COMPUTERIZATION OF AGRO-TECHNICAL PROCESSES AND PLANT HEALTH IN A RICE PRODUCING COMPANY

Informatización de los procesos de Agrotecnia y Sanidad Vegetal en una empresa productora de arroz

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ABSTRACT. The agribusiness company of grains ˝Fernando Echenique Urquiza˝ from Granma dedicate to the production of rice consumption and seed, through different processes including agro-technical and plant health, where a large volume of information related to planting and crop care is controlled. The accounting process is performed manually or through Microsoft Excel electronic tab to which different documents are required, causing delays and the possibility of mistakes. In response to these needs, this research aims to develop a *web* application. To implement the methodology of software development Extreme Programming was used, also the programming languages Hypertext Preprocessor, HyperText Markup Language, Cascading Style Sheets and JavaScript, the *Web* application server Apache, the CodeIgniter and Extend JavaScript frameworks, the integrated development environment NetBeans and database manager My Structure Query Language database. With its use the information management and data processing related to agro-technical and plant health data so that it can be quickly provided, enabling greater consistency, security and raising the level of efficiency from the organizational control and the analysis information.

RESUMEN. La empresa agroindustrial de granos ´Fernando Echenique Urquiza´ de Granma, se dedica a la producción de arroz para el consumo y semilla a través de diferentes procesos entre los que se encuentran la agrotecnia y la sanidad vegetal, donde se controla un volumen de información relacionada con la siembra y cuidado del cultivo. El proceso contable se realiza de forma manual o a través del tabulador electrónico Microsoft Excel, lo que provoca retrasos y la posibilidad de que se cometan errores al consultar los diferentes documentos. Para atender a estas necesidades, la presente investigación tiene como objetivo desarrollar una aplicación *web*. Para su implementación se empleó la metodología de desarrollo de software Programación Extrema, los lenguajes de programación Hypertext Preprocessor, HyperText Markup Language, Cascading Style Sheets y JavaScript, el servidor de aplicaciones *web* Apache, los frameworks CodeIgniter y Extend JavaScript, el entorno de desarrollo integrado NetBeans y el gestor de base de datos My Structure Query Language. Con su empleo se facilita la gestión de la información y procesamiento de los datos de la agrotecnia y la sanidad vegetal de manera rápida, al permitir una mayor consistencia, seguridad y elevar el nivel de eficiencia para el control, la organización y el análisis de la información.

Key words: rice, farming, fertilizers, management, pesticides, production

Palabras clave: agricultura, arroz, fertilizantes, gestión, plaguicidas, producción

INTRODUCTION

Rice (*Oryza sativa*) is cultivated in 113 countries and it is deeply integrated into the cultural heritage of societies. It is considered one of the most important cereals for world nutrition, since it is the staple food of more than half of the world's population and 40 % depends on it for 80 % of their diet. It represents a genetically diverse species with wide adaptation to different sowing conditions and it is one of the most important cereals, considering its energy contribution in calories, as well as in proteins (1-3).

In Cuba, rice is one of the main foods, with an annual per capita consumption of more than 60 kg, to fulfill this demand, high levels of imports must be made.

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Production is reduced due to financial difficulties in the specialized sector, while the non-specialized sector (popular), characterized in small and medium scale has been potentiated in parallel. It is applied fundamentally in the principles of sustainable agriculture with the participation of the different forms of production (4). As an alternative, the Ministry of Agriculture in 1996 started the non-specialized rice production program, with the purpose of increasing family and institutional self-sufficiency, in addition to stabilizing the permanence of this product in the agricultural markets, based on the development of numerous systems; by stimulating the use of low inputs (5). The cultivation of state or specialized rice has been limited by the lack of fuel and chemical products for nutrition and protection of plantations against pests and diseases (6,7).

In Granma province, the rector of this work is the agroindustrial grain company 'Fernando Echenique Urquiza'. 84 productive bases composed of four Basic Business Units (UEB) and four municipal units are subordinated to it. The UEB are composed of the state and peasant sectors, the latter are integrated by Credit and Services Cooperatives (CCS), Basic Units of Cooperative Production (UBPC) and Cooperatives of Agricultural Production (CPA). The municipal units are conformed only by the peasant sector.

