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Application of Information System of Varieties of Common Knowledge in PVP

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Abstract

PVP (Plant Variety Protection) has been playing an increasingly important role in social development, and it has attracted great attentions worldwide. The rapid growth in PVP has placed mounting pressure on the selection of similar varieties used in PVP examination, or DUS test. Such situation makes the traditional way of similar variety selection relying on manual work in trouble. Information System of Varieties of Common Knowledge was proposed in this paper with the aim of improving the accuracy and efficiency of PVP examination and sorting out all kinds of information of plant varieties. The framework, management, maintenance and function of this System was introduced, and the application of this System in the selection of similar varieties was also illustrated in this paper. Based on this System, selection of similar varieties can be standardized, simplified, and independent of subjective judgment from PVP examiners. The information of plant varieties can be managed as well.

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1. Introduction

With the coming of knowledge economics, intellectual property has become an important index of weighing the comprehensive strength and core competitiveness of any country or region. It has been playing an increasingly important role in science & technology progress, economic development and social stability^[1, 2]. As one form of intellectual property, plant variety protection (PVP) is not only the key to the development of modern agriculture, but also the guarantee of social development^[3].

In 1999, China officially joined the International Union for the Protection of New Varieties of Plants (UPOV), and became its 39th member. Over the past 13 years, our course on PVP has started from scratch and witnessed continuous development. The number of PVP application and granting has been increasing. The annual quantity of application rose from 115 twelve years ago to 1138 in 2011. By the end of 2010, the accumulative total of applications from 30 provinces (as well as autonomous regions and municipalities) in China and 14 other countries had reached 6989, and of which, 2890 applications have been authorized^[4].

In a country where PVP is implemented, PVP can only be granted to those varieties which are determined to be distinct from any varieties of common knowledge (“known varieties” hereinafter), and PVP examination is based on DUS test which is conducted with the reference of similar varieties. Similar varieties are generally selected from the known varieties. In one case of DUS test, similar varieties need to be as few as possible to improve the efficiency and save the labor and cost. Therefore, the selection of similar varieties from the known varieties is of great importance to the efficiency and accuracy of DUS test^[5].

Known varieties include varieties sold for years, applied for the grant of PVP, or entered in an official register. At the time when a new variety is in conformity with preliminary examination of PVP, the variety could be deemed as known variety. The number of known varieties has thereby been increasing along with the rapid growth of PVP, which has placed mounting pressure on the selection of similar varieties. Such situation makes the traditional way of similar variety selection relying on manual work in trouble. Therefore, PVP examination is in urgent need of an information-based platform, which can sort out various kinds of information of known varieties and ensure the selection of similar varieties accurate and effective.

The Information System of Varieties of Common Knowledge has been established since 2007 and put into use since 2012. In this paper, the structure and function of this System were introduced.^[6]

2. Framework of the System

The Information System of Varieties of Common Knowledge sorts out the following 6 categories of information of known varieties, including basic information, registration information, storage information, characteristic information, DNA information, photograph information and DUS test information. Based on information of characteristic expression, DNA fingerprint and visual photograph, the System provides effective support for the selection of similar varieties from the known varieties.^[7, 8]

To ensure the safety of the System, access to its use and maintenance is clearly defined. As shown in Fig.1, access to the maintenance of system framework and variety information is available to administrators, and any revision to the two parts is restricted to administrator. The function of the System in selecting similar varieties is available to examiners and other users.

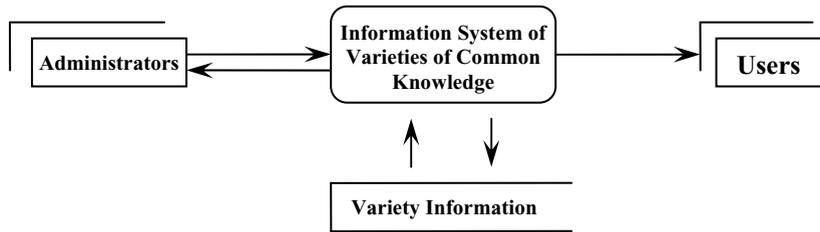


Fig1 the top layer of the system

2.1. Management of System Framework

The System framework is divided into three parts: characteristic description, DNA fingerprint and visual photograph, which can provide basis for the collection and management of variety information, and thus the selection of similar varieties from the known varieties.

- Framework of Characteristic Description

Each variety can be described by characteristic expression. To illustrate the characteristics and compare certain characteristics among varieties, the expression range of each characteristic can be divided into a number of states, and the whole set of expression states can be assigned as Note “1-9”, or “1-5” et al.. In the framework of characteristic description, the whole set of Notes for each characteristic and corresponding expression states are established, which are included into “Characteristic Dictionary”.

In the “Dictionary”, each characteristic has one standard code. Besides, information related to characteristic’s full name, expression type, expression states and corresponding notes are included in each characteristic. Characteristics with the same or similar name, expression states and notes can be merged into one, and given one standard code.

