary Financial Report

USD

2007 Income Vs Expenditures

		PROJECTION Jan-Dec
Income		
Unsecure		
DFID [1/]	4,400,000	
EC [2/]	5,500,000	9,900,000
Secure		
Pioneer		20,000
RF		411,340
Sweden [3/]		50,000
Switzerland [4/]		300,000
World Bank		2,000,000
Sub-Total		**12,681,340**
Interest		150,000
Total Income		**12,831,340**
Expenditure		
Salaries & Benefits		613,500
Salaries & Benefits (Subprogram Leaders 1,2,4)		207,800
Operational Travel (GCP Management)		135,000
Conferences & PSC expenses		477,000
Office Supplies & Services		88,500
Vehicle Expenses		23,000
Printing & Design		50,000
Consulting		255,000
Research		12,636,022
Research commitments prior years [5/]	1,662,815	
Commissioned Research WorkPlan Yr3 (2006 20%)	1,114,666	
Commissioned Research Yr4 (2007 8/12mos - 80%)	3,547,139	
Competitive Grants Yr3 (2007 8/12mos - Round 1 - 80%)	3,608,006	
Competitive Grants Yr1 (2007 - Round 2)	1,999,031	
Operational Support SPLs (8/12 mos 80% /100%)	300,000	
RF Grants	404,365	
Sub-total		**14,485,822**
Capital		20,000
Sub-Total		**14,505,822**
Indirect Costs (4% / 18%) [6/]		711,413
Total Expenditure		**15,217,234**
Surplus/(Deficit) for year [8/]		**(2,385,895)**

[1/] By March remains the expectation of a contribution to be received in two installments Jul & Dec equivalent £ 2.5m. (note 7)
[2/] Minimum contribution expected by the end of the year equivalent Eur 4.7m (note 7)
[3/] Equivalent SEK 0.350m (note 7)
[4/] Equivalent CHF 0.450m (note 7)
[5/] Outstanding disbursements due to clarifications on technical and/or financial reports; and some 2006 research projects transferred to 2007
[6/] Indirect costs: 18% on Direct Costs & 4% on services and Pass-through funds
[7/] All foreign currency receipts subject to ExRate fluctuation
[8/] See Statement of Changes in Net Assets - below

Statement of Changes in Net Assets

	2006	2007
Designated		
Opening balance	4,853,435	7,341,035
Net Surplus/(Deficit) for year	2,487,600	(2,385,895)
Closing Balance - Net Assets	**7,341,035**	**4,955,140** [a/]
Undesignated		
Contingency Reserve	1, 000,000	1,000,000
Total Net Assets	**8,341,035**	**5,955,140**
Represented by:		
Accounts Receivable	1,256,000	-
Cash held at Cimmyt	7,085,035	5,955,140
Total Net Assets	**8,341,035**	**5,955,140**

[a/] 2007 Research commitments transferred to 2008

Appendices

Appendix A. 2006 Generation Challenge Programme Consortium Members and Partners

Consortium Members
Africa Rice Center (WARDA)
African Centre for Gene Technologies (ACGT)
Agropolis
Bioversity International
Brazilian Agricultural Research Corporation (Embrapa)
Centro de Investigación y de Estudios Avanzados (CINVESTAV)*
Chinese Academy of Agricultural Sciences (CAAS)
Cornell University
Indian Council of Agricultural Research (ICAR)
Institut National de la Recherche Agronomique (INRA)*
International Center for Agricultural Research in the Dry Areas (ICARDA)
International Center for Tropical Agriculture (CIAT)
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
International Institute of Tropical Agriculture (IITA)
International Maize and Wheat Improvement Center (CIMMYT)
International Potato Center (CIP)
International Rice Research Institute (IRRI)
Instituto Agronomico per l'Oltremare (IAO)*
John Innes Centre (JIC)
National Center for Genetic Engineering and Biotechnology (BIOTEC)*
National Institute of Agrobiological Sciences (NIAS)
Wageningen University and Research Centre (WUR)

