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Development and Application of Computer Decision-making System for Crop Grey Breeding (CDSCGB)

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***Abstract*—In this paper, we introduce the theory basis of Computer Decision-making System for Crop Grey Breeding, development environment and procedure, main models and its functions and demonstrate its application living example. Based on this, we discuss the merits and demerits of the system and its wide application prospects.**

I. INTRODUCTION

With the development of computer techniques, the development and research of crop breeding expert system have begun since the eighties of the 20th century. F. J .Muehlbauer et al. (1981) made the first computer simulation for the single seed descent and mass selection method: Mokinion. J .M（1985）taken the breeding expert system as the potential domain of development of agricultural expert system; Chinese Academy of Agricultural Sciences (1990) developed breeding expert system for winter wheat and breeding expert system for corn hybrid respectively on the basis of the breeding experiences of Academician Zhuang Qiaosheng, a well-known expert in wheat genetic breeding and Academician Li Jingxiong, a well-known expert in corn genetic breeding [1,2]. Sun Qixing and Zhang Aiming et al. (1991) established the computer evaluation system for wheat parent selective breeding according to the system method of wheat yield breeding, the least two multiplication method of parent selective breeding, the method of combination expression index, and the method of forecasting strong superiority combination [3]. Liaoning Academy of Agricultural Sciences (1993) developed the breeding expert system for rice in accordance with the breeding of northern rice improved variety [4]. The expert systems above-mentioned advance the crop breeding works to a certain degree, but they have limitations: either confine to a certain breeding link lacking integration, or do not have extensive adaptability owing to learning from the experiences of breeding expert to a certain specific stage. Thus, Ma Hongweng et al. (2002) and Guo Ruilin et al. (2003) developed the crop grey breeding computer decision-making system based on the Visual Basic 6.0 and PowerBuilder 6.0 separately taking the book Crop Grey Breeding Science as the original version[5-7].The two systems make up some deficiencies of expert systems above-mentioned, but their applications are limited because the former without succession, doesn't support multithread technique, and doesn't run cutting across the platform; the latter is incompatible with Windows XP and Vista. For this reason, we carried out the development of crop grey breeding computer decision-making system based on the Java technique in 2007, made considerable headway, and provided a convenient, swift and effective means for the breeding workers [8].

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II. THEORY BASIS OF COMPUTER DECISION-MAKING SYSTEM FOR CROP GREY BREEDING (CDSCGB)

Computer decision-making system for crop grey breeding (CDSCGB) is set up on the basis of crop grey breeding science which is a new interdisciplinary subject combing the theory of grey system with the theory of crop breeding. The birth of it indicated a revolutionary leap from traditional crop breeding to modernized, informational and quantitative breeding, thus making the crop breeding level climb to a quantitative stage from a qualitative one, and developing the crop breeding subject into a precise one from a qualitative and descriptive one. Adopting the theory and method during the course of the crop breeding breeding workers can not only consider multi-factors comprehensively and supply exact effective decision-making methods for modern crop breeding, but also realize highly intelligence for crop breeding. Even breeding newcomers can also come up to the decision-making standards of a breeding expert. Consequently, Developing the computer decision-making system for crop grey breeding (CDSCGB) based on the theory of crop grey breeding science is of momentous significance to promoting the crop breeding.

III. DEVELOPMENT CIRCUMSTANCES OF COMPUTER DECISION-MAKING SYSTEM FOR CROP GREY BREEDING (CDSCGB) AND ITS PROCEGURE

A. Development circumstances

Computer decision-making system for crop grey breeding (CDSCGB) adopts the MVC model, using the Java2

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developed by Sun Corporation in America as technique support, using JBuilder 2006 as integrated development circumstances, and using Microsoft Access 2000 as background data base. JBuilder 2006 is a strong enterprise development platform of Java which can develop various application programs under the frame of J2EE, integrating all Java techniques and containing every process of soft life cycle. It can not only stride across platform, accomplish writing once, running anywhere, and fit in with various computer operation system, but also program facing the object. Design of soft structure in JBuilder 2006 is distinct and obvious, strengthening its extension and duplication. It also provides 4 unitary interfaces which can make the system connect all current management system of data base such as Oracle, Sybase, Microsoft SQL Server, IBM DB2, Informix, Access, Foxpro, Paradox and so on. It is special commendable that the soft is apt to bring about network. Thus it can be seen that the development circumstances of computer decision-making system for crop grey breeding (CDSCGB) is very advantageous.

