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SISDAM: WEB APPLICATION FOR PROCESSING DATA ACCORDING TO A MODIFIED AUGMENTED DESIGN

SISDAM: Aplicación web para el procesamiento de datos según un diseño aumentado modificado

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ABSTRACT. The research processes in the agricultural sector such as breeding programs cultivars are no strangers to the need for the intervention of Information and Communications Technology as tools for managing large volumes of information generated by them. Taking into account the constraints that exist in the control of environmental heterogeneity and considering the advantages of using the Latin Square Design, with setting through the "Row-Column" method, web application "Automated system for the data processing according to a Modified Augmented Design was developed where the researcher may have to run a graphic guide planting of an experiment, with strict control of these factors and their graphic field location, time will speed to capture and process information relating to the various lines of evidence, will feature a customization on reports to the selection criteria, which can be used in other statistical packages increasing the effectiveness of the selection if the data matrix obtained is processed through a multivariate analysis and also loss of information and the collection of errors are avoided and time optimization by users, facilitating the efficient use of Modified Augmented Design and Development Breeding Programs cultivars in Cuba.

RESUMEN. Los procesos investigativos en el sector agrícola, como los programas de mejoramiento genético de cultivares, no son ajenos a la necesidad de la intervención de las tecnologías de la información y las comunicaciones, como herramientas para la gestión de los grandes volúmenes de información que generan los mismos. Tomando en cuenta las restricciones que existen, en cuanto al control de la heterogeneidad ambiental y, considerando además, las ventajas del empleo del Diseño Cuadrado Latino, con el ajuste a través del Método "Fila-Columna", se elaboró la aplicación web "Sistema automatizado para el procesamiento de datos, según un Diseño Aumentado Modificado", donde el investigador podrá contar con una guía gráfica para ejecutar la siembra de un experimento, con un estricto control de las variables evaluadas y su localización gráfica en el campo. Se agilizará el tiempo en captar y procesar la información referente a las distintas líneas de prueba. Se contará con una personalización en los reportes para los criterios de selección, los que pueden ser usados en otros paquetes estadísticos, incrementando la efectividad de la selección, si la matriz de datos obtenida es procesada a través de algún análisis multivariado y, además, se evitará la pérdida de información y la captación de errores, así como la optimización del tiempo por los usuarios, facilitando el uso eficiente del Diseño Aumentado Modificado y el desarrollo de los Programas de Mejoramiento Genético de cultivares en el país.

Key words: computer application, software development, plant breeding, statistical methods, selection

Palabras clave: aplicaciones del ordenador, desarrollo de programas, mejoramiento genético de plantas, métodos estadísticos, selección

INTRODUCTION

Technologies of Information and Communication Technologies (ICT) are the set of processes and products derived from the new tools (hardware and software), media information and communication channels related to storage, processing and transmission of digitized information (1).

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Currently acting precipitously on our society, what motivates and accelerates the processes of change that radically altered forms of work, access to knowledge, forms of communication and production processes. ICT is an irreplaceable social advancement element, wealth generation, strengthening cultural identities, social cohesion, the fight against poverty and hunger, preventing climate change and energy crisis, as well as the promoting a culture of peace. The technologies are being conditioned by the evolution and route of access to content, services and applications (2-4).

Information is a major asset in organizations, manage it correctly determines the success or failure of it. For this, necessary solutions that provide better access to information and what adds value to its analysis, approving the processes of teaching and research (5) are made. Research processes in the agricultural sector, such as breeding programs cultivars, are no strangers to the need for the intervention of ICT as tools for managing large volumes of information generated by them (6, 7)[A].

Specifically in the selection of genotypes, researchers begin with a large number of test lines coming from crosses among cultivars or through the introduction of foreign sources. Most times the number of lines can increase exponentially. Experimental designs with replication are the most used in the world to check the performance levels among lines and cultivars; but the material available for each test line is often limited, not being enough, sometimes for several aftershocks, also with the disadvantage that the environmental heterogeneity cannot be easily calculated, therefore, is another factor in the matter.

Cuba does not escape these problems by Design Raised Modified (DRM), which has been re-analyzed and proposed, have achieved satisfactory results in breeding programs, considering the advantages of using Design Latin square by adjusting through method "Row-Column" (8).

Compatible with Microsoft Windows Operating System and developed at the Institute of statistics Agricultural Research in India, it is known of the existence of the computer program, Statistical Package for Augmented Designs (SPAD), established

by Rajender Parsad, V.K. Gupta and Abhishek Rathore, using Microsoft Visual C ++ in its version 6.0. This product is designed to implement the enhanced designs that are based solely on the classic experimental design "Blocks Random".

Taking as its premise the use of DRM, is effective adoption of current strategies for managing information and knowledge, and that despite the benefits and successful results achieved, according to information gathered as part of exploratory studies, it was found that in its application is not available adequate means of organizational control of information.

