AN EFFICIENT TOOL FOR MANAGING THE SUGARCANE QUARANTINE IN CUBA: CUARENT FOR WINDOWS VERSION 2.5

By

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Abstract

CUARENT for Windows version 2.5, based on advanced-computational techniques, is presented for control of quarantine information and progress of foreign sugarcane varieties in the quarantine program in Cuba. This software gives services to researchers and technicians of the Sugarcane Genetic Improvement Program and offers the following possibilities: assistance for describing some physical characters of foreign genetic material in the greenhouse and field trials; database-management of the passport information of modern varieties, including original forms and parental information; and a record of diagnostic, sanitary and agronomic observations. The program allows decisions to be made about the final geographic destination of the foreign material, to determine the adequate diagnostic tool for evaluating sanitary quality before release, and offers some general criteria about the commercial and/or genetic value of individuals arriving into the country.

Introduction

A screening and evaluation process, under controlled quarantine conditions, should be an essential requirement to evaluate the benefits of introduced foreign varieties or species on the economy and livelihood of the target population (Sowei, 1991).

The sugarcane quarantine schedule to import varieties into Cuba begins with the introduction of foreign varieties at Isla de la Juventud, a territory belonging to the Republic of Cuba but distant from the principal island to avoid possible propagation of diseases. The post-entry phase is developed in Matanzas province, following the Cuban and international requirements to ensure accurate control of sanitary regulations, as described by the International Plant Genetic Resources Institute (Frison and Putter, 1993).

Sugarcane quarantine in Cuba is vital for the national sugar production:

- The international movement of sugarcane varieties has been an important factor for increasing sugar yields (Chinea, 1997).
- The quarantine phase is established in all the countries that exchange genetic material and new promising varieties, as an effective measure for the sanitary protection of the crop (Chinea, 1997).
- The majority of Cuban sugarcane varieties grown in Cuba have at least one foreign progenitor (Jorge et al., 2003). This is one of the main reasons justifying an increase in introduction of foreign sugarcane varieties to our breeding program.
- These elements and voluminous data generated in the sugarcane quarantine, which require high organisation and storage security, motivated specialists of the Sugarcane Genetic Improvement Program, together with specialists of computer science, to develop the software that is presented in this paper.

Several computer management systems have been developed to record information on plant germplasm or other biological material (CSIRO, 2002; FAO, 1998; Jaya Suriya and Dissanayaka, 1998; Secretariat of the Pacific Community, 2003; Shen, 1999). CLIMEX for Windows, originally developed in Australia by CSIRO (Division of Entomology) in 1985 is a computer-based system for predicting the potential distribution and relative abundance of species in relation to climate. CLIMEX is currently used in more than 20 countries to examine the distribution of insects, plants, pathogens and vertebrates for a variety of purposes, including biogeography in quarantine, biological control strategies, and impacts of changes in...
climate and climate variability (CSIRO, 2004). A database referred to as GRIN (Germplasm Resources Information Network) has been developed in the USA by the United States Department of Agriculture (USDA), Agricultural Research Service (ARS). The Australian Plant Pest Database (APPD) integrates existing reference databases enabling efficient retrieval of detailed information. The system will provide critical support to decision making during emergency management of incursions by exotic plant pests, birds for market access and justification of quarantine measures to exclude potentially harmful, exotic organisms (CSIRO, 2002).

The Secretariat of the Pacific Community (SPC) reported that the Pest List Database (PLD) for the Pacific is an information system to record pest occurrences within a country and to provide various reports of those pest occurrences. It is used by several quarantine services to record pest interceptions at ports and airports (Secretariat of the Pacific Community, 2003). Additionally, colleagues from our Institution have recently reported the existence of software used by FUNDACAÑA and Experimental Station ‘Obispo Colombres’ in Venezuela and Argentina, respectively, which assists technicians in the registration of passport data and quarantine information of sugarcane varieties and to help to make decisions.

When we started to develop our computer management system, no system similar to CUARENT was, to our knowledge, available for sugarcane. The main objective of this paper is, therefore, to present a computer system that is presently used to assist specialists of the Sugarcane Genetic Improvement Program in Cuba to manage the progress of imported germplasm in the quarantine program, and to record observations of the foreign varieties in our environmental conditions. In this way, our team contributes to the development of an effective quarantine system, which includes pathogen detection and disease diagnostics during the introduction phase of foreign sugarcane germplasm.