Management of this framework includes adding new characteristics, deleting wrong characteristics, revising and inquiring the information related to characteristics, including expression states, notes et al..

- Framework of DNA Fingerprint

To provide basis for DNA fingerprint of varieties, information related to the primers used in DNA fingerprint is collected and managed in the framework of DNA fingerprint, including name of molecular marker, primer code, primer loci, et al.

Management of this framework includes adding, deleting, revising and inquiring the mentioned information related to primers.

- Framework of Visual Photograph

Photography is another effective way to visually describe varieties besides characteristic description. For the sake of comparing different varieties with the aid of photographs, the parts of single plant which are used as the targets of photographs should be defined. Information related to the plant parts (photograph targets) is thus included in this framework.

Management of this framework includes adding, deleting, revising and inquiring the plant parts (photograph targets).

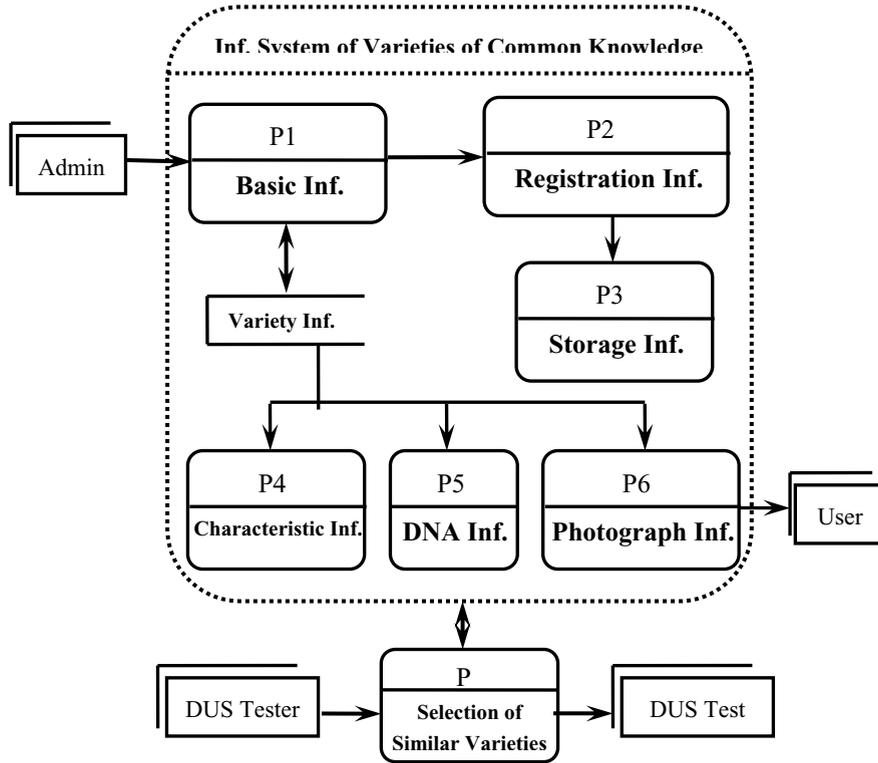


Fig2 design of the first layer

2.2. Management of Variety Information

Each variety in the System has its own ID. If the variety is a PVP-granted variety, the ID for this variety is its application code. IDs for other varieties are codes meeting certain requirements.

To fully understand a variety, 6 categories of information should be concluded and managed in the System, namely, basic information, registration information, storage information, characteristic information, DNA information, photograph information (Fig.2).

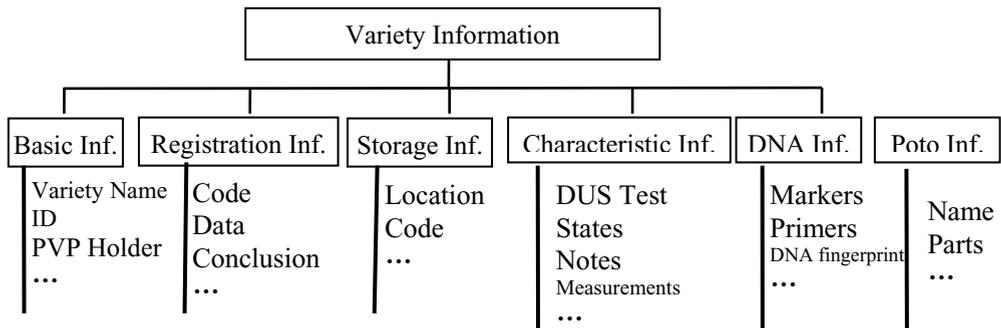


Fig3 functional structure of the System

- Basic Information

Basic information of a variety generally refers to the information related to variety name, ID, applicant, PVP holder, the way to reproduction, plant genera or species to which the variety belongs. Management of this part includes adding, deleting, revising and inquiring the basic information of certain variety.

- Registration Information

Registration information can be generated when a variety enters into the National or Provincial Registration of Varieties. Registration information of a variety refers to the registration code, registration date, registration conclusion, et. al.. Management of this part includes adding, deleting, revising and inquiring the registration information.