In addition, it does not have a graphical guide with identification of each test lines when executing planting in the field and capture processes and data processing are very extensive and they are performed in Microsoft Excel; which may facilitate uptake errors, since the amount of test lines that can be processed becomes high. The processes of replacement and adjustment of the values of each line, using statistical methods, are performed completely manually at present and, because of all the above stated; the selection of the best lines of evidence is not always effective.

Taking into account the restrictions that has SPAD, as for the control of environmental heterogeneity and considering the advantages of using Design Latin Square, with adjustment through Method "Row-Column". The building of the web application is based automated system for processing data; according to a Modified Augmented design (SISDAM according its acronyms in Spanish) with the base design and method of adjustment, mentioned above.

In dissimilar web application development techniques and technologies have advantages, disadvantages, constantly develop, and evolve used. In the current software, market is prevailing performing applications that interact with the user. The development of software construction techniques, has led to applications that are used by multiple users at the same time, through the Internet, have become of great importance in the current panoramic computing; they are multiple examples (9, 10).

MATERIALS AND METHODS

APPLICATION TYPE

Maintenance

Web applications need to be installed only once and not separately on each computer. It is easy to support, as changes are made only on the server where the application is installed.

[A] Cámara, F. A. *Sistema automatizado para el procesamiento y control de información en la aplicación del Diseño Aumentado Modificado en la Unidad Científica Tecnológica de Base «Los Palacios»*. Tesis de Grado, Universidad de Pinar del Río, Cuba, 2014, 81 p.

Easy to use

Usability for the web emerged from the birth and development of the Internet as communication network. If the *software* is able to attract the user and has quality, it can say that there is a usability technique applied correctly. Many organizations have included in their projects usability requirements as one of its *software* specifications; as they have identified the importance representing develop "usable" products that help them attract more users to their applications.

Web applications are convenient to access from anywhere using the Internet. Instead of creating clients for different platforms, the web application is written once and run everywhere the same (11).

Such *software*

The software, according to the freedoms of use, can be classified as free or proprietary. It has been adopted as policy in the country using free tool that promotes development and technological innovation and break the bonds with the big monopolies. With free software, it can get solutions that meet the needs of each entity and have the support of a large community that is committed to it. According to the definition of Free Software Foundation (FSF), this type of software allows users to run, copy, distribute, study, change and improve (12, 13).

Programming languages

For the realization of the system some of the programming languages most used side today to compare and choose the benefits that can be applied to the project server investigated. Below are finally selected:

♦ PHP (acronychal of "PHP: Hypertext Preprocessor"):

is an interpreted language widely used general purpose, specially designed for web development and can be embedded into HTML. Generally, it runs on a web server and allows connection to different types of database servers such as MySQL, PostgreSQL, Oracle, Microsoft SQL Server, and SQLite. It can be deployed in almost all operating systems and platforms (14).

♦ Symfony2: it is a *framework* designed to optimize the development of web applications based on the Model View Controller pattern, which separates the business logic, the logic of the presentation server and the web application. It provides several tools and classes aimed at reducing the development time of a complex web application.

Symfony2: it is fully developed in PHP 5.3. It has been tested in many real projects and is used in commerce websites premier. It is compatible with most database managers, such as MySQL, PostgreSQL, Oracle and Microsoft SQL Server. It can run on both platforms (Unix, Linux, etc.) and Windows platforms.

Selection System Manager Database

MySQL: the database management systems (DBMS) provide interfaces among the database and the user. Provide an interface between applications and operating system, getting access to the data is performed more efficiently, easier to implement and, above all, safer.

The MySQL DBMS was chosen for its easy use for designing large databases and their integration with PHP. It is the database most popular open source world and is widely used in the creation of Web pages (15).

Usability

The system is aimed to be used by people who do not necessarily have extensive computer knowledge. It will encourage users according to their role, to achieve their goal efficiently and effectively.

Portability

It is designed to be installed on a web server and centralized database. By developing with PHP language and MySQL database can run on different Web servers and operating systems.

Security and Reliability

The system will ensure that each user only has access to features and content that correspond according to their role, otherwise it will show a form of authentication. SHA 512 mechanism for data encryption should not travel to the server in clear text is used, as in the case of passwords.

Hardware

The computer for the Web server must have the following minimum requirements: P4, 1 GB of RAM, 80 GB hard drive and the computer that corresponds to the server database must have: P4, 1 GB of RAM, 80 GB of disk hard.

