

Introduction of Taiwan agricultural pest database

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Abstract

The Taiwan Agricultural Pest Database (TAPD) was established in 2003. The purposes are mainly to provide the Bureau of Animal and Plant Health Inspection and Quarantine (BAPHIQ) and other administrative and research bodies with an inquiry interface for formulating counter policies to pest status and with pest information of our crop as requested by imported countries. This database consists of two sections, including the Front-End Data Reading Section and the Back-End Data Managing Section. The front-end section presents data output to browsers on the pest checklists for economically important crop and the single pest data sheet. The content of single pest data sheet for each pest species covers its taxonomic position, geographical distribution, morphology, biology, control methods, and economic importance. The back-end data managing section includes data establishment and management for agricultural pest checklist, single pest data sheet, and general introduction of crop pest for each economically important crop. By the end of June, 2006, fifteen Taiwan agricultural pest checklists of the crops were completed and 711 entries of pests were included on the lists. Among these entries, 117 pest data sheets for the primary or secondary pest species were also accomplished by the specialists. Before the end of 2010, detailed information about species labeled as a primary or secondary pest in the database can be linked and retrieved by its scientific name.

Key words: Taiwan, agricultural pest, database, checklist

Introduction

For years, an all-inclusive and standard encyclopedia of Taiwan agricultural pests

has long been in need for agricultural research institutes, administrations and schools. Several factors have been attributed to the absence of such an encyclopedia: Systematic and long-term surveys were inadequate; researches were often limited to academic scope and seldom applied to other uses, and few scholars and specialists worked on the revision of the taxonomic position of pests. As a result, the scientific names, biological information, geographical distribution, etc., in the existing literatures from checklists, pictorial encyclopedias, special publications, and scientific papers lack in coherence. Hence, it is necessary to construct a highly accurate and united database. The database will not only fortify the monitoring and prevention of plant pests but can serve as reference for international trading negotiation of agricultural administrations.

Since becoming a member of the WTO (World Trade Organization) in 2002, plant protection and quarantine measures in Taiwan have had to comply with international treaties such as IPPC (International Plant Protection Convention) and SPS (Agreement on the Application of Sanitary and Phytosanitary Measures). Also, domestically, related information should be transparent and open to the public. With the growth in the importation and exportation of agricultural products, issues concerning phytosanitary measures continue to emerge in international trading negotiations. Taking this into consideration, the comprehensiveness and accuracy of the plant pest checklist will definitely strengthen the clarification and announcement of the pest situations in Taiwan and bring great benefits to agricultural exportation in return. For these reasons, the Bureau of Animal and Plant Health Inspection and Quarantine (referred to as BAPHIQ in the following sections), Council of Agriculture, Executive Yuan have domestic authorized related research institutes and scholars to commence the construction of Taiwan Agricultural Pest Database. In the beginning stage, the focus was on consolidating the existing literatures including scientific research papers, checklists, encyclopedias, and special publications to be the building blocks for later construction. In the following year, based on preliminary data, specialists and scholars started writing and compiling detailed information of the agricultural pests and the agricultural pest checklist for the reference and consultation of plant protection and quarantine administration and academic bodies. The compiled information will also facilitate the government in implementing the electronic agricultural policies and also strengthening agricultural produce competitiveness.

Objectives and developmental stages of database

The purpose of developing this database is to build plant protection data of the

crops and their pests in Taiwan for agricultural administrations to use as reference information to form agricultural policies or develop protection measures. The development of the database can be divided into three the initial stage, the intermediate stage, and the final stage.

Initial Stage

The first stage spans over two years (2003-2004). In this stage, pest species data were gathered to establish the standard framework of the database. Also, a digitized website managing system composed of a front-end data reading section and a back-end data managing section was also designed in this phase (Wu and Shih, 2006).

Intermediate Stage

This stage will last up to 6 years (2005-2010). From 2005-2008, the primary goal will be recruiting specialists to write about the newly developed crops in Taiwan that are competitive in the market. The topics will cover the following: General Introduction of Crop Pests (a comprehensive review of integrated pest management of specific crops), Agricultural Pest Checklist (as a complete record of the primary, secondary and occasionally occurring pest species to specific plants for all cultivation stages ; this checklist will be updated every year), and Single Pest Data Sheet (detailed information of every pest specie). The format of the article written by specialists will be reviewed by the Back-End Management Team as well as other specialists. The goal for 2009-2010 is to invite specialists to write and review detailed information of the secondary pests of the mentioned crops .

Final Stage

The final stage will be the sustainable maintenance and management of the database. While completing all pest checklists and detailed information of the primary and secondary pests of Taiwan crops, instant updates and function furnishing will be conducted to ensure the accuracy of the database.

Introduction to the main structure s of the system

The database divides crop plants into several categories --- fruit trees, floral plants, vegetables, agronomic crops, ornamentals, spices, medicinal herbs, and biofuel plants. Harvested seeds and processed agricultural produce are put into the harvested products category. As for the pest species, the categories include noxious

plants (e.g. weeds, parasitic plants), plant pathogens (e.g. bacteria, fungi, viruses, microplasma, etc.), vertebrates (e.g. rodents, birds), and invertebrates (insects, mites, nematodes, snails, etc.)

