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Uniform information system of field tests and its use for development of up-to-date agrotechniques of cultivation of agricultural crops

Zaryshniak A.[1], Baliuk S.[2], Lisovyi M.[3]
[1]National academy of agrarian sciences of Ukraine, Mykhailo Omelianovych-Pavlenko Str., 9, Kyiv, 01010, Ukraine, [2, 3]NSC «A.N. Sokolovsky Institute of soil science and agrochemistry», Chaikovska Str., 4. Kharkiv, 61024, Ukraine; e-mail: [1]prezid@naas.gov.ua, [2,3]pochva@meta.ua

The purpose. To develop information system «Uniform information system of field tests» which provides creation of uniform database, accumulation, preservation and exchange of scientific information between institutes of National academy of agrarian sciences of Ukraine. **Methods.** «Uniform information system of field tests» is built on the basis of web-server architecture which provides server of database of clients-users. Server of database carries out functions of accumulation, preservation of scientific information and processing inquiries of clients-users. **Results.** For work of information system two companies are selected: the 1-st presents hosting — «Ukrainian hosting», the 2-nd presents domain names — «imena.ua». Some modules for functioning of web-resource in the Internet are created. System database is also created which collects and uses information files on web-resource. Forms are developed which grant submission of experimental information of field tests for current year of researches. **Conclusions.** Development allows gathering of information of field tests, its complete preservation, operative access to information by means of uniform interface and drawing up reports according to inquiries of clients-users. Operative use of information of field tests by scientific employees will allow to reduce financial expenses for unit of scientific production.

Key words: *field tests, information system, database, modules, web-resource, uniform interface, reports.*

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In Ukraine, there is a network of field experiments, the results of which are used to develop the scientific basis for the highly effective application of fertilizers and ameliorants, to increase the productivity of farming and to save material and financial resources [1]. According to the results of the conducted inventory (2014), 89 stationary field experiments were registered in Ukraine, the experimental information is in most cases stored in field and laboratory journals. This way of keeping information leads to its loss and the impossibility of generalization for the whole period of research. For prompt and systematic accumulation of experimental information, its reliable preservation and statistical processing, the computer program "Information System" Stationary Field Experiments "(Certificate of Registration of Copyright for Work No. 24933 dated July 10, 2008) has been developed. It allows to create an information database annually and for the entire period of research [2, 3].

The computer program includes two components: the first - "Passport of field experience", the second - the experimental data of research for the year. In the passport of field experience, the general characteristics are given: institution, country, administrative area, administrative region, city, climatic zone, agro-soil province, geographical coordinates (latitude, longitude, altitude), address, telephone, fax, e-mail. Experimental information includes such indicators: atmospheric precipitation, air humidity, air temperature, institution, certificate number, name of experience, culture, variety, crop rotation, rotation, scheme options, fertilizers, fertilizer forms, fertilizer application methods, yield, product quality, soil name, soil indicators, moisture reserves in the soil.

Also, the information database provides a sample of experimental data according to the researcher's request and processing them using mathematical statistics methods, using the standard Statistic package or other statistical methods [4]. Considering that 89 stationary field experiments were registered in Ukraine, it became necessary to develop the "Unified Information System of Field Experiments".

The purpose of the research is to develop the information system "Unified information system of field experiments", which is aimed at creating a unified database, which will ensure the accumulation, storage and exchange of scientific information among institutions of the National Academy of Agrarian Sciences that conduct field stationary research.

The Regulation on the system "Unified information system of field experiments" was developed on the basis of the Decree of the Presidium of the National Academy of Agrarian Sciences of Ukraine "Strategic approaches to solve the problems of degradation and restoration of fertility of agricultural lands" (Minutes No. 2 dated February 18, 2015). The provision includes: general provisions, purpose and objectives, the principles of creation and functioning, the structure and composition, use and maintenance, the procedure for replenishing information, the procedure for accessing and using information, the organizational and legal framework for scientific and practical implementation.

The main developer and coordinator of the "Unified Information System of Field Experiments" system is the National Scientific Centre "Institute of Soil Science and Agrochemistry named after Sokolovsky". The development was carried out in accordance with PND of the National Academy of Agrarian Sciences of Ukraine on Applied Problems 01.03.02.02.P "To develop a unified information system for collecting, storing and exchanging scientific information on field experiments between scientific institutions and educational institutions of Ukraine" for 2016-2018. The terms of reference have been developed that include: the basis for development, the purpose and designation of the development, the requirements for the program, the stages of development, the order of development and procedure of its acceptance [5].