RESULTS AND DISCUSSION

User interface

The design application interface was performed prioritizing the principles of simplicity, flexibility and user friendliness. It consists of two interfaces, the first in the area of authentication (Figure 1), where the entry form is displayed

to the system and also logo SISDAM which is composed of three colors, brown, green and blue represent somehow the elements involved directly in the agricultural process: the soil, plants and water. The other interface (Figure 2) is shown after being authenticated in the system and predominantly gray and black colors, assuming a trend of innovative design, in addition to the aforementioned logo is always present, yielding a contrast of nice colors to view. The structure of the layout of the pages is very simple, consisting of a header, a vertical menu located on the left and the contents are displayed in the center.

Main functions

The system provides a set of functions at contribute to the efficient implementation of Augmented Design Modified, and in turn, allows a correct selection of appropriate test lines in breeding programs.

Manage Experiments

With this functionality the researcher can create, modify, delete and process their own experiments, always using as a standard the Design Raised Modified (Figure 3) and can also appreciate the graphic design (Figure 4).

Manage Variables

The system also allows researchers to introduce their own variables to study the behavior of the lines and cultivars, this feature makes it is suitable for processing experiments of different crops. In addition to creating variables, users can establish a valid range of values for each, making more efficient data capture experiments.

Manage Cultivars

With this functionality can add, modify or delete cultivars that are to be used in various experiments.

Manage test line values

Experiments created in the system can be modified and "Process data" that is nothing more than manage the values obtained from the test lines and cultivars studied. Here the above variables to be introduced to study are used for these lines and values must be within the range that the researcher predicted by introducing these variables (Figure 5).

Figure 1. Access Interface to the system
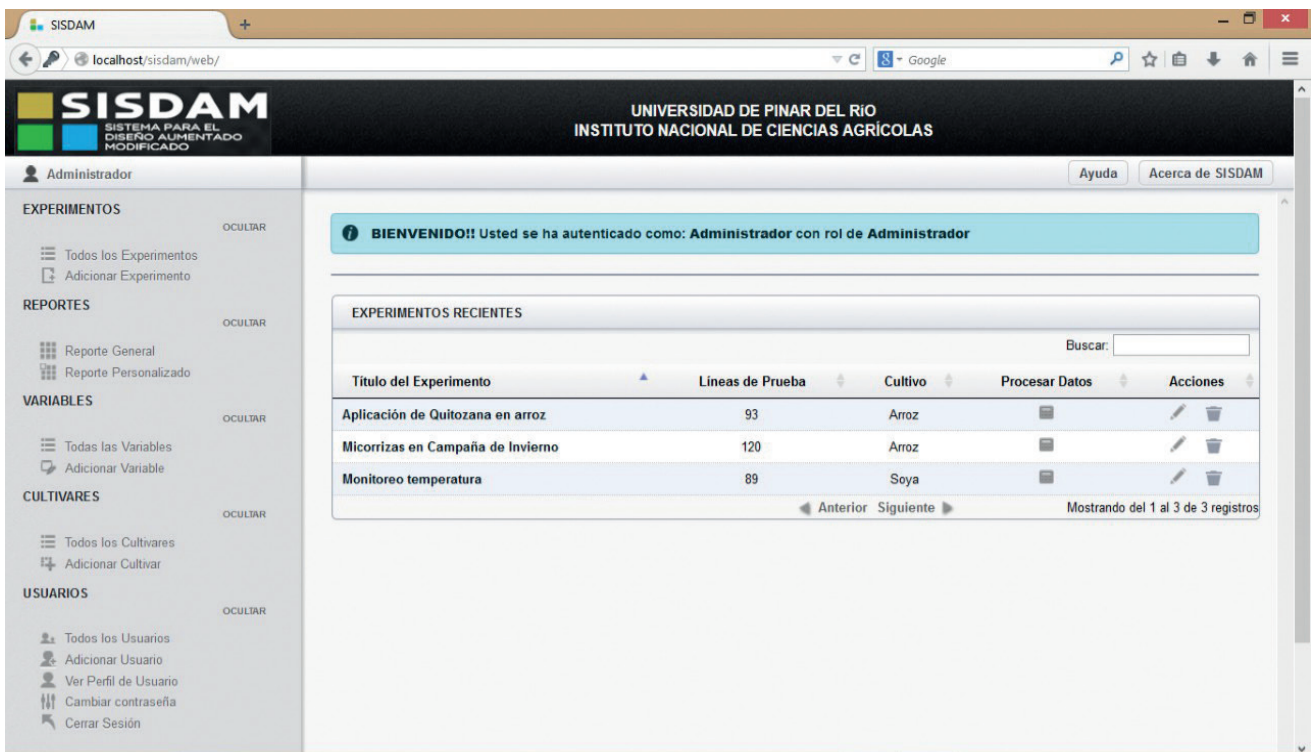
Figure 2. Interface of work
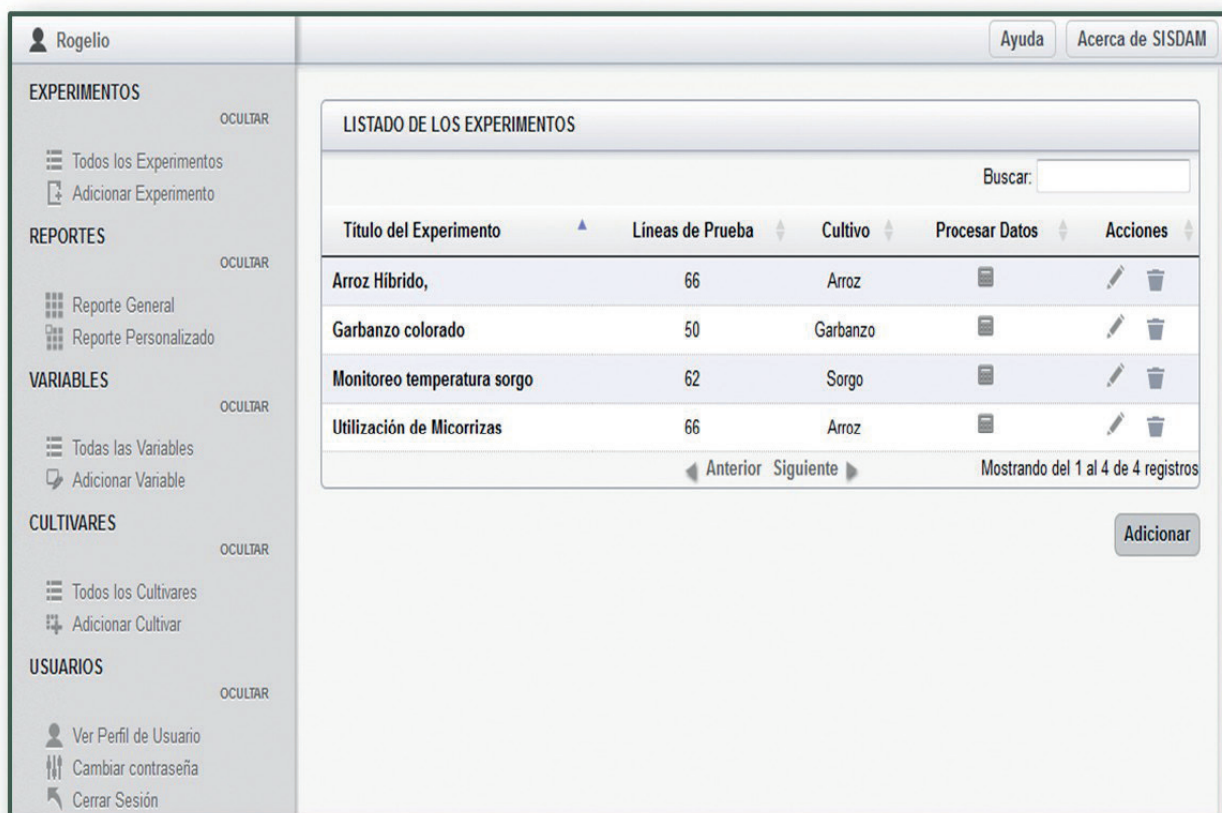
Figure 3. Screen to manage the experiment

