# Ontology-driven International Maize Information System (IMIS) for Phenotypic and Genotypic Data Exchange

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## The International Crop Information System (ICIS) Model

- Open-source and open-licensed generic crop information system.
- Developed by the Consultative Group on International Agricultural Research (CGIAR), national agricultural research and extension systems, agricultural research institutes, and private-sector partners.
- Designed to fully document germplasm genealogies with associated meta-data such as passport data and to accurately cross-link germplasm entries with associated experimental observations from evaluations undertaken in the field, greenhouse, or laboratory.

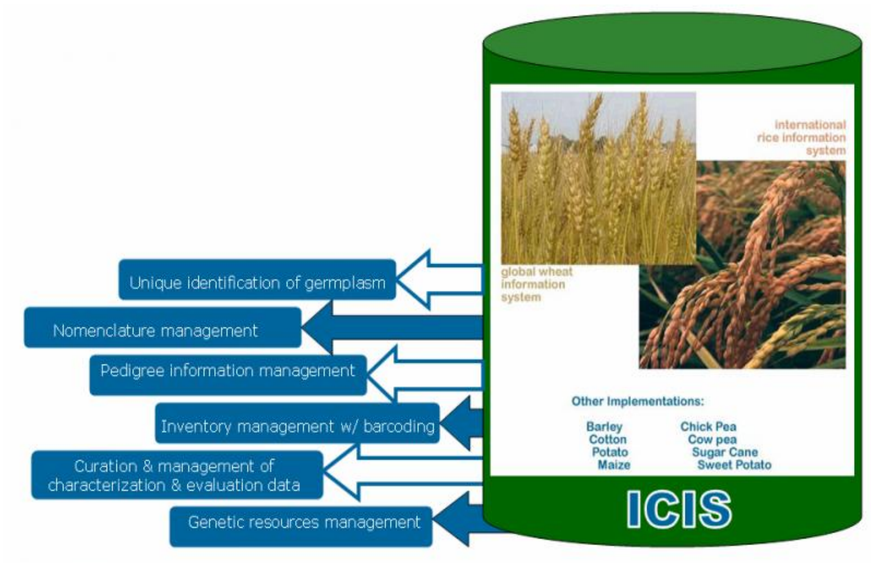
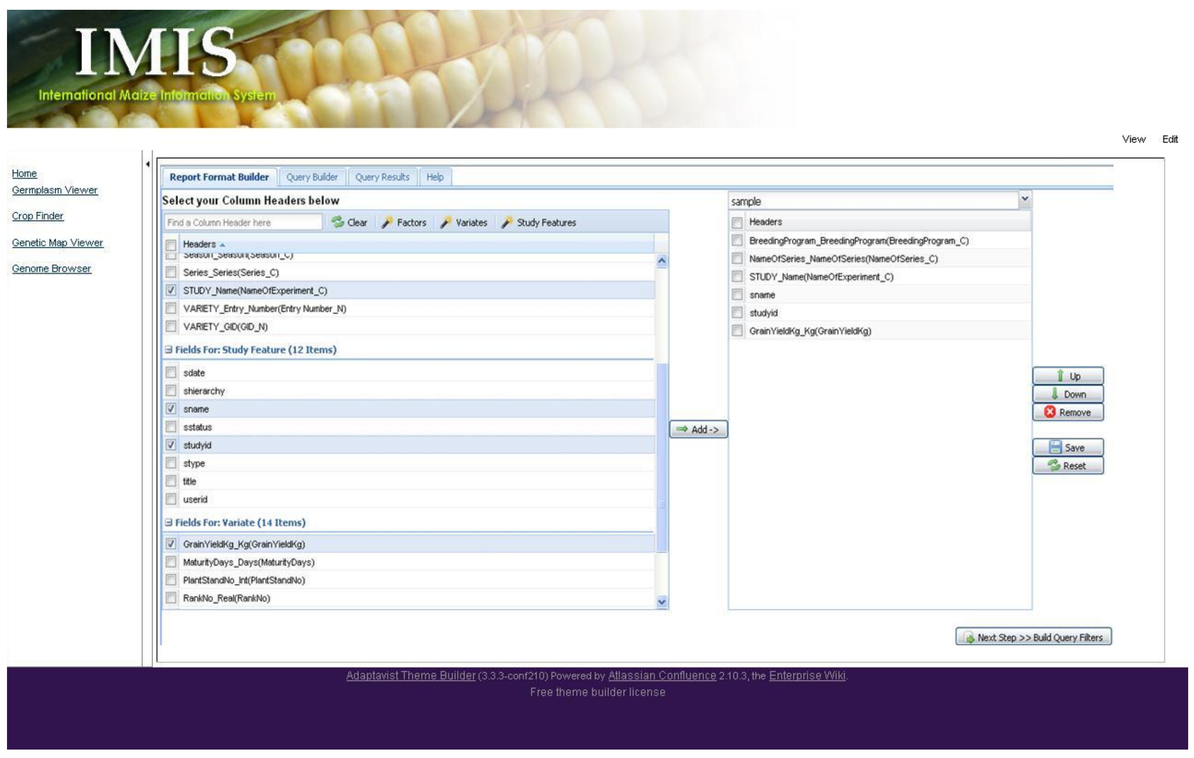



