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### RELATIONAL DATABASE SUPPORTING EXPERIMENTS CONNECTED WITH PLANT PROTECTION

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#### ABSTRACT

Carrying out studies connected with application of plants protection products for chemical methods of plants protection against pests and diseases requires to use databases in order to collect the obtained results. Databases, and more precisely information stored in them, may be used not only in the process of conducting further trials, but they may also be helpful for users of the bases, for example with their scientific work. This article presents a database application, "Documents archive", based on the relational database designed and implemented by using SZBD Microsoft Access 2010. The software allows recording results of research and experiments related to efficacy of plant protection products at the Research Institute of Horticulture in Skierniewice, and effective usage of results obtained earlier in the research process of this unit. Uncomplicated, user-friendly and fully automated interface of the presented database application was implemented based on diverse forms, with the usage of macro and VBA language procedures. Possibility of cooperation with diverse software significantly increases the possibilities that are offered by database application "Documents archive" in finding and processing the stored data, which makes it a very useful tool (IT tool) for research connected with plant protection. In this way, based on the research and experiments results stored in the base, the database application allows a quick evaluation of the applied plants protection products, as well as selection of the most effective scenario of their usage for a specific crop or pest.

### Introduction

Nowadays, it is very difficult to imagine production of plant produce without application of plant protection products (PPPs) in the farms. In order to enable effective control of plant pests and diseases, products of this type should be used appropriately. Besides, their application is inevitably connected with a possible threat to the natural environment, including human and animals' health. Therefore, carrying out research and experiments that, on one hand deal with effectiveness of application of PPPs, and on the other hand consider

protecting the natural environment against their side effects is thus justified and required by the European Union legislation.

Currently, databases are a mean to store and process huge amount of diverse information. A database may be defined, inter alia, as a model of a certain part of real world (unnecessarily existing in a physical way or such that has never existed physically) that is a subject of interest for future users. A piece of reality that may be modelled by means of databases is farming and, as a particular component, scientific research and experiments conducted in this respect. Examples of database applications supporting farmers in their everyday work are a few (Sarec et al., 2007; Sieczko, 2012; Treder et al., 2013; Bzowska-Bakalarz and Gil, 2008), including some that refer to diverse aspects connected with research of farm production (Urbańska and Gierszal, 2003). The systems of collection of data on sale and consumption of PPPs are the basis to develop national strategies of sustainable plant protection (Stobiecki, 2006). The decision support system presented by Urbańska et al. (2010) is an IT tool for farmers and other professionals (e.g. advisors) aiming at easing identification of pests and diseases, as well as helping to perform an appropriate evaluation of potential threats and the threshold level of infection for a particular crop.

#### **Database application “Documents archives”**

To manage the data gathered in experiments and trials carried out at the Research Institute of Horticulture in Skierniewice (RIH), a “Documents archive” database was created. Its main aim was storing the diverse information obtained from efficacy studies of PPPs, and enabling an effective usage of previously obtained results. The need for such kind of software results from the European Union (EU) requirements of electronic archives for efficacy studies (Reg. EU 1107/2009).

The system developed enables thus registering all types of information connected with this activity, storing the data organized in appropriate documents, according to the requirements of the EU and the Main Inspectorate of Plant Protection and Seed Production (GIORiN) as well as internal department procedures. The application carries out the following operations: introduction and management of data (data about contractors, orders, plants protection means, research, experiments, subcontractors), browsing information from diverse charts in the form of documents, all types of inquiries related to the information stored in the database, data exchange (export/import) with other applications, data archiving after certain time, data protection.

The scheme of relational “Documents archive” data base created at SZBD Microsoft Access (2010) for the efficacy studies carried out at RIH is presented in Figure 1.