**Description of Cuban quarantine schedule**

Herein we describe the quarantine schedule, as well as the data flow considered to design and implement the software CUARENT version 2.5 for Windows (Figure 1). Following issues are considered for a foreign sample: passport data, reception date and characteristics of each shipment. Samples are inspected and, if some phytopathological symptoms or damages in the genetic material are found, the whole package is incinerated. Acceptable samples go to the next phase.
Both sanitary analyses and diagnostics are made in the greenhouse and in specialised laboratories for two years (plant and first ratoon crops). Both sanitary analyses and agronomical evaluations are repeated in controlled trials. When the resulting decision is 'recycling', it means that the specific variety must begin the process starting from the phase where this claim was emitted. It allows for a new evaluation and is a note of caution to be mindful if disease symptoms do not reappear or if they are absent.

When the material is released for evaluation studies to the post-entry stage on the experimental station in Matanzas, all agronomic, phytopathological and diagnostic controls are repeated for 12 months.

There are three important periods of introduction of foreign genetic material through the application of the requirements and procedures of the sugarcane genetic improvement in Cuba (Figure 2). In the period 1990–2003, the introduction of foreign varieties has been limited by the economic problems the country was facing; nevertheless, genotypes of high genetic and commercial value have been introduced. The foreign varieties that have been introduced in Cuba from different countries by sugarcane germplasm exchange have increased the genetic variability in our country (Figure 3). Following this quarantine procedure, 1494 cultivars have been eliminated, 493 because of quarantine diseases and the rest for physiological death. Detected diseases were caused by viruses (70%), bacteria (25%) and fungi (5%).

Fig. 2—Number of foreign varieties received in Cuba (1969–2003).

Fig. 3—Introduction of sugarcane foreign varieties in Cuba by countries (1969–2003) described by Jorge et al. (2003).
Sanitary control and regulation in the software

The system has seven main options (Figure 4). The option Control allows the data registration of the material arriving at the quarantine station. It means that data are captured and stored including sanitary evaluations and diagnoses at the different phases of the cycle before release of the genetic material.

![Fig. 4—Main menu of the system.](image)

Data characterising the shipment at its arrival at the Quarantine Station are stored and registered through the option General Data from Control submenu. Other information recorded for each introduction includes: code of the shipment, reception date, country of origin, the person's names who delivered and received the shipment, treatment applied to the shipment (chemical, thermal or both) in its original country, and number of individuals (Figure 5).

![Fig. 5—Registering data of the shipment which arrives in Cuba.](image)

When observations and analysis about the quality and state of each material are made, the decision and registration are shown in the system by using the Individuals option of the Control submenu (Figure 6).

![Fig. 6—Registering data of the individual as part of the shipment.](image)
Data characterising each individual are stored in this option, including the variety code that identifies an individual, the code of the shipment to identify the origin, the condition of the seeds (good, regular, bad), the quantity of buds per cutting, and the number of buds that are classified as good, bad, regular or germinated.

The specialist in charge will decide if the individual goes up to the next stage, taking into account phytopathological observations.

Also, from this option, the specialist can store in the database information related to the variety, such as name, progenitors, country of origin of the variety, species, genera, details about breeding, as shown in Figure 7.

Following this, the user can see options to implement the next stages, and a variety must overcome each stage in quarantine in order to be released.

The options are Greenhouse, Field trials and Post-entry. During the greenhouse stage, the sowing date, the number of available buds, and the germination percentage are recorded (Figure 8).

To be registered in field trials, variety data must be stored including sowing date, number of available seeds, number of sown seeds, and germination percentage (Figure 9).
For each of the three stages, checkups are made weekly, and each annotation and observation can be kept. Also, the individuals receive phytopathological evaluation and all essential pieces of information are registered to decide if the material is eliminated or recycled (Figure 10).

In each stage, data about techniques, detected diseases or pests, laboratory entry dates, and analysis dates are recorded.

In Figure 9, related to Field trials, a button ‘Agronomic Evaluation’ is shown which describes the agronomic characteristics of the individual in plant and first ratoon crops. The characteristics observed are the number of stems per stool, height, internode dimensions and habit of growth, refractometric brix, vigour and dates of flowering (Figure 11).

When the individual is released to the post-entry trials, it is sent to the experimental station located in Matanzas province where the computer system is also installed. Data to be observed and recorded include the code of the individual’s identification, the date of release to post-entry, the quantity of received cutting seeds, the percentage of seed that can be sown, and the germination percentage.
In the post-entry stage, characterisation of individuals includes information regarding phytosanitary and agronomic evaluations. Phytosanitary evaluations are similar to those in previous phases; however, the agronomic ones have different characteristics measured in field trials. They include habit of growth, height, diameter and number of stems per stool, dates of flowering, as well as values of brix, pol and purity.

The system also possesses other additional options such as the production of reports, the subsistence of materials in each phase, the results of laboratory analyses, the reason(s) for discarding an individual, and many consultations requested by the researchers.