**Figure 1.** International Crop Information System (ICIS) model for addressing the problem of ambiguous germplasm identification, difficulty in tracing pedigree and lack of integration between genetic resources, breeding, evaluation , utilization and management trait data.

## The International Maize Information System (IMIS)

- The IMIS is the public maize implementation of ICIS and CIMMYT's flagship germplasm database.
- Contains about 33,000 germplasm ID (GID) entries with thousands of associated data points in hundreds of experimental studies, including many phenotypic observations and growing numbers of genotypic measurements.
- Query interface is available for researchers to search germplasm and associated maize breeding data.
- Many of these data sets are published in IMIS and initiated sharing data with collaborating databases such as MaizeGDB.



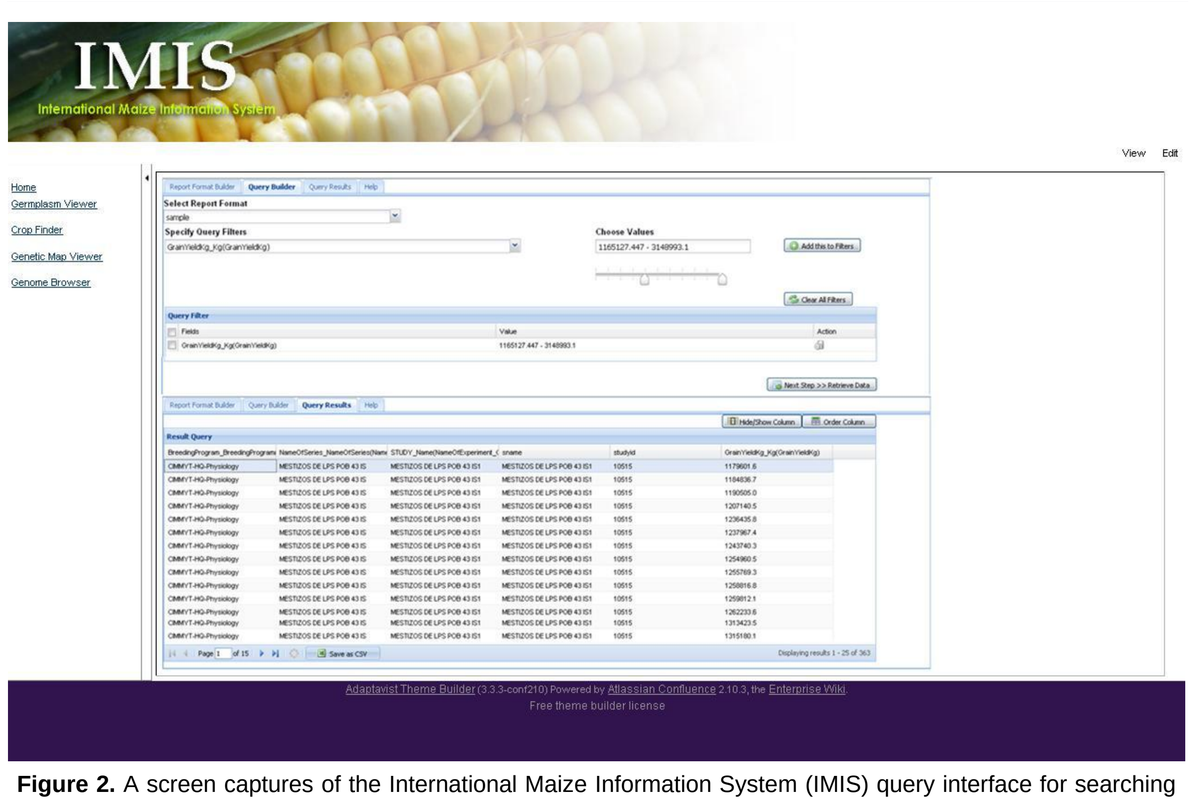
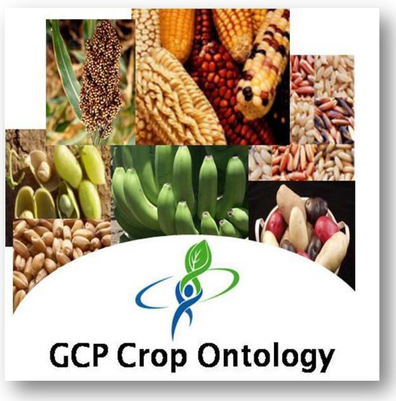