B. Development procedure

The second innovation and development of computer decision-making system for crop grey breeding (CDSCGB) has been made based on the book Crop Grey Breeding Science, combined with Guo Ruilin's study fruits in recent years. Its development procedures are as follows: system analysis of crop grey breeding →system design of crop grey breeding →set up application objects of crop grey breeding →generate user object, function and structure of crop grey breeding → establish windows and menu of crop grey breeding →create data window object of crop grey breeding →compile events of crop grey breeding →debugging and application →test system →product executable file.

IV. MAIN MODULES OF COMPUTER DECISION-MAKING SYSTEM FOR CROP GREY BREEDING (CDSCGB) AND THEIR FUNCTIOINS

A series of activities of crop breeding are a great deal of decision-making processes in essence. Multiple modules will be used during those processes which constitute core contents of computer decision-making system for crop grey breeding (CDSCGB).

A. Module and function of grey relation analysis of breeding targets

Adopting the principle and method of grey relational analysis, the module is used to analyze influence of main characters on the yield and quality, to distinguish main characters and secondary ones, to make the relation among characters clear, and to provide scientific basis for ascertaining objective and reasonable breeding targets.

B. Module and function of parent grey classification

Adopting the principle and method of parent grey classification, the module is used to determine the genetic differences quantitatively, to classify parents from essence attribute by this relation, and to guide the formulating of cross combinations.

C. Module and function of grey evaluation of cross combinations

Using the principle and method of grey evaluation of cross combination, the module is used to evaluate F_1 combinations comprehensively, thus determining key combinations.

D. Module and function of single-plant grey selection

Using the principle and method of single-plant grey selection, the module is used to select single-plant in segregation generations, thus deciding which to use.

E. Module and function of grey multi-target comprehensive evaluation of variety

Using the principle and method of grey multi-target comprehensive evaluation of variety, the module is used to evaluate varieties in regional variety test, thus providing scientific basis for examining and popularizing of variety.

F. Module and function of grey distribution of variety

Using the principle and method of grey distribution of variety, the module is used to analyzing results in joint regional variety test, to propose appropriate varieties in various ecological area.

G. Module and function of grey similarity cultivation of variety

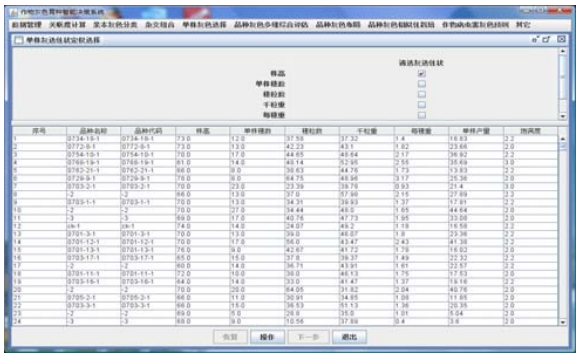
Using the principle and method of grey similarity cultivation of variety, the module is used to determine similarity variety by the grey similarity degree between the new variety and the popularizing variety, thus realizing complete sets of good variety and good cultivation measures.

H. Module and function of grey forecasting of crop diseases and insect pests

Using the principle and method of grey forecasting of crop diseases and insect pests, the module is used to forecast crop diseases and insect pests, thus supplying prevention tactics to agricultural production.

V. APPLICATION EXAMPLE OF COMPUTER DECISION-MAKING SYSTEM FORCROP GREY BREEDING (CDSCGB)

Let us illustrate application of computer decision-making system for crop grey breeding (CDSCGB) in crop breeding with example of wheat F_2 single-plant selection in Anyang



Institute of Technology in 2008.

