The formation of the database information component in the genetic monitoring of Siberian forms of barley

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Abstract. The article discusses the formation and the replenishment of a set of the database parameters with the spring barley genetic and economic-valuable indicators, related, inter alia, to modifications of data representation graphical forms and the choice of data manipulation technologies. The visibility and the advantage of graphical forms in the MS Access database in displaying electrophoretic spectra of barley hordeins and conducting genetic monitoring of spring barley forms by hordeins are revealed.

1. Introduction
Currently, the stabilization of crop production as well as the promotion of grain crops in the Northern regions in the context of global climate change increase the importance of selecting varieties with a high adaptability level.

Thanks to the efforts of Siberian scientists, technologies and methods for optimizing the selection process of grain crops in the severe Siberian conditions have been developed in order to increase productivity while simultaneously restoring and expanding genetic diversity. The gene pool of grain crops in the Siberian region is unique in terms of cold resistance and maturation time. Priority areas of research in the field of genetic resources are strengthening the work on molecular genetic monitoring of the gene pool in crop production and the use of molecular genetics methods for the identification of genotypes [1].

The implementation of these tasks is based on solving the issues of data collection, storage, identification, operational editing and use. An important role in solving these issues is assigned to modern information technologies, which provide wide opportunities for creating electronic catalogues, computer databases and their use in educational and production processes [2].

2. The database
The article presents the results of continuing work on the construction of a conceptual relational database model «Genetic formulae of spring barley in Eastern Siberia on hordein-coding loci» and additional solutions to the issues of storage structure, access and data extraction methods. The main part of the data was imported from MS Excel tables and modified in the DBMS Access [3].

Earlier, the first article on discussing the methodology and design stages of the database under consideration [4] showed the logical scheme of the database, the ability to search, view and select data through graphical forms. In total, the database includes genetic formulae of hordeins of Siberian modern varieties (72 varieties), 14 varieties of spring barley of Krasnoyarsk research agricultural institute.
selection, their parent forms (16 varieties), as well as genetic formulae of local Siberian ancient forms (40 samples). Data is presented in the corresponding tables and viewed through graphical forms that are opened using the button menu of the Main database form.

In order to eliminate the cumbersome and confusing selection of objects-tools for working in the database, most of the objects are hidden. Access to information, search, selection and addition of data (records) is organized through the button menu of forms, starting from the Main database form (figure 1).

![Main database form](image)

**Figure 1.** The Main database form.

Database modifications involve changes in the table structure and creating new queries for searching and viewing information. The main part of the added objects became auxiliary for the development of visual forms that are available through the button menu of the Main form.

In the process of testing and using the database in the educational process of the Krasnoyarsk state agrarian university, the database tables were supplemented. The changes are related to the fact that the basic economic-valuable signs of spring barley varieties of the Krasnoyarsk research agricultural institute selection were added to the table «Varieties of KSRAI». In the Constructor mode, the following fields were introduced: «Productive tilling capacity», «Length of the main ear, cm», «Number of grains of the main ear, pcs.», «Grain mass of the main ear, g.», «Yield, g/m²». Table layouts were changed, their forms (figure 2) were changed as well as illustrations for a number of records (varietals) of tables were replaced, double drawings of electrophoretic spectra (for heterogeneous varieties) were added.

In order to add images to database records, the field types: Attachment and OLE object Field were used. OLE technology (Object Linking and Embedding) is a method for transferring information as objects between Windows applications that allows to embed and to edit an embedded object by the source application that created it. We used the field type OLE object Field to place images that can be changed and commented on while viewing records.
When placing an OLE object, photos of hordein spectra are stored in the Paint image editor format in files with the *.bmp extension. For static images, the Attachment type is selected. In this field, embedded illustrations are saved with the *.gif and *.jpeg image extensions.

Photos of the hordein electrophoretic spectra were also added to the «Formulae of local ancient forms» table for the local ancient «Lykovsky» sample (figure 3). This sample is characterized by a heterogeneous structure and was cultivated by the Lykov family, who lived in isolation in the mountains of the southern Krasnoyarsk territory for more than 70 years. The sample was studied in detail in the Krasnoyarsk research agricultural institute, where for the first time an unknown allele of hordein HrdA44 was determined in modern varieties of spring barley [5]. Later, this allelic variant was registered by A. A. Pomortsev at the Institute of general genetics (IGGEN of the USSR Academy of Sciences) under the number A44. It is important to note that studies of local Siberian forms of barley have shown that the HrdA44 allele was the most frequently encountered variant among ancient Siberian barley, but was lost in the process of modern selection.

The conducted screening of Siberian selection varieties of barley for the hordeins spectra (42 varieties) revealed a decrease in diversity both in the hordeins allelic composition and in the number of heterogeneous varieties compared with local ancient forms (40 samples of 9 Siberian regions: Omsk, Tomsk, Novosibirsk, Kemerovo, Irkutsk, and Chita regions, Krasnoyarsk Territory, Republic of Buryatia, Republic of Sakha (Yakutia)). The differences in the frequencies of occurrence of the hordeins allelic variants in the Siberian zones are established. For example, in varieties and samples of Krasnoyarsk research agricultural institute selection, the most frequently encountered alleles of hordeins B13, B17, A12, A2 are identified.
Figure 3. Electrophoretic spectra of the heterogeneous ancient sample «Lykovsky» (2.13.2. and 44.1.3.).

3. Conclusion
Thus, the developed concept of creating an educational-applied database in MS Access and the developed algorithms for forming and modifying the main objects can be transferred and used for designing other educational and applied databases for various grain varieties. Approaches to database structure design and search automation can also be applied by employees and students studying databases at the initial level.

Testing of the database in the educational process showed the visibility and the advantage of MS Access database graphic forms in displaying the electrophoretic spectra of spring barley hordeins. The ability to search and display electrophoretic spectra allows to conduct genetic monitoring of barley forms by hordeins, identify and control the bio-typical composition of sort varieties.

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