Through the Help option of the system, the specialist can be assisted for each option. The 'Help' was edited in a clear and precise way, guaranteeing that indications are offered at each moment about the actions to be carried out. It is organised in such a way that the user can navigate to resolve his/her doubts and receive orientations about the use and purpose of the active window during a specific moment by a key combination.

All stages of the sugarcane quarantine schedule of Cuba are included in the software. The names of the different options to support registration are similar, if not identical, to common scientific terms. Data about behaviour of foreign genetic material in each stage (greenhouse, field trials, post-entry) and check up results, phytopathological and agronomic evaluations (field trials and post-entry stages) are registered in the database used by CUARENT version 2.5.

The graphical user interface of the system is conformed by pull-down menus, icons, dialogue boxes and other visual controls. This interface design helps to represent the capacities of the system and it allows the specialists to select parameters, data, and to obtain reports easily.

The minimum requirements for the use of this software are:

- Microcomputer IBM or compatible Pentium or higher with Windows 95 or higher.
- 32 megabytes of RAM (although better results are obtained with 64 megabytes).
- Hard disk with available space of 20 megabytes.
- Monitor VGA or compatible higher resolution with Microsoft Windows.
- Printer and mouse; although the mouse is not indispensable, its use is recommended to better use the graphic interface that Windows provides.

The biological utility of the software is given by the automation of the information that flows during the quarantine process. Decisions regarding each studied individual are facilitated, and search of alternatives is easily possible for each introduced material.

This program is available commercially but one must keep in mind that data registration of foreign genetic material and quarantine schedules are different in each country carrying out this activity. Modifications of the software might be requested to adjust the requirements of the specialists in a country where the program will be used.

635
So far we have not found a complete description of similar computer-assisted quarantine software for sugarcane in other countries. CUARENT version 2.5 is original because it integrates the data of each quarantine step and emits progressively the history file of each sugarcane variety received in Cuba.

Conclusions

- CUARENT system allows the tracking of the introduction and progress of a variety introduced into the country, from the quarantine phase until its incorporation into the breeding program, germplasm collection, and to record the cause(s) of elimination if not released by the quarantine.
- CUARENT version 2.5 for Windows guarantees the control of the sugarcane genetic material introduced, following step by step the phytosanitary regulations for its release.
- Through this software, it is possible to store in an organised and efficient way the information of the sugarcane quarantine process in Cuba.

REFERENCES


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CUARENT POUR LA VERSION 2.5 DE WINDOWS : UN OUTIL EFFICACE POUR GÉRER LA QUARANTAINÉ DE CANNE À SUCRE À CUBA

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MOT CLÉ: Logiciel.

Résumé

CUARENT pour la version 2.5 de Windows, un logiciel développé à partir de techniques informatiques avancées, est proposé pour la gestion des données de quarantaine et le suivi des variétés de canne à sucre étrangères dans le programme de quarantaine à Cuba. Ce logiciel est utile aux chercheurs et techniciens du Programme d'Amélioration Génétique de la canne et offre de multiples possibilités dont l'aide à la description des caractères physiques du matériel génétique étranger en serre et dans les essais au champ, la gestion de la base de données obtenues à partir du passeport des variétés étrangères modernes incluant les formulaires originaux et l'information sur les parents, le relevé du diagnostic et des observations sanitaires et agronomiques. Ce programme permet, en outre, de choisir la destination géographique du matériel étranger, de déterminer l'outil de diagnostic approprié pour évaluer la qualité sanitaire du matériel avant sa libération et offre quelques critères d'ordre général sur la valeur commerciale et/ou génétique des clones importés.

CUARENTENA DE LA CAÑA DE AZÚCAR EN CUBA A TRAVÉS DE CUARENT, EN VERSIÓN 2.5 PARA WINDOWS

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Resumen

SE PRESENTA CUARENT para Windows versión 2.5 basado en técnicas computacionales avanzadas para el control de la información de la cuarentena y la planificación de la introducción de variedades extranjeras de caña de azúcar en Cuba. El programa brinda servicios a investigadores y técnicos del Programa de Mejoramiento de la Caña de Azúcar, ofreciendo las siguientes posibilidades: ayuda para registrar los expedientes y analizar de forma integral el comportamiento de los materiales genéticos extranjeros en las etapas de invernadero y en el campo por año; gestión de la base de datos de la información pasaporte de las variedades, formas originales y géneros afines y evaluaciones estadísticas de diagnóstico, evaluaciones sanitarias y agronómicas. De esta forma los especialistas toman decisiones acerca del destino final de los materiales foráneos, eligen las técnicas de diagnóstico adecuadas para reconocer el estado fitosanitario antes de su definitiva liberación, se ofrecen criterios sobre el valor comercial y/o genético de los individuos que arriban al país.