The taxonomic position of the crop and pest species mentioned above have all been established in the database by their scientific names, *i.e.* the systematic classification of kingdom, phylum, class, order, family, genus, to species. The scientific names will be used as the unitive code for their identification in the database. With this unitive code, we will be able to retrieve and link information both within and outside the database and share data with related databases such as Taiwan Agricultural Pests' Natural Enemies Database and The Information System for Management of Plant Disease and Pest Status.

The database displays the main structure of the system interface (see Fig. 1), which is composed of a Front-End Data Reading Section and a Back-End Data Managing Section (Wu and Shih, 2006).

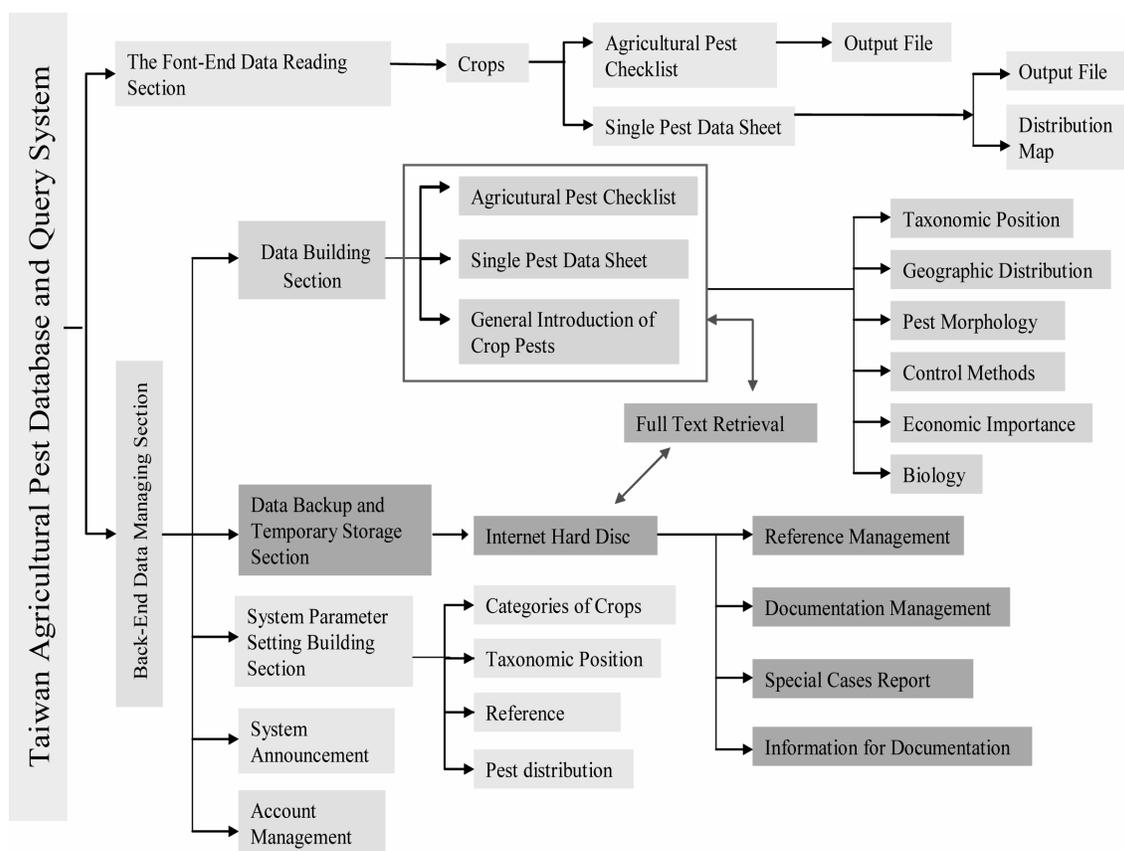


Fig. 1. The main system structure of Taiwan agricultural pest database and query system.

Introduction to the front-end data reading section

The purpose of the front-end data reading section is to provide BAPHIQ and other administrations and research bodies with an inquiry interface for pest status when formulating counterpolicies.

All three topics displayed in the front-end data reading section, the Agricultural Pest checklist, General Introduction of Crop Pests, and Single Pest Data Sheet on Agricultural Pest Species, will have undergone secondary review (format reviewed by the Back-End-Team and first specialist review) and the tertiary review (format reviewed by the Back-End-Team, and first and the second specialist review). Moreover, the three topics will be open for online-inquiries, browsing, and downloading. The data will be outputted in Word or Excel format. Besides, to provide the specialist with a standard format, a Pest Species Specialist Composing Format (Word files for each entry) can be downloaded from the interface of the front-end data reading section.

As of now, the development of the database has moved into the intermediate stage, where all information are written by plant protection specialists for each crop pest (including diseases, insects, and mites). The entries will focus on three topics including the Agricultural Pest Checklist, General Introduction of Crop Pests, and Single Pest of Data Sheet on Agricultural Pest Species.