Figure 4.Experiment setting

Figure 5. Entering values of test lines

The number of lines is limited to the type incorporating Latin Square that was specified when the experiment was designed.

Set Values of Test Lines

In the system, when the values of the variables are studied for each of the test lines are obtained, they can be adjusted using a statistical method (row-column) amending its values taking into account the values of the variables studied for cultivars in this experiment. This process is performed on each test line that is part of the design.

Output Format Reports

Reports of an application are a tool that exposes a set of data on the screen. These are very important for researchers because they will work with the system and will show for each of the test lines and adjusted their original values.

In the application there are two types of reports, depending on their structure, the first General Report, showing an experiment all its lines of evidence with all the variables studied it (Figure 6) and the second, Custom Report allows us to choose the variables to be shown in the Report (Figures 7 and 8). The reports in the application are presented to users in two different formats, such as the application is on a Web platform, reports are displayed in HTML within the application itself and also allow you to export these reports to Microsoft Excel (Figure 9).

Error Handling

The design and implementation of the system enables the possibilities of introducing erroneous information by the researcher are minimal, carrying out spot checks on the client side to avoid sending incorrect data to the server. This validation includes errors, such as user input or incorrect password, leave empty fields, matching field, errors validity of data types, among others (Figures 10, 11, 12 and 13).
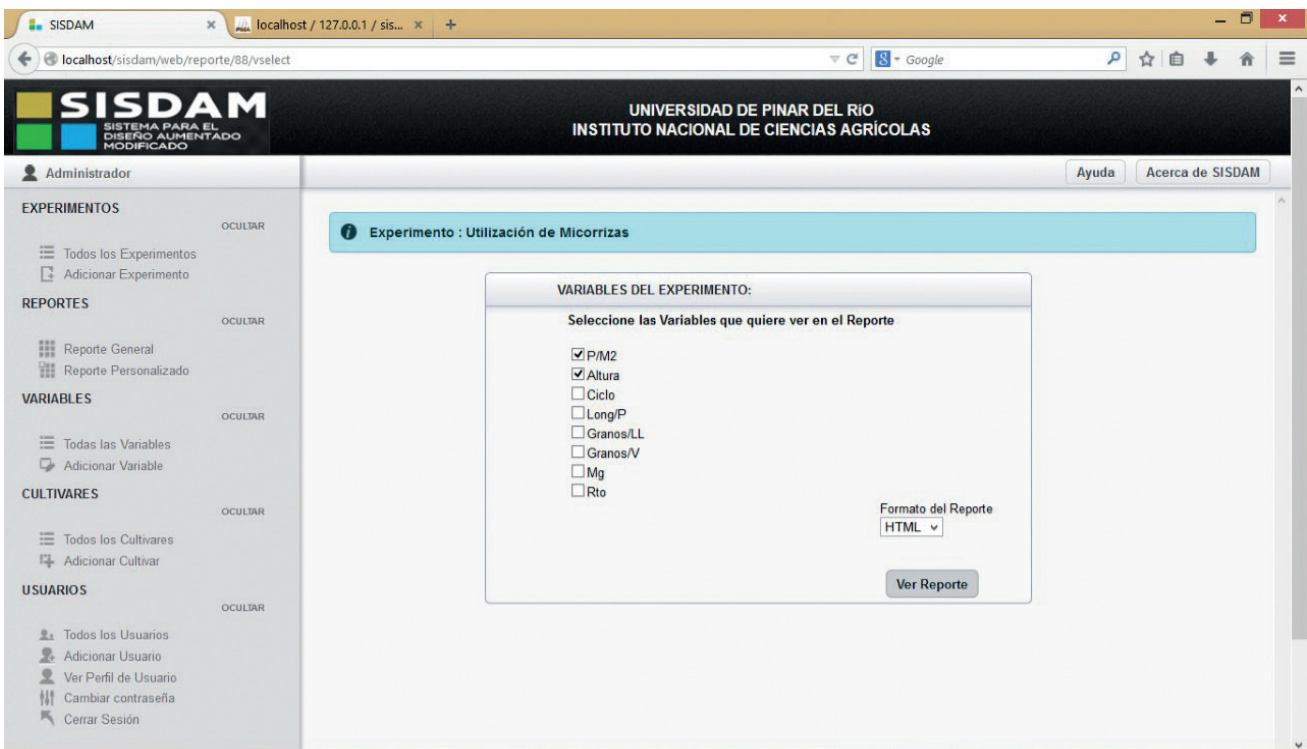

Figure 6. General Report in HTML format

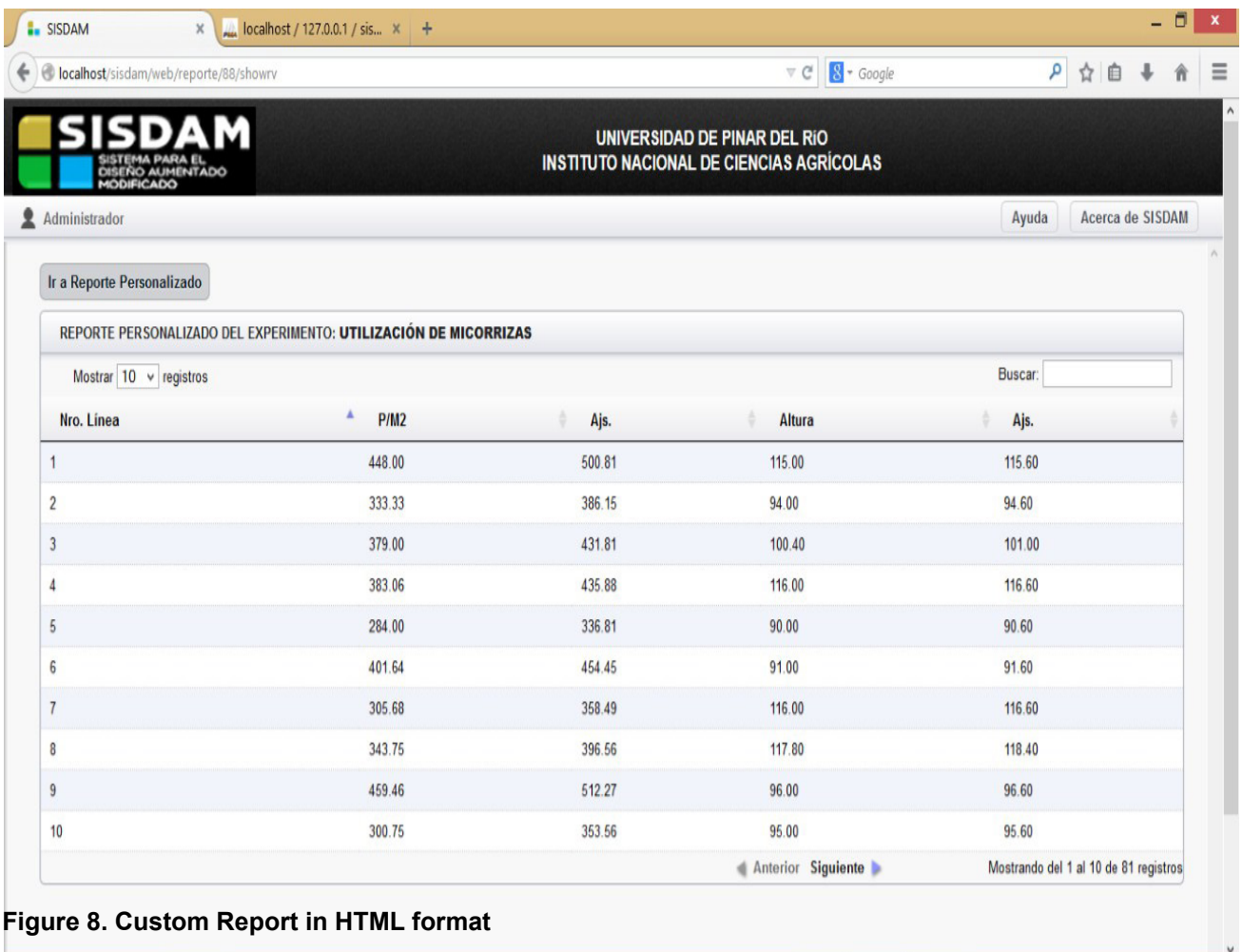**Figure 7. Selection of variables for the custom report**