## Relational database supporting...

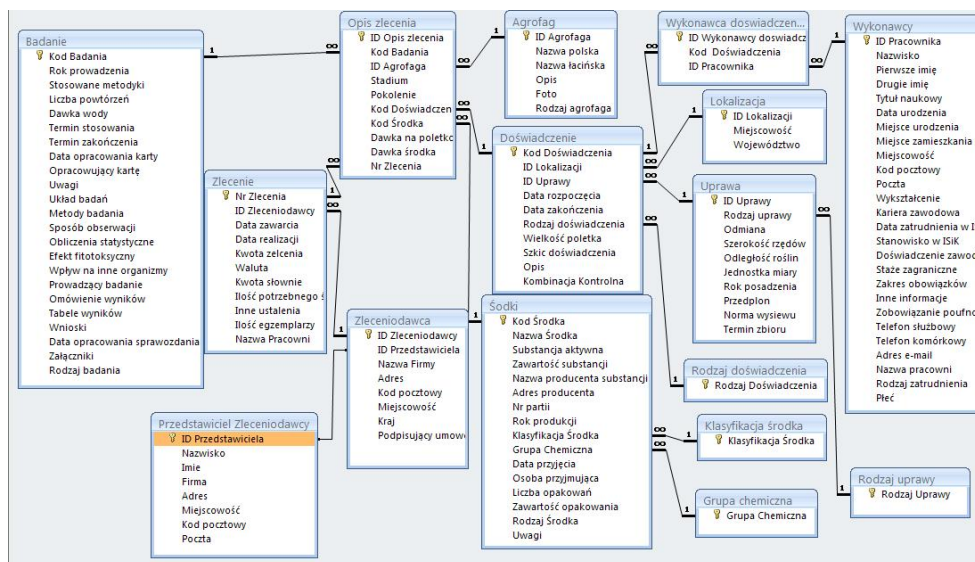


Figure 1. Scheme of the relational database "Documents archive".

In the database all stored data is divided into the following headings: Ordering Party, Orders, Products, Research, Experiments, Pests, Contractors, that were initially planned to be the base charts. However, after the analysis of the scheme it turned out that certain data would be duplicated (i.e. were redundant). Therefore, an initial normalization was carried out of the existing relations. As a result other base relations have been created (e.g. Crop – containing data related to the crop, or Location – storing information about the place of the crop). Some of the database relations store general and basic data, e.g. Products Classification is grouping PPPs on account of their use (insecticide, fungicide, herbicide); the chart Chemical Group classifies the PPPs according to their active substance; the kinds of crops that are subject of the research are considered in the Crop Kind chart.

### Interface of database application „Documents archive”

The interface for the database application was developed based on diverse forms offered by Microsoft Access. For it automation, there were various macros diverse macros, as well as with procedures and functions of the Visual Basic for Application language. A simplified scheme of the database application "Documents Archive" is presented in Figure 2.





### Possibilities of cooperation with other software

Among the softwares that can be interfaces with the database „Documents archive” can be listed: calculation sheets, text editors, applications sending mails, fax machines and internet browsers. This is made possible by tools exporting data to other applications, as well as tools that facilitate import of data from such applications. This characteristic improves significantly the possibilities of making available and processing of the stored data. „Documents archive” database application can cooperate with diverse components of MS Microsoft Office package, as well as with other software (e.g. ARM7 application) that support conducting experimental research. Data exchange between the database and other applications can be obtained using MS Access tools and by means of them to Exchange data from the whole chart or sheet (in case of data import from MS Excel). It is also possible to exchange only a part of data included in the chart, but appropriate macros must be created and configured also using Visual Basic software. An example of data exchange with MS Excel in „Documents archive” database is presented in Figure 4.

