

# GRIN-Global:

## An International Project to Develop a Global Plant Genebank and Information Management System

Peter D. Cyr<sup>1</sup>, Brock E. Weaver<sup>2</sup>, Mark J. Millard<sup>1</sup>, Candice A. Gardner<sup>1</sup>, Mark A. Bohning<sup>3</sup>, Gorm Emberland<sup>3</sup>, Quinn P. Sinnott<sup>3</sup>, Gary R. Kinard<sup>3</sup>, Tito Franco<sup>4</sup>, Michael Mackay<sup>5</sup>, Luigi Guarino<sup>6</sup>, Joseph D. Postman<sup>7</sup>, Kim E. Hummer<sup>7</sup>, Tomás Ayala-Silva<sup>8</sup>, Peter K. Bretting<sup>9</sup>

<sup>1</sup>USDA-ARS-PIRU G212 Agronomy Hall Iowa State University Ames, IA 50011-1170; <sup>2</sup>Bioversity Intl. G212 Agronomy Hall Iowa State University Ames, IA 50011-1170; <sup>3</sup>USDA-ARS-NGRL Room 400 10300 Baltimore Avenue BLDG 003 BARC-WEST Beltsville, MD, 20705-2350; <sup>4</sup>Bioversity Intl. Cali, Colombia; <sup>5</sup>Bioversity Intl. Rome, Italy; <sup>6</sup>Global Crop Diversity Trust c/o FAO Viale delle Terme di Caracalla 00153 Rome, Italy; <sup>7</sup>USDA-ARS-NGRL 33447 Peoria Road Corvallis, OR 97333-2521; <sup>8</sup>USDA-ARS-STHR 13601 Old Cutler Road Miami, FL 33158; <sup>9</sup>USDA-ARS-NPS Room 4-2212 5601 Sunnyside Avenue GWCC-BLTS/LV Beltsville, MD, 20705-5139

### Abstract

The mission of the GRIN-Global Project is to create a new, scalable version of the Germplasm Resource Information System (GRIN) to provide the world's crop genebanks with a powerful, flexible, easy-to-use plant genetic resource (PGR) information management system. The system will help safeguard PGR and information vital to global food security, and encourage PGR use. Developed jointly by the USDA Agricultural Research Service, Bioversity International and the Global Crop Diversity Trust, GRIN-Global will be deployed in selected plant genebanks worldwide for 2010. The .NET Framework and Visual Studio development environment were chosen for the project. A core set of web services, enterprise services or other technologies will update data stored locally or on networks, distribute centralized data to off-site systems, and enable third party data sharing. The database and interfaces will accommodate commercial and open-source programming tools, be database-flexible (MySQL, MS SQL Server, Oracle), and require no licensing fees. The database will be deployable on stand-alone computers or networked systems. Iterative programming strategies will support continuous product evaluation and refinement; advanced prototypes will be extensively beta-tested. Bioversity International will deploy GRIN-Global internationally, working cooperatively to document the new system in Arabic, English, French, Russian and Spanish, translate its interface, and implement it in developing countries. Implementation will be monitored and barriers to adoption identified. The impact of system use will be evaluated by users during and following database implementation.

### Background

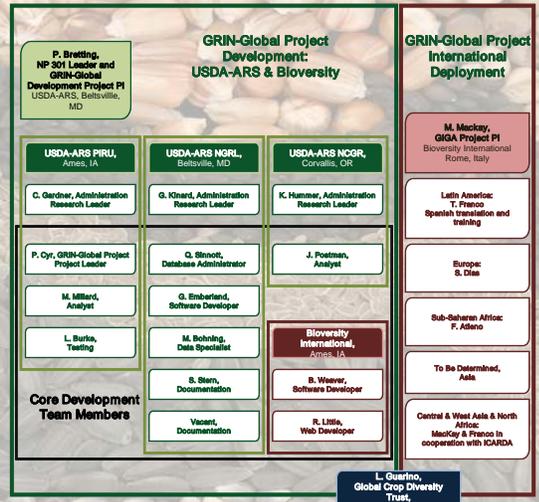
#### GRIN and the Need for GRIN-Global

Many of the world's national genebanks, responsible for the safeguarding and availability of their country's PGR collections, have lacked access to high quality IT needed to document and manage their collections electronically. The Trust recognized the common needs of the world's genebanks and the resources being expended by many genebanks or consortia independently (see <http://www.croptrust.org/main/>) and, consequently initiated the G-G project.