Methods of research. The research methodology is based on the web server architecture, which provides free access to information at any time and from any place in the world. The administrator monitors those who enter the websites under the registered name and only after the necessary checks made, the permission is given to the user to put the information into the database. Clients-users can independently put the information on computers of scientific institutions and educational institutions, for this they are allocated a separate access to the database. On the client-user side should be provided the high speed of information transmission in the Internet and the sufficient computer power for correct operation.

Results of the research. For the operation of the information system, two companies are selected: 1 -company hosting provider "Ukrainian hosting", 2 -company provider of domain names "imena.ua".

The content management system (CMS) Drupal [6,7], which is written in the PHP programming language, is chosen as the core of the website and as a data storage location uses a relational database that supports MySQL (free relational database management system), PostgreSQL (object-relational database management system) [8].

Several modules have been identified for the functioning of a web resource via the Internet:

1. Modules for backup of the website "Backup and Migrate". A backup is a copy of the data, which provides the ability to perform information recovery when the original data is lost (the original data from which the backup was created). In this case, the loss should be understood as the occurrence of an event that led to a change in the data, after which they lost their value, or they were removed at all.

2. Modules for information delivery, such as "CKeditor". The CKEditor Drupal module allows you to replace text field areas with the CKEditor editor. CKEditor is an online editor for extended text that is embedded directly into web pages. This WYSIWYG-editor and means that the edited text in it, most like the one that the user sees after publishing of the document. It contains all the most popular functions of

desktop word processors such as Microsoft Word and OpenOffice.org Writer. CKEditor is easy to use and does not require installation on the client computer.

3. Module for rearranging the site core, all modules and plug-ins "Locale". The module “Locale” provides an opportunity to a Drupalovsky site to become non-English and multilingual. The work of the Locale module is to support the translation of the database, and to test how a particular text should be displayed. If there is translation of the text into the language in which the site is displayed, then the translation is displayed, and not the original text. If there is no translation, then the original text is displayed and, in the future, it can be viewed and translated.

4. The Node module manages the creation, editing, deletion, adjustment and display of the main content of the site. The content elements, managed by the Node module, are usually displayed as the pages of the site and contain a title, some metadata (author, creation date, material, etc.) and optional fields containing text and other data.

Taxonomy - provides an opportunity to classify the materials of the site. To classify materials, dictionaries containing related terms are defined, and then assign dictionaries to certain types of material.

5. The Path module provides the ability to mark a synonym or its own URL-address for the existing internal system path. In addition, to improve the readability of URL-addresses, synonyms also improve the indexing of site content by search engines.

6. The Search module provides the ability to index and search for materials, by keywords, and to search users by the name and the e-mail address.

7. The User module provides users with the ability to register, sign in and sign out from the accounts. It also allows users with the appropriate authority to manage user roles (this is used to classify users) and the authorities that are associated with these roles.

8. The Administration menu module creates a drop-down menu in which one or two clicks open most of the pages of administrative tasks and other shared links (for users with the appropriate rights). The administration menu also shows the number of registered users and allows modules to add their menu items. Integration in the menu changes from module to module; for example, the module “Devel”, created for donations, quite productively uses the Administration menu module providing quick access to the developer tools.

To create the appearance of a website, the layout [9] was used by languages such as HTML (Hypertext Mark-up Language) [10] and CSS (cascading style of the tables) [11].

A system database has been developed that allows you to save and use information using files on a web resource. A database "Field Experiments" was also created in the SQL programming language [8].

A database is a collection of data organized according to a concept that describes the characteristics of these data and the relationships between their elements; this set supports at least one of the application areas (according to the standard of ISO / IEC 2382: 2015). In general, the database contains schemas, tables, views, stored procedures, and other objects. Data in the database is organized in accordance with the data organization model. Thus, the modern database, in addition to the data, contains their description and contains means for their processing.

When working with databases, the special-purpose languages are used:

- Data definition language (DDL) is a language that describes data and data structures, as well as defines the relationships between them (in accordance with the standard of ISO / IEC 2382: 2015);

- Data manipulation language (DML) is a speech that is supported by a database management system that provides operations for obtaining, adding, changing and deleting data (according to the standard of ISO / IEC 2382: 2015);

- Query language is a language for users that provides receiving and processing data in a database (according to ISO / IEC 2382: 2015).

When working with relational databases the language of Structured Query Language (SQL) is used. It combines all three functions (data definition, data modification and sampling).