- Storage Information

Storage information refers to the information related to the storage location and code of varieties, which makes it easy to find the varieties. Management of this part also includes adding, deleting, revising and inquiring the storage information.

- Characteristic Information

Characteristic information is the information related to the characteristic measurements gained in past years and different test stations, including Test No. of each variety, expression states and corresponding notes of characteristics, as well as the initial measurements of characteristics. Management of this part includes adding, deleting, revising and inquiring the characteristic information as above, and besides, data importing in batches. Two or more years' DUS test data will be combined into one set to facilitate the harmonization of variety description.

- DNA Information

DNA information is the information related to DNA fingerprint of a variety, especially the primers and molecular markers used in the analysis of DNA fingerprint. Management of this part is same as characteristic information, including adding, deleting, revising, inquiring, and data importing in batches.

- Photograph Information

In accordance with the photography protocols, the photographed parts of a variety are clearly defined, and each plant genera or species has their confirmed photographed parts. Besides, photographs should be taken by the same type of camera, and each photograph should be named according to certain rules. The name of one photograph composes of "variety name_photographed parts_No.". Photograph information related to photograph names, locations, dates, photographed parts is included in this part. Management of this part includes adding, deleting, revising and inquiring photograph information.

3. Selection of Similar Varieties

A variety applying for PVP should be DUS tested with the reference of similar varieties. Similar varieties are selected from the known varieties. Selection of similar varieties is based on two aspects, characteristic description and DNA fingerprint. When a variety has the most similar characteristic description and DNA fingerprint with the given variety, the variety is considered as the similar variety of the given variety.

3.1. Selection based on Characteristic Description

Steps of selection in this regard are as follows:

1. The range of candidate varieties should be confirmed. Candidate varieties should be in the same plant genera or species as the given variety, or in the same group (i.e. subgroup) of plant genera or species in the case where the given variety belongs to certain subgroup.

2. To avoid the mirrors in similar variety selection caused by variation of characteristic expression which is mediated by environmental changes, location of DUS test should be considered. If the expression of a characteristic can be easily influenced by environmental changes, the characteristic should be excluded for the consideration of similar varieties selection.

3. After the consideration of plant genera or species and characteristic variation, selection of similar varieties enters the critical phase: comparison of expressions of the same characteristic. According to the expression types of characteristics, characteristics are grouped as qualitative characteristics (QL), quantitative characteristics (PQ) and pseudo-quantitative characteristics (QN). It is important to note that characteristic expressions should be compared in following order: QL->PQ->QN. The specific method is as follows:

a. Similar varieties should share the same notes for the expression states of qualitative characteristics (QL) with the given variety, especially for those qualitative characteristics (QL) which are assigned as grouping characteristics. Candidate varieties with different notes for QL may not be considered as similar varieties.

b. Difference of the notes for the expression states of pseudo-qualitative characteristics (PQ) between similar varieties and the given variety is allowed. However, the difference should be as little as possible. If a pseudo-qualitative characteristic is a grouping characteristic, any difference in the characteristic between similar varieties and the given variety should be avoided.

c. Difference of the notes for the expression states of quantitative characteristics (QN) between similar varieties and the given variety is also allowed. The difference should also be as little as possible.

In the course of similar variety selection, the number of characteristics used for comparison is different according to specific situation. In the case where the number of candidate varieties is larger, more characteristics can be used.

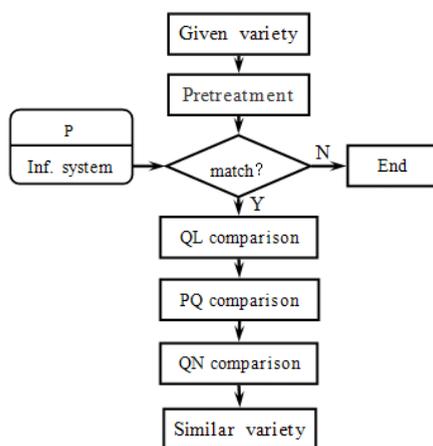


Fig4 the working flow of “Selection based on Characteristic Description”

3.2. Selection based on DNA Fingerprint

Steps of selection in this regard are as follows:

1. The range of candidate varieties should be confirmed, and candidate varieties should be in the same plant genera or species as the given variety, or in the same group (i.e. subgroup) of plant genera or species if the given variety belongs to certain subgroup.

2. Since different methods of molecular markers have different primers and DNA fingerprints, the type of markers should be considered before comparison. Only DNA fingerprints gained by the same markers and same primers can be used to select similar varieties.

3. DNA fingerprint is detected by PCR amplification and electrophoresis, and is composed of different DNA bands. DNA fingerprint is described by the loci of DNA bands. Thus, selection of similar variety in this regard is based on comparison of DNA fingerprint, or the loci of amplified DNA bands, and difference should also be as little as possible.

4. Function of this System

Based on this System, selection of similar varieties can be standardized, simplified, and independent of subjective judgment from PVP examiners. The information of plant varieties can be managed as well.

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