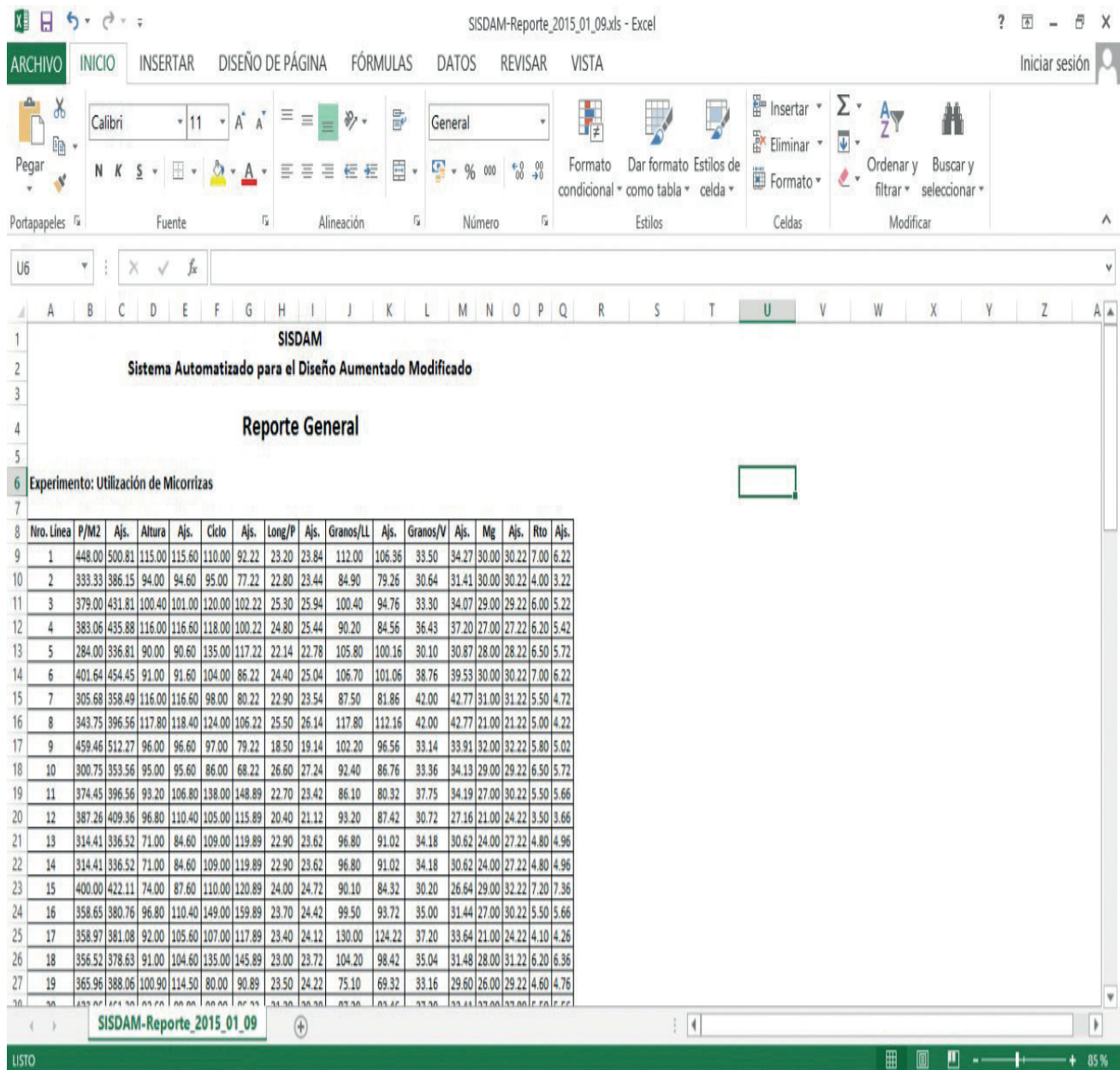**Figure 8. Custom Report in HTML format**