SQL (Structured query language) is a declarative programming language for user interaction with database, it is used to generate queries, update and manage relational databases, create a database schema and its modifications, and control systems for accessing the database. By itself, SQL is neither a database management system nor a separate software product. Unlike the actual programming languages (C or Pascal), SQL can generate interactive queries or, when it is built into application programs, it acts as an instruction for data management. In addition, the SQL standard contains functions for defining, modifying, verifying and protecting data.

SQL is a dialog programming language for querying and making changes to databases, as well as database management. Many databases support SQL with standard language extensions. The SQL core forms a command language that allows you to search, insert, update, and delete data using the management system and administrative functions. SQL also includes CLI (Call Level Interface) to access and manage databases remotely.

A list of the main types of experimental information is developed. It is provided for the current year of research. General information: year of research, certificate number, name of experience, soil name, crop rotation, rotation number, field number, culture, variety (hybrid), hydrothermal coefficient (Hydrothermal coefficient of moistening after Selyaninov) during the growing season and long-term of hydrothermal coefficient of moistening.

Tables with an experimental information:

1. Scheme of options for experience

Variant №	Variant (norm and compounds of different types of fertilizers)

2. Types and forms of fertilizers

Types of fertilizers	Form of fertilizers with the content of nutrients

3. Methods of applying fertilizers

Variant №	Main application		Presowing		fertilizing		fertilizing	
	Norm	Date	Norm	Date	Norm	Date	Norm	Date

4. Results of laboratory analyses of soil in the year of studies

Variant №	Variant of soil, cm	Type of analysis	Method of determination	Values	Unit of measurement

5. Crop yield (average after repetitions)

Variant №	Main products (unit of measure)	Secondary products (unit of measure)

Accuracy of the study, %
The Least Significant Difference (LSD) 0.05

6. Content of nutrients in the main products

Variant №	Indicators and their meanings								

7. Content of nutrients in secondary products

Variant №	Indicators and their meanings								

8. Quality of the main products

Variant №	Indicator	Method of determination	Values	Unit of measurement

Taxonomic dictionaries have been developed for convenient filling of the form and the possibility of searching and filtering information on the site. Added a module for the full translation of the core of the website into Ukrainian language. The types of client users and the features that will be assigned to them have been worked out. The decision is made, and the measures are taken about the limited registration on the website.

If the experience is carried out on several fields, then the results of the research are provided for each field separately. If varieties or hybrids are investigated in the experiment, then the data are provided for varieties and hybrids

Thanks to SQL, connections and information requests have been developed.

The connections are made in three forms: 1-link "one-to-many"; 2-link "many-to-many"; 3-link “one-to-one”.

Links between tables are created explicitly, using the "data schema" window or by dragging a field from the list of fields. The Access program uses links between tables to determine how to merge tables in cases when they need to be used in a database object. The links must be created between tables before creating other database objects (for example, forms, queries and reports) for several reasons: 1-links between tables reveal the structure of queries, 2-links between tables open the structure of forms and reports, 3-links between tables - this is the basis for ensuring the integrity of data. This helps to prevent the occurrence of lost records in the database. The lost records are the records, which refer to another entry that does not exist, for example, the records of an order that refer to a missing user entry.

A query is the formulation of the informational needs of some database or information system by a user, for example, a search engine. To make a query, the language of search requests is used.

A feedback service has been developed. It is presented on all pages of the site. This service allows the user to send a message to the centre, and for example, to make an agreement on cooperation.

The model "Unified information system of field experiments" has been developed (Fig. 1).