**Figure 2.** A screen captures of the International Maize Information System (IMIS) query interface for searching genotypic or phenotypic data. In the figures, query steps and result for the trait data "grain yield" are shown in detail.

## The Crop Ontology (CO)

- The CO provides controlled vocabulary sets for several economically important plant species and facilitates biocurators working in genebanks of plant genetic resources (PGR) and crop breeding data curation and annotation.
- It also facilitates data exchange within and between globally distributed databases, developing user-friendly query interface for searching crop data and allowing researchers to perform comparative studies across crops.




- The maize-trait ontology is developed based on the traits that are in the Data management system (DMS) trait table of IMIS database along with the traits that are described in maize crop descriptor and GCP datasets.

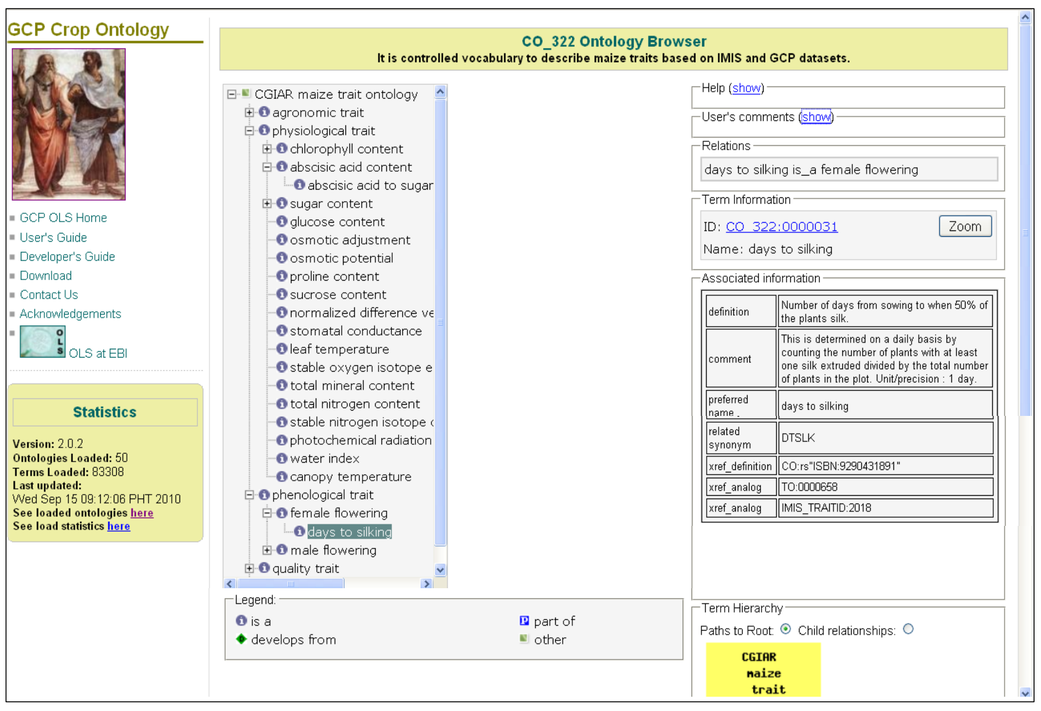



**Figure 3.** A screen capture of the GCP Crop Ontology Lookup Service (OLS) browsing maize trait ontology. The information for the highlighted trait "Days to silking" is shown such as trait ID, trait description, synonym.