In the production of rice for consumption and seed in this agribusiness company of grains involved different processes among which are the agrotechnics, which is dedicated to the process of preparation of land, planting, harvesting and plant health covering the distribution of pesticides and fertilizers for crop protection from the damage caused by pests. In both processes, some deficiencies were detected:

For the statistical processing of the information volume on agrotechnics and plant health, time is invested, because it is done manually by the CCS, UBPC and CPA or by means of Microsoft Excel spreadsheets by the UEB and the agroindustrial company.

It requires the consultation of several documents which implies that mistakes can be made. There is no information security because there is an alteration by unauthorized personnel and the loss of relevant information due to the deterioration of the paper with the passage of time and subtraction.

A search was made of computer tools that contribute to the management of rice production information: A computer system was developed at the national level to control the agricultural production of rice, which is called the Cost Based Management System for Activities in the Agricultural Rice Production (8).

At the international level, there is the Integral Production System (SIP), carried out by the Computer Training and Services Studies Company (9).

These systems do not solve the situation previously exposed in the agro-industrial grain company 'Fernando Echenique Urquiza' because they do not meet their particular needs and are also not available.

When not found any program that can be used in the company is proposed the development of one that manages the information quickly and efficiently.

MATERIALS AND METHODS

An investigation was carried out to understand the behavior of the problem and to determine the fundamental difficulties, through the analysis and synthesis, the information that needs to be controlled was collected and processed. The personnel of the agrotechnics and plant health departments of the agro-industrial grain company 'Fernando Echenique Urquiza' were interviewed to learn how the management process is carried out. Other computer systems related to the subject were studied in search of a better solution route.

A bibliographic study was made on the possible tools, technologies and languages to be used for the development of web applications according to their features, current trends and novelties, in order to maintain the greatest possible integration and select the appropriate ones (10).

It was chosen as software development methodology Extreme Programming (XP), since it is an agile methodology focused on the constant interaction between the client and the development group, fluid communication among all the participants, simplicity in the implemented solutions and ability to face the changes (11).

The programming languages on the client side HTML 5, CSS 3 and Javascript version 3.0.0 were chosen by the PHP server version 5.4.12 (12). The database management system chosen was MySQL version 5.6.12. The Model-View-Controller pattern was selected, which aims to reduce the programming effort, necessary in the development of multiple and synchronized systems of the same data, from standardizing the design of the applications. This pattern divides the parts that make up an application in the Model, the Views and the Controllers, which allows the implementation of each element separately, in this way the updating and maintenance of the software is guaranteed in a simple way and in a small space of weather.

From the use of frameworks based on this pattern, a better organization of the work and greater specialization of the developers and designers can be achieved (13). The CodeIgniter frameworks, version 3.0.6, were selected to allow the rapid development of projects, since it has a large set of libraries and ExtJS 3.0.0. The NetBeans integrated development environment version 7.3 is free to use, free and has no restrictions on use, it can also write, compile, debug and run programs written in Java (14). As web server Apache version 2.2.22 was chosen since it is free software and it is the most used at present (15).

The phases that were followed to take into account what the XP methodology established were the following:

Exploration: It defined the scope of the project, specified the functionalities that were desired to computerize to meet the needs of the client through user stories, consisting of three or four lines written by the client in non-technical language without much emphasis in the details, estimating the development time of each, which was not greater than three days. Among the defined functionalities are: updating and visualizing the information regarding pesticides, fertilizers, the planned and actual flight hours, the amount of rice planted, planned harvested and actually made, existence, application and allocation of fertilizers, pesticides, as well as the consumption of pesticides at company and municipal level, among others.

Delivery plan: A detailed estimation of the time to be used in the development of the user stories was made, for this they were divided into three iterations or deliveries to the client. In the schedule it was estimated that the duration of the first and the second iteration would be three weeks each and the third of four weeks.

1- Iterations: The implementation stage was planned, defining the tasks to develop each user story in terms of design and programming, each one was described and the duration time was estimated.

2- Production: The web application was designed, codified and tested. After the first iteration was created, work was continued on the new iterations.