NARS Partners
Agricultural Biotechnology Research Institute of Iran (ABRII), Iran
Barwale Foundation (BF), India
Cambodia Agricultural Research and Development Institute (CARDI)
Central Rainfed Upland Rice Research Station (CRURRS), India
Central Rice Research Institute (CRRI), India
Centre Africain de recherché sur bananas et plantains (CARBAP), Cameroon
Centre Research for Biotechnology, Bogor Agriculture University (IPB), Indonesia
Centre d'Etude Régional pour l'Amélioration de l'Adaptation à la Sécheresse (CERAAS), Senegal
College of Agriculture, Rewa, India
Crop Research Institute (CRI), Kumasi, Ghana
Dhaka University, Bangladesh
Department of Agricultural Research (DAR), Myanmar
Fedearroz, Colombia
Huazhong Agricultural University, China
Institut d'Economie Rurale (IER), Mali
Institut de l'Environnement et de Recherches Agricoles (INERA), Burkina Faso
Instituto de Botánica del Nordeste (IBONE), Argentina
IGAU, India
Indian Agriculture Research Institute (IARI)
Indonesian Centre for Agricultural Biotechnology and Genetic Resources and Research Development (ICABGRRD), Indonesia
Indonesian Department of Agriculture
Institute of Dry Farming, Hebei Academy of Agricultural Sciences (HAAS), China
Instituto Nacional de Investigación Agropecuaria (INIA), Uruguay
International Centre for Genetic Engineering and Biotechnology (ICGEB), India
Kasetsart University, Thailand
Kenya Agriculture Research Institute (KARI), Nairobi, Kenya
Luoyang Academy of Agricultural Sciences (LAAS), China
Moi University, Kenya
Nakhon Sawan Field Crops Research Center, Thailand
Namulonge Agricultural and Animal Production Research Institute (NAARI), Uganda
Nanjing Agricultural University (NAU), China
National Agricultural and Forestry Research Institute (NAFRI), Laos
National Agriculture Research Centre (INIA), Chile
National Maize Research Institute, Vietnam
National Root Crop Research Institute (NRCRI), Umudike, Nigeria
New Partnership for African Development (NEPAD), Union of South Africa
Ningxia University (NU), China
Philippine Department of Agriculture
Philippine Rice Research Institute (PhilRice), Philippines
Punjab Agricultural University, India
Rice Gene Discovery Unit (RGDU), Thailand
Scientific and Industrial Research and Development Centre (SIRDC), Zimbabwe
Shanxi Academy of Agricultural Sciences (SAAS)
Tamil Nadu Agricultural University (TNAU), India
Tishreen University, Syria
Ubon Ratchatani University (UBU), Thailand
Unversidade Católica de Brasilia (UCB), Brazil
University of Agricultural Sciences, Dharwad (DWR), India
University of Agriculture and Forestry (NWSUAF), China
University of Hyderabad, India
University of KwaZulu-Natal, South Africa
Universidad Autónoma Chapingo, México
Yunnan Academy of Agricultural Sciences (YAAS), China

ARI Partners
Australian Centre for Plant Functional Genomics Pty Ltd. Australia
Botanic Garden and Botanical Museum Berlin-Dahlem (BGBM), Germany
Centre National de Génotypage (CNG), France
Colorado State University (CSU), USA
Commonwealth Scientific & Industrial Research Organisation (CSIRO), Australia
DArT P/L, Australia
European Bioinformatics Institute (EBI), United Kingdom
ETH-Zurich, Switzerland
Genaissance, France
Graingenes (CSIRO), Australia
Hebrew Univ. of Jerusalem, Israel
Institut für Pflanzenbau und Pflanzenzüchtung, Germany
Institute Agronomique Mediterranean de Montpellier (CIHEAM-IAMM), France
JIRCAS, Japan
Kansas State University (KSU), USA
MOBY-S, Canada
National Center for Genome Resources, USA
Oregon State University (OSU), USA
Scottish Crop Research Institute (SCRI)
Sichuan Agriculture University, China
The Institute for Genomic Research (TIGR), USA
United States Department of Agriculture - Agricultural Research Service (USDA-ARS), USA
United States Department of Agriculture, North Carolina State University (NSCU)
Universita' di Udine, Italy
University of Aarhus, Denmark
University of Adelaide, Australia
University of Agricultural Sciences (UAS), India
University of Alberta, Canada
University of Arizona, USA
University of Bologna, Italy
University of California-Berkley, USA
University of Madrid, Spain
University of Missouri, USA
University of Queensland, Australia
University of Tsukuba, Japan
University of Virginia, USA
Vanuatu Agricultural Research and Training Centre (VARTC) Vanuatu