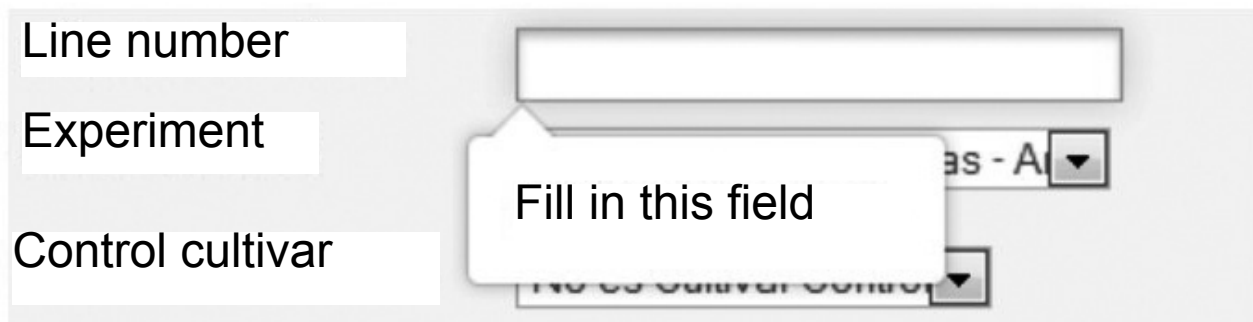**Figure 9. General Report in Microsoft Excel format**

