

FINAL REPORT

Australian Tropical Grains Germplasm Centre DAQ00131

Project Details

- **Project Code:** DAQ00131
- **Project Title:** Australian Tropical Grains Germplasm Centre
- **Start Date:** 01.07.2008 **End Date:** 30.06.2010
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Summary

DAQ00131 project activities aimed to: conserve tropical grains germplasm under long-term storage conditions; acquire new germplasm with unique traits of interest to clients (particularly to breeding programs); the maintenance of germplasm through viability testing and regeneration; and to increase awareness of the availability of tropical grains germplasm to clients. New project goals were to facilitate the creation of the national grains Genetic Resources Centre (GRC) and included training GRC staff in the use of GRIN-Global (GG), a software management system, so that grains data can be nationalised across Australia; and contribute to the action plan development for the relocation of tropical grains germplasm to both Tamworth and Horsham.

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Old Reports

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Conclusions

Tropical grains germplasm has been increasing in importance over recent years due to a range of factors, including climate change and the development of new technologies to successfully breed with extremely diverse germplasm. The Biloela GRC fulfils a vital role in providing the scientific and breeding community with an increasingly diverse range of germplasm from a wide range of tropical grain crops and their wild relatives. The increasing use and characterisation of this germplasm are directly linked to the breeding of new varieties of tropical grain crops with improved productivity, leading to increased productivity and hence profitability of grains crops.

The pending release and implementation of GG in Australia will nationalise the data and create a united front for the grains GRCs in Australia. This is a period of significant change for genetic resource infrastructure in Australia, and one that will create a nationalised, co-ordinated approach for continued conservation of these critical plant genetic resources.

Recommendations

It is essential that a co-ordinated national approach be formed for genetic resources in Australia. Under the current reform and infrastructure review, a position must be formed for 1) the national leadership, 2) a standardised approach for the application of Material Transfer Agreements, and 3) obligations under the federally ratified International Treaty on Plant Genetic Resources (in particular for our indigenous plant species).

Outcomes

The outcome is improved productivity of tropical grain crops in Australia through the breeding and development of new varieties that contain new sources of genetic diversity from germplasm conserved by the Australian Tropical Grains Germplasm Centre in Biloela. New sources of diversity will lead to improved resistance to both abiotic and biotic stresses, improved water use efficiency, and a reduced agricultural footprint of tropical grain crops.

Economic outcomes:

No direct economic outcomes were realised during the course of this project as the tropical grains germplasm used to develop new lines takes many years for commercial returns. The post-project improved productivity will be realised through increased characterisation of tropical grains germplasm in research and breeding programs. These programs lead directly to the development of new breeding lines targeting traits for improved productivity and hence profitability including yields, grain quality and human health (gluten free).

Environmental outcomes:

The development of breeding lines with improved pest and disease tolerance following on from this project will reduce the use of chemical pest control applications, with a direct benefit for the environment. Use of the native sorghum species in breeding programs has the most potential to realise these environmental benefits in the medium term.

Social outcomes:

Grains including sorghum, maize, sunflowers and legume crops are an integral part of the northern grain farming systems. Increasing profitability through provision of germplasm to breed new varieties will help maintain the viability of rural communities. The tropical grains germplasm distributed by this project is used in research and breeding programs that are training new scientists and plant breeders. An indirect social benefit is building the capacity of the Australian scientific community.

Achievement/Benefit

Background

The future of Australian agriculture is reliant on access to new sources of plant germplasm sourced from existing Australian Genetic Resource Centre collections, or when necessary, imported from other countries. This enables plant breeders to develop new improved varieties of crops and forages. Australia's long-term food security is hence dependent on secure access to plant germplasm. The Australian Plant Genetic Resource Centres provide this long-term security while also meeting current industry needs for ongoing plant improvement.

Australia ratified the International Treaty on Plant Genetic Resources for Food and Agriculture in 2005. It has obligations under this Treaty that will be met most appropriately through a national system for managing plant genetic resources. The Australian network of six independent Genetic Resource Centres is being restructured into a nationally co-ordinated system. This restructuring will present a unified, sound national system to the rest of the world that will satisfy the requirements of the Treaty by enabling Australia to be represented by a single entity encompassing all germplasm collections. A significant additional benefit of a national system would be to have the Commonwealth, states and industry stakeholders working together in a long-term strategic approach to conserve and manage Australia's valuable collections of plant genetic resources with the assistance of a national steering committee and a national coordinator. A national repository for long-term backup collections is also considered important to safeguard collections and hence food security.