Figure 1 Interface Selecting Grey Characters Please

First, double click the icon of computer decision-making system for crop grey breeding (CDSCGB) with mouse in windows VDU, enter the system, and click the data base attachment in the menu of database management. Then, click the menu of Single-plant Selection, select the table F208, click the Determination button, and the interface Selecting Grey Characters Please appears (Figure 1).

Choose characters to be evaluated, click the button Operation and Next respectively, and get into the interface Please Input Parameter of Grey Selection Degree 1(Figure 2).

Figure 2 Interface Please Input Parameter of Grey Selection Degree 1

Input the values of characters and submit them, click the button Next, and the interface Whited Function of Grey Selection Degree 1 for Characters appears (Figure 3).

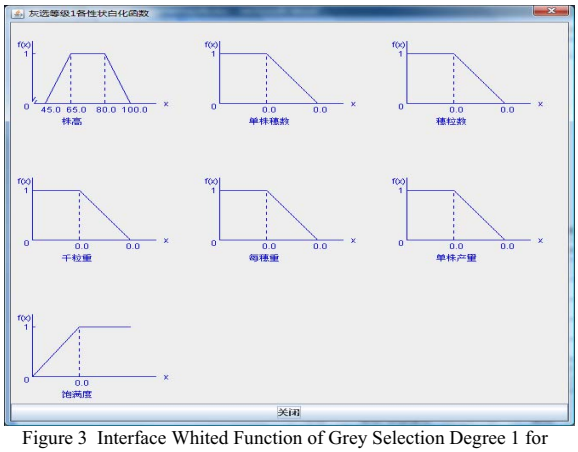


Figure 3 Interface Whited Function of Grey Selection Degree 1 for Characters

Click the button Next, enter the interface Please Select Way Of Determining Weighted Value Of Characters (Figure 4), choose one way wantonly among Expert Determination, Grey Degree Computing Determination, Deviation Computing Determination, Information Entropy Computing Determination and Judgment Matrix Determination according to concrete conditions, and select the way Judgment Matrix Determination in the example. After inputting corresponding values, click the button Accomplishing Determination Of Weighted Value and Next separately. The interface Please Input Parameter Of Grey Selection Degree 2 and Please Input Parameter Of Grey

Selection Degree 3 emerges separately. Input corresponding values

Figure 4 Interface Please Select Way Of Determining Weighted Value Of Characters

respectively and submit them. Then click the button Demonstration Of Coefficient Matrix and , attain the results of single-plant degree evaluation as shown in the figure 5.

The results show that 635 single-plants are first degree single-plant, 1204 single-plants are second degree single-plant, and 192 single-plants are third degree single-plant. Among them, the growing scale of the first degree single-plant should be extended adequately according to concrete conditions the next year, and be observed and selected as key plant lines; the second degree single-plant should be retained to grow, and be selected continuously; the third degree single-plant should be eliminated. The whole process above takes only 5 minutes, 100 times faster than the usual time required in accordance with the experiences of breeding expert, so a lot of time are spared, the work efficiency of breeding researchers and breeding selection effects are raised greatly.

VI. CONCLUSION

For a long time, the selection of crop new variety has been at a qualitative experience stage. This is why only few breeding experts with rich experiences can achieve success. Undoubtedly, the breeding experiences include breeding art and skill which are not only the fruit of painstaking labor and wisdom of breeding expert's whole lifetime, but also valuable spiritual wealth of crop breeding area. However, only a few breeding experts have these experiences, others do not have. Let alone the breeding experiences which are only effective for a given period of time. For example, it is very difficult to apply the experiences of high yield breeding in guiding the high quality breeding. This status increases the mystery of breeding experiences, and becomes one of the difficult problems puzzled the breeding workers. The development of computer decision-making system for crop grey breeding

(CDSCGB) based on the Java technique brings about hopes for getting rid of the difficult problem. Leaping from the traditional experience breeding to quantitative breeding has been realized because of introducing the grey math, even the breeding newcomer can also attain the level of breeding expert by the system, and the work efficiency can be increased