## Implementation of the CO in the IMIS database

- The IMIS traits are mapped to those of maize-trait ontology and linked them to ontology databases by term (trait) identifier.
- Similarly, the scales for trait measurement, locations for germplasm collection [which are listed in the table of Genealogy Management System (GMS) of IMIS] and experimental sites are mapped to the generic ontologies such as scale ontology, gazetteer ontology.

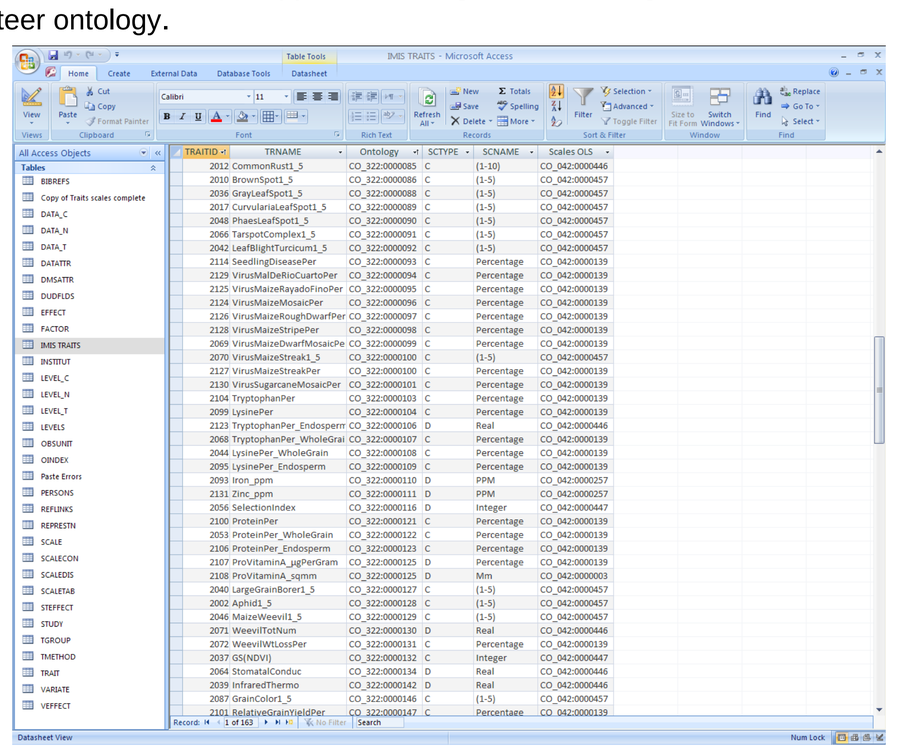



**Figure 4.** The Data Management System (DMS) table of the IMIS showing mapping traits to the maize_trait ontology and also IMIS trait scales to the ICIS scale ontology. The curation is expended for linking phenotypic data to genotypic data by mapping the IMIS traits with molecular data such as QTL to the maize_trait ontology

## REFERENCES

- Bruskiewich R, Senger M, Davenport G, et al. 2008. The Generation Challenge Programme Platform: Semantic Standards and Workbench for Crop Science. International Journal of Plant Genomics Article ID 369601, 6 pp.
- McLaren CG, Bruskiewich RM, Portugal AM et al. 2005. The International Rice Information System. A Platform for Meta-Analysis of Rice Crop Data. Plant Physiol. 139:637-642.
- Shrestha R, Arnaud E, Mauleon R, et al. 2010. Multifunctional crop trait ontology for breeders' data: field book, annotation, data discovery and semantic enrichment of the literature. AoB Plants. plq008.

## AVAILABILITY

- The ICIS information is available at http://www.icis.cgiar.org.
- The IMIS query interface is available at http://imis.cimmyt.org/ for searching maize data.
- The GCP crop ontology and platform are described on the pantheon website at http://pantheon.generationcp.org.
- The GCP Lookup Service is available at http://cropontology.org to browse ontologies.
- The CropForge software project management site is available at http://cropforge.org/projects/gcpontology for the collaborators and users.

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