Appendix B. Full List of First Round Competitive Projects[1]

1. Identifying Genes Responsible for Failure of Grain Formation in Rice and Wheat under Drought

Budget Summary by Partner	IRRI	CSIRO	NIAS	TNAU	NANJING	TOTAL
Total Direct Cost	414,712	198,000	90,000	30,000	30,000	762,712
Indirect Costs	74,648	35,640	16,200	5,400	5,400	137,288
Total Costs	489,360	233,640	106,200	35,400	35,400	900,000
In-Kind Contribution	93,220	146,320	---	---	---	239,540

2. Revitalizing Marginal Lands: Discovery of Genes for Tolerance of Saline and Phosphorus Deficient Soils to Enhance and Sustain Productivity

Budget Summary by Partner	IRRI	CSIRO /Graingene	UCD	Dhaka University	ICABGRRD	TOTAL
Total Direct Cost	384,712	105,000	125,000	76,000	72,000	762,712
Indirect Costs	69,248	18,900	22,500	13,680	12,960	137,288
Total Costs	468,120	109,740	147,500	89,680	84,960	900,000
In-Kind Contribution	214,000	169,000	119,500	31,500	31,500	565,500

3. Identifying the physiological and genetic traits that make cassava one of the most drought tolerant crops

Budget Summary by Partner	EMBRAPA/ CNPMF	CIAT	IITA	Cornell University	SARI/Ghana	ARI, Tanzania	TOTAL
Total Direct Cost	221,830	201,330	165,830	145,880	45,900	45,900	745,761
Indirect Costs	39,929	36,239	29,849	26,258	1,836	1,836	121,384
Total Costs	272,379	226,949	100,207	172,138	47,736	47,736	867,145
In-Kind Contribution	92,000	160,000	170,000	150,500	3,000	3,000	578,500

4. An eco-physiological – statistical framework for the analysis of GxE and QTLxE as occurring in abiotic stress trials, with applications to the CIMMYT drought stress programmes in tropical maize and bread wheat

Budget Summary by Partner	WUR	CSIRO	CIMMYT	INIA-URUGUAY	TOTAL
Total Direct Cost	445,000	412,200	102,000	36500	995,700
Indirect Costs			18,600		18,600
Total Costs	222,500	206,100	60,300	18,250	507,150
In-Kind Contribution	105,000	102,767	240,000	---	447,767

5. Unlocking the genetic diversity in peanut's wild relatives with genomic and genetic tools

Budget Summary by Partner	EMBRAPA	UCB	ICRISAT-India	ICRISAT-Kenya	IBONE	CERAAS	Aarhus	CIRAD	TOTAL
Total Direct Cost	211,995	111,992	179,000	55,000	46,470	52,500	67,144	54,000	778,101
Indirect Costs	26,701	16,799	32,220	9,900	6,971	8,715	13,429	5,400	120,135
Total Costs	238,695	128,791	211,220	64,900	53,441	61,215	80,573	59,400	898,235
In-Kind contribution	450,000	300,000	315,000	150,000	100,000	165,000	90,000	50,000	1,620,000

6. Marker Development and Marker-Assisted Selection for Striga Resistance in Cowpea

Budget Summary by Partner	IITA	CERAAS	UVA	TOTAL
Total Direct Cost	250,969	60,000	451,743	762,712
Indirect Costs	45,174	10,800	81,314	137,288
Total Costs	296,143	70,800	533,057	900,000
In-Kind Contribution	60,000	30,000	31,188	121,188

[1] There were no requirements for institutions to specify in-kind contributions. Those in-kind contributions that were provided are shown in the interest of completeness.