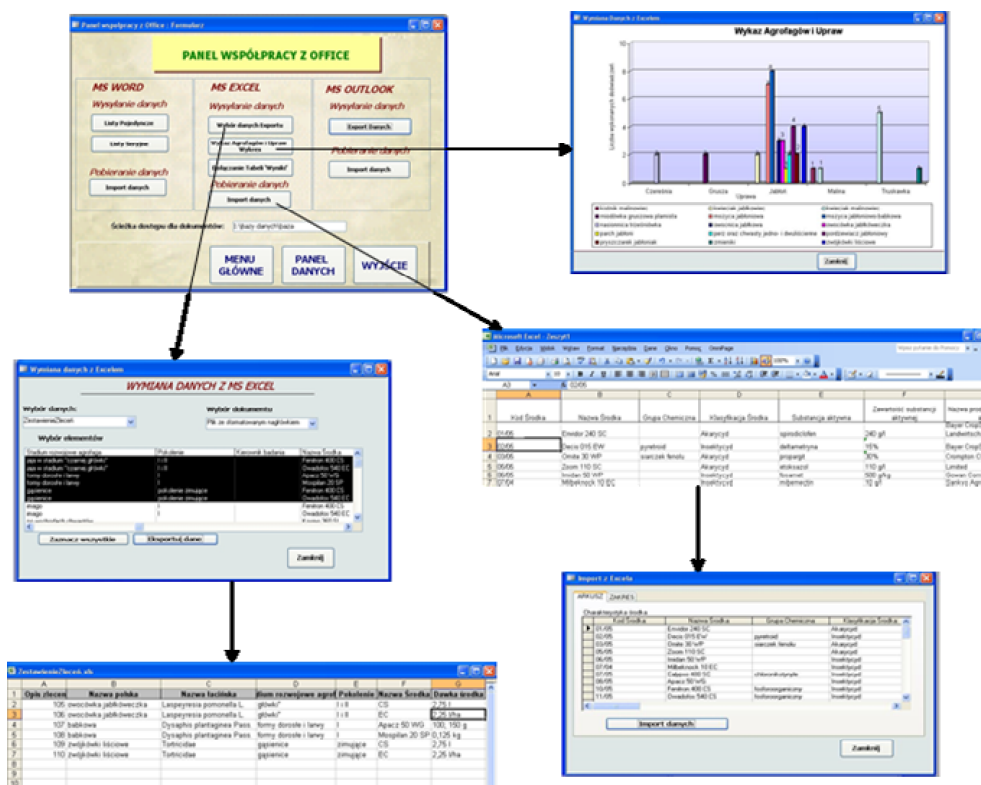


Figure 4. Scheme of data exchange with MS Excel at the relational database “Documents archive”

The database application „Documents archive” uses also sites for data access (DAP – Data Access Pages), which are prepared to be used for websites. They combine features of forms and reports in HTML format documents connected directly with data in the database, which can be placed in the Internet or can be used in MS Access program environment. Access sites use the information that changes dynamically, i.e. a browser can access dynamic data stored in databases in an interactive way. One of the most interesting features of DAP sites is a possibility of accessing grouped data, which is presented in Figure 5. This feature allows using data for the analysis of information stored in charts and makes it possible to browse collected information and access data in a deeper way in order to find out more on specific data connected with collected information.

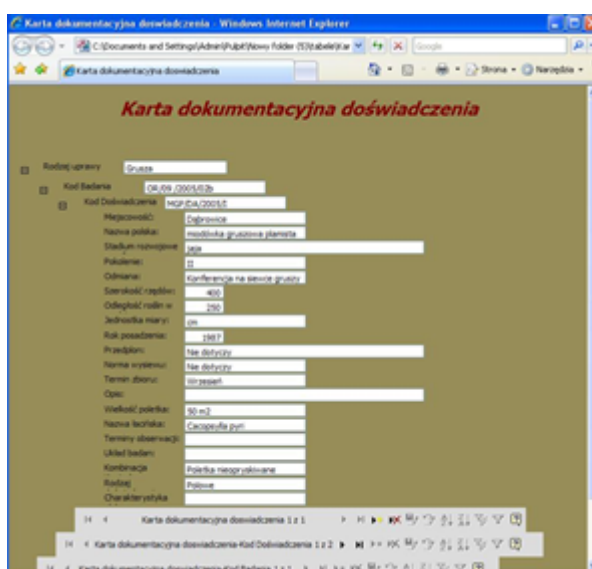


Figure 5. The interface of the relational database “Documents archive” – an access page “Documentation card of the experiment” with shown grouping selectors

In the relation database „Documents archive”, it was used Java language, which is the effective language of Java Server Pages (JSP) technology that is part of JavaPlatform System. JSP uses a bridge in order to make a connection with the database and acquire data: JDBC:ODBC. JDBC allows giving instructions SQL from the level of Java language, and ODBC is an appropriate steering tool for the base. By means of such configured connection it is possible to make all operations at the database using available data (adding, removing, editing and records modification), using the interface created in another programming language. Java language was used in some HTML forms, and in their case all actions are performed by means of the code included in the files \*.jsp placed at the local server. It allows using database by users of the local internet web (intranet). Upon performing registration procedure, each time the user’s login and password are verified, and if the correctness is confirmed (i.e. they are in the chart ‘Users’) steering is transferred to another website, e.g. Dane.html (fig. 6), where a user may find all necessary data that refer to a particular PPP, or

may display information on all PPPs available at the data base. When pressing the „Find” button, appropriate data will be selected from the database (Fig. 6).