Biloela is the most diverse and unique germplasm centre in Australia. It contains a wide range of grain species and their close relatives. Much of this living seed collection is globally unique, and some is irreplaceable. It is therefore vital that this valuable germplasm is conserved and available to be used by the scientific community to continue the economic development of both domestic and global grains industries. This project will continue to provide long-term security for the germplasm which underpins Australia's tropical grains industry.

Objectives:

The project had three main objectives: 1) to continue to conserve tropical grains germplasm relevant to plant breeders and the scientific community, 2) to increase the use of the germplasm and 3) to facilitate the transfer of the germplasm to Tamworth and Horsham, including the implementation of the GGdatabase in Australian centres.

1) Conserve tropical germplasm

The promotion of tropical grains germplasm to clients at industry meetings, conferences, workshops and through personal networks has seen an increase in demand more than in previous years for germplasm not held within the Biloela GRC or elsewhere in Australia. The acquisition of new tropical grains germplasm during this project period has primarily focused on germplasm with environmental adaption traits. These traits were identified through communication with international and domestic researchers, literature review, and examination of global genetic resource centre databases. The germplasm imported during this project period (and into the next 12 months) has been specifically targeted for cold and heat tolerance, water use efficiency and pest and disease tolerances, as well as for broad genetic diversity. There has also been increased demand for germplasm from representative 'genetic diversity panels' within the sorghum crop group. Representatives of these diversity panels have also been imported.

Acquisition of germplasm from within Australia is focused on Australian indigenous tropical grain crop relatives. The target is to increase the genetic diversity and geographic diversity represented in the collection. A single wild sorghum accession was acquired during this project period. An in principal agreement has been made with University of Queensland (UQ) scientists to lodge all wild sorghum accessions that will be collected under the Global Crop Diversity Trust funded GAP Collection project to be undertaken November 2010 through to May 2011. It is expected that up to 100 new accessions of wild sorghum will be acquired from this project.

An in principal agreement has also been made during this project period with Professor Robert Lawn to lodge his substantial collection of indigenous *Vigna* species in the Genebank. These *Vigna* represent a globally unique set of accessions that have been extensively characterised (morphologically and genetically). The significant consultation and communication that the Biloela GRC staff undertook during the project have therefore secured the conservation of two globally unique germplasm sets within the next project period.

2) Increase the use of tropical grains

The use of the tropical grains germplasm collection has increased twofold each year for the past three years. This is directly related to the active promotion of grains germplasm by Biloela GRC staff at industry meetings, conferences,

workshops and through personal networks. There has been a misconception that the Biloela GRC has been shut down, or is being shut down, and that grains germplasm is not being distributed amongst some Australian grains users. Significant effort has been made by GRC staff to ensure clients that germplasm is still available for their research and breeding programs.

Over the past decade, there has been increasing demand for a greater diversity of germplasm and in particular for wild related species of tropical grain crops. Over this project period, there has been a significant increase in demand for specific wild sorghum species for use in applied genetic studies and breeding programs. There has also been considerable interest in the indigenous wild *Vigna* species, particularly from overseas. The increase in genetic and physiological characterisation of this germplasm will lead to more targeted use in breeding programs beyond this project period.

There has been significantly more interest in pulse species during this project period than in the cereal grains, especially for the navy bean and lablab crop groups. This indicates that there is potentially an increasing research focus to improve these two grain crop industries within Australia.

During this project period, all germplasm originating from Iran was returned to its national Genebank system. During this process, Dr Sally Norton established a good working relationship with the curator of the Iranian Biological Resource Centre, which has facilitated access to their unique germplasm collection. Currently, the Iranian Biological Resource Centre does not have a digitised germplasm management system, therefore access to this germplasm can be difficult. Through Dr Norton's suggestion, the Iranian Biological Resource Centre is exploring the adoption of GG within their Genebank.