7. Measuring linkage disequilibrium across three genomic regions in rice

Budget Summary by Partner	Cornell University	ICABGRRD	TOTAL
Total Direct Cost	55,000	29,746	84,746
Indirect Costs	9,900	5,354	15,254
Total Costs	64,900	35,100	100,000
In-Kind Contribution	---	---	---

8. Targeted discovery of superior disease QTL alleles in the maize and rice genomes

Budget Summary by Partner	Cornell University	IRRI	CSU	NCSU	Kari	TOTAL
Total Direct Cost	294,687	123,150	141,245	119,500	83,800	762,382
Indirect Costs	53,044	22,167	25,424	21,510	15,084	137,229
Total Costs	347,731	145,317	166,669	141,010	98,884	899,611
In-Kind Contribution	---	---	---	---	---	---

9. Development of Low-Cost Technologies for Pyramiding Useful Genes From Wild Relatives of Cassava into Elite Progenitors

Budget Summary by Partner	CIAT	EMBRAPA/ CNPMF	NAARI	CRI	NRCRI	TOTAL
Total Direct Cost	346,900	118,700	110,737	110,737	110,736	797,810
Indirect Costs	62,442	21,366	4,429	4,429	4,430	97,096
Total Costs	409,342	140,066	115,166	115,166	115,166	894,906
In-Kind Contribution	255,000	66,000	27,500	27,500	27,500	403,500

10. Exploring Natural Genetic Variation: Developing Genomic Resources and Introgression Lines for Four AA Genome Rice Relatives

Budget Summary by Partner	Cornell University	CIAT	FEDEARROZ	EMBRAPA	WARDA	TOTAL
Total Direct Cost	233,400	330,000	58,000	60,000	62,000	743,400
Indirect Costs	42,000	59,400	10,400	10,800	11,200	133,800
Total Costs	353,600	459,300	85,000	87,300	89,700	1,074,900
In-Kind Contribution	400,800	380,000	32,000	32,000	288,000	1,132,800

11. Functional genomics of cross-species resistance to fungal diseases in rice and wheat (CEREALIMMUNITY)

Budget Summary by Partner	AGROPOLIS	CIMMYT	EMBRAPA	JIC	INRA RENNES	NIAS	UCD	TOTAL
Total Direct Cost	135,000	95,000	140,000	177,000	87,000	75,000	130,000	839,000
Indirect Costs	10,000	10,000	10,000	8,000	3,000	10,000	10,000	61,000
Total Costs	145,000	105,000	150,000	185,000	90,000	85,000	140,000	900,000
In-Kind Contribution	140,000	100,000	100,000	200,000	80,000	90,000	140,000	850,000

12. Drought Tolerant Rice Cultivars for North China and South/Southeast Asia by Highly Efficient Pyramiding of QTL's from Diverse Origins

Budget Summary by Partner	CAAS	IRRI	TOTAL
Total Direct Cost	498,000	264,000	762,000
Indirect Costs	74,700	52,800	127,500
Total Costs	572,700	316,800	889,500
In-Kind Contribution	---	---	---

13. Development of informative DNA markers through association mapping in maize to improve drought tolerance in cereals

Budget Summary by Partner	CIMMYT	Cornell University	INRA	KARI	SAU	SIRDC	NSFCRC	Genaissance	TOTAL
Total Direct Cost	401,000	132,000	36,000	28,100	28,100	28,100	28100	95000	776,400
Indirect Costs	72,180	23,760	6,480	5,058	5,058	5,058	5058		122,652
Total Costs	473,180	155,760	42,480	33,158	33,158	33,158	33,158	95,000	899,052
In-Kind Contribution		540,000	300,000	45000	45,000	45,000	45,000	---	1,020,000

14. Characterisation of genetic diversity of maize populations: Documenting global maize migration from the centre of origin