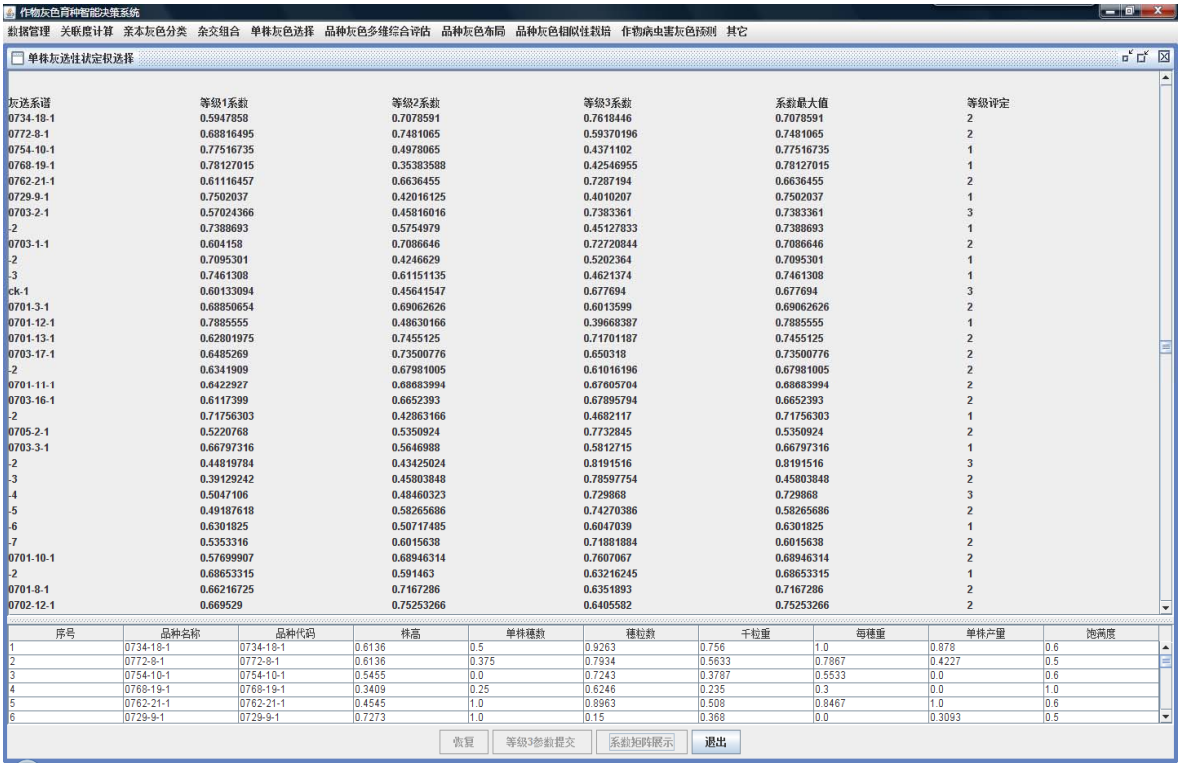


Figure 5 Selection results of single-plant of F_2 in 2008

extremely. This is the first significant feature of computer decision-making system for crop grey breeding (CDSCGB).

The second feature of computer decision-making system for crop grey breeding (CDSCGB) is that it can run on different platforms. As mentioned above, the system writes programs facing up to the object by using the Java technique in the development circumstances of JBuilder 2006, which can be transplanted conveniently, and can obtain writing once, running anywhere.

The third feature of computer decision-making system for crop grey breeding (CDSCGB) is that it has a complete range of functions and amiable interface, and can be learned and used easily. The system can realize all decision-making functions of various links during the process of crop breeding.

The fourth feature of computer decision-making system for crop grey breeding (CDSCGB) is that it has excellent robustness and security. As a kind of net language, the system can provide enough safeguard, and protect it from virus.

The fifth feature of computer decision-making system for crop grey breeding (CDSCGB) is that it supports multithread technique.

The features mentioned above promise that computer decision-making system for crop grey breeding (CDSCGB) has a wide application prospect. We believe that computer decision-making system for crop grey breeding (CDSCGB) will be an effective implement for breeding workers with the lapse of time. Certainly, there are some weaknesses in the system. For example, the establishment of tables, inputting and modifying of data and so on are not as convenient as Excel, which will be set by for further studying and improving.

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