



Knowledge-based system for rainfed *natu* tobacco (*Nicotiana tabacum*) germplasm

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Received: 4 January 2012; Revised accepted: 23 February 2012

ABSTRACT

Tobacco (*Nicotiana tabacum*) is a commercial crop in many countries. Most of them are maintaining large number of germplasm collections without computer databases. Accessing the large amounts of plant genetic resource data requires the development of germplasm databases. Tobacco germplasm are of different 'types', with large numbers of accessions in each type. Among the different tobacco types grown in India, rainfed *natu* tobacco is an indigenous type mainly used for domestic consumption. Based on the data available on various parameters of rainfed *natu* tobacco accessions, a knowledge-based system for rainfed *natu* tobacco germplasm was developed with user-friendly menus using RDBMS technology. This software allows the users to store, update and retrieve the germplasm data of all tobacco types on various parameters and acts as a decision-making tool. This database can be kept in the web server for global accessing.

Keywords: Database, Germplasm, Rainfed *natu*, Software, Tobacco

The knowledge-based systems (KBS) are computer programmes developed for simulating problem-solving behaviour of an expert in a narrow domain or discipline. One of the applications of knowledge-based systems in agricultural sciences is development of databases for germplasm resources (Fox *et al.* 1996, Fox and Skovmand 1996, Bruskiwich *et al.* 2003, Christopher *et al.* 2005, Chen and Huang 2007, Agrawal *et al.* 2007, Mundankar and Karibasappa 2008, Ravisankar *et al.* 2009). Expert systems on nutrient management and abiotic stress, in tobacco were developed (Ravisankar *et al.* 2009b, Ravisankar *et al.* 2010). In the present study, an attempt was made to develop a user-friendly knowledge based system for rainfed *natu* tobacco germplasm.

Tobacco (*Nicotiana tabacum*) is a commercial crop in many countries. Most of them are maintaining large number of germplasm collections without computer databases. Accessing the large amounts of plant genetic resource data requires the development of germplasm databases. In India, Central Tobacco Research Institute (CTRI), under Indian Council of Agricultural Research, Ministry of Agriculture, Government of India, is recognized as the National Active Germplasm Site for tobacco (Rao *et al.* 2005) and takes the responsibility of collection, maintenance, evaluation and documentation of all types of tobacco germplasm so as to

facilitate their improvement for domestic and export purposes. The Institute is maintaining a total of 2 992 accessions, including 57 wild *Nicotiana* species. These are different types of tobacco and each type have a large number of accessions. Due to lack of germplasm information of all these accessions at one place, a knowledge-based system was developed for storing/updating/accessing the tobacco germplasm data with various parameters. Such data bases helps in ready retrieval and faster accessing of the germplasm Information. Data on various parameters related to 81 rainfed *natu* tobacco accessions were fed into the software system for instant accessing.

MATERIALS AND METHODS

Among the different tobacco types grown in India, rainfed *natu* tobacco is an indigenous type tobacco mainly used for domestic consumption. A panel of experts in the field of tobacco germplasm was consulted and collected the information about various parameters of *natu* tobacco germplasm accessions. Based on the information collected on rainfed *natu* tobacco germplasm, a datasheet has been prepared with 40 characters that are categorized into six modules, viz. name of the accession, crop specific records, description of the accession, growing season, cured leaf yield and quality characteristics. Using this datasheet, a database was designed in MS-ACCESS (Microsoft Corporation, 1994). The application programme with various modules, viz. Storing, Updating, Query and Report has been developed in Visual Basic 6.0 (Muller 1999).

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System design (Kiong 2005) composed of several basic components: a user interface, database, knowledge base and an inference mechanism (Fig 1). System development usually proceeds through several phases including problem selection, knowledge acquisition, knowledge representation, programming, testing and evaluation. In the knowledge base, information on *natu* tobacco germplasm accessions can be stored as rules of inference that are used during the reasoning process for knowledge extraction of *natu* tobacco accessions. These rules may be if...then...else nature or any other valid form. The inference mechanism guides the reasoning process through knowledge base by attempting to match the facts in the database to other rule conditions. Inferences are identified to meet the user requests to find availability of the data in rainfed *natu* tobacco knowledge base. The transactional data from operational sources are fed into the database which in turn converts into facts and rules.

To use the system easily, the user friendly interface was developed with Graphical User Interface (GUI). The three major activities considered in designing the system are ‘New Accession’, ‘View accession’ and ‘Query’. ‘New Accession’ option provided to add new records into the database; ‘View accession’ option to view the entire information on a particular accession and ‘Query’ option to select the parameters and impose the conditions using logical operators to view and print the required information.

At present, data related to 81 rainfed *natu* tobacco accessions were fed into the software system, for storage and accessing. Open Data Base Connectivity (ODBC) has been provided to access the data from the database with the developed application.

RESULTS AND DISCUSSION

This software is a user-friendly system and provides a set of facilities to store, retrieve and update the tobacco germplasm data easily. It also has the capability to access the data by searching the photo of the accession. The main menu of this software consists of four options, viz. New accession, View accession, Query and Exit (Fig 2).