Budget Summary by Partner	CIMMYT	INRA	KARI	IITA	Indian Ag.	Thailand	Indonesia	Phil DOA	CAAS	Vietnam	TOTAL
Total Direct Cost	369,500	109,500	22,000	22,750	22,750	14,750	14750	7000	14,750	10000	607,750
Indirect Costs	66,510	19,710	3,960	4,095	4,095	2,655	2655	1260	2,655	1800	109,395
Total Costs	436,010	129,210	25,960	26,845	26,845	17,405	17,405	8,260	17,405	11,800	717,145
In-Kind Contribution	---	---	---	---	---	---	---	---	---	---	---

15. Determination of a common genetic basis for tissue growth rate under water-limited conditions across plant organs and genomes

Budget Summary by Partner	CIMMYT	ACPFG-Australia	INRA	ETH-Zurich	IRRI	IGAU-India	SIRDC-Zimbabwe	TOTAL
Total Direct Cost	245,000	73,500	165,000	90,000	136,000	33,000	25,200	767,700
Indirect Costs	44,100	13,230	29,700	9,000	24,480	5,940	4,536	130,986
Total Costs	289,100	86,730	194,700	99,000	160,480	38,940	29,736	898,686
In-Kind Contribution	---	465,000	330,000	450,000	---	75,000	75,000	1,395,000

16. Isolation and Characterisation of Aluminium Tolerance Genes in the Cereals: An Integrated Functional Genomic, Molecular Genetic and Physiological Analysis

Budget Summary by Partner	Cornell University	EMBRAPA Maize & Sorghum	EMBRAPA Wheat	EMBRAPA Rice and Beans	MOI University	TOTAL
Total Direct Cost	282,501	278,010	88,500	61,500	52,200	762,711
Indirect Costs	83,601	30,888	9,000	6,000	7,800	137,289
Total Costs	366,102	308,898	97,500	67,500	60,000	900,000
In-Kind Contribution	---	---	---	---	---	---

17. Allele Mining Based on Non-Coding Regulatory SNPs in barley germplasm

Budget Summary by Partner	ICARDA	Adelaide	Udine	Tushreen University	TOTAL
Total Direct Cost	339,000	254,500	207,500	45,000	846,000
Indirect Costs	53,000				53,000
Total Costs	392,000	254,500	207,500	45,000	899,000
In-Kind Contribution	---	254,265	---	---	254,265

Appendix C. Full List of 2007 Commissioned Projects

SP1

2005-06. Supporting emergence of reference drought tolerance phenotyping centers

Budget summary by partner	EMBRAPA	TOTAL
Total	$148,430	$148,430

2006-01. Developing strategies for allele mining within large collections

Budget summary by partner	CIAT	EMBRAPA	ICRISAT	ICARDA	IRRI	TOTAL
Total	$12,020	$12,256	$18,030	$6,010	$42,298	$90,614

2006-02. A dataset on allele diversity at orthologous candidate genes in GCP crops (ADOC)

Budget summary by partner	Agropolis	CIP	ICRISAT	INRA-CNG	IRRI	ICARDA	CIAT	TOTAL
Total	$62,800	$72,000	$25,400	$122,000	x	$2,400	$2,400	$287,000

2006-04. Phenotyping in the field: global capacity accessible to the GCP--Inventory of phenotyping resources and capacity for the GCP

Budget summary by partner	IPGRI	TOTAL
Total	$49,000	$49,000

G4007.01. Composite set genotyping: quality assessment and consolidation

Budget summary by partner	Agropolis	TOTAL
Total	$50,000	$50,000

SP2

G4007.02. Validation of drought-response/resistance pathways genes by phenotypic analysis of mutans

Budget summary by partner	Virginia Tech University	IRRI	Huazhong Agric. Univ.	TOTAL
Total	$35,400	$33,012	$31,860	$100,272

SP3

G4007.03. The 'Community of Practices' Concept applied to Rice Production in the Mekong Region: Quick conversion of popular rice varieties with emphasis on drought, salinity and grain quality improvement

Budget summary by partner	BIOTEC	UBU	NAFRII	CARDI	DAR	TOTAL
Total	$44,000	$1,500	$6,500	$6,500	$6,500	$65,000

G4007.04. Association mapping of downy mildew resistance in elite maize inbred lines in Thailand – Community of Practices