3) Facilitate grains transfer of tropical grains to new destination, including GG

Close collaboration with Greg Grimes at the Winter Cereals Collection (Tamworth), and Dr Bob Redden at the Temperate Field Crops Collection (Horsham), has seen the development of a transitional project for 2010-2011 for relocation of the tropical grains seed from Biloela. The transitional project includes continuation of regeneration activities at Biloela following relocation of the seed. A draft action plan has been developed for the physical movement of the seed that will occur prior to completion of the transitional project, and after GG has been successfully rolled out in Horsham and Tamworth.

In April 2010, Dr Norton attended the GG 'Train the Trainers' workshop in Beltsville, USA. At this workshop, she had intensive training in the layout and schema of GG, and learnt how to use the Beta Test Version of the software. On returning to Biloela, Dr Norton converted the Biloela GRC passport and inventory data into the GG required format. This involved preparing templates for passport and inventory data loading into GG, that indicate mandatory and optional data fields for each table with GG. Once all table templates are completed, these will be distributed to Tamworth and Horsham GRCs for data input.

Dr Norton has been crosschecking the similarity of data field names and descriptors used in the Biloela and Horsham GRC passport and inventory datasets with that of the accepted terminology used in GG. This required renaming some fields in the Biloela dataset, and will also be required in the Horsham datasets. The Tamworth dataset had not been received by the end of this project period.

Extensive discussions between the curators of the Biloela, Tamworth and Horsham centres have been held regarding the implementation of GG. A meeting has been set for mid October to decide appropriate germplasm accession numbering systems so that the identity of the three GRCs can be easily transferred into GG, and importantly, to minimise the labour required integrating Biloela germplasm into Tamworth and Horsham seed banks.

GG will be installed and implemented in Tamworth and Horsham once the release version becomes available. Extensive changes have been made to the GG test version by the developers, so there will be a time period required for Dr Norton to familiarise herself with the released version of GG prior to running training and implementation within the Tamworth and Horsham GRCs. GG will be fully implemented and working alongside existing database systems by the end of the 2010-2011 transitional project phase. It is essential that GG is run alongside existing database systems for a period of time to ensure data is being stored and examined accurately (i.e. ensure no data is being lost or overwritten).

Other Research

Global Crop Diversity Trust Grant received for the collection of wild sorghum species from northern Australia and Indonesia and Timor-Leste. This project is being led by Drs Pete Prentis and Ed Golding at the University of Queensland, and includes Dr Sally Norton (DEEDI) as one of the senior members of the project team. This project will target poorly collected or represented Australian indigenous sorghum species from the Northern Territory, Western Australia, Queensland, New South Wales and Victoria, as well as wild sorghum species indigenous to Indonesia and Timor-Leste. This project will significantly increase the value of the wild sorghum collection held in the Tropical Grains GRC.

Intellectual Property Summary

There is no Intellectual Property associated with this project.

Collaboration Organisations

United States Department of Agriculture (USDA) (Iowa State University and National Germplasm Resources Laboratory).

Mark Millard (Germplasm Curator and GRIN-Global database)

Marty Reisinger (GRIN-Global database developer)

Pete Cyr (GRIN-Global database developer)

Gary Pederson (Germplasm Curator)

Nature of collaboration:

- a) training and assistance in GRIN-Global
- b) exchange of information on germplasm characteristics
- c) germplasm exchange

Bioversity International (Rome).

Michael Mackey (Program Leader)

Nature of collaboration:

- a) training and implementation of GRIN-Global.

International Maize and Wheat Improvement Center (CIMMYT), Mexico.

Ana Luisa Ordaz Cano (Seed distribution unit)

Nature of collaboration:

- a) exchange of information on germplasm characteristics
- b) germplasm exchange

International Crops Research Institute for the Semi Arid Tropics (ICRISAT), India.

Hari D Upadhyaya (Head of Genebank)

Nature of collaboration:

- a) exchange of information on germplasm characteristics
- b) germplasm exchange

Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement (CIRAD).

Joseph M'Balla Morgan (Seed distribution unit)

Nature of collaboration:

- a) exchange of information on germplasm characteristics
 - b) germplasm exchange
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Collaboration Details

Most of these international collaborations involved the exchange of information and germplasm (both acquiring germplasm for Australia, and exporting germplasm to other countries). Extensive information exchange with the USDA and Bioversity was for the purpose of GG training.