♦ *Design*: To achieve a solid, reusable system and based on the practices of the selected methodology, we worked on a simple and easy to use design. The database was designed with 30 tables normalized to the normal Boyce-Codd form using the Embarcadero ER/Studio tool.

♦ *Coding*: The reuse of code was taken into account to speed up the implementation. A coding standard was established to achieve uniformity and facilitate understanding of the code.

♦ *Tests*: Tests were carried out on the system, including unit and acceptance tests, which allowed correcting the detected difficulties, raising the quality of the same and thus checking its operation. Units or white boxes were developed by the programmers to verify the code, that is, the procedural details (the logic of the system) (16). The acceptance tests, also called functional or black box tests, were supervised by the client based on the requirements taken from the user stories, and the expected result of a specific transaction was verified and carried out on the interface. These tests allowed finding interface errors, in data structures, initialization, spelling, and incorrect functions and not correct updating of the computer data (17).

3- Maintenance: During the development, the opinions of the client were taken into account. In this stage, needs were identified that led to changes in the web application, which led to the maintenance of an adaptive, corrective and perfective type.

4- Death of the Project: The final documentation was generated; as no further changes were required in the architecture, when the client did not have more user stories to include and being satisfied with the system since it generated the expected benefits, the *web* application was terminated.

RESULTS AND DISCUSSION

In order to develop the web application, the needs of the user were taken into account and, once implemented, an easy-to-use computer tool was made available to manage the information of the agrotechnics and plant health processes in a fast, safe and efficient manner. It presents a simple design with a comfortable interface that facilitates navigation. To access it, three levels have been established, that of administrator, the technician of agrotechnics and the plant health. The passwords have been encrypted with the md5 method. In this way the security of the information is guaranteed, where only authorized users can update the data.

Among the information that can be updated with the web application are the company data, such as the province, municipalities, units and production bases. This allows the application to be deployed in any agro-industrial grain company in the country when its data can be updated.

Plant health as shown in Figure 1 has two sub-processes, pesticide and fertilizer. The *web* application allows updating in both the amount that is assigned to the company of the superior instance, to each unit and to the productive bases and the data of its application in the field. In addition to the pesticide data, the information regarding the activity, the flight hours planned and actually performed can be updated.

Figure 2 shows the data that is collected to assign the pesticides to a production unit. Some elements were taken into account that help to minimize human errors as it is, the selection in this case of the unit, the pesticide and the date instead of having to type it; also when assigning the amount of pesticide to the unit if the company does not have an amount greater than or equal to the one that is intended to assign the system is able to report the error and not store the information. To update the data, the system follows the same design to make it comfortable for the customer. For example, the accept button in the forms will always indicate to store the information in the database.

The agrotecnics option as shown in Figure 3 allows to manage everything related to the technology of sowing, the sowing plan by technology, the plan and real sowing and harvesting.