Budget summary by partner	BIOTEC	Kasetsart University	Nakhon Sawan Field Crop Research Center	TOTAL
Total	$25,689	$4,543	$4,543	$34,775

G4007.05. Bridging genomics, genetic resources and breeding to improve wheat and barley production in Morocco – Community of Practices

Budget summary by partner	INRA-M	TOTAL
Total	$100,000	100,000

G4007.06. Integrating marker-assisted selection into the conventional breeding procedure for improvement of wheat (triticum aestivum L.) in the drought-prone areas of Northern China

Budget summary by partner	CAAS	Ningxia University(NU)	NWSUAF	SAAS	LAAS	HAAS	TOTAL
Total	$57,000	$5,400	$3,500	$2,900	$2,900	2,900	$74,600

G4007.07. Marker assistant selection for sweetpotato virus disease (SPVD) resistance in sweetpotato germplasm and breeding populations

Budget summary by partner	CIP	TOTAL
Total	$114,000	$114,000

G4007.08. Integration of genomic tools with conventional screening for developing NERICA rice cultivar for West Africa

Budget summary by partner	WARDA	IER	IRD	TOTAL
Total	$54,339	$57,820	$14,750	$126,909

SP4

2005-22. Development of GenerationCP domain (data) models ontology

Budget summary by partner	IRRI	NIAS	CIMMYT	Bioversity	TOTAL
Total	$49,112	$14,750	$86,140	$14,750	$150,00

2005-23. Implementation of web services technology in GenerationCP Consortium

Budget summary by partner	Bioversity	TOTAL
Total	$120,000	$120,000

2005-24. Application and development of web services technology

Budget summary by partner	IRRI	CIRAD	Bioversity	TOTAL
Total	$8,260	$10,380	$61,360	$80,000

2005-25. Creation and maintenance of data templates for GenerationCP Data Storage in Repositories

Budget summary by partner	CIMMYT	IRRI	Bioversity	TOTAL
Total	$40,00	$28,820	$11,180	$80,000

2005-26. Management of GenerationCP Central Registry

Budget summary by partner	CIMMYT	Bioversity	TOTAL
Total	$11,800	$73,750	$85,550

2005-27. Integration of the High Performance Computing (HPC)-facilities in the GenerationCP toolbox

Budget summary by partner	CIP	ICRISAT	IRRI	TOTAL
Total	$44,250	$14,750	$14,750	$73,750

2005-34. GCP software engineering and collaboration platform

Budget summary by partner	IRRI	TOTAL
Total	$38,940	$38,940

2006-08. Data analysis support for existing projects in SP2 with emphasis on integrating results from microarray and mapping experiments

Budget summary by partner	CIMMYT	IRRI	NIAS	JIC	TOTAL
Total	$21,220	$19,760	$10,620	$10,900	$62,500

2006-16. Development of an integrated GCP information platform

Budget summary by partner	EMBRAPA	CIRAD	IRRI	NIAS	TOTAL
Total	$10,000	$50,000	$50,000	$40,000	$150,000

2006-17. GenerationCP data quality improvement and assurance

Budget summary by partner	IRRI	ICRISAT	CGN	IPGRI	SCRI	TOTAL
Total	$15,930	$39,530	$53,100	29,500	$9,440	147,500

2006-35. Support for existing projects in SP1 on Germplasm Data Analysis (GDA supp) (new name?)

Budget summary by partner	CIRAD	WUR	TOTAL
Total	$12,000	$63,000	$75,000

G4007.09. Methodology and software development for marker-trait association analyses

Budget summary by partner	WUR	TOTAL
Total	$100,000	$100,000

G4007.10. Support to GCP Scientists regarding issues related to Bioinformatics and Data Handling

Budget summary by partner	WUR	TOTAL
Total	$56,640	$56,640

G4007.11. Refinement and Distribution of iMAS for Use by NARS and Other User Communities

Budget summary by partner	ICRISAT	IRRI	CIMMYT	TOTAL
Total	$65,250	$8,850	$5,900	$80,000

G4007.12. Development of Tools and Technology to Increase the Functionality of the GCP Information Platform

