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SHiNeMaS : A database and its web interfaces dedicated to seed lots history, phenotyping and cultural practices

Yannick De Oliveira¹, Laura Burlot¹,²,³, Isabelle Goldringer¹, Darkawi Madi¹, Pierre Rivière¹,², Delphine Steinbach¹, Gaëlle Van Frank¹ and Mathieu Thomas⁴

¹ INRA, UMR Génétique Quantitative et Évolution - Le Moulon, 91190, Gif-sur-Yvette, France
² Réseau Semences Paysannes, 10 Place Clémencette, 47190, Aiguillon, France
³ AgroBioPérigord, 7, impasse de la Truffe, 24430, Courcas, France
⁴ CIRAD, UMR AGAP, Avenue Agropolis, 34398 Montpellier Cedex 5, France

SHiNeMaS is designed to support multiple species, in the same instance of the database, dealing with different life cycles of plants from annual to perennial. The tests trials are located in farms or in experimental stations and split into small plots. A mixture of species can be grown in a single small plot. SHiNeMaS can therefore deal with species association like prairie trials.

SHiNeMaS also provides powerful query forms to search data. Information can be searched by two way. The first one is a global form (1) that searches over all the seed lots, germplasm, relation, and gives a direct access to their profile card (the picture on the right shows a seed lot card). The second is an advanced query form with much filters (year, germplasm, location, variables measured etc.) that displays a data table with a list of seed lots resulting of the query. A card shows all the information and data related to an entity (seed lot, germplasm, relation). For example, a seed lot card will show its basic information, history (2) and stock information (3). A relation card will also show global data as well as individual data as a table. From any access, the data table can be downloaded as a text file.

The figure below is a simplified representation of the database schema of SHiNeMaS. The schema is centered around the Seed Lot. A seed lot is characterized by a Germplasm which is characterized by a Species. Users can describe dynamically germplasm's type like cross, mixture, population, local variety, inbred line, etc.

SHiNeMaS is developed using the python technology with django framework. The database management system used is PostgreSQL but SHiNeMaS should be able to run with MySQL, Oracle or SQLite.

Participatory plant breeding programs

In 2005, a collaboration started between the French National Institute for Agricultural Research (INRA) and the farmer organization Réseau Semences Paysannes (RSP). The aim was: (1) to study on-farm management of crop diversity, cultural and selection practices; (2) to develop population-varieties adapted to organic and low inputs agriculture in the context of a participatory plant breeding program involving farmers, NGOs, facilitators and researchers. In these projects, it is needed to map the life cycle of seed lots using the network formalism.

To reach this aim, we developed SHiNeMaS (Seeds History and Network Management System) a database with its web interface, dedicated to the management of the history of seed lots and the associated data.

Data organization & technologies

The graph on the left shows a classic network coming from a participatory plant breeding program. Each circle represents a seed lot, and a same color for a seed lot points up a same population. Such networks aim to provide answers about:

- Which population-variety are the most diffused ?
- Which population-variety are conserved from one year to another ?
- Do farmers select same varieties ?

The farmers and researchers aim also to get information about seed lot management (stock and location).

Web interfaces

Data submission

1. SHiNeMaS provides interfaces to load massively the data with tabulated text files. These files contain information like:
   - Seed lots list, year, quantity
   - Plot position
   - Data measured

2. export pre-filled file with:
   - Sowed seeds lots list (previous harvested seeds lots)
   - Sowing/harvesting year

3. User fill the file with plot location, quantity, data measured

4. the exported file can contains existing relations and can be used to delete data

Data management

The Django framework provides an automatic admin interface that we decided to use in SHiNeMaS. We enriched it with administration features. Other features were developed to manage data through the web interface.

A user can edit/delete data on a profile card (see below) or delete a whole series of data if he decides to reload it through a data file.

Data querying

SHiNeMaS provides powerful query forms to search data. Information can be searched by two way. The first one is a global form (1) that searches over all the seed lots, germplasm, relation, and gives a direct access to their profile card (the picture on the right shows a seed lot card). The second is an advanced query form with much filters (year, germplasm, location, variables measured etc.) that displays a data table with a list of seed lots resulting of the query. A card shows all the information and data related to an entity (seed lot, germplasm, relation). For example, a seed lot card will show its basic information, history (2) and stock information (3). A relation card will also show global data as well as individual data as a table. From any access, the data table can be downloaded as a text file.

Perspectives and next developments

An instance of SHiNeMaS is in production at the GQE laboratory. It stores about 2 000 germplasms, 19 000 seed lots, 18 000 relations and more than 1 600 000 records of collected data on the network. SHiNeMaS 1.0 is already available under the AGPL license and SHiNeMaS 1.1 will be available in early 2019. Development of version 2.0 is ongoing and will include new data types management (germplasm level data, images and climatic data). Features will be available to export data in PPBSStats format, a R package to analyze data stored in SHiNeMaS. In the next versions we aim also to improve management of user access, quality control on imported files and use ontologies. This software has been developed with the collaboration of DEAP team (GGE-Le Moulon).