GRIN, developed by the USDA-ARS NPGS, is widely recognized as a superior genebank management system, largely because it has been continuously developed and enhanced during the past 22 years. As its system complexity has grown, so has the importance of its information content and delivery systems to researchers and genebank personnel. But, international genebanks interested in adopting GRIN have been challenged by technology licensing fees and GRIN's inherent complexity.

New 'best of breed' tools such as Microsoft .Net technology make it possible to construct a system architecture so that the database, and the business and presentation tiers can be developed and then continuously maintained or modified independently. Interoperability with other databases is facilitated by the design of the business tier, essentially, calls from the presentation tier(s) are for data only. By supporting use of MySQL, MS SQL Server or Oracle, and by providing all source code for system components, G-G enables a genebank to tailor information management decisions to their specific circumstances.

### GRIN-Global – A \$2.3 M Project Partnership



### Acronyms Used:

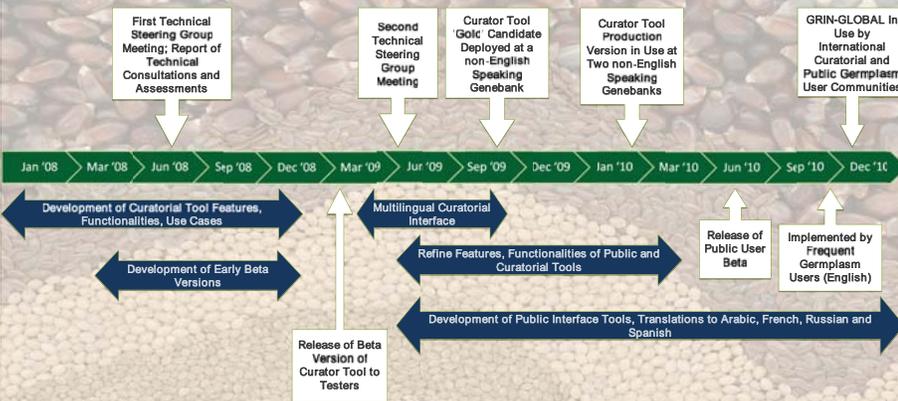
API	Application Program Interface
CGIAR	Consultative Group on International Agricultural Research
G-G	GRIN-Global
GRIN	Germplasm Resources Information Network
IM	Information Management
IT	Information Technology
MOD	Model Organism Database
MS	Microsoft
NPGS	National Plant Germplasm System
PGR	Plant Genetic Resources
SRP	System-wide Genetic Resources Programme
Trust	Global Crop Diversity Trust
USDA-ARS	United States Department of Agriculture – Agricultural Research Service

### Objectives for the GRIN-Global Project

Create a scalable version of GRIN that provides the world's crop genebanks with a powerful, flexible, easy-to-use plant genetic resource (PGR) information management system that:

- Safeguards PGR and information vital to global food security
- Encourages PGR use
- Provides database features and functionality for effective IM
- Will be free of recurring licensing costs, database flexible, and with open, free source code to system components