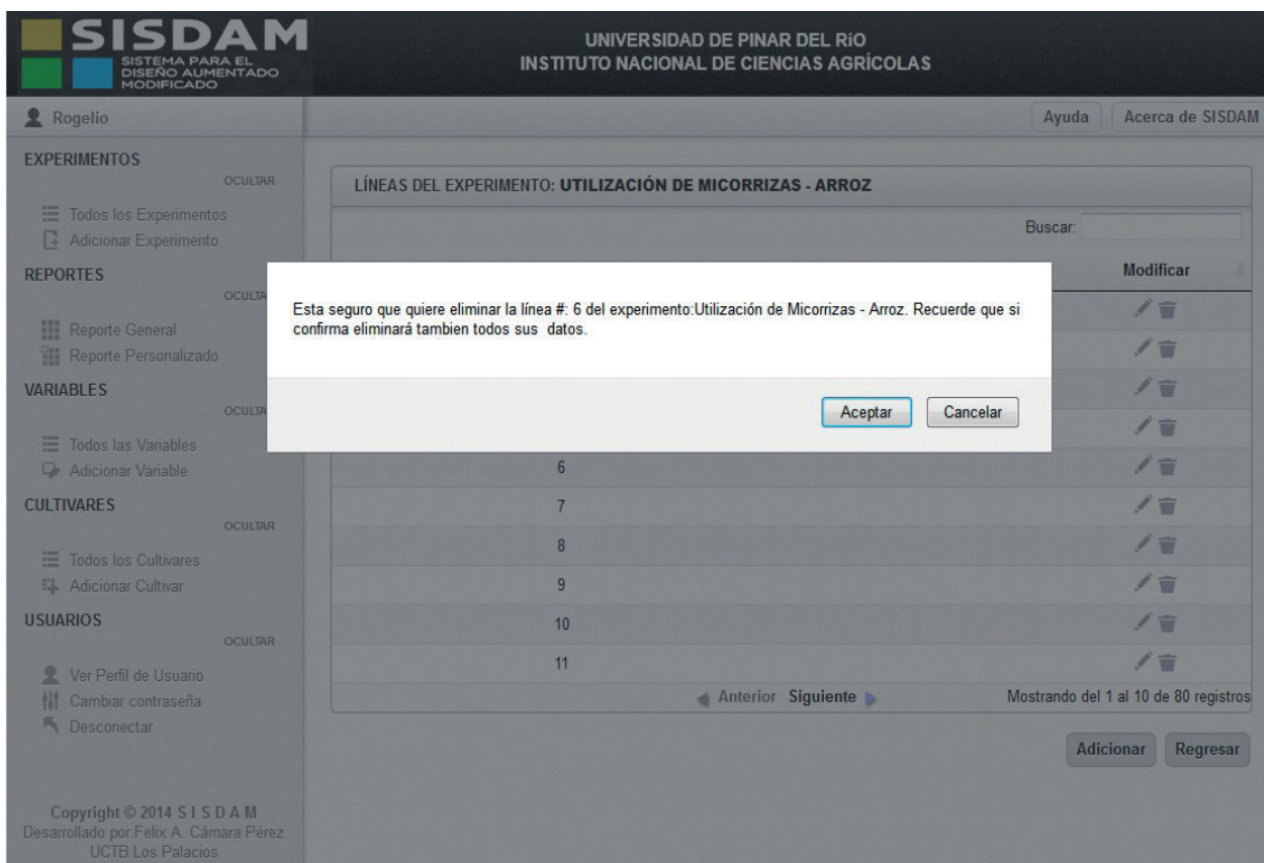**Figure 10. Alert message**

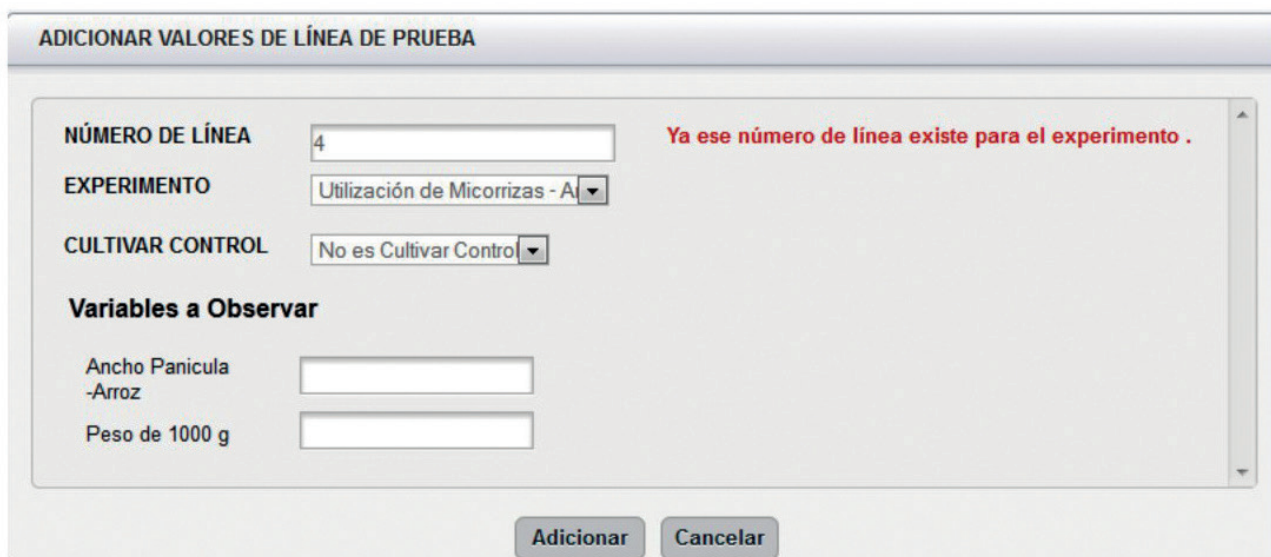**Figure 11. Message confirmation**

Figure12. Error message due to duplication of information

Figure 13. Error Message in data capture

With the SISDAM Web application, the researcher may have a graphical guide that did not exist until now, to run the planting of an experiment designed from a DRM with strict control of the variables evaluated and its graphical countryside location, time will be speeded up to capture and process information concerning the different lines of evidence. It will feature a customization in reports to the selection criteria, which can be used in other statistical packages, increasing the selection effectiveness, if the data matrix obtained is processed through a multivariate analysis. In addition, loss of information and capture errors and time optimization for users who previously processed by hand should be avoided.

CONCLUSIONS

♦This application facilitates the efficient use of Modified Augmented Design, contributing to the development of breeding programs cultivars in the country, which until now suffered from a tool for data processing of this design.

♦The SISDAM is in operation since June 2014 in the Scientific Technological Base Unit ¨Los Palacios¨ the National Institute of Agricultural Sciences. Specifically in research related to genetic improvement of rice cultivation, promoting the advantages of the DRM as to comparing a large number of evidence lines, overcoming the limitations of an experiment not replicated, providing an economic benefit by reducing area, saving experimental material and control of environmental heterogeneity.

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