Budget summary by partner	EBI	TOTAL
Total	$100,000	$100,000

SP5

2005-CB16. Intellectual Property and Access&Benefit Sharing-helpdesk and On-line-Resource for the GCP Community, Partners and Stakeholders

Budget summary by partner	Bioversity	TOTAL
Total	$30,000	$30,000

2005-CB23. Genotyping Support Service

Budget summary by partner	TOTAL
Total	$300,000

2006-12. Support to competitive projects in development and implementation of delivery plans

Budget summary by partner	TOTAL
Total	$160,000

2006-14. Ex Ante Impact Analysis of Marker-Assisted Selection Technologies Supported by the Generation Challenge Program (GCP)

Budget summary by partner	Virginia Tech	TOTAL
Total	$50,000	$50,000

2006-15. Fellowships and travel grants

Budget summary by partner	TOTAL
Total	$280,000

2006-27. Contribution to special conferences

Budget summary by partner	TOTAL
Total	$30,000

2006-36. Capacity Building and Research Project

Budget summary by partner	University of KwaZulu	TOTAL
Total	$100,098	$100,098

G4007.13. Capacity Building a la carte

Budget summary by partner*	TOTAL
Total	$600,000

*Funds to be committed during 2007

G4007.15. Project progress monitoring

Budget summary by partner	TOTAL
Total	$50,000

G4007.16. Consultants to SP5 (3)

Budget summary by partner	TOTAL
Total	$50,000

SP5 Uncommitted funds

Budget summary by partner	TOTAL
Total	$17,702

Appendix D. Detailed Expenditure Schedule for 2006
USD

Description	Expenditures	Total
Salaries & Benefits		**323,737**
International Staff [1/]	248,895	
National (Mexican) Staff	74,842	
Salaries & Benefits SPLeaders		**284,134**
Subprogram Leaders 1, 2, 4 & 5 [1/]	284,134	
Travel		**54,754**
Mngm Int'l Team - Fares & Subsistence	54,754	
Conferences		**659,109**
PSC	67,735	
Annual Research Meeting (2006) [2/]	361,652	
Annual Research Meeting (2005) [3/]	172,446	
Stakeholder's Committee (GFAR) (EC)	58,038	
AGM + Forum for Civil Society Organizations (CSOs) [4/]	(831)	
Others	68	
Office Supplies & Services		**73,884**
Office	10,656	
Shipping & Postage	14,552	
Maintenance & Repair	39	
Calls & Fax	8,694	
ICT Service (Inf & Comm. Technologies)	23,081	
Serial Subscriptions [5/]	6,254	
SPL3 & Mng Int'l Commun recruiting process [6/]	10,608	
Printing & Design		**49,450**
Printing & Design	41,358	
Software/Website	8,093	
Vehicle Expenses		**12,755**
Gasoline	2,515	
Insurance	4,344	
Maintenance	5,897	
Consultants (salary & benefits, travel)		**165,541**
Implementation (Quality Control & Delivery)	71,867	
(Web content management) - replacement	21,250	
Legal consultant	9,834	
Consultants / Facilitator	62,590	
Research		**10,900,742**
Comm Research WorkPlan Yr2 (2005 - 20%)	619,039	
Comm Research WorkPlan Yr3 (2006 - 80/100%)	4,498,274	
Competitive Grants Yr2 (2006 - Round 1)	4,360,029	
Operational Support SPLs	400,000	
RF Grants Yr2 (2006)	1,023,400	
Capital		**19,862**
Projector	1,545	
Cars (1)	18,318	
Indirect Costs		
Indirect Costs 4%		**487,207**
TOTAL EXPENDITURE		**13,031,175**

[1/] SPLeader 3 now part of GCP Int'l Staff full time
[2/] Higher spending due to increase of participants and increase from a 3-day meeting to a 5-day meeting
[3/] 2005 commitment billed in Mar 06 by the host institution
[4/] Net spending of $18k external funding
[5/] Not budgeted
[6/] Not budgeted

