GRIN-Global:
An International Project to Develop a Global Plant Genebank and Information Management System

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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 (PostgreSQL, MS SQL Server, Oracle, MySQL), 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.

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
SGRP	System-wide Genetic Resources Programme
Trust	Global Crop Diversity Trust
USDA-ARS	United States Department of Agriculture – Agricultural Research Service

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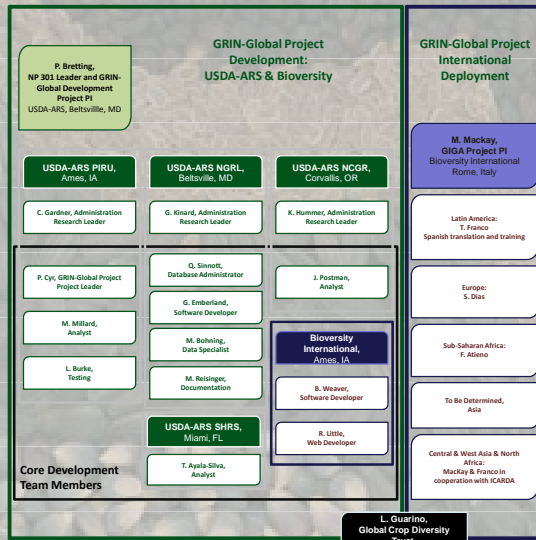
New 'best of breed' tools such as Microsoft .Net technology make it possible to construct a system architecture so that the database, and the business and presentation tiers can be developed and then continuously maintained or modified independently. Interoperability with other databases is facilitated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

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
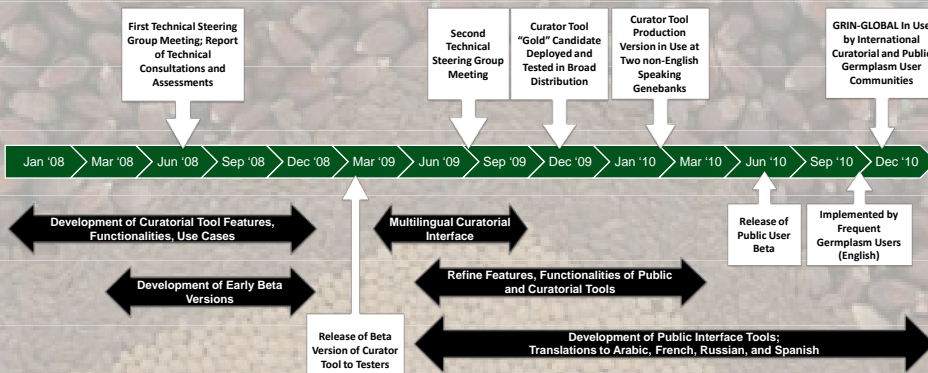
GRIN-Global – A $2.3 M Project Partnership

USDA-ARS NPGS Project Role
http://www.ars.usda.gov

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

Support deployment of G-G internationally, through regional PGR networks, its Regional Offices and the SGRP, 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

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.

GRIN-Global Project Timeline

Advantages of GRIN-Global for Genebank Use

- User friendly information system that can promote worldwide access and effective management and use of PGR
- Built on the current GRIN, which for more than 20 years has efficiently and effectively managed 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 a widely distributed information management system that manages all local genebank activities, including the support of on-line user searching and germplasm ordering
  - Can be implemented on a networked system or on a stand-alone personal computer
  - Will support PostgreSQL, MS SQL Server, Oracle, or MySQL 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 the input of genebank managers throughout the world
- Provides drag and drop capabilities from G-G to spreadsheets or directly from spreadsheets to the G-G database
- Provides ability to customize multiple screen views, forms, and menus
- Lists can be created and dropped into different work areas
- Includes a 'Google-like' internal search engine

Advantages of GRIN-Global 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
- Incorporates extensive user feedback during program development
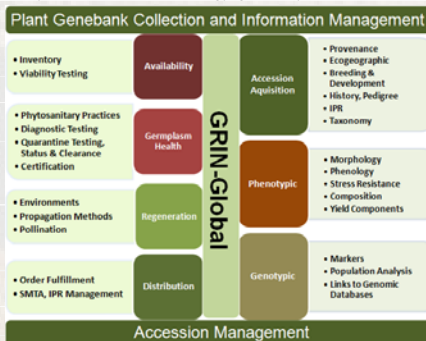
Design of the GRIN-Global System
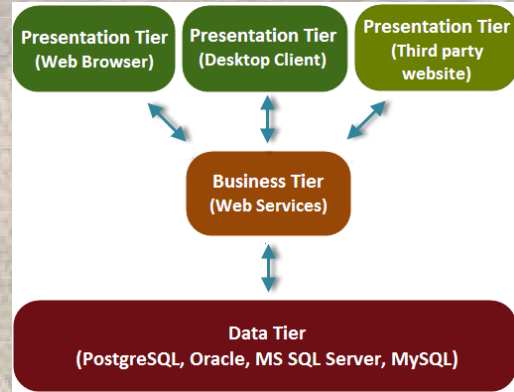
The G-G system is built using the well established three-tier architecture design pattern consisting of Data, Business, and Presentation Tiers.

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 PostgreSQL, Microsoft SQL Server, Oracle, and MySQL 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.

Please provide input at: http://www.grin-global.org/forums/

Information wiki site: http://www.grin-global.org