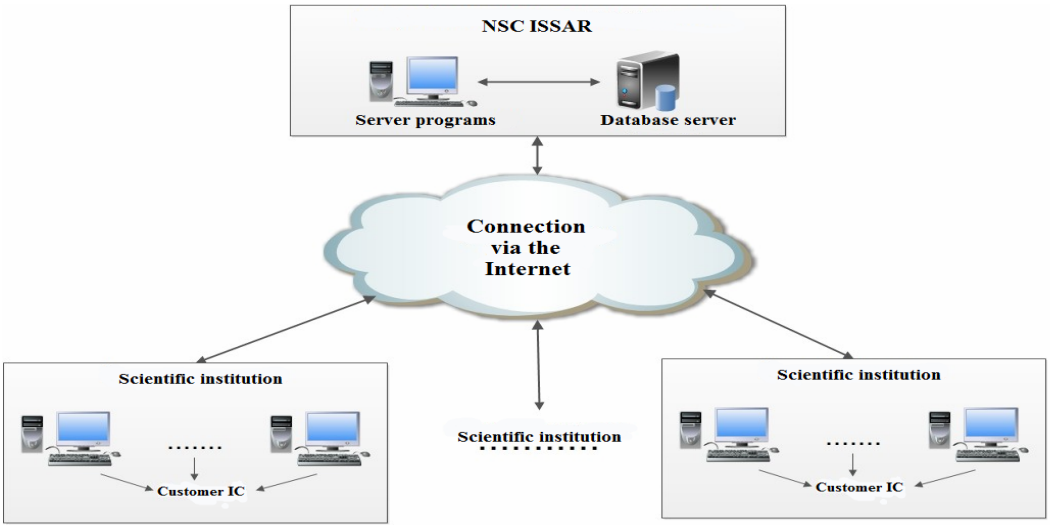

Figure 1 - Model "Unified Information System of Field Experiments"

A scheme of connections of the information has been developed (Fig. 2).

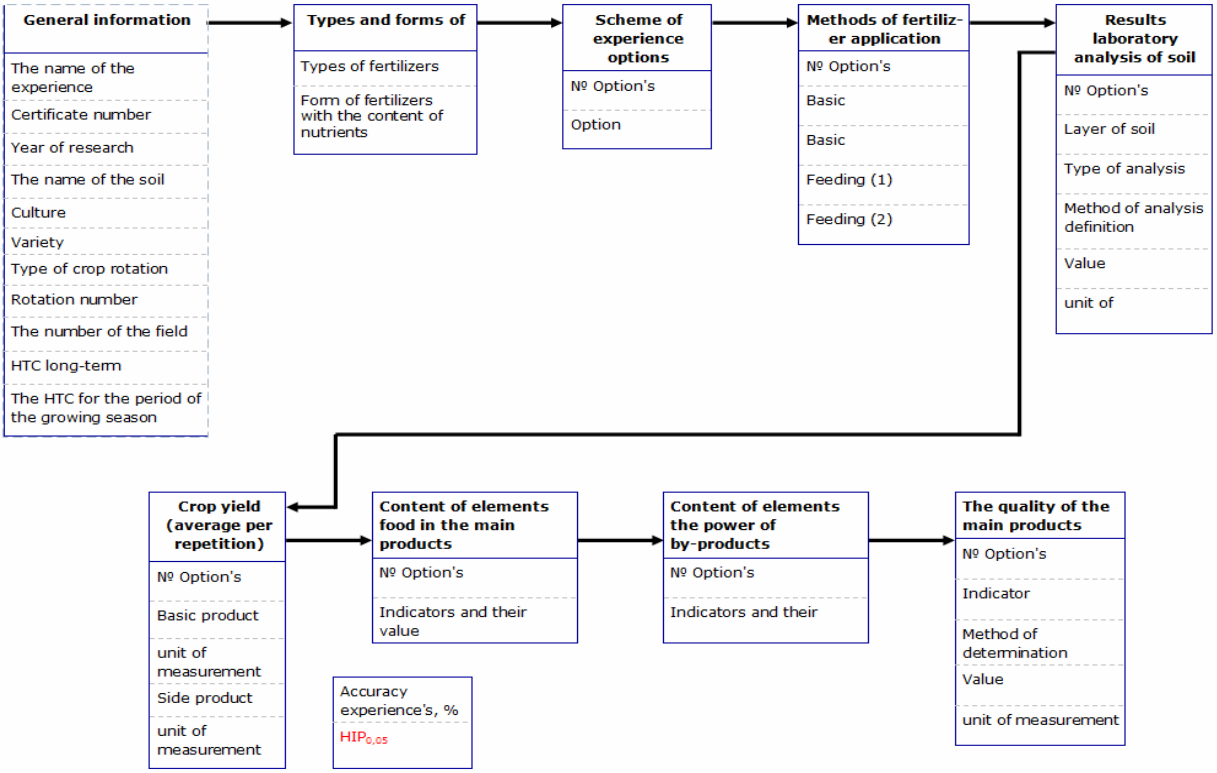

Figure 2 - Diagram of the connections between the data of the tables.

Conclusions

1. The "Unified Information System for Field Experiments" has been created. It allows the collection of data from field experiments, integrating it safely, prompt access to information using a single interface, exchange it between scientific institutions, and compiling reports in accordance with the requests of the client users.

2. The functioning of the information system is provided on the website on the Internet.

3. The use of experimental information from field experiments, by a wide range of scientists from different institutions, will reduce the financial costs per unit of scientific output and will allow the development of modern agricultural technologies for growing crops.

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