Among the three topics, fifteen entries were already completed for the agricultural pest checklist. In addition to consolidating the records of pest species in Taiwan over the years, specialists also made clarifications and revisions on the incorrect information cited from the past. The newly emergent and invasive pests (e.g. Chinese pear psyllid, *Cacopsylla chinensis* Yang et Li, 1981) that threaten the plants in discussion were also supplemented by the specialists to ensure the authority and accuracy of the database.

Each pest checklist will cover all the pests of a certain crop and their taxonomic position, geographical distribution, host plants, pest significance rank and cited references. Among them, the pests whose significance rank that fall on the primary or secondary pest rank are “requested” to be written and recorded by specialists and compiled in Single Pest Data Sheet.

By the end of June, 2006, fifteen Taiwan agricultural pest checklists have been completed by specialists, with a total of 711 entries of pests being listed. Among these entries, the data sheets of 117 primary and secondary pest species have been

accomplished. Before the end of 2010, detailed information about species labeled as primary or secondary pests in the agricultural pest checklist can be referred to and retrieved by its scientific name.

As for Single Pest Data Sheet on Agricultural Pest Species outputted or browsed from the front-end data reading section, the content covers the pest species' taxonomic position, host plants (host range), geographical distribution, morphology, biology, economic significance, natural enemies, control methods, references, illustration files, authors and reviewers.

The General Introduction of Crop Pests are corporate reports on integrated pest managements of pest species collaborated by specialists from different fields (including experts of diseases, insects, and mites). The above information will serve as reference for agricultural administrations.

The function and purposes of the back-end data managing section

In the beginning of the database development stage, a back-end data managing section was set to filling out information, and also submitting and maintaining information. Information publishing, management and maintenance will not interfere with the data display of the Front-End Data Reading Section. To achieve this goal, Back-End Data Managing Section will include the Data Building Section, Data Backup and Temporary Storage Section, System Parameter Setting Section, System Announcement, and Account Management Section.

From 2003 to 2004, the main resources of the Data Building Section are from the research papers, checklists, pictorial encyclopedias, and special publications concerning the important agricultural crops in Taiwan. In the early stage, checklists of diseases, insects, mites and weeds were collected to become the basis for establishing the prototype of the system, and for further testing and revising the system functions.

Since 2005, the BAPHIQ, National Taiwan University and TARI (Taiwan Agricultural Research Institute) have been planning the intermediate-stage development of the database. Collaborated by National Taiwan University, all illustrations and descriptions in the database's glossary, dissertations on agricultural pest topics were edited and reviewed by specialists from plant protection fields to meet the needs of government agencies, research organizations, farmers, and units of agricultural product transportation and sales.

The construction, management and maintenance of the Data Building Section were assigned to a Back-End Data Managing Team (a.k.a. Back-End-Team) formed by TARI, National Cheng Kung University, Taiwan Agricultural Chemicals and Toxic Substances Research Institute. The Back-End-Team is in charge of the data management concerning information of the pests in the database.

Besides building up the taxonomic information on the Family category of the pests and plants, the task of the Back-End-Team also covers the input/output of the data and the revision of the system functions for the database. Following the schedule set by the collaborator, all materials will be uploaded to the system for the preliminary editing of their format and content. After preliminary editing, the data will be reviewed by specialists for the first time. To ensure the completeness and quality of the data, the same materials will be double-checked by another editor afterwards. The Back-End-Team will update the said data immediately after each round of editing. As for the obstacles encountered in the process of input/output, the Back-End-Team will conduct the work of trouble-shooting, furnishing and communicating.

The construction and content of the database in discussion will use the taxonomic position of pests and plants as the basis of coding. This coding will be the nucleus linking to the data in all categories of the database. Also, the code can serve as a basis to retrieving and searching among different databases. By searching in Taiwan Agricultural Pests' Natural Enemies Database, the integration of data will be completed for the Taiwan Agricultural Pests and their Natural Enemies Database.

Conclusion

Since the early development of the system, integrating resources with the existing Information System for Management of Plant Disease and Pest Status of BAPHIQ has been considered the long-term goal of the project. After the integration, once a region is reported to be damaged by a certain pest specie through BAPHIQ's existing monitoring system, the pest can be located in the database by using the unitive code. The code, which serves as a nucleus linking to both systems, will solicit related information of the pest, such as its taxonomic position, geographical distribution, morphology, biology, economic significance and control strategies.

To consolidate the information about the natural enemies of the pests for biological control, BAPHIQ also developed the Taiwan Agricultural Pests' Natural Enemies Database in 2005. The database will use the structure of Taiwan Agricultural Pest Database as its foundation and develop an appropriate structure according to the

characteristics of the natural enemies of the pests. So far, the system construction and tests have been completed for Taiwan Agricultural Pests' Natural Enemies Database. The information of the pests' enemies will be built into the database within years.

For the sustainable development of the database, we have completed its integration with the database of pests' enemies. Following respective goals in each stage, we are looking forward to accomplishing an inquiry system of Taiwan Agricultural Pests and their Natural Enemies Database that is highly comprehensive and precise.

References

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