### GRIN-Global Project Timeline

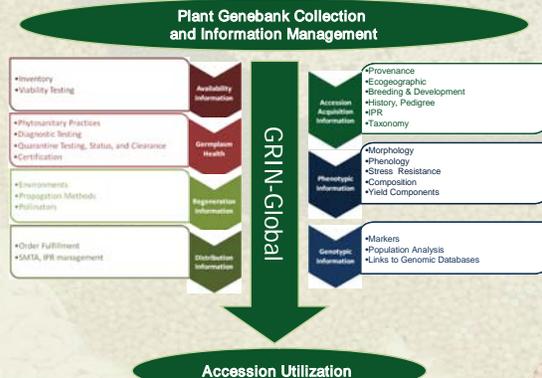


### Advantages of G-G for Genebank Use

- User friendly PGR information system that can promote access to, and the efficient and effective management and use of PGR worldwide
- Built on the current GRIN, which for more than 20 years has efficiently and effectively managing PGR information
- The flexible system architecture enables customization of G-G to meet local requirements
  - Local system administrator can implement G-G in different ways, ranging from a simple genebank inventory application, through managing all local genebank activities to a widely distributed information management system that also supports on-line user searching and germplasm ordering.
  - Can be implemented on a networked system or on a stand-alone personal computer
  - Will support MySQL, MS SQL Server, or Oracle databases
  - Layered security design for maximum flexibility to delegate user rights
  - Provide interfaces in Arabic, English, French, Russian and Spanish
- Will enable many genebanks in both developing and developed countries to obtain an information management system that will be continually maintained and updated.
- Its scope and functionality result from input of genebank managers throughout the world
- Ability to drag and drop from G-G to spreadsheets or from spreadsheets directly to G-G database
- Ability to customize multiple screen views, forms and menus
- Ability to create lists and drop them into different work areas
- Includes a 'Google-like' internal search engine

### Advantages of G-G for Researchers

- Provides ready access to information on PGR valuable for research and development
- Incorporates a user-friendly interface for extracting and manipulating PGR information
- Utilizes a 'Google-like' search engine
- Facilitates ordering germplasm that meets specific research needs
- Provides for interoperability requirements with other databases
- Will incorporate extensive user feedback during program development



Please Provide Input at: <http://www.grin-global.org/forums/>

Information Wiki Site: [http://www.grin-global.org/index.php/Main\\_Page](http://www.grin-global.org/index.php/Main_Page)

### USDA-ARS NPGS Project Role

<http://www.ars.usda.gov/main/main.htm>

Provide an enhanced GRIN database schema and to construct and provide a core set of web services, enterprise services or other technologies for updating data stored on a centralized information management system and for distributing centralized data to existing, off-site systems. This approach will enable GRIN-Global to serve either centralized or decentralized genebank networks and to share data with other third parties. Supports the G-G Project via almost \$1 million of in-kind contributions.

### Bioversity International Project Role

[http://www.bioversityinternational.org/bioversity\\_international\\_homepage/](http://www.bioversityinternational.org/bioversity_international_homepage/)

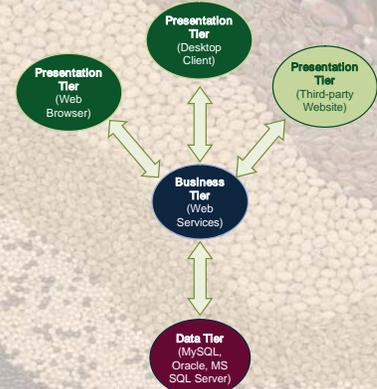
Support deployment of G-G internationally, through regional PGR networks, its Regional Offices and the SRP, working with project personnel to identify cooperators to document G-G in other languages, translate the new system into Arabic, English, French, Russian and Spanish, and implement it in developing countries. Implementation will be monitored and barriers to adoption identified. The impact of system use will be evaluated by users during and following implementation.

### The Trust Project Role

<http://www.croptrust.org/main/>

Provides a \$1.4 million grant for the development of G-G and its international deployment to support effective PGR conservation, and to ensure that GRIN-Global meets international genebank and information management needs.

### Design of the GRIN-Global System



The G-G system is built using the well established three-tier architecture design pattern consisting of a Presentation Tier, Business Tier and Data Tier.

The Data Tier is quite simply the database where all of the PGR data is permanently stored. Fundamental to the design of the G-G system is the principle of database flexibility – currently MySQL, Microsoft SQL Server, and Oracle database systems are supported. Future efforts (beyond scope of current project) could include adding support for other database systems.

The system's Business Tier contains a full complement of web services (software modules that are accessible over the internet via standard messaging protocols) that enable the entire database repository to be made accessible to any other computer system connected to the internet. The web services currently implemented in the Business Tier will provide data in XML format using the SOAP protocol to any computer system capable of processing this type of transaction. Future efforts (beyond scope of current project) could include web services based on JSON and YAML.

Because the Business Tier is built using web services, the Presentation Tier can assume many different forms with no compromise in data accessibility. For example, the G-G website will retrieve all PGR data from the database using the web services of the Business Tier. In like fashion, the G-G Curator Tool (a desktop .NET Windows application) uses the same web services to retrieve data and enable the Curators to create, update, and delete data from the database. Finally, any third-party application or website (ex. MaizeGDB, SoyBase, etc.) wishing to retrieve data from the G-G system can do so by connecting to the Business Tier web services in exactly the same way as the G-G website or Curator Tool application.