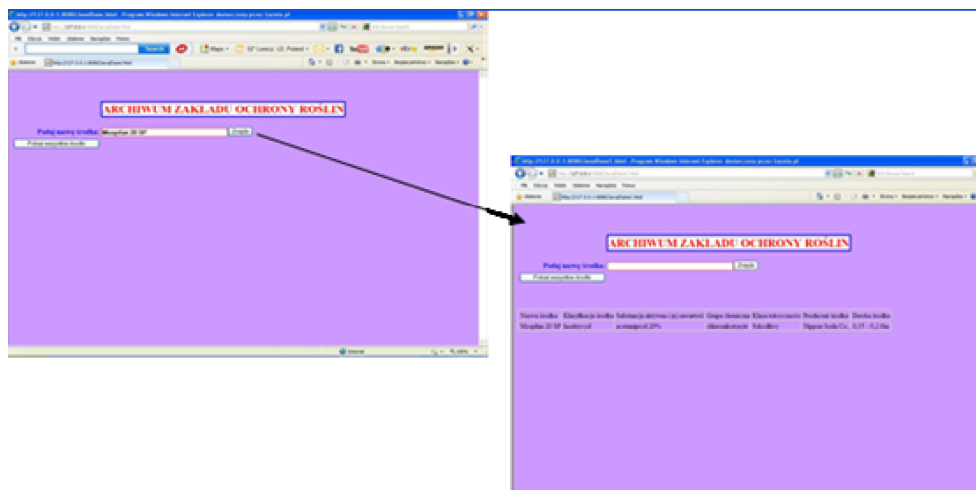


Figure 6. The interface of the relational database “Documents archive” – an example of forms created at JavaPlatform by using Java language

## Conclusions

Databases may become an extremely helpful scientific tool used in experiments connected with plant protection. The “Documents archive” database that we have developed is an example of such tool that has been used for storing information obtained from efficiency trials of PPPs conducted at the Horticulture Department of the Research Institute of Horticulture in Skierniewice. It contains all information related to the trials, including the data of employees who performed the study, the used means of plant protection, kind of crop that is the subject of the research, location of experiments and tests, as well as their descriptions. In this way the complete amount of information is made available that may be used for further scientific studies. The scheme of the relational database, on which the presented database application is based, was validated (e.g. charts were appropriately normalized), which prevents redundancy of data. A fully automated interface of the program (because of the usage of macros and VBA language) enables its users, by means of specially selected forms, to quickly acquire the data stored in the database and to display them on the monitor or to print them after selecting one of the several specially designed report forms. A possibility of interfacing with diverse softwares (components of MS Microsoft Office, ARM7 application) as well as using diverse IT tools (Visual Basic for Applications language, SQL language, DAP – Data Access Pages, Java language, Java Server Pages technology, HTML language) allows the presented information system to offer diverse ways of obtaining the stored information and processing it according to the requirements and needs of the users. It is believed that such a database system is a significant support for conducting efficacy stud-



ies of PPPs, which was practically verified by implementing it at the Horticulture Department of the Research Institute of Horticulture in Skierniewice.

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## **RELACYJNA BAZA DANYCH WSPOMAGAJĄCA PROWADZENIE DOŚWIADCZEŃ ZWIĄZANYCH Z OCHRONĄ ROŚLIN**

**Streszczenie.** Prowadzenie badań związanych ze stosowaniem środków ochrony w chemicznych metodach ochrony roślin uprawnych przed szkodnikami i chorobami wymaga wykorzystania baz danych w celu gromadzenia uzyskanych wyników. Bazy danych, a ściślej informacje w nich przechowywane, można wykorzystać nie tylko w trakcie prowadzenia dalszych doświadczeń w tym obszarze badawczym, ale także mogą być pomocne dla użytkowników tych baz, choćby w ich pracy naukowej. W niniejszym artykule została zaprezentowana aplikacja bazodanowa „Archiwum dokumentów” oparta na relacyjnej bazie danych zaprojektowanej i zaimplementowanej przy wykorzystaniu SZBD Microsoft Access 2010. Program ten umożliwia zapisywanie wyników badań i doświadczeń prowadzonych nad skutecznością środków ochrony roślin w Oddziale Sadownictwa, Instytutu Ogrodnictwa w Skierniewicach oraz efektywne wykorzystanie wcześniej uzyskanych wyników w toku procesu badawczego w tej jednostce naukowej. Nieskomplikowany, przyjazny użytkownikowi i w pełni zautomatyzowany interfejs prezentowanej aplikacji bazodanowej został zaimplementowany w oparciu o rozmaite formularze, przy wykorzystaniu makr i procedur języka VBA. Natomiast możliwość współpracy z różnorodnym oprogramowaniem znacznie zwiększa możliwości, jakie oferuje aplikacja bazodanowa „Archiwum dokumentów” w kwestii wyszukiwania i przetwarzania przechowywanych informacji, czyniąc z niej użyteczne narzędzie (informatyczne) wykorzystywane w prowadzeniu badań i doświadczeń naukowych związanych z ochroną roślin. W ten sposób, w oparciu o przechowywane w bazie danych wyniki badań i doświadczeń, aplikacja bazodanowa umożliwia szybką ocenę stosowanych środków ochrony roślin oraz wybór najbardziej optymalnego wariantu, jeśli chodzi o ich wykorzystanie dla konkretnej uprawy lub agrofaga.

**Słowa kluczowe:** relacyjna baza danych; aplikacja bazodanowa; interfejs bazy danych; ochrona roślin