The reports show a consolidation of all the information updated during a month, among which are the pesticide consumption at company and municipality level (Figure 4), the doses of the pesticides, the sowing and production plan as well as compliance with flight hours. To obtain them, it is only necessary to access the option and it generates it quickly by replacing the manual calculations that were previously made and reducing the time for its completion. In this way, detailed and accurate information is acquired, which guarantees a better understanding and saving of resources such as paper when it is done in digital format and can be consulted when needed. In addition, the reports are designed according to the official models that allow exporting them to Microsoft Excel and printing them.
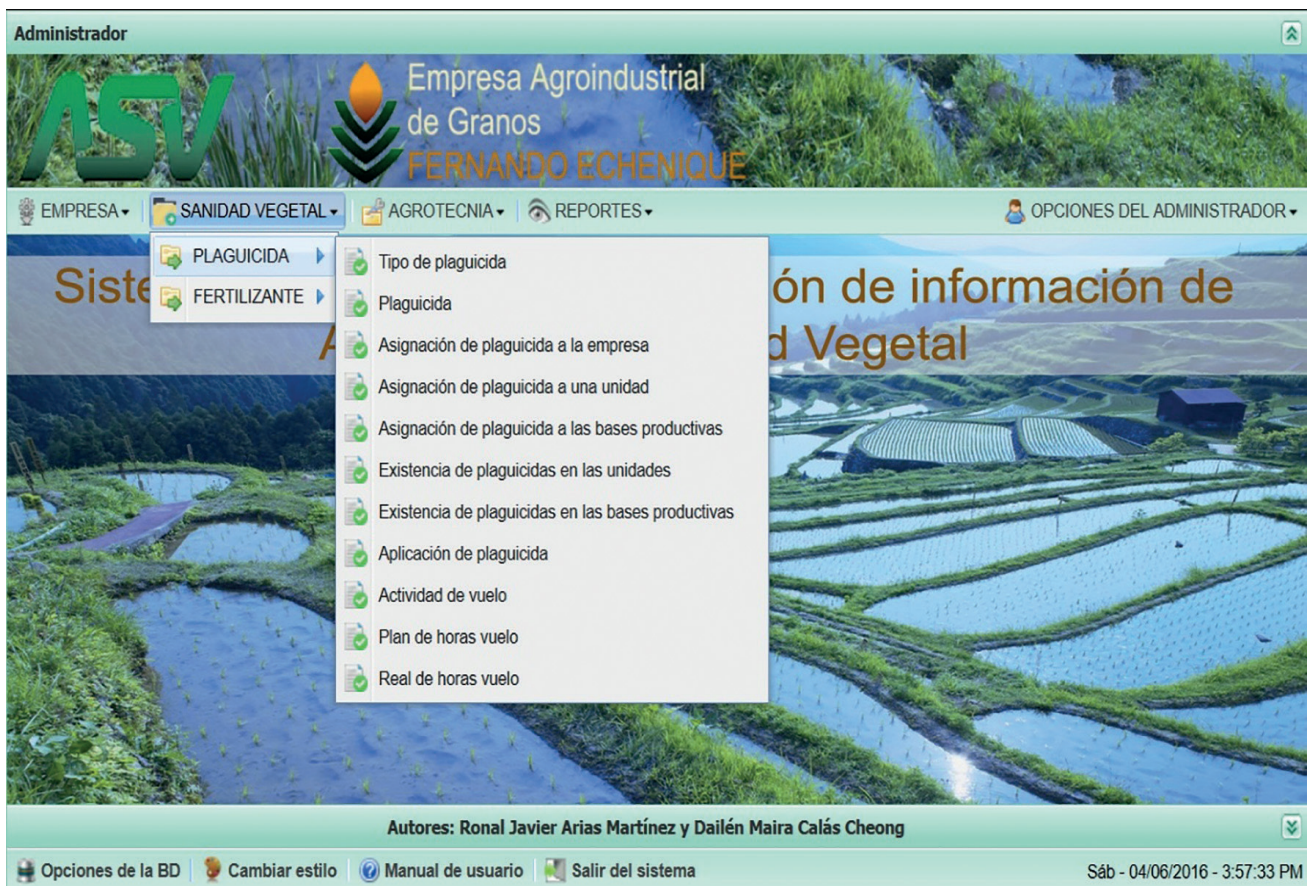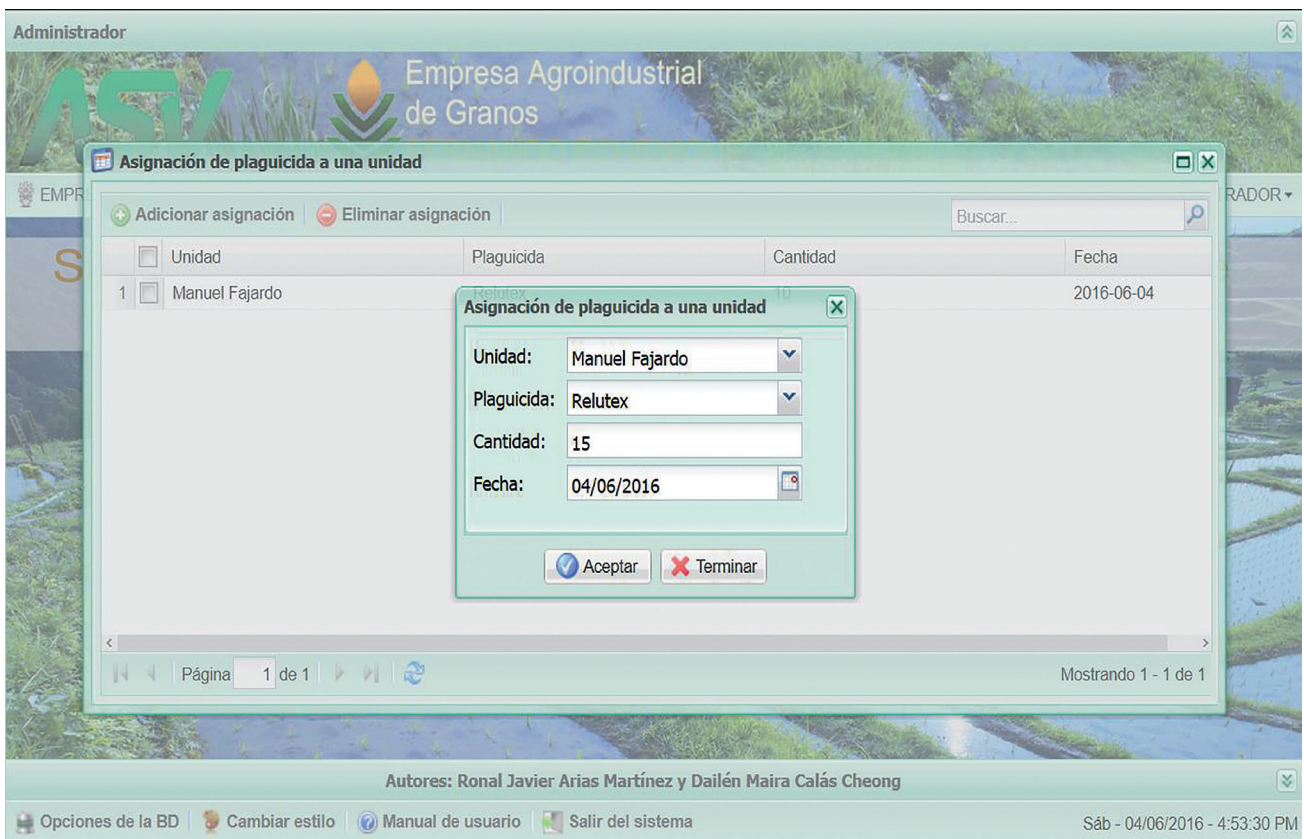