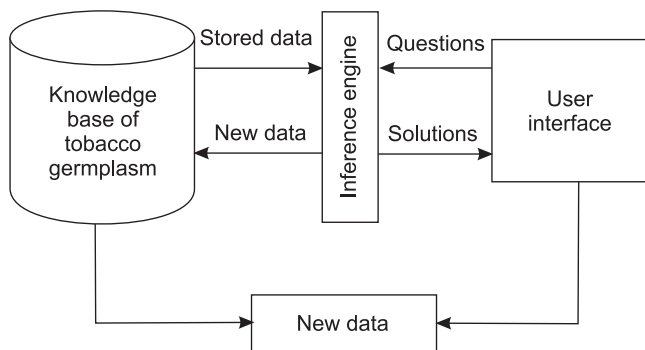


Fig 1 Knowledge base system design architecture

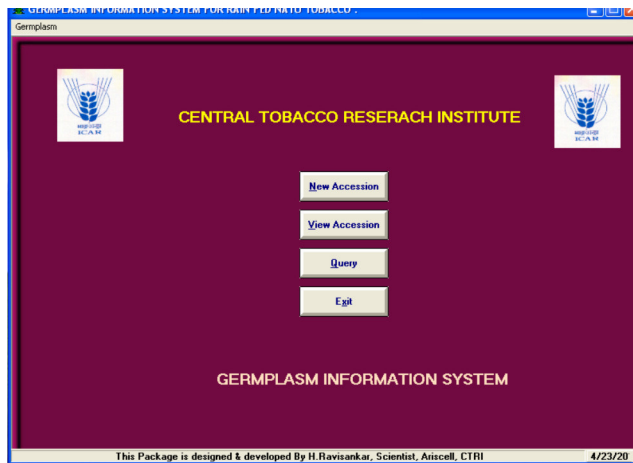


Fig 2 Main menu

New accession

This menu (Fig 3) allows the user to Add, Save, Edit, Delete and Find the records of a germplasm accession from/to the database. For adding new record into the database, click the option ‘name of the accession’ and enter the name of the accession. Then, the system verifies the existence of a duplicate record, if any, on the given accession name and allows the addition of that record, in case of non availability. By selecting the ‘Add Photo’ option, the user can add the photo of that accession to the database. Information related to an accession on various fields, viz. Description of the Accession (plant habit, internodal length, stem color, etc.), Leaf characteristics (shape, margin, surface, base, tip, colour, stalk, size, angle of insertion, etc.), Quality characteristics (percent of chlorides, nicotine, reducing sugar, etc), Reaction to biotic and abiotic stresses (diseases, pests and abiotic stress), Crop season (crop condition, green leaf, cured leaf, bright leaf, grade index), Total leaf number, suckering habit, flower colour, seed colour, rooting habit, etc. can be entered

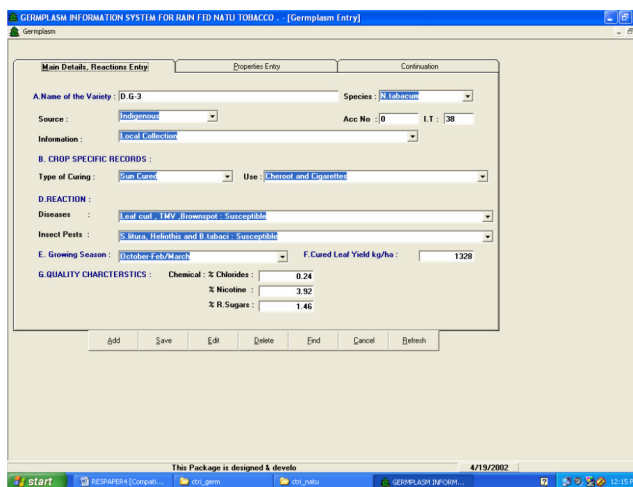


Fig 3 New accession menu

into the database. Clicking the 'Save' will save the entire record into the database. With 'Edit' option, existing record can be opened and data can be modified. The 'Delete' option allows deleting the entire record of a particular accession. 'Find' option searches the data of a requested accession.

View accession

From the main menu of the software, 'View Accession' option allows to view the complete data for a particular accession (Fig 4). Selection of 'View Accession' option displays two selection buttons, viz. photo and name of the accession. Selecting 'photo' option displays list of photos stored in the database with names. The complete details of the accession get displayed when a particular photo is selected. Selection of the name of the accession option displays list of all the accessions stored in the database. By moving the cursor to an accession, complete details of that accession gets displayed.

Query

Query option allows retrieving the data by making conditional queries on various field combinations (Fig 5). After selecting the required fields, the query displayed for verification and upon pressing the 'OK' button, query gets accepted. Selection of 'Names only' or 'Print' buttons displays the result. 'Names only' option display the names of the accessions which satisfies the given condition whereas 'Print' option displays the complete data of the accessions.

This software is developed in 'English' language for global accessing. "Setup" programme was developed for easy execution which increases the portability and compatibility of the system. Execution of this software requires a personal computer system with minimum of 64 MB RAM, preloaded with Visual Basic 6.0 and MS-Access.

Fig 4 View accession menu (based on photo)

Fig 5 Query menu

Rainfed Natu Tobacco Germplasm Database

Data related to all the 40 characters for 81 rainfed *natu* tobacco accessions were fed into the software system (Fig 6). This will enable the scientists to access the stored data on the selected parameters with conditional queries and allows adding, deleting and updating the existing data on various parameters and accessions of rainfed *natu* tobacco germplasm. This database can be kept in the web server for on-line access by the scientists engaged in tobacco research throughout the world.

The knowledge-based system for *natu* tobacco germplasm was developed with the integration of image and textual data. The user-friendly software developed using windows environment, providing enough facilities for storing and accessing information on any combination of germplasm lines. This software acts as a useful handy tool for researchers in collecting information in a very short time

Fig 6 Result menu

and take quick decisions in research based on the data stored in the database.

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