Appendix E. 2007 Budget Details

USD

Description	PROJECTION Expenditure	Total
1. Salaries & Benefits		**613,500**
International Staff (includes SPL3 & SPL5)	504,000	
National (Mexican) Staff	109,500	
2. Salaries & Benefits SPLeaders		**207,800**
SPLs salaries & benefits	207,800	
3. Travel		**135,000**
Mngm Int'l Team - Fares & Subsistence	135,000	
4. Conferences		**477,000**
PSC	100,000	
Annual Research Meeting	300,000	
Stakeholder's Committee (GFAR) (EC)	62,000	
AGM	10,000	
Others	5,000	
5. Office Supplies & Services		**88,500**
Office	12,000	
Shipping & Postage	14,000	
Maintenance & Repair	3,000	
Calls & Fax	13,500	
ICT Service (Inf & Comm. Technologies)	34,000	
Subscriptions	7,000	
Recruiting expenses	5,000	
6. Vehicle Expenses		**23,000**
Gasoline	8,000	
Insurance	5,000	
Maintenance	10,000	
7. Printing & Design		**50,000**
Printing & Design	30,000	
Software/Website	20,000	
8. Consultants (salary & benefits, travel)		**255,000**
Implementation (Quality Control & Delivery)	120,000	
Web content management	25,000	
Legal consultant	30,000	
Consultants / Facilitator	80,000	
9. Research		**12,636,022**
Research commitments prior years [1/]	1,662,815	
Commissioned Research WorkPlan Yr3 (2006 - 20%)	1,114,666	
Commissioned Research WorkPlan Yr4 (2007 8/12mos- 80/100%)[2/]	3,547,139	
Competitive Grants Yr3 (2007 8/12mos - Round 1 80%) [3/]	3,608,006	
Competitive Grants Yr1 (2007 - Round 2)	1,999,031	
Operational Support SPLs (2007 8mos 80% / 12 mos 100%)	300,000	
RF Grants Yr3 (2007)	404,365	
10. Capital		**20,000**
Cars (1)	20,000	
Indirect Costs [4/]		**711,413**
Indirect Costs - 18% (Items 1,3,4,5,6,)		
Indirect Costs - 4% (Items 2,7,8,9,10) [5/]		
TOTAL EXPENDITURE		**15,217,234**

Research projects under scheme 80/20%

[1/] Outstanding disbursements due to clarifications on technical and/or financial reports; and some 2006 research projects transferred to 2007

[2/] 2007 budget \$2.045m 8/12 contracts (80%) = \$1.636m + 4 projects (100%) \$106.5k. Or, 2007 budget \$4.308m 12/12 contracts (80%) = \$3.447m + 4 projects (100%) \$100k

[3/] 2007 Yr3 8/12 mos \$2.952m (80%) = \$2.362m. Or, 2007 Yr3 12/12mos \$4.104km (80%) = \$3.283m + 1 project (100%) \$325k =\$3.608m

[4/] Indirect costs: 18% on Direct Costs & 4% on services and Pass-through funds

[5/] Research grants for GCP Host Institution not subject to indirect costs

Generation

Cultivating Plant Diversity for the Resource-Poor

For more information about the Generation Challenge Programme, please contact:

Jean-Marcel Ribaut, Director

Apdo. Postal 6-641 06600 Mexico D.F., Mexico

Telephone: +52 55 5804 2004 x1312 Fax: +52 55 5804 7558

Email: **j.ribaut@cgiar.org**

Visit us on the web at **www.generationcp.org**

Consortium members

African Centre for Gene Technologies (ACGT) • Agropolis • Brazilian Agricultural Research Corporation (Embrapa) • Chinese Academy of Agricultural Sciences (CAAS) • Cornell University • Indian Council for Agricultural Research (ICAR) • International Center for Tropical Agriculture (CIAT) • International Maize and Wheat Improvement Center (CIMMYT) • International Potato Center (CIP) • International Center for Agricultural Research in the Dry Areas (ICARDA) • International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) • International Institute for Tropical Agriculture (IITA) • International Plant Genetic Resources Institute (IPGRI) • International Rice Research Institute (IRRI) • John Innes Centre • National Institute of Agrobiological Sciences (NIAS-Japan) • Wageningen University • Africa Rice Center (WARDA)