Figure 1. Plant health options menu

Figure 2. Form to assign a pesticide to a basic business unit

Figure 3. Agrotechnology options menu

Figure 4. Report monthly part of pesticide consumption

The system also has the features to perform and restore salvoes, to ensure the security of data before the server breaks. The client was suggested to do it periodically, which could be at the end of each working day and also in several storage media.

The *web* application has a positive influence on the processes of plant health and agrotechnics. With its implementation it is not necessary to improve the available equipment because it was developed according to its technical requirements. The technologies required for its operation are based on free software so it can be modified in case of any technical error. It represents benefits in terms of the time factor, human errors are minimized and control is more systematic.

For its use, it is necessary to comply with hardware and software requirements with the following characteristics (minimum conditions): client computers must have Mozilla 1.7 or higher. The operating system must be Windows 98 or higher. The server computer machine must have Windows 2000 or higher, Apache *web* server version 2.2.8 or higher, MySQL version 5.0.51b or higher and PHP version 5.2.6 or higher and must be connected to the network.

Surveys were conducted to the workers who interacted with the tool and stated that it improves the quality of work by being able to carry out operations more quickly. It helps them to raise their professional and cultural level since they are in contact with the technology that is used in most of the world in terms of communication and computerization.

CONCLUSIONS

With the development of this work, a computer system was obtained that contributes to improve the management and processing of information on agrotechnics and plant health in the company 'Fernando Echenique Urquiza'. Through its use, information is obtained when it is needed in a detailed, precise and consistent manner, which improves analysis, understanding and raises the level of efficiency for the control, organization and analysis of information. It is validated by software tests